Point Reyes National Seashore
Non-Native Deer Management Plan:
Protecting the Seashore's Native Ecosystems

Final Environmental Impact Statement

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United States Department of the Interior
National Park Service

Non-Native Deer Management Plan
Final Environmental Impact Statement
Point Reyes National Seashore

This *Non-Native Deer Management Plan Environmental Impact Statement* (Plan) analyzes a preferred alternative, no action, and four additional alternatives for future management of Axis deer (*Axis axis*) and Fallow deer (*Dama dama*) in Point Reyes National Seashore (PRNS) and Golden Gate National Recreation Area lands administered by PRNS. As lead agency for the plan, the National Park Service (NPS) developed the alternatives to address problems and management concerns of non-native deer in PRNS. The management plan would assist NPS in the restoration of native ecosystems within the park, prevent spread of non-native deer into surrounding private and public lands, and address adverse impacts to agricultural permittees within the PRNS.

The alternatives differ primarily in their approach to deer population control and in desired future numbers of deer. Alternative A, the No Action alternative, calls for no change in existing management of non-native deer, and results in increased range and numbers of both species. Alternatives B and C call for controlling numbers of both species at a pre-determined level (i.e., 350 axis and 350 fallow deer) using lethal removal alone or a combination of lethal removal and long-acting contraceptives. Alternative D calls for complete removal of both species by 2021 using lethal removal alone. Alternative E is the preferred alternative and would completely remove both species of non-native deer from the Seashore by 2021 using a combination of long-acting contraceptives and lethal removal. Issues raised during public scoping were incorporated in the analysis and are discussed in the document. A number of alternatives calling for relocation, fencing, hunting, and contraception alone are discussed as Considered but Rejected.

Environmental consequences of the five alternatives are divided into the impact topics of natural resources (water, soils, vegetation, wildlife, and special status species), human health and safety, visitor experience, park operations, and regional economy. Impacts to areas outside the park are discussed as they might be affected by dispersing or expanding non-native deer populations.

Responses to comments submitted to the Seashore during the 63-day public comment period (from February 4, 2005 thru April 8, 2005) are included in Chapter 5. Additional detail was added to the EIS concerning issues that engendered the most frequent comments. Updated scientific information, relating to impacts of non-native deer to PRNS natural resources, can be found in Chapter 3, Affected Environment, as well in the impact sections for each alternative.

The Record of Decision adopting the alternative or actions constituting the approved plan will be prepared not sooner than thirty days after the publication in the Federal Register of the Environmental Protection Agency's notice of filing of the FEIS. The complete FEIS will be posted on the Seashore's website at http://www.nps.gov/pore/pphtml/documents.html and the printed document and digital version on compact disk will also be available for viewing at the park headquarters and local libraries. For further information on the FEIS, please check this website or contact Seashore headquarters at the telephone number below.

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Summary

This *Non-Native Deer Management Plan Environmental Impact Statement* analyzes options for the management of non-native axis and fallow deer at Point Reyes National Seashore (PRNS) and the PRNS-administered lands of Golden Gate National Recreation Area (GGNRA), together referred to hereafter as the “Seashore”, “Park” or “PRNS.” The preferred alternative is the removal of all individuals of these exotic species through a combination of shooting and contraception.

Need for Action

The impacts of non-native deer on the native ecosystem in the park and regulatory policies indicate the reduction or elimination of these species is needed. The alternatives analyzed in this EIS investigate the degree of removal required and the means to do so.

In the NPS *Management Policies* 2001, the National Park Service instructs parks such as Point Reyes National Seashore to “re-establish natural functions and processes in human-disturbed components of natural systems (sec 4.1.5).” This same section includes non-native (also called “exotic” or “alien”) species as an example of a human-caused disturbance that can have severe impacts on natural biota and ecosystems.

Parks are specifically mandated to control exotic species “up to and including eradication” of a population if that species does not meet an identified park purpose and if such control is “prudent and feasible.” Only through the removal of exotics and other changes resulting from human disturbance can the NPS return its park units to the most natural condition possible and meet its mandate to preserve them in this condition for future generations.

The presence of non-native axis and fallow deer is both the result of human activities and disruptive to many elements of the natural ecosystem at PRNS. Some of the more serious effects these non-native deer have at the Seashore include competition with and displacement of native tule elk and black-tailed deer (particularly in high deer density or low forage conditions), the potential for transmitting disease to these native deer, heavy use of and resulting direct impacts to riparian and woodland habitats and indirect impacts to the native wildlife dependent on this habitat. Fallow deer have been documented to cause denudation of major areas of woodland and riparian areas during the breeding season (Fellers and Osbourn 2006). They have also been shown to cause trailing, girdling of young trees and trampling of riparian vegetation. Both axis and fallow deer browse shrubs when grasses are not available and consume the same plant species as native deer and elk (Elliott 1983, Elliott and Barrett 1985, Fellers 2006; Fallon-McKnight 2006). Loss of riparian habitat can affect a number of species at PRNS, including several special status species, such as California red-legged frog, Coho and Chinook salmon and steelhead trout. Fallow and axis deer also affect Seashore ranchers by damaging fences and through depredation of livestock pastures and supplemental livestock feed.

Populations of both species of deer have increased in recent years and the range of fallow deer appears to be expanding eastward, towards and beyond Seashore boundaries. This population and range expansion, if allowed to continue, could mean these same types of impacts would occur on private and public lands outside PRNS. Currently, the population of axis deer and fallow deer are about 250 and 860, respectively.

Purpose and Objectives

The purpose of this management plan is to define management prescriptions for non-native deer management. Both the park's General Management Plan (GMP) and Resource Management Plan, identify goals for management of these exotic species. The park Resource Management Plan (NPS 1999) indicates that: "Regardless of potential competition and disease issues, the presence of these non-native deer compromises the ecological integrity of the Seashore and the attempts to reestablish the native cervid fauna comprising tule elk and black-tailed deer" and notes that three scientific panels comprised of federal, state, and university researchers and managers recommended the removal of non-native deer to promote native deer and elk.

The objectives of the plan are:

- To correct past and ongoing disturbances to Seashore ecosystems from introduced non-native deer and thereby to contribute substantially to the restoration of naturally functioning native ecosystems.
- To minimize long-term impacts, in terms of reduced staff time and resources, to resource protection programs at the Seashore, incurred by continued monitoring and management of non-native deer.
- To prevent spread of populations of both species of non-native deer beyond Seashore and GGNRA boundaries.
- To reduce impacts of non-native deer to agricultural permittees within pastoral areas through direct consumption of forage, transmission of disease to livestock and damage to fencing.

Alternatives

The following five alternatives, including the preferred alternative (Alternative E), were created by reviewing public comments, consulting with NPS personnel, and by reviewing relevant literature. Public input consisted of verbal comments made during a public meeting in Point Reyes Station on May 4, 2002, and letters and emails from the public, sent to the superintendent during the scoping period of May 4 to July 5, 2002. In addition, after the notice of availability of the draft EIS was published in the *Federal Register* on February 4, 2005, the Seashore received approximately 1,650 letters and emailed comments during the subsequent 63-day comment period, which ended April 8, 2005. A public informational meeting on the plan was held on March 3, 2005, at the Red Barn Conference Room, in the Seashore. An Exotic Deer Interdisciplinary Team, made up of PRNS staff from several divisions, and the Environmental Quality Division of the NPS (Biological Resource Management Division) reviewed all submitted comments. The Interdisciplinary Team considered all scoping comments, as well as pertinent literature, laws, policies and NPS mandates in formulating the alternatives. It also reviewed comments on the range of alternatives or on specific alternatives themselves made during the review of the draft EIS, and has responded to them (along with all other substantive comments) in Chapter 5 of this final EIS.

Alternative A: No Action

No non-native deer control actions would be undertaken. Monitoring activities would continue for the life of the Plan.

Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal

Non-native deer populations would be controlled initially to a level of 350 for each species (700 total axis and fallow deer). Control of each non-native deer species to 350 animals would be accomplished with lethal removal by NPS staff or contractors specifically trained in wildlife sharpshooting. Efforts would be made to reach target levels in 15 years, to ensure continued presence of both species in the Seashore, and to reduce risks of range expansion beyond Seashore boundaries. This would entail removing between 150 and 250 deer per year for the first ten years with harvest numbers decreasing to 100-150 deer per year from 2016 on. The total number of deer that would require removal is unknown (infinite). Where axis and fallow deer carcasses could be moved, they would be donated to charitable organizations as food for the needy or for endangered species recovery programs. In cases where carcasses could not be accessed, they would be left in place to recycle nutrients into the ecosystem. Monitoring activities would continue for the life of the Plan.

Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control

Non-native deer populations would be controlled initially to a level of 350 for each species (700 total axis and fallow deer) using both lethal removal and fertility control. Efforts would be made to reach target levels in 15 years.

The contraceptive program would incorporate the latest contraceptive technologies to safely prevent reproduction, for as long as possible, and with minimal treatments per animal. Because no long-acting "sterilant" has been registered for use in wildlife by the Environmental Protection Agency, studies on safe and efficacious use of a candidate drug would have to be conducted at PRNS.

Population modeling for fallow deer at PRNS suggests that, in this alternative, total numbers of non-native deer removed by 2050 would be at least 3,000 (2,200 axis and 800 fallow deer). Fallow deer would be treated with an experimental long-acting contraceptive that shows promise for multi-year effectiveness in this species. No agents show the same promise for axis deer, but should such contraceptive technology become available, its practicality and effectiveness would be tested on axis deer as well. Total numbers of fallow does treated by 2050 with a lifetime contraceptive, should one exist, would vary depending on overall sex ratios and density dependent factors but could range from 200 to 300. Because the effectiveness of long-term contraceptives on axis deer is unknown, similar models have not been developed for this species.

Because the goal of this alternative would be to control axis and fallow deer at a specified level and not to eradicate them from PRNS, annual culling and fertility control would continue indefinitely and total numbers of deer removed and treated with contraceptives is unknown (infinite). Monitoring activities would continue for the life of the Plan.

Alternative D: Removal of All Non-Native Deer by Agency Personnel

In Alternative D, all axis and fallow deer inhabiting the Seashore and the GGNRA lands administered by the Seashore would be removed by 2021 through lethal removal by NPS staff or NPS contactors specifically trained in wildlife sharpshooting. This would entail culling approximately 250 non-native deer per year. Total numbers of non-native deer removed could range from 1,400 to 2,200 depending on starting population size and structure, composition and type of deer removed early in the program, and herd growth rates. Where deer carcasses could be moved, they would be donated to charitable organizations as food for the needy or for endangered species recovery programs. In cases where carcasses could not be accessed, they would be left in place to recycle nutrients into the ecosystem. Monitoring activities would continue until all non-native deer were removed, by 2021.

Alternative E (Preferred Alternative): Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility Control

In Alternative E, all axis and fallow deer inhabiting the Seashore and the GGNRA lands administered by the Seashore would be removed by 2021 through lethal removal and fertility control. Culling would be conducted by NPS staff or NPS contactors specifically trained in wildlife sharpshooting.

As in Alternative C, a percentage of fallow deer females would be treated with an experimental long-acting contraceptive, and both axis and fallow deer would be removed via shooting. Should such contraceptive technology become available for axis deer, its practicality and effectiveness would be tested on females of this species as well.

Population modeling for fallow deer at PRNS suggests that, in this alternative, total numbers of both species of non-native deer removed by 2021 are projected to be at least 1,350 (800 axis and 550 fallow deer) while total numbers of fallow does treated by 2021 with a lifetime contraceptive, should one exist, could range from 100 to 150.

Where deer carcasses could be moved, they would be donated to charitable organizations as food for the needy or for endangered species recovery programs. In cases where carcasses could not be accessed, they would be left in place to recycle nutrients into the ecosystem. Monitoring activities would continue until all non-native deer are removed, by 2021.

A number of issues, raised by the public during scoping, are beyond the scope and direction of this document. Some are discussed as they relate specifically to non-native deer (i.e., impacts to native deer or livestock of the various alternatives), while other topics are addressed in other NPS planning documents.

Several alternatives were considered by the NPS or proposed by the public but rejected because they are beyond the document's scope, are technically or economically infeasible, are outside laws, regulations and policies that govern the park or are unable to meet park objectives. These include:

- Managing native deer at PRNS
- Managing non-native deer outside of NPS boundaries
- Managing livestock at PRNS
- Public hunting of non-native deer

- Yearly contraception
- Use of long-acting contraceptives (“sterilants”) alone
- Surgical sterilization
- Relocation
- Restricting deer to a fenced area
- Trapping and euthanasia by lethal injection

Alternatives D and E were identified as environmentally preferable and Alternative E is the park’s preferred alternative at this time.

Impacts

Water Quality and Water Resources

Fallow and axis deer can adversely affect water quality by, creating wide trails, destroying streamside vegetation, increasing erosion and turbidity and through increased nutrient input. Current impacts to water quality and resources from non-native deer in the park are minor to moderate (depending on the area), but continued growth and expansion of the population would result in impact intensity increasing inside the park to moderate in the long term. As the range of each species expands, the potential for moderate to major impacts outside the park becomes greater. Alternatives B and C would slightly reduce impacts inside the park, but would provide possible substantial benefits to water resources in the region by reducing the risk of the expansion of non-native deer outside the Seashore. Alternatives D and E would increase benefits in the park to moderate, and would eliminate the risk of the expansion of the population and water quality impacts to the region. No impairment (as defined relative to the Organic Act, see Chapter 1, Purpose and Need, Regulatory Background section) to park water resources would occur from implementing any alternative.

Soils

Soils would be affected by non-native deer in several ways; through direct mechanical disturbance and compaction, through erosion related to the loss of overlying vegetation, through the addition of nutrients in waste products, and by more subtle changes in soil characteristics related to physiological responses of vegetation to grazing.

Currently, more than 120 acres of park soils are impacted by fallow deer during the breeding season, which constitutes a moderate adverse impact. Expansion of the populations inside and outside the park could result in even greater (though still defined as “moderate”) adverse impacts to soils through compaction and loss. If Alternative B or C was selected, a negligible to minor short-term improvement to soils in some localized areas currently used by deer could occur compared to the No Action alternative in the first few years, although the continued presence of large herds of axis and fallow deer would result in residual impacts to nearly 100 acres of ground, e.g. long-term continued minor to moderate adverse impacts. Substantial benefits relative to Alternative A related to a reduced risk of non-native deer expanding outside the park and affecting soils regionally are likely with all action alternatives, that is, Alternatives B, C, D and E.

Moderate beneficial impacts to soils would result from adopting Alternative D or E from elimination of disturbance, compaction, erosion, and the changes to such substantial acreage from nutrient input and grazing.

No impairment of park soils would occur under any alternative.

Vegetation

Deer, and other ungulates, cause a variety of impacts on vegetation. They consume vegetation, which results in changes to physical structure, structural diversity, species composition and productivity in plant communities, as well as weed and nutrient dispersal. They also trample vegetation, break branches and girdle saplings, particularly when they congregate in large groups or during the rutting season. Deer can alter patterns of nutrient cycling both within plant communities and by transferring nutrients from one community to another, and can change the distribution of nutrients between plant shoot and root structures. Depending on the soil fertility, intensity of grazing, and the vegetation being grazed, deer and other ungulates can stimulate or suppress vegetative productivity across a landscape.

Damage to riparian and understory vegetation within a large area (more than 120 acres) of the Seashore has been documented by congregating and rutting non-native deer and is currently considered moderate in intensity depending on the specific location it occurs within the park. However, this is expected to increase over time under the No Action Alternative (e.g., continuing existing management) to a moderate to locally major level because of increasing deer densities and increasing geographical scope. Impacts outside the park would be major in intensity.

Under Alternatives B and C, the impact intensity is expected to decrease slightly initially compared to No Action (some beneficial impact), but remain measurable at a moderate adverse level because of localized high deer densities over the long term. Eliminating non-native deer in Alternatives D and E would increase these benefits, especially in some locations where deer are currently in high densities (moderate to major beneficial impacts). Substantial benefits from any action alternative (B, C, D, or E) are likely relative to Alternative A from lowering the risk of non-native deer expansion outside the park and reducing impacts to vegetation regionally.

No impairment to park vegetation would occur under any alternative.

Wildlife

Non-native deer can affect native wildlife by displacing them, changing habitat features and by eating the same food. Action alternatives would affect non-native deer by increasing mortality or eliminating them, and by disturbing them or changing reproduction and recruitment through contraception.

Given the projections of growth for both axis and fallow deer, these types of impacts would spread over a wider area of the park as well as outside the park in Alternative A. Pockets of extremely high non-native deer density, such as those currently seen in Olema Valley, are likely to be found increasingly throughout Marin County. Native animal species richness and diversity would decrease in those high-density areas. Dietary overlap between non-native deer and native black-tailed deer is expected to increase to the point where the Seashore black-tailed deer population would be reduced by over 60%. Overall, the magnitude of Alternative A's impacts to native wildlife within NPS boundaries is considered major in intensity, adverse and long-term. Because of their geographic scope, adverse impacts outside the boundary are also considered major in intensity.

In Alternatives B and C, fallow deer numbers would be reduced, but axis deer would grow to 350. Axis deer range is expected to increase in pastoral and natural areas of the Seashore. Although this expansion may benefit a few native species, it would cause a change in the abundance of native wildlife and therefore have moderate adverse impacts to wildlife inside and outside the park. Compared to an even larger axis deer range expansion expected under the No Action Alternative, Alternatives B or C would result in relative benefits for native wildlife. Native species richness and diversity would likely decrease over a smaller area than in Alternative A.

Alternatives D and E would result in a marked decrease in and eventual elimination of non-native deer. The impacts are expected to be beneficial, within NPS boundaries, to a large number of native species and adverse to a much smaller number of native species. Overall and in the long-term, the magnitude of impacts to native wildlife within and outside of NPS boundaries is considered major in intensity and beneficial.

Neither under current conditions nor under those resulting from Alternatives B, C, D and E would impairment of wildlife occur. Alternative A would result in major adverse impacts to native black-tailed deer and therefore affects a resource that is key to the natural integrity of the park or to opportunities for enjoyment of a park. As such, impairment would likely occur (see NPS 2000a, section 1.4.5).

Species and Habitats of Management Concern

The federally listed species that are likely to be affected by non-native deer include northern spotted owls (*Strix occidentalis caurina*), western snowy plover (*Charadrius alexandrinus nivosus*), California red-legged frog (*Rana aurora draytonii*), Coho and Chinook salmon (*Oncorhynchus kisutch and Oncorhynchus tshawytscha*), steelhead trout (*Oncorynchus mykiss*), California freshwater shrimp (*Syncaris pacifica*), and Myrtle’s silverspot butterfly (*Speyeria zerene myrtleae*). No impairment to these species or other non-listed, but protected, species (see bird species of concern, below) would occur under any alternative.

Northern Spotted Owl - Threatened

The northern spotted owl preys almost exclusively on small mammals, particularly dusky-footed wood rats in the Seashore (Chow 1998). Woodrats, in turn, are dependent on roots, stems, leaves, seeds, and mast (Linsdale and Tevis 1951; Willy 1992). Fallow deer have been recorded in areas where spotted owls nest and roost. To date, no direct effects have been noted on the productivity or survival of owls. However, deer compete with the prey species of owls, and therefore, likely have an indirect negative impact on food resources. Alternatives B and C would likely continue this impact, with continued minor, long-term adverse effects. Because of the likely beneficial impact on rodent prey base due to reduced competition for food and cover, Alternatives D and E would have a minor, long-term beneficial impact on northern spotted owls.

Western Snowy Plover – Threatened

Western snowy plovers nest along the sandy beaches of the Seashore that are used sporadically by axis deer. A large herd of 60 axis deer has been seen on South Beach within the last five years, and where the herd occurred, the ground was heavily impacted (S. Allen, NPS, personal communication). Plovers are known to be disturbed by cattle that once roamed on Seashore beaches, and would be similarly disturbed or perhaps disrupted from nesting by the presence of non-native deer. Because this likely only occurs occasionally, the overall adverse impact of Alternative A to plovers in the Seashore is minor. Because Alternatives B and C result in higher populations of axis deer within the Seashore, such adverse impacts would increase slightly in frequency, but would remain minor in intensity. With the elimination of axis and fallow deer under Alternatives D and E, plovers would likely experience a minor, long-term benefit.

California Red-legged Frog - Threatened

Fallow deer regularly frequent riparian areas where California red-legged frogs live and/or breed. They have been documented to destroy vegetation by trailing, trampling or eating plants, and by thrashing their antlers during the rut (Fellers and Osbourn 2006). Overall, the adverse impacts of Alternative A to frogs in the Seashore and in Marin County would be minor and long-term. Impacts would remain adverse, minor and long term if either Alternative B or C were implemented. A relatively minor, long-term benefit from eliminating axis and fallow deer would accrue if Alternative D or E were adopted.

Coho Salmon, Steelhead Trout, and Chinook Salmon - Endangered and Threatened, respectively

Coho and Chinook salmon and steelhead trout occur in many of the streams of the Seashore, particularly in Olema Creek and Lagunitas Creek. Fencing has been installed to restrict cattle from riparian areas, in part to protect other sensitive and protected wildlife. These fences, however, do not impede the movement of fallow deer. The destruction of riparian vegetation reduces cover, increases water temperature and contributes to earlier drying of streams exposed to sunlight. Overall, the adverse impacts of Alternative A to anadromous fish in the Seashore and in Marin County would be minor and long-term. This would not change if Alternative B or C were selected, but would be eliminated with relatively minor, long-term benefits under either Alternative D or E.

California Freshwater Shrimp - Endangered

The California freshwater shrimp inhabits lower Lagunitas Creek and lower Olema Creek, within the current fallow deer range at PRNS. Shrimp are highly dependent on overhanging riparian vegetation, under which they live year-round. Fallow deer have not been observed within known shrimp habitat. However, in other areas of both Lagunitas and Olema Creeks, high densities of fallow deer have been observed to destroy riparian vegetation (Fellers and Osbourn 2006; Brannon Ketcham, NPS, personal communication). An increase in fallow deer range, resulting from Alternative A would likely cause loss of shrimp habitat thus adversely impacting shrimp survival at all stages of the life cycle. The relative decrease in deer range under Alternatives B or C, or in density under Alternatives D or E, would not be likely to result in measurable changes to current impact levels.

Myrtle’s Silverspot Butterfly - Endangered

Two populations of Myrtle’s silverspot butterfly occur within the Seashore. The PRNS coastal dune system and coastal prairie provide critical habitat for this species. To date, it is not known whether non-native deer browse on the preferred nectar or larval host plants of the butterfly. However, research elsewhere indicates they graze on species similar to the one plant that serves as a larval host for Myrtle’s silverspot butterfly at PRNS. Overall, the adverse impacts of Alternative A to Myrtle’s silverspot butterfly in the Seashore and in Marin County would be moderate to major and long-term. Because the potential for increasing fallow deer range would decline while axis deer range would increase with Alternatives B and C, adverse impacts may be reduced to moderate and long-term. With elimination of grazing by non-native deer (in Alternatives D or E), a moderate to major relative benefit, compared to No Action, would occur.

Bird Species of Concern (Not Federally Listed)

Numerous restoration projects and fire management actions have strived to improve nesting success in land birds, particularly in riparian areas. In addition, the park is an active member of the Partner-in-Flight program, collaborating with other agencies and organizations to protect and restore populations of neotropical migratory songbirds. Destruction of riparian habitat and grazing of vegetation from ground level to a height of 2 meters by non-native deer has been documented in Olema Valley and coastal areas of the Seashore (Fellers and Osbourn 2006) and can adversely affect habitat and remove food and nesting resources used by bird species. These include not only ground or low-nesting species, but also those that nest in the forest understory. The potential impacts on reproductive success and survival are unknown. Overall, the adverse impacts of Alternative A to understory nesting songbirds of concern in the Seashore and in Marin County would be moderate to major and long-term. With fewer fallow deer, the chances of habitat destruction would be lower, and adverse impacts of Alternative B or C would be reduced compared to No Action, although residual minor to moderate adverse long-term impacts would remain. Eliminating the impact of non-native deer to understory nesting songbirds of concern in the Seashore and in Marin County by adopting Alternative D or E is beneficial, moderate to major and long-term.

Plant Species of Special Concern

Non-native deer can impact rare plant species directly by consuming, thrashing and trampling them. Fallow deer herds have been observed often in grassland, oak woodland, evergreen scrub, and Douglas fir/redwood plant communities (NPS 2001b, Fellers and Osbourn 2006), all of which can provide habitat for rare plant species. Adverse impacts to rare plants in the Seashore are currently considered to be minor and short-term. Alternative A would result in increased ranges and densities for both species and would likely lead to adverse impacts which were moderate and long-term. Alternatives B and C would result in slightly reduced deer densities compared to No Action, but would continue existing minor adverse impacts. Alternative D or E would result in minor, long-term beneficial impacts to rare plants.

Human Health and Safety

Impacts to human health or safety would result from deer-vehicle collisions, the use of firearms and the use of aircraft. The risk of a deer-vehicle collision would be highest under Alternative A because the total number of non-native deer is highest. Minor benefits relative to No Action in Alternatives B and C from reductions in numbers, and minor to moderate benefits in Alternatives D and E would result from elimination. The risk to staff from firearms used to control deer would be a minor adverse impact associated with all action alternatives. The duration of this impact would be shorter in Alternatives D and E than in Alternative B or C, as culling would occur indefinitely for these latter alternatives. Additional risks to staff safety from capturing animals for administering contraceptive treatment also result from Alternatives C and E.

Visitor Experience

The impacts to visitor experience would primarily involve opportunities for viewing native or non-native deer, although actions in the alternatives could also affect soundscape, visitor access, viewsheds and wilderness qualities. Alternative A would provide the opportunity to view both native and non-native deer; more non-native deer than action alternatives, and fewer native deer. Impacts would vary depending on the social values of the visitor, but would be negligible or minor. In addition, implementation of Alternative A would likely increase adverse impacts to wilderness character and viewshed enjoyment over time as impacts to natural resources increase. Alternatives B and C would permanently decrease the fallow deer herd, and allow axis deer to increase. Negligible to minor, long-term benefits to visitors with naturalistic or ecologistic social values related to wildlife viewing of native ungulates, and this same level of adverse impacts to visitors with moralistic or humanistic social values would occur. Similarly Alternatives B and C would have adverse or beneficial impacts to those members of the public with anthropocentric or biocentric wilderness values, respectively. These impacts to visitors' social and wilderness values would both increase to moderate if Alternatives D or E were selected. Minor short-term adverse impacts on the visitor experience, in wilderness and other areas, from noise and deer management activities, would occur under Alternatives B and C. These may increase to moderate, short-term adverse impacts if Alternative D or E were selected. All adverse impacts of action alternatives (B, C, D and E) to wilderness character would be offset by a long-term increase in natural processes, restoration of native species and habitats, and an eventual reduction in the imprint of human manipulation.

Park Operations

Park operations would continue to be affected indefinitely under Alternatives A, B or C, as perpetual monitoring would be required under all three, and perpetual management needed under B or C. Costs associated with monitoring, including purchase and operation of equipment is about 2.9% of the annual park budget. As the herd size increases and occupies land outside the park, monitoring and mitigation efforts would increase, as would the potential for litigation. This could increase costs to the park of this alternative to from 5 to 15% of the total PRNS budget over the long term, a moderate adverse impact. Although reductions and management in Alternatives B and C would initially cost more, in the long term, avoidance of litigation and lack of extensive monitoring and mitigation outside the park would likely result in a reduction in costs compared to the No Action Alternative. Costs would be about 3-6% of the park budget, a beneficial impact compared to Alternative A. These costs would continue in perpetuity. Alternative C would require additional funds to capture and research the treatment of deer with contraceptives. Because boosters and continued contraception would be required, costs would be about 3-12% of the park budget in perpetuity. Again, because deer would be much more likely to remain in the park under this alternative, costs related to monitoring, mitigation and litigation would be less than under the No Action alternative, with comparatively negligible to minor benefits to park operations. Alternative D would be the lowest cost alternative, as all non-native deer would be removed by shooting within 15 years, and no continued monitoring or management beyond that time would be required. Alternative D would require a 4.6% increase in the park budget for 15 years. Alternative E would be more expensive than Alternative D, and would require a 5-9% increase for 15 years. Because they are finite costs, both Alternative D and E offer moderate benefits to park operations compared to Alternative A.

Regional Economy

Alternative A would continue existing minor adverse impacts to the regional economy indefinitely as non-native deer interfere with park ranching and grazing operations. Impacts to agricultural concerns could increase over time to a moderate, adverse level as the density of deer and the damage they cause increase. Negligible to minor, adverse socioeconomic impacts are also possible to low-income/minority farm workers should the viability of agricultural operations be threatened under this alternative. As the population of non-native deer expands outside the park, impacts to agricultural operations would become more widespread and, because of this larger geographic scope, could become major in intensity. Alternatives B and C would reduce the risk of the herds leaving the Seashore and affecting agricultural production, a minor long-term benefit. Alternatives D and E would eliminate any risk of the spread of these deer, a greater benefit than in Alternatives B or C, but still minor in intensity.

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Chapter 1: Purpose and Need

Introduction

In conformance with the National Environmental Policy Act (NEPA), this Final Environmental Impact Statement (FEIS) has been prepared to assist the National Park Service (NPS) in the development of a Non-Native Deer Management Plan for Point Reyes National Seashore, and for lands administered by the Seashore within Golden Gate National Recreation Area (GGNRA) (together referred to as "Seashore," "PRNS," or "park"). The purpose of the NEPA review process is to examine a series of alternatives for non-native deer management through "appropriate participation by the public; the application of scholarly, scientific, and technical information in the planning, evaluation, and decision-making processes; the use of NPS knowledge and expertise through interdisciplinary teams and processes..." (NPS 2001b).

The alternative that is selected by the Seashore in the Record of Decision will become its non-native deer management plan and will include prescriptions related to the management of all axis deer (*Axis axis*) and fallow deer (*Dama dama*) within PRNS and Seashore-administered portions of GGNRA.

Need

As a unit of the National Park System, the Seashore is managed according to NPS policy. The primary mission of the NPS is the preservation of resources, including natural resources, in an unimpaired condition. The NPS's *Management Policies* 2001 sets forth the policies that apply to all national parks. The Management Policies recognize that non-native (also called "exotic" or "alien") species are an example of human-caused disturbance that can have severe impacts on natural biota and ecosystems.

Pursuant to Section 4.4.4.2 of the Management Policies, parks are specifically mandated to control exotic species "up to and including eradication" of a population if that species does not meet an identified park purpose; if such control is "prudent and feasible"; if the exotic species interferes with natural processes, disrupts the genetic integrity of native species, damages cultural resources, significantly hampers park management or affects other specified criteria.

The presence of non-native axis and fallow deer within PRNS and GGNRA is the result of human activities because each species was introduced to park lands for hunting purposes prior to the establishment of the parks. These species are disruptive to many elements of the natural ecosystem in the Seashore. Some of the more serious effects of non-native deer are competition with, and displacement of, native tule elk and black-tailed deer (particularly in high deer density or low forage conditions); the potential for transmitting disease to these native ungulates; and heavy use of and resulting impacts to riparian and woodland habitats and to the native wildlife dependent on these habitats. Chapter 3 of this FEIS, Affected Environment, contains additional information on the effects of non-native deer.

Analysis of dietary studies done on native black-tailed and non-native deer in the Seashore has shown that all three species utilize similar plants, found in limited quantities during times of low forage availability (Elliott 1983; Fallon-McKnight 2006). It is thought by researchers that for every one to two non-native deer in the Seashore, one native black-tailed deer is lost (Fellers and Osbourn 2006). Tule elk in particular may be sensitive to the presence of fallow and axis deer for several reasons. All three species are primarily grazers, and so compete for food and habitat (Fallon-McKnight 2006). Anecdotal evidence and the scientific literature suggest fallow deer are more aggressive than other deer or elk at PRNS and so may displace them when the species compete for forage. In addition, both tule elk and black-tailed deer are susceptible to paratuberculosis, which is carried by axis and fallow deer at the Seashore, and which is transmitted more easily in high deer densities. Both species of non-native deer gather in large herds, and both are increasing at PRNS. Prevalence of paratuberculosis was about 10% and 8% in axis and fallow deer, respectively, during the most recent survey (Riemann et al. 1979b). See Chapter 3, Affected Environment, for more information on non-native deer studies and impacts.

The Seashore has re-introduced tule elk to the park because they are the historically dominant native herbivore in California coastal and central grasslands from Shasta County southward to Santa Barbara County. In 1998, PRNS re-introduced free-ranging tule elk to the Limantour wilderness area of the Seashore. This elk herd currently numbers 45 animals, but resource managers are concerned that they may be kept from fully occupying habitat in PRNS by competition from fallow and/or axis deer. The NPS *Management Policies* 2001 require parks to consider the removal of exotic species when they interfere with the restoration of natural systems, including restoration of native plants or animals (sec. 4.1.5).

The native ungulates (deer and elk) in the park are not the only wildlife that may be affected by axis and fallow deer. Fallow deer are known to cause reduction or local extinctions of small mammals that rely on the same ground-level grasses and forbs as the deer (Putman et al. 1989). Both axis and fallow deer browse shrubs when grasses are not available, and alter riparian cover and vegetation through browsing, establishment of mating territories (in fallow deer) and the creation of trails. Loss of riparian habitat can affect a number of species at PRNS, including several special status species, such as the California red-legged frog, Coho and Chinook salmon, and steelhead trout. It is for reasons like these that both the joint PRNS/GGNRA General Management Plan and the Point Reyes Resource Management Plan direct park staff to protect existing ecosystems and reduce or eliminate exotic plants and animals (see Relationship to Other Federal Laws, Plans, and Polices for more information).

Fallow and axis deer also affect Seashore ranchers by damaging fences, through depredation of pasture and supplemental livestock feed, by overgrazing fallow fields, and through an increase in the risk of disease transmission. Populations of both species of deer have increased in recent years and the range of both species appears to be expanding eastward, towards and beyond Seashore boundaries. This population and range expansion, if allowed to continue, could mean these same types of impacts would occur on private and public lands outside PRNS. In 2003, the populations of axis deer and fallow deer were about 250 and 860, respectively. An expanding deer herd would also adversely affect riparian areas currently being restored outside the park.

The cost to the park for staff, equipment, vehicles, and supplies to monitor and manage non-native deer currently totals approximately $140,000, or 2.5% of the park annual budget. The diversion of staff and money to the management of an exotic species is at the expense of preservation and the re-establishment of native species and habitat at the Seashore.

Given the mandate of the NPS Management Policies (Section 4.4.4.2) to control or eradicate non-native species that are harming park resource values or adversely affecting park management, the Seashore needed to review options for non-native deer management, including eradication.

Purpose and Objectives

The purpose of this non-native deer management plan is to present and evaluate options for the control or removal of non-native deer from PRNS and GGNRA. Both the park's General Management Plan (GMP) and Resource Management Plan (RMP) identify goals for management of these exotic species. The Seashore's RMP (NPS 1999) states that: "Regardless of potential competition and disease issues, the presence of these non-native deer compromises the ecological integrity of the Seashore and the attempts to reestablish the native cervid fauna comprising tule elk and black-tailed deer." The RMP also notes that three scientific panels comprised of federal, state, and university researchers and managers recommended the removal of non-native deer to promote native deer and elk.

As noted above, the primary problems associated with the presence of these non-native deer are:

- adverse effects to native species and native ecosystems,
- conflicts with the laws, regulations, and policies of the NPS regarding restoration of natural conditions and native species, and
- impacts on park operations and budget and on ranchers in the park along with the potential for each of these to increase as the population expands beyond park boundaries.

The specific objectives of this plan are:

- To correct past and ongoing disturbances to park ecosystems from non-native deer and thereby to contribute substantially to the restoration of naturally functioning native ecosystems.
- To minimize long-term impacts, in terms of reduced staff time and resources, to resource protection programs at the Seashore, incurred by continued monitoring and management of non-native deer.
- To prevent the spread of populations of both species of non-native deer beyond Seashore and GGNRA boundaries.
- To reduce impacts of non-native deer through direct consumption of forage, transmission of disease to livestock, and damage to fencing to agricultural permittees within pastoral areas.

Background

Management of Axis and Fallow Deer

Axis deer (*Axis axis*) are native to India and Sri Lanka. They are typically found in large herds of up to 150 animals in agricultural pastures and open grasslands intermixed with low, open scrub. Axis deer are considered grazers, with grasses making up the bulk of their diet, although they eat increasing amounts of forbs during the dry season. Eight axis deer were purchased from the San Francisco Zoo by a local landowner and released on the western slope of Inverness Ridge in 1947 for hunting purposes (Elliott 1973; Jones 1973). By the time the Point Reyes National Seashore was established in 1962, the axis deer population was well established, with an estimated population size of several hundred. Today the herd numbers approximately 250.

European fallow deer (*Dama dama*) are native to Asia Minor, the southern Mediterranean region, and possibly northern Africa. Like axis deer, fallow deer are considered grazers, eating predominately grasses during most of the year and increasing their intake of forbs during times of low forage availability. This species also congregates in large herds of up to 140 animals. Twenty-eight European fallow deer were purchased from the San Francisco Zoo and introduced by the same landowner to the area over the period of 1942 to 1954 (Wehausen 1973; Jones 1973). By 1973, there were an estimated 500 animals. Today the population is estimated to be approximately 860.

Population management of fallow and axis deer did not begin until 1968 (Gogan et al. 2001). Until this time, ranchers shot only small numbers. From 1968 through 1971, in a more concerted effort to reduce population size, ranchers in the Seashore removed 256 axis and fallow deer under California Department of Fish and Game (CDFG) permits (Wehausen and Elliott 1982).

In 1971, NPS closed the Seashore to public hunting. An interim management plan was implemented in 1973 in conjunction with CDFG, linking population control to research on deer-borne diseases and competition between deer and cattle (Brunetti 1976). CDFG issued NPS a scientific collecting permit and indicated control was to be accomplished by NPS staff (Buckmann 1973). In 1973, a 2-year disease survey conducted by the CDFG resulted in the collection and necropsy of 290 axis, fallow, and black-tailed deer. The researchers found evidence of exposure to several livestock diseases in both non-native species and a high incidence of liver flukes in fallow deer (Brunetti 1976; Elliott 1976a). One axis buck was captured and donated to M. Hoffman, a private citizen, in June 1976 under permit from CDFG. The buck died soon after release into an enclosed facility and no further deer were relocated (CDFG 1976).

In 1976, an informal management plan was approved to limit populations of each species to 350 through “tenant rancher permits” and, as needed, ranger culling (NPS 1976). State law required that ranchers donate all meat collected in such depredation hunts to charity (NPS 1984). A Point Reyes National Seashore/Golden Gate National Recreation Area Citizen’s Advisory Committee later that year recommended that population control take place through ranger culling only, without public or rancher hunting (NPS 1984). The chosen target population levels of 350 were based on estimated 1973 populations and future target populations were stipulated to depend on axis and fallow deer carrying capacities, to be determined through further research. A cooperative research program with CDFG, which extended through 1980, resulted in collection and necropsy of 586 more deer with the carcasses donated to charity (Gogan et al. 2001).

In 1976, a portion of the Seashore was designated as wilderness (PL 94-544, 90 Stat. 2515 and PL 94-567, 90 Stat. 2692), and from 1980 to 1984 control of non-native deer was expanded beyond the pastoral areas of the park into wilderness. PRNS rangers culled a total of 513 deer in 1981 through 1983 (NPS 1984). Venison was donated to the California State Penitentiary at San Quentin and St. Anthony’s Charity in San Francisco (NPS 1984).

In 1984, with direction from the Assistant Secretary of the Interior, NPS proposed initiating public hunts for exotic deer, in cooperation with CDFG (NPS 1984; Gogan et al. 2001). The idea met with strong public opposition and was never pursued. In 1990, those institutions receiving donated venison notified NPS that they could no longer pay for the transportation of carcasses from the Seashore to the processing plant. NPS assumed these costs and the number of deer culled declined. Funding difficulties and controversy over the culling in the media led to discontinuation of the deer control program in 1994. Since then, two to five non-native deer per year have been culled and donated to the local Native American tribes for use during traditional ceremonies. In 2000, nine fallow deer and seven axis deer were collected as part of an NPS disease survey. Lung and intestinal parasites were found, as well as evidence of exposure to anaplasmosis and leptospirosis, two livestock diseases. One collected axis deer was positive for paratuberculosis or Johne’s disease (NPS unpublished data (g)). In 2005, seven fallow deer and five axis deer were collected as part of a U.S. Department of Agriculture research project on non-native ectoparasites of deer. Examples of a non-native louse species, heretofore unknown in the U.S., were discovered on axis deer, while on fallow deer, non-native lice known to infect native black-tailed deer were found (Mortensen, USDA, personal communication). It is estimated that since 1968, over 2,900 axis and fallow deer have been collected from the Seashore (NPS unpublished data (h); Gogan et al. 2001).

NPS Mandates and Policies / Park Purpose and Significance

This section identifies in more detail the laws and policies that are prompting the Seashore to take action to return the park ecosystem to a more natural condition.

Organic Act The primary mandate of the NPS is to preserve park resources and values unimpaired for future generations. This mandate comes from the law that established the NPS, the Organic Act (16 U.S.C. 1). Park units are prohibited from taking actions that would result in impairment to park resources or values, and findings in the environmental impact statement are used as a basis for determining whether such impairment is possible if action is taken. Similarly, parks are obliged to take action to eliminate actions that are resulting in impairment (NPS *Management Policies* 2001, sec. 1.4.7). The term "impairment", as used in this document, is defined as an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values (NPS 2001). An impact would be more likely to constitute an impairment if it affects a resource that is:

- Necessary to fulfill specific purposes identified in the establishing legislation of a park,
- Key to the natural or cultural integrity of a park or to opportunities for enjoyment of a park, or
- Identified as a goal in the park's general management plan or other NPS-planning documents.

Although it is not automatic that the presence of a non-native species would impair native park resources, invasive or wide-spread exotic species are recognized by the NPS as having the potential to severely disrupt or harm the integrity of natural ecosystems in park units. Non-native species are defined as those that did not evolve in concert with the species native to an ecosystem, and occupy it as the result of deliberate or accidental human activities. As noted above, the 2001 Policies direct managers to restore natural ecosystem functioning that has been disrupted by past or ongoing human activities. The 2001 NPS Policies specifically require managers to manage all non-native species not maintained for an identified park purpose, up to, and including eradication, if control is prudent and feasible and the species "interferes with natural processes and the perpetuation of natural features, native species or natural habitats." In addition, high priority is mandated for the management of "exotic species that have, or potentially could have, a substantial impact on park resources, and that can reasonably be expected to be successfully controllable" (sec. 4.4.4.2).

Adherence to NPS *Management Policies* 2001 is mandatory for every NPS unit unless specifically waived or modified by the Secretary of the Interior, the Assistant Secretary of the Interior, or the Director of the NPS. As such, Point Reyes National Seashore is required to evaluate current non-native deer management practices for potential impairment; develop a non-native deer management plan and environmental impact statement (EIS) to determine whether impairment is possible; restore natural ecosystems to the extent possible; and consider removal, up to and including eradication, of non-native deer.

PRNS/ GGNRA Enabling Legislation

The Seashore has additional direction from Congress to specifically protect and restore the natural environment in the park through two amendments of its enabling legislation.

The Point Reyes National Seashore Act (PL 87-657, 76 Stat. 538; 16 U.S.C.) established the park in 1962 for "purposes of public recreation, benefit, and inspiration, a portion of the diminishing seashore of the United States that remains undeveloped." It also refers specifically to hunting within the Seashore: "The Secretary may permit hunting and fishing on lands and waters under his jurisdiction within the Seashore in such areas and under such regulations as he may prescribe during open seasons prescribed by applicable local, State, and Federal law." However, public hunting is not allowed at GGNRA, and the Superintendent's compendium current prohibits it inside PRNS as well.

Public Law 94-544 (90 Stat. 2515; 16 U.S.C.) and **94-567** (90 Stat. 2692; 16 U.S.C.) established the Point Reyes Wilderness Area of 25,370 acres and potential for 8,003 more acres. The laws amend the

Seashore's enabling legislation (PL 87-657) by inserting in Section 6(a) after "shall be administered by the Secretary," the words: "…without impairment of its natural values, in a manner which provides for such recreational, educational, historic preservation, interpretation, and scientific research opportunities as are consistent with, based upon, and supportive of the maximum protection, restoration, and preservation of the natural environment within the area."

Golden Gate National Recreation Area Act (PL 92-589, 86 Stat. 1299 U.S.C.) established the park in 1972 in order to "preserve for public use and enjoyment certain areas of Marin and San Francisco Counties, California, possessing outstanding natural, historic, scenic, and recreational values, and in order to provide for the maintenance of needed recreational open space necessary to urban environment and planning."

Beyond the provisions and requirements of the Organic Act and NPS *Management Policies* 2001, the Seashore is guided by the Wilderness Act, the Act that established wilderness at Point Reyes National Seashore, plans and policies of PRNS and other relevant laws, policies, and regulations. Each of these is discussed in more detail in the section on federal laws and plans below. However, a few particularly relevant laws and policies are summarized here.

About 35%, or 32,000 acres of the Seashore is either designated or proposed wilderness and is managed under the Wilderness Act and its regulations. Wilderness lands are generally undeveloped and show little or no influence of humans. They are protected or managed to preserve natural conditions. The NPS *Management Policies* 2001 regarding wilderness indicate parks should "seek to sustain the natural distribution, numbers, population composition, and interaction of indigenous (e.g., native) species." Management actions in wilderness are restricted to those "necessary to correct past mistakes, the impacts of human use, and influences outside of wilderness boundaries" (sec. 6.3.7). The legislation designating 25,370 acres at PRNS as wilderness and the potential for an additional 8,003 acres required the land be administered "without impairment of its natural values."

Relationship to Other Park Plans

Point Reyes National Seashore General Management Plan (GMP) Although the Seashore is currently in the process of updating its GMP, the most recent version was completed in 1980. It contains no specific directives in regards to non-native deer but states that, throughout the Seashore, "restoration of historic natural conditions (such as the reestablishment of tule elk) will continue to be implemented when such actions will not seriously diminish scenic and recreational values" (p. 13). The GMP also requires natural resource managers "to enhance knowledge and expertise of ecosystem management through … exotic plant and animal reduction, regulation and control of resource use, and pollution control" (p. 1).

Golden Gate National Recreation Area General Management Plan (GMP), 1980 In the section on Preservation and Restoration of Natural Resources, the GMP requires the recreation area to "maintain and restore the character of natural environment lands by maintaining the diversity of native park plant and animal life, identifying and protecting threatened and endangered plant and animal species, marine mammals, and other sensitive natural resources, controlling exotic plants, and checking erosion whenever feasible" (p. 9).

Point Reyes National Seashore Resource Management Plan, 1999 cites as one of the most important resource issues to be addressed, the "control of non-native plants and animals that disrupt natural (ecosystems) or prevent their restoration" (p. 30). In reference to non-native deer specifically, the Resource Management Plan states (p. 40):

> "Due to the non-native nature of fallow and axis deer, and to the potential for forage competition with native deer and elk and disease transmission to them, a determination of the feasibility of complete removal of the fallow and axis deer should be undertaken. The issue of exotic deer management consumes a considerable amount of staff time that could be devoted to other resource management needs. Removal of the exotic deer from the Seashore would reduce a continual burden on the small natural resources staff, improve a major component of the ecosystem, provide additional habitat for native ungulates, and eliminate the potential for disease transmission from these exotics to native deer and elk."

Golden Gate National Recreation Area Resources Management Plan, 1999 states in Section 4.1 that the objectives of the Natural Resources program are to: "prevent loss of native species and habitats by eliminating or controlling non-native and feral species populations" (p. 38).

As noted above, the park's resource management plan, which is its most recent guidance document for the management of natural resources, indicates that axis and fallow deer "compromise the ecological integrity of the Seashore" and calls for their removal to promote native deer and elk. Both the PRNS and Golden Gate National Recreation Area resource management plans (1999) indicate a primary objective of the natural resource program is to control non-native plants and animals and prevent the loss of native species and habitats.

Relationship to Other Federal Laws

In addition to the Organic Act and Wilderness Act described above, the following laws are relevant to this project:

The Redwood National Park Act, as amended in 1978 (PL 95-250, 92 Stat. 163, 16 U.S.C. §1a-1) states, in reference to all NPS units: "The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress." Derogation and impairment have been determined by the NPS to be the same standard.

The National Environmental Policy Act (NEPA) of 1969 (Section 102(2)c) requires that an environmental impact statement be prepared for proposed federal actions that may significantly affect the quality of the human environment. The Council on Environmental Quality regulations (40 Code of Federal Regulations [CFR] Part 1500) and the NPS Director's Order 12 provide further guidance on the procedural requirements of NEPA.

The Endangered Species Act of 1973 (PL 93-205, 87 Stat 884, 16 U.S.C. §1531 et seq., as amended) defines the purpose of that act: "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species…" Section 7 of the Endangered Species Act directs federal agencies to further the purposes of the Act. Federal agencies are required to consult with the U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA) to ensure that any action authorized, funded or carried out by the agency does not jeopardize the continued existence of listed species or critical habitat. Consultation with the USFWS and NOAA indicates the action alternatives evaluated in this EIS would not result in a "finding of adverse effect" on any federally listed species or critical habitats.

The Wilderness Act of 1964 (78 Stat. 800; 16 U.S.C. §1131-1136). Actions to remove exotic deer in the wilderness may be required. Therefore, provisions of the Wilderness Act restricting how this may be accomplished are relevant. The Wilderness Act states that: "…each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area and shall so administer such area for such other purposes for which it may have been established as also to preserve its wilderness character." It further stipulates that: "Within wilderness areas designated by this Act the use of aircraft or motorboats, where these uses have already become established, may be permitted to continue subject to such restrictions as the Secretary of Agriculture deems desirable. In addition, such measure may be taken as may be necessary in the control of fire, insects, and diseases, subject to such conditions as the Secretary deems desirable."

Section 106 of the Historic Preservation Act. Section 106 of the Historic Preservation Act requires federal agencies to take into account the effects of their actions on properties listed on, or eligible for, the National Register of Historic Places. Because this project does not affect historic structures or districts, Section 106 compliance is considered not to be applicable.

The Federal Food Drug and Cosmetic Act (FFDCA, 21 U.S.C. §§ 301-395) regulates the sale of drugs and assigns the regulation to the Food and Drug Administration. Until recently, a division of the Food and Drug Administration, the Center for Veterinary Medicine regulated the manufacture and distribution of food additives and drugs that are given to animals.

The Federal Insecticide, Fungicide and Rodenticide Act (7 U.S.C.) provides federal control of pesticide distribution, sale, and use. A pesticide is defined any substance designed to prevent, destroy, repel, or mitigate any pest. Under some circumstances, wild animals can be considered pests. The Environmental Protection Agency (EPA) must register all pesticides, as well as each use of that pesticide. The EPA must also approve the product label. Early in 2006, EPA assumed regulatory authority from the Food and Drug Administration over all chemicals used for wildlife management, including contraceptives and immunocontraceptives.

Executive Order 13112 on Invasive Species, signed by President Clinton in 1999, mandates that:

> "Each Federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law, (1) identify such actions; (2) subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to: (i) prevent the introduction of invasive species, (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner, (iii) monitor invasive species populations accurately and reliably, (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded, (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species, and (vi) promote public education on invasive species and the means to address them; and (3) not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions."

Compendium of Superintendent's Orders for Point Reyes National Seashore and Golden Gate National Recreation Area (36 CFR 1.7 (b)) specifies that the taking or hunting of wildlife by the public is prohibited within the boundaries of the park.

Relationship to State Laws and Other Agencies, Laws, Policies and Plans

California Fish and Game Code (California Code of Regulations), Title 14. One of the alternatives considered but rejected is the relocation of non-native deer to private property elsewhere in the state. The following summarized sections of the California Code of Regulations are relevant to the decision to reject this alternative as infeasible.

It is unlawful to import, transport, possess, or restrict wild animals alive into this state, except under a revocable, nontransferable permit issued by the California Department of Fish and Game (Title 14, sec. 671).

Written permission from the California Department of Fish Game Commission is required to release any wild animal into the wild, including those that are domestically reared which are not native to the state, may be diseased or have the potential for disease (Title 14, sec. 671).

A Fallow Deer Farming Permit is required for the rearing of fallow deer for commercial sale of meat, parts, or live deer (Title 14, sec. 676).

A fully certified fallow deer farm requires that all of the deer are marked such that they are individually identifiable and all deer must have been tested numerous times for tuberculosis and brucellosis and determined by the Department to be negative or have originated from fully certified fallow deer farm (Title 14, sec. 676(c)(1)).

Only certified fallow deer farms can serve as sources for breeding stock for new fallow deer farms (Title 14, sec. 676(c)(1)(D)).

The permit requirements for fallow deer are extensive, and include requirements for fence height (8 feet), materials (12.5 gauge wire) and posts (4 x 4 wood) (Title 14, sec. 676 (g)).

Hunting inside the park is currently not allowed. Hunting regulations outside the park would require a deer license tag or permit from the Department. The hunting season is determined by the California Fish and Game Commission.

Scoping Process and Public Participation

The Seashore conducted a formal public scoping process between May and July 2002, including a public meeting in Point Reyes Station in May 2002. The purpose of scoping is to present preliminary information to the public and asks for input regarding additional environmental issues or alternatives. This scoping was advertised through over 200 letters ("Dear Friend of Point Reyes National Seashore") to interested persons, groups, agencies, libraries, and local community members. In addition, an April 28, 2002 article in the *Marin Independent Journal*, and a May 2, 2002 article in the *Point Reyes Light* both announced the time and place of the public meeting.

During the public meeting on May 4, 2002, four individuals and a spokesperson for one organization (In Defense of Animals) presented comments to the PRNS and GGNRA Citizen's Advisory Commission. Public comments from the meeting are summarized in Chapter 5.

During the scoping period of May 4 – July 5, 2002, the Seashore received 31 letters or emails offering comments and concerns about the non-native deer management plan. A table in Chapter 5 summarizes the issues raised and alternatives suggested.

On February 4, 2005, a Notice of Availability (NOA) of the Draft Non-Native Deer Management Plan/Draft Environmental Impact Statement was published in the *Federal Register* (v70, n12, pp. 063-64). In addition, over 200 letters ("Dear Interested Party") were mailed to advertise the NOA, the initiation of a 60-day public comment period, and an upcoming public information workshop on March 3, 2005, at the Red Barn Classroom in the Seashore. The list of recipients included concerned community members, environmental, animal rights and community organizations, along with state and county agencies. Similar information was communicated in the *Point Reyes Light* and the *Marin Independent Journal*. In the Seashore's letter, the public was encouraged to view the entire Draft Environmental Impact Statement (DEIS) on the park website. Alternatively, the letter specified that a compact disc containing the document or a hard copy of the document itself would be made available upon request. The public comment period opened on February 4, 2005 and closed on April 8, 2005.

The objective of the March 3, 2005 public informational workshop (held from 6:30 p.m. to 8:30 p.m.) was to provide background information regarding the proposed plan and the alternatives for non-native deer management. Approximately 60 people attended the meeting. After presentations by a NPS biologist and an ecologist from Colorado State University, attendees were encouraged to submit questions, in writing, to the workshop moderator. Approximately 20 questions were asked and answered by a panel of wildlife biologists and NPS staff. Question topics ranged from wildlife contraceptive technologies to impacts of non-native deer to donation of deer meat to charity. At the end of the workshop, Seashore staff and wildlife biologists manned "breakout stations" at which attendees could ask further questions or present comments. All comments and questions at these "stations" were recorded on flip charts.

During the public comment period, approximately 1,700 letters, emails, facsimiles, and telephoned comments (recorded by park staff) were accepted. Chapter 5 provides more detail on the comments and a response to all substantive comments submitted.

Issues and Impact Topics

The following is a summary of environmental issues or impact topics found to be relevant to the management of non-native deer. The NPS interdisciplinary team developed these issues with input from the public during scoping. Each of these is examined in more detail in chapter 4 of this EIS.

Water Resources and Water Quality

Axis, and particularly fallow deer, congregate in large groups, return to and remain in areas for long periods of time. When they occupy riparian areas, they heavily trample and browse vegetation. During the rut (reproductive season), fallow bucks denude large areas, scrape holes up to 2 feet deep, thrash plants with their antlers, and strip bark from riparian trees. Fallow deer create wide, straight trails to stream banks through repeated and heavy use. All this results in a loss of the stability that vegetation provides, with resulting destabilization of stream banks, changes in stream flow, and increased erosion and sedimentation of streams, ponds, and rivers in the park. Increased levels of nutrients and pathogen loading are also common sequelae.

Soils

Large herds of fallow or axis deer compact soils, and denude them by trampling and browsing vegetation, scraping and tearing at the soil during rut. Denuded soils are then subject to erosion and destabilization.

Vegetation

Large herds of fallow deer (up to 150 animals) remain in and return to certain pastures and forests, and can cause loss of a substantial amount of vegetation through grazing, thrashing, and trampling. This is particularly noticeable in oak woodland and riparian areas, especially in those riparian areas that have been fenced to exclude cattle for restoration purposes. Because deer are able to pass through most fences, they interfere with watershed and vegetation restoration efforts.

Wildlife

The diets of fallow deer and axis deer overlap with native ungulates. Because fallow deer are more aggressive, that can compete for and occupy habitat which could otherwise be occupied by tule elk. Non-native deer also compete with native black-tailed deer when forage is scarce, with reduced black-tailed productivity and lower fawn survival as likely outcomes. Fallow and axis deer also serve as reservoirs of paratuberculosis, to which both black-tailed deer and tule elk are susceptible. PRNS fallow and axis deer have been found to harbor lice which are not native to black-tailed deer or tule elk but are potentially transmissible and pathogenic to them. Oak woodlands and riparian areas contain the most wildlife species of any habitat in California. Damage to these habitats by non-native deer, as has been documented at PRNS, would consequently impact a large number of species. Non-native deer eat the same food as several native PRNS small mammal and bird species, and indirectly affect other wildlife through the loss of habitat from deer browsing or trampling of vegetation.

Species and Habitats of Management Concern

Exotic deer compete for food with prey species of the federally threatened northern spotted owl. They also occupy beach habitat used by western snowy plovers (federally threatened) as nesting habitat. In addition, fallow deer frequent riparian areas and disturb soils, trample, thrash, and browse vegetation, resulting in the removal of habitat for threatened California red-legged frogs, coho and Chinook salmon, steelhead trout, and the endangered California freshwater shrimp. Non-native deer may also browse plants used by the endangered Myrtle’s silverspot butterfly for nectar or as larval hosts.

Although they do not have special federal status, several rare bird species in the park occupy habitat in brush or nest on the ground in areas where non-native deer might browse or destroy vegetation. Deer may eat or trample special status plant species as well.

Human Health and Safety

Deer may offer safety hazards for drivers; as numbers increase, the risk of collisions may increase.

Visitor Experience

Reductions in the number of axis or fallow deer may adversely affect visitors who seek to view non-native deer, but would eventually improve the chances of viewing native ungulate species. Landscape vegetation changes are also possible in some areas as understory or grasslands regrow. Social values, which differ among visitors and which help shape visitor experience, would also be affected by management strategies such as contraception use or the shooting of deer.

Park Operations

Park staff, equipment, vehicles, and supplies are used to monitor and manage exotic deer, including censusing, disease testing and monitoring, erecting deer-proof fencing, and monitoring of native species to understand impacts.

Regional Economy

Ranchers have reported costs associated with the presence and growth of exotic deer populations, including fence repair, forage depredation, and veterinary costs.

Issues Considered and Rejected

This section describes environmental and/or management issues that were suggested by the public or members of the NPS interdisciplinary team, but were not carried forward for complete analysis. The reasons for rejecting the issues were either because initial analysis showed negligible or no impacts to a particular resource, or because the issue was outside the scope of this planning effort.

Management of Native Deer at PRNS

Commenters suggested broadening this planning effort to include native deer and elk at Point Reyes National Seashore. However, an existing document, the “Point Reyes National Seashore Tule Elk Management Plan and Environmental Assessment,” completed in 1998 (NPS 1998), already directs management of native tule elk in the Seashore. Although there is no planning document for native black-tailed deer, management actions for this species are not anticipated in the near future and so there has, to date, been no need for such a document. Should such a need arise, a black-tailed deer management plan would be developed and appropriate compliance completed.

Management of Non-Native Deer Outside of NPS Boundaries

The NPS has no management jurisdiction over wildlife outside of its boundaries; such management jurisdiction rests with the CDFG. Therefore, planning for areas outside NPS boundaries, on state or private lands in which non-native deer reside now or in the future, is beyond the scope of this document. However, because deer currently inside the park would very likely begin to travel outside the park under certain alternatives as the population size continues to increase (No Action, for example), the impacts of their migration outside the park are analyzed in this document. Also, agencies and private landowners whose properties are adjacent to PRNS have been given the opportunity to contribute to the development of this document through public scoping and interagency meetings.

Livestock Management at PRNS

Some commenters have noted that cattle grazed in pastures inside the park are also non-native species and have impacts on native wildlife habitat, and that this plan should include their management as well. However, ranching pre-dates the park and is specifically mentioned by the enabling legislation and general management plans of both PRNS and GGNRA as allowed. The 1980 PRNS General Management Plan (GMP) designates a “Pastoral Lands” zone of approximately 17,040 acres in the National Seashore “to permit the continued use of existing ranchlands for ranching and dairying purposes.” The 1980

GGNRA GMP specifies that the northern Olema Valley be part of a Pastoral Landscape Management Zone in which “where feasible, livestock grazing will continue within limits of carefully managed range capacities.” Through the Special Use Permit system, natural resource managers have been working with the agricultural community to modify operations within the lease areas to reduce adverse impacts associated with livestock concentration. Ranching operations have been reduced from their historic extent on the entire Point Reyes Peninsula to about 25% of the overall land area. Nearly all of the remaining 75% of Seashore land is managed as natural or wilderness areas. In areas that are managed for agriculture, tools to exclude livestock from sensitive areas, riparian zones and creeks have been implemented with great success. Changes in park zoning are possible in the next cycle of general management planning, which is expected to begin in both parks within the next 2 years. In addition, park staff has recently prepared a Biological Assessment in accordance with Section 7 of the Endangered Species Act (NPS 2002c) to analyze the extent to which agricultural lease renewals in the Seashore might affect any of the federally listed Threatened or Endangered species at the Seashore. The U.S. Fish and Wildlife Service has reviewed this assessment and issued a Biological Opinion which found that, although lease renewals might adversely affect several threatened and endangered species at the park, they were “not likely to jeopardize” them. The species identified in the Biological Opinion included salmonids, red-legged frogs, western snowy plovers, and six species of threatened and endangered plants. Both the Biological Assessment and Biological Opinion are available by request.

Required Impact Topics

Any NPS EIS is required to consider a set of mandatory topics to decide whether they apply. These are discussed below.

Conflicts Between the Alternatives and any State or Local Land Use Plans or Policies

As noted in the section on state plans, policies, and regulations, the state Department of Fish and Game does have several policies relevant to exotic deer game farming, and to the release of non-native animals into the wild. The policies guide deliberate release, but show that the state is concerned about and controls, through individual permits, the import, transport, or release of exotic and/or diseased wildlife. The state code is relevant to animals that may leave the park, as the Department would take over their management outside the park.

Wetlands and Floodplains

Riparian areas are frequented by fallow deer herds and are analyzed along with other vegetation impacts (in the Vegetation section of Chapter 4, Environmental Consequences) in this document. Non-native deer do not otherwise affect wetlands or floodplains.

Prime and Unique Agricultural Lands

As noted in other sections of this document, the Seashore and GGNRA both include areas grazed by cattle. The relationship between these lands and the management of exotic deer is confined to adverse impacts of the deer on cattle forage and on fences. Neither of these issues is related to prime or unique agricultural lands, and so this topic is considered irrelevant to this deer planning effort.

Important Scientific or Cultural Resources

The scientific resources that are affected are the native species in the parks. These resources are analyzed in the soils, water quality, vegetation, and wildlife sections of this EIS. Cultural resources are not likely to be affected by any of the management actions in any of the alternatives. It is possible that trampling of vegetation and resulting loss of soil through erosion or bank failure related to the congregating of large herds of deer (particularly during the rut, for example) might uncover buried archeological resources. This possibility is considered remote and the impact negligible. Therefore, the impacts to cultural resources are not analyzed in this EIS.

The following additional resources would not be affected and so are not analyzed:

- Sacred sites
- Indian trust resources
- Energy conservation
- Natural or depletable resource conservation
- Urban quality and the built environment

Chapter 2: Alternatives

Introduction

Alternatives are the different ways of meeting the objectives of the plan that resolve most, if not all, of the environmental issues associated with the proposal. As stated in the Chapter 1, Purpose and Need, the objectives of the Seashore's non-native deer management plan are: (1) to correct past and ongoing disturbances to Seashore wilderness ecosystems in the form of introduced non-native deer, (2) to prevent spread of both species beyond Seashore and GGNRA boundaries, (3) to reduce impacts to agricultural permittees, and (4) to minimize long-term diversion of staff time and Seashore resources from other resource management projects. Except for the No Action alternative (Alternative A), the action alternatives discussed below substantially further each of these project objectives. Reasonable alternatives are those which, as defined by the Council on Environmental Quality "are economically and technically feasible, and show evidence of common sense" (Director's Order 12 handbook, sec. 2.7) in addition to resolving need and meeting project objectives.

The Process for Formulating Alternatives

NEPA and its regulations envision a multi-step environmental planning process to produce an EIS. The NPS has taken the language of NEPA and regulations governing all agencies and produced its own set of NEPA policies in its Director's Order 12 "Conservation Planning, Environmental Impact Analysis and Decision Making" (NPS 2001). In DO 12, the NEPA planning process that all parks are required to follow is set out in detail (sec. 2.1), including when and how to formulate alternatives. The Seashore followed this process in first defining its need for action and its purpose in taking action. These are identified in Chapter 1. Specific goals are listed as objectives. Also as explained in Chapter 1, the park is required by its own governing laws, regulations, and policies to take certain actions, and constrained by these same laws in some cases from taking other actions. In this case, the NPS laws and policies direct the park to restore natural conditions, favor native species, and eliminate or control non-native species that adversely affect the natural ecological balance. In other words, the laws and policies became part of the need for action. All alternatives analyzed by the NPS in an EIS must resolve the need for action, meet the purpose of taking action and meet the stated objectives to a large degree. This is an essential component of the reasonableness of any alternative; therefore, those that are unable to resolve need or meet the purpose of the action are eliminated from further analysis by the NPS interdisciplinary team.

Within the framework provided by purpose, need, objectives, laws, and policies, the interdisciplinary team is tasked with creating a full range of options aimed at resolving any identified environmental issues. Many of the issues were identified during public scoping, conducted between May and July 2002, which included a public meeting in Point Reyes Station in May 2002. The NPS team reviewed all public comments (see Chapter 5 of this EIS for more detail) to help define the list of issues, and it considered any alternatives suggested by the public during scoping.

In addition to analysis of public comment, all federal, state, and local agencies with jurisdictions and policies affected by non-native deer were consulted as part of an extended exotic deer interdisciplinary team (see Chapter 5).

The No Action alternative and two categories of action alternatives were analyzed. The No Action alternative (Alternative A) is identified in the NEPA regulations as the continuation of existing management practices. As explained in Chapter 1, the Seashore has historically managed deer through an informal management plan in which both species were limited to 350 individuals since 1976. Since 1995, when ranger culling was discontinued, there has been no active management of either species. The No Action alternative in this EIS is therefore the continuation of no active management or control of the non-native deer populations.

The action alternatives are divided into two categories—control and removal of all non-native deer. The first category of action alternatives (Alternatives B and C) would focus on the reduction and long-term management of population sizes by the Seashore to a level that has historically kept non-native deer from expanding to habitat outside the Seashore. The alternatives explore a range of techniques to accomplish this reduction. The other category of action alternatives (Alternatives D and E) would result in the removal of all non-native deer from the Seashore and GGNRA. As in Alternatives B and C, removal would be accomplished with various wildlife management techniques, either alone or in combination.

The remainder of this chapter is devoted primarily to a description of these alternatives. A discussion of alternatives eliminated from further study, along with reasons for their elimination, follows the description of alternatives analyzed in this EIS. In addition, two required summary tables are presented at the end of the chapter: (1) a summary of the features of each alternative, and (2) a summary of the impacts of each alternative.

Actions Common to All Alternatives

In order to ensure protection of native species and ecosystems and to assess success of any management program, continued monitoring for at least 15 years would be an integral part of any alternative chosen. In some alternatives, monitoring would continue for a longer period. For example, monitoring of non-native deer would not be required in perpetuity if both species were completely removed in 15 years (Alternatives D and E), whereas there is no such time limit for monitoring of non-native deer in cases where both species remain in the Seashore indefinitely (Alternatives A, B, and C). Monitoring and data collection activities common to all alternatives could include any or all of the following:

- Monitoring of native and non-native deer numbers through park-wide aerial and/or ground censusing, indirect indices (pellet group or spotlight counts) or area sampling, performed at intervals of 1–3 years. Any use of aircraft to monitor deer would comply with Office of Aircraft Safety regulations and policies for all NPS aerial operations (Director's Order 60).

- Monitoring of native and non-native deer population growth rates through composition counts, with or without multi-year surveillance of marked animals for determination of survival and fecundity rates.

- Monitoring of non-native deer range year-round with special emphasis on identifying expansion of non-native deer range beyond Seashore boundaries and alteration of range as a reaction to management actions. Should exotic deer expand outside the park, the Seashore would provide assistance to the CDFG to conduct monitoring programs outside its borders.

- Monitoring of the diets of native and non-native deer to assess dietary overlap given the new ranges occupied by exotic deer and new deer herd sizes since the previous dietary studies of 1973–1976 (Elliott 1983). Particular attention would be given to assessing the importance of threatened and endangered plant species in the diets of all deer species as well as dietary overlap between non-native deer and native tule elk, re-introduced to the Seashore in 1978.

- Surveillance for evidence of deer overgrazing in natural or wilderness areas in which non-native deer are found in high densities. This could include the erection of deer-proof exclosures, as experimental controls, in wilderness areas.

- Monitoring of disease in all non-native deer found in high densities within pastoral areas, and in direct contact with livestock, within Seashore boundaries. Such periodic (every 1–3 years) screening would attempt to identify any threats of disease transmission between deer and livestock. Disease testing could entail collection and complete necropsy of a sample of any deer species for which the two above requirements were satisfied, along with laboratory analysis of appropriate biological samples.

- Monitoring of the costs of the management program, including staff time, training, administrative, legal, and public relations costs and the costs of monitoring as described above.

- Formal or informal surveys of visitor response to non-native deer management. Periodic monitoring of park visitation with special attention to changes in visitation during or after specific management actions.

All actions which involve direct management of individual animals, ranging from aerial surveillance to live capture and lethal removal, would be conducted in a manner which minimizes stress, pain, and suffering to every extent possible. Culling would be conducted by NPS staff or contractors specifically trained in wildlife sharpshooting. In addition to other federal contracting requirements, for the purposes of this plan, a contractor is a fully-insured business entity, non-profit group, or government agency engaged in wildlife management activities that include trapping, immobilization and the lethal removal through sharpshooting and chemical euthanasia. The contractor must possess all necessary permits and be able to pass any needed security clearances. Efforts would be made to deliver immediately lethal shots to target animals and sharpshooters would be required to complete NPS range qualifications specifically designed for ensuring humane and effective wildlife removal. NPS would use recommendations of the American Veterinary Medical Association for humane treatment of animals (see www.avma.org/resources/euthanasia.pdf, the American Veterinary Medical Association website, for examples). As such, every effort would be made to minimize the degree of human contact during all procedures that require handling of wild ungulates. In addition, an attempt would be made, in all pertinent alternatives (B, C, D, and E) to "reduce pain and distress to the greatest extent possible during the taking of an animal's life" (AVMA 2001).

All actions occurring in designated wilderness, from monitoring to active deer management, would be consistent with the "minimum requirement" concept. This concept is a documented process used to determine whether administrative activities affecting wilderness resources or the visitor experience are necessary, and how to minimize impacts. Such activities could include use of motorized transport or aircraft in wilderness areas. Instructions and a worksheet for the minimum requirement analysis are attached in Appendix A.

Where fallow and axis deer carcasses can be easily moved, they would be donated to charitable organizations as food for the needy. In remote and sensitive locations where removal of a carcass is difficult, it would be left to recycle nutrients into the ecosystem.

Alternative A: No Action

NEPA requires analysis, in any EIS, of a No Action alternative, i.e. analysis of the future circumstances without the proposed project. This alternative would perpetuate the non-native deer management practices undertaken since 1995, when ranger culling was discontinued. No actions to control the size of non-native deer populations would be taken. Monitoring activities, as outlined above in *Actions Common to All Alternatives,* would continue in perpetuity.

Current estimates indicate approximately 250 axis deer and 860 fallow deer occupy the Seashore (NPS 2003 and PRNS unpublished data (f)). In their deer population models, Gogan et al. (2001) and Hobbs (2003), both considered current numbers to be below the carrying capacity of the habitat. Using a combination of predictions from these models, census data, information from monitoring, and the literature, it is likely that the numbers and range of both species would increase over the lifetime of this planning effort (20 years). Modeling shows that populations of axis and fallow deer would likely increase to an equilibrium level on parklands. This means non-native deer would occupy existing lands at higher densities. In other words, larger groups of non-native deer would be present on pastoral lands, in Olema Valley and in wilderness areas of the Seashore.

Non-native deer would also likely extend their range, both within the parks and outside. To date, fallow deer have occasionally been sighted as far east as Nicasio Reservoir and Woodacre (PRNS unpublished data (k)). Monitoring of herd movements over the past 10 years suggest that they would continue this expansion to the east as well as to the south, eventually spreading beyond Seashore boundaries into private lands and lands administered by California State Parks and Marin Municipal Water District. Favorable non-native deer habitat (interspersed grasslands and forests) exists in close proximity to PRNS, GGNRA, and throughout Marin and Sonoma Counties. This expansion could occur relatively soon and continue quickly. Fallow deer in New Zealand have been documented to spread at rates of up to 4.5 miles per year (Mungall and Sheffield 1994).

Historically the population of axis deer in the study area boundary has been larger than it is currently. Given this, it is considered likely that this species would also increase in range and total number under a No Action alternative. The successful colonization of axis and fallow deer over a broad area within the Seashore suggests that they would expand their ranges throughout at least some portions of these counties. Expansion rates of non-native deer would depend on a number of factors beyond the control of PRNS, namely, range conditions and hunting pressure outside the park.

Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal

As noted in other sections of this document, this planning effort is being undertaken to accomplish four objectives:

- To correct past and ongoing disturbances to Seashore ecosystems from non-native deer and thereby to contribute substantially to the restoration of naturally functioning native ecosystems;
- To minimize long-term impacts, in terms of reduced staff time and resources, to resource protection programs at the Seashore, incurred by continued monitoring and management of non-native deer;
- To prevent spread of populations of both species of non-native deer beyond Seashore and GGNRA boundaries; and
- To reduce impacts of non-native deer through direct consumption of forage, transmission of disease to livestock and damage to fencing to agricultural permittees within pastoral areas.

The interdisciplinary team examined several methods of accomplishing the objectives of this plan, but agreed that a reduction in numbers was an essential component of any reasonable alternative. Alternatives such as fencing to restrict deer to a particular location or use of contraception alone were considered but rejected (see the Alternatives and Actions Considered but Rejected section below). The two strategies the team felt were reasonable to consider to reduce non-native deer populations were lethal removal and decreasing reproductive rates with fertility control. Alternative B would focus on the use of lethal control to reduce the size of the non-native deer populations. This alternative includes the monitoring listed in the Actions Common to All Alternatives section in Chapter 2, Alternatives).

Non-native deer populations would be maintained at a level of 350 for each species (700 total axis and fallow deer). Because fallow deer concentrations are higher than this currently, and axis deer populations are lower than this target, the focus of initial reductions would be on fallow deer. This target population level was chosen because of its history, and for the management reasons listed below. However, the number would be re-evaluated by NPS resource managers regularly and could be changed based on results of ongoing monitoring programs as described below. Efforts would be made to reach target (reduced) levels in 15 years and to ensure continued presence of both species in the Seashore. Because fallow deer currently exceed 350 animals, and axis deer have historically done so, any chosen population control method would need to be used in perpetuity to maintain each species at this population size.

As noted in Chapter 1, 350 individuals of each species is the level that was named in an informal 1976 management plan, with the stipulation that future research and monitoring could change the number. Since 1976, the following information has been collected:

- Data on the success and cost of controlling both species to this level is available for determining the impacts of this alternative and ability to satisfy project goals. For 1984–1994, records exist of how many deer were culled and how many ranger hours were expended (PRNS non-native deer collection data, 1984-1994). Data also exists on current minimum numbers for non-native deer 8 years after discontinuation of the control program (PRNS unpublished data (a) and (f)). This constitutes some level of knowledge on expected cost, effort and likelihood of long-term success in limiting exotic deer populations to levels of 350 for each species.

- Based on non-native population models developed by Gogan et al. (2001) and Hobbs (2003), controlling non-native deer to these levels is unlikely to result in a natural decrease to extirpation of either species from the Seashore or GGNRA.

- To date, historical information suggests that neither population of non-native deer has moved out of the park at these (350 animals in each species) population levels (Wehausen and Elliott 1982, Elliott, 1977b) .

- Historical records indicate populations of this size do not cause more than negligible damage to forage and fencing to ranches inside the park (Elliott 1982).

It is important to note that, based on monitoring data, target deer population levels might change. For example, as populations of deer are reduced to below carrying capacity, the increased nutrition available to each adult can result in an increase in birth rate. Eventually, the maximum sustained yield is reached, where the population level is such that the output of young is at its highest. In deer, the maximum sustained yield is usually reached when the population equals 50– 65% of the carrying capacity. If deer herds are culled to the level of maximum sustained yield, future culling to maintain numbers at this level would require the maximum effort, with the maximum number of animals being removed on a regular basis (McCullough 1987). Carrying capacities of non-native deer in the study area are estimated at 775 fallow and 455 axis (Gogan et al. 2001; Hobbs 2003). Maximum sustained yield populations and carrying capacities for axis and fallow deer at PRNS are currently unknown, but have been estimated at 62% of carrying capacity, or approximately 280 axis deer and 480-620 fallow deer (Gogan et al. 2001; see Appendix B for an explanation of non-native deer population models).

Non-native deer would be culled (shot) by trained Seashore staff. The timing and location of culling as well as age, sex, and numbers of deer culled would be determined by resource managers to ensure that populations are maintained at desired levels and to reduce risks of range expansion beyond Seashore boundaries. Any deer control program involving lethal removal of animals with firearms has the potential to scatter deer herds and push deer out of the Seashore into adjacent lands. Efforts to remove animals from the edges of the Seashore before culling animals deeper within the park would mitigate such scattering.

Culling would be conducted by NPS staff or contractors specifically trained in wildlife sharpshooting. (In addition to other federal contracting requirements, for the purposes of this plan, a contractor is a fully-insured business entity, non-profit group, or government agency engaged in wildlife management activities that include trapping, immobilization and the lethal removal through sharpshooting and chemical euthanasia. The contractor must possess all necessary permits and be able to pass any needed security clearances.) Efforts would be made to deliver immediately lethal shots to target animals and sharpshooters would be required to complete NPS range qualifications specifically designed for ensuring humane and effective wildlife removal.

Culling would take place year-round, weather permitting, and throughout the Seashore, with the exception of northern spotted owl breeding areas during owl nesting season (February 1–August 1), and a ¼-mile coastal buffer zone, to minimize disturbance to marine mammals and protected shorebirds. Shooting would be limited to non-peak times in high-visitation areas—ideally, early and late in the day.

Sharpshooters would occasionally need to use vehicles to access deer for culling and carcass removal, but would attempt to remain on roads and trails whenever possible. Particularly in wilderness and sensitive areas, cross-country use of vehicles would take place only if absolutely necessary.

During the first several years, the focus of culling would be on fallow deer, as population numbers are substantially higher in this species. This initial "reduction" phase is predicted to last 8 years, during which culling of fallow deer would be intense. Thereafter, park management of fallow deer would enter its maintenance phase, where a much smaller number of deer each year would be taken. Because the population of axis deer is currently under the target of 350, culling in this population would remain very low initially, but would increase as the population surpassed 350.

An estimate of the number, sex, and age of deer that would be removed is based on predictions by Gogan et al. (2001) and Barrett (2000) regarding the response of the populations to culling. As noted above, when the population is decreased and food and shelter are relatively more abundant for the remaining animals, birth rate and recruitment (e.g., the successful addition of newborns to the population, or the survival rate of newborns) increase. When a population is close to its biological "carrying capacity," birth rate and recruitment decrease. Carrying capacity is defined as the maximum number of animals of a species that can live in a given environment (Shaw 1985). It is not a fixed number, but rather varies with changes in climate and habitat. Gogan et al. (2001) and Hobbs (2003) estimated carrying capacities for Seashore axis and fallow deer by modeling population parameters and using cited species population parameters, along with past PRNS census and PRNS deer removal data. For purposes of discussing potential control actions, fixed carrying capacities were assumed to be static numbers, and the Gogan et al. estimates for fallow and axis deer carrying capacity (775 and 455 animals, respectively) were used in this analysis. However, because of the variables mentioned above, the actual response to culling and precise harvest numbers are unknown and would be adjusted based on the results of future monitoring efforts such as those described in the Actions Common to All Alternatives section and in Appendix C..

Using a PRNS fallow deer harvest model developed by Barrett (2000), and assuming the constant carrying capacity of 775 for PRNS fallow deer as estimated by Gogan et al. (2001), the annual removal of 100–200 fallow deer beginning in 2005 for 10 years, followed by culling of between 50 and 100 deer from 2016 on, would reduce the fallow population to 350 by 2021 (see Appendix B).

To predict axis deer response to harvest using the Barrett model, and assuming the constant carrying capacity of 455 for PRNS axis deer proposed by Gogan et al. (2001), the current population of ~250 axis deer would reach 350 in a few years. At this point, culling 25–50 axis deer per year thereafter would allow the population to remain stable at 350. See Appendix B for an illustration of the axis deer population trajectory under this scenario.

Because the focus of this alternative is the maintenance of axis and fallow deer at a specified level and not their eradication from PRNS, annual culling would continue indefinitely, and total numbers of animals removed over the lifespan of deer management is very high. As an example, although the exact number of fallow deer in the project area is unknown, past research indicates a reliable estimate is approximately 859 (90% Confidence Interval = 547 – 1170). Given fluctuations in climate, habitat conditions, and the response of deer to culling, Alternative B could result in the removal of over 2,000 axis deer and over 5,000 fallow deer by 2050. If current numbers and true carrying capacities were higher than postulated by Gogan et al. (2001), total numbers of non-native deer removed would be higher.

Where fallow and axis deer carcasses can be easily moved, they would be donated to charitable organizations as food for the needy or for endangered species recovery programs. In remote and sensitive locations where removal of a carcass is difficult, it would be left to recycle nutrients into the ecosystem.

Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control

As in Alternative B, non-native deer populations would be maintained at a level of 350 for each species (700 total axis and fallow deer) through a combination of lethal removals and fertility control. Because fallow deer concentrations are higher than this currently, and axis deer populations are lower than this target, the focus of initial reductions would be on fallow deer. As noted above, this target population level was chosen because of its history and for the management reasons listed. However, the number would be re-evaluated by resource managers regularly and could be changed based on results of ongoing monitoring programs, described in Actions Common to All Alternatives. Efforts would be made to reach target (reduced) levels in 15 years and to ensure continued presence of both species in the Seashore. Because fallow deer currently exceed 350 animals, and axis deer have historically done so, any chosen population control method would need to be used in perpetuity to maintain each species at this population size.

The number of deer that require removal and those that can be treated through contraception depends on several variables, including carrying capacity, birth rate, climate, forage conditions, and in this alternative, the effectiveness of the contraceptive method selected. Fallow deer populations would be reduced using a combination of long-duration fertility control and shooting. The assumption used in modeling was that 25% of fertile females could be permanently marked and treated with a long-term contraceptive every 4 years, effectively removing a quarter of the females as targets for shooting. Over the 15-year time period of this plan, about 345 deer would be shot to bring the population to 350 by year

15. Thereafter, 12–14 deer would be shot yearly and another 25% of the fertile females would be given contraception every 4 years (Hobbs 2003).

Although axis deer populations are currently below the 350 target, past history suggests they would increase to this level. Because no long-duration contraceptive has ever been tested in axis deer and because of the difficulty of contracepting a species in which does might be pregnant at any time of year, in Alternative C it is estimated that between 25 and 50 axis deer would be shot each year after the population reaches 350.

As in Alternative B, non-native deer would be removed (shot) by Seashore staff or contractors. The timing and location of culling as well as age, sex, and numbers of deer culled would be determined by resource managers in future years and would depend on the effectiveness and availability of long-term contraception. The objective of both the culling and contraceptive programs would be to ensure that populations are maintained at desired levels and to reduce risks of range expansion beyond Seashore boundaries.

Culling would be conducted by NPS staff or contractors specifically trained in wildlife sharpshooting. Efforts would be made to deliver immediately lethal shots to target animals and sharpshooters would be required to complete NPS range qualifications specifically designed for ensuring humane and effective wildlife removal.

The same conditions as described in Alternative B for when and where culling would take place would apply in Alternative C; that is, it would occur year-round and away from protected species. Off-trail vehicle use would take place only when absolutely necessary, particularly in wilderness and sensitive areas.

Any deer control program involving lethal removal of animals with firearms has the potential to scatter deer herds and push deer out of the Seashore into adjacent lands. Provisions described in Alternative B that specify removing animals from the edges of the Seashore before culling animals deeper within the park would mitigate such scattering. However, large numbers of fallow deer on the Vedanta Society property, a private inholding, would remain outside NPS management authority.

Required Characteristics of a Fertility Control Agent

The goals of the contraceptive program would be to incorporate the latest contraceptive technologies to safely prevent reproduction for as long as possible and with minimal treatments per animal. The following characteristics are required for any chosen fertility control agent:

- The agent should have few adverse effects, other than inhibition of reproduction, on non-native deer. Drugs that cause damage to organ systems or disrupt non-reproductive functions would be considered undesirable.
- The agent should act specifically on the target species, in this case non-native deer. The agent should not cause any adverse impacts to non-target species (i.e., predators or scavengers) or humans that might consume non-native deer or otherwise share their environment. Capturing target non-native deer individually, marking them and administering the agent through injection or implants can improve specificity of action of any infertility agent. Depending on the agent used, "Do Not Consume" eartags could mitigate human health risks.

- The agent should have a multi-year duration or act irreversibly to prevent reproduction in non-native deer. This is because each per-animal treatment required in order to ensure contraception increases the likelihood of treatment failure due to incomplete administration or lack of physiological response.

- The agent must be registered for use in wildlife by the EPA or must have an EPA-approved "experimental use" or "Section 18" request permit which would allow its use as an experimental drug with wild fallow or axis deer. There are currently no contraceptive drugs registered for use in wild deer. In order to be registered, a drug sponsor is obliged to provide the EPA with substantial evidence of the drug's effectiveness through controlled studies and must demonstrate the safety of the agent on the target and non-target species. Environmental and human safety issues must be addressed as well. In order to receive either an "experimental use" permit, per Sections 3 and 5 of the Federal Insecticide, Fungicide and Rodenticide Act, NPS and the sponsor would need to submit to EPA safety and effectiveness data on the proposed chemical. Alternatively EPA could grant the NPS a "Section 18" request, as per Section 18 of the Act, if the agency could document that the use of the chemical would avert an emergency, either of an agricultural or an ecological nature.

- Use of the agent must be logistically and economically feasible. An agent that requires frequent boosters in order to remain effective or is exorbitantly expensive to produce and procure would result in an unsustainable program.

Because both species of non-native deer are polygynous and a small proportion of bucks accomplish a large proportion of breeding, male contraception is inefficient and impractical (Warren 2000). Surgical sterilization, because of the time and cost required to accomplish safely, is impractical for large numbers of wild ungulates and is discussed in the Alternatives and Actions Considered but Rejected section. The options that are available or are likely to become available during the life of this plan for female deer are described below, and include contraceptive vaccines, synthetic steroids, and hormonal agonists. Information about contraceptives that would last for only one season is presented only as background, since the application of 1-year duration contraceptives has been shown to be impractical in either reducing the populations to 350 or for eradicating them (Hobbs 2003).

There is currently no EPA-registered contraceptive for wild deer. Registration of the first prospective long-duration contraceptive for deer chemical could be completed by mid-2007 (M. Laws, EPA, personal communication). Unregistered chemicals for use in animals would have to be used experimentally with an "experimental use" permit issued by EPA. Alternatively, unregistered chemicals could be used as part of a Federal Insecticide, Fungicide and Rodenticide Act Section 18 emergency request to EPA. The NPS would need to partner with an agency or organization that has data on the effectiveness and safety of a proposed contraceptive. Such groups could include the United States Department of Agriculture (USDA)-National Wildlife Research Center (PzP and GnRH vaccines), the Humane Society of the United States (PzP vaccine), or Spayvac for Wildlife, Inc. (PzP vaccine). For Spayvac®, additional USDA Veterinary Services permits would be needed to ship the vaccine from Canada. As of this writing, Spayvac® is no longer being made available for deer trials by the manufacturer (M. Fraker, Terramar, personal communication).

Contraceptives with Short (1 year or less) Duration

Reversible contraceptive drugs, as used experimentally in female deer, have been shown to prevent pregnancy in one of several ways: (1) by causing the treated animal to mount an immune response to its own ovum or egg (immunocontraceptive vaccines), (2) by acting as a hormonal agonist or tissue-specific toxin and thereby directly acting to prevent the secretion of an animal's own reproductive hormone (GnRH agonists, pituitary toxins), and (3) by mimicking a reproductive hormone and thereby blocking secretion of the animal's own hormones (synthetic steroids). In addition, contragestives are products that terminate pregnancy either prior to or after maternal recognition of pregnancy.

The synthetic steroids, such as melangestrol acetate, megestrol acetate, or diethylstilbestrol are generally not considered a practical and safe option because of the potential for entry into the food chain via scavengers and predators. However, norgestomet, a synthetic progestin approved for use in food animals, has minimal potential for food chain effects and has been found to prevent pregnancy in black-tailed deer for 1 year when used in a biobullet form (Jacobsen et al. 1995). Its effectiveness in fallow or axis deer is unknown.

A GnRH agonist, leuprolide, has been tested in elk and deer and has been found to cause infertility for one breeding season (Baker et al. 2002, 2004, and 2005). Because leuprolide is a neuropeptide or protein, and broken down by digestion, it pose no risks of passing into the food chain. It is effective for one breeding season and can be purchased with a veterinary prescription for use in deer and elk. Leuprolide's limitations are that the animals must be treated prior to the breeding season since it is not effective in pregnant animals, and fertility is suppressed for only one breeding season or year**.** Its effectiveness in axis or fallow deer is currently unknown.

Immunocontraception with the porcine Zona Pellucida (pZP) vaccine has also been shown to prevent conception for 1 year in a variety of deer species, including fallow and axis deer (Kirkpatrick et al. 1996a; Deigert et al. 2003). PZP is a protein that would be destroyed by digestion in predators or scavengers and thus would not enter the food chain. Freund's adjuvant, a compound added to the pZP vaccine to increase the immune response, has potential for carcinogenicity in humans. The Food and Drug Administration requires that all treated deer be marked permanently with a "Do Not Consume" eartag or collar. Such marking would require capture of the deer. Formulations of pZP that do not contain Freund's adjuvant are currently in development (Fagerstone et al. 2002). The short duration formulation of pZP, should it indeed prove effective in preventing pregnancy in axis or fallow deer, would likely require two initial injections, at least 3 weeks apart, and regular re-inoculations to remain effective. In order to locate treated does for annual retreatment, all individuals given contraception would have to be captured in the first year and permanently marked with eartags or radio telemetry collars.

Contragestives, such as PDF2α (Luteolyse®), which interrupt pregnancy and induce abortion, have been shown to be effective in deer. Luteolyse® must be administered to does during each pregnancy, is commercially available and has no withdrawal period for use in domestic food producing species.

For reasons described below and in the Alternatives and Actions Considered but Rejected section, contraception or contragestion that only provides annual or short term prevention of pregnancy or birth is unworkable as a solution by itself. Even as an adjunct to lethal controls, cost and logistic difficulties of capturing, holding, injecting, and marking treated animals would likely make annual fertility control infeasible.

To date, there have been a few successful control programs for deer in which short duration contraceptives were used. These, however, have all involved small populations (less than 400 animals) in enclosed areas or on islands (Miller et al. 1998; Rudolph et al. 2000; Naugle et al. 2002; Rutberg et al. 2004). Accessing animals every year for retreatment appears to be a major obstacle for control of free-ranging deer occupying large areas of rugged habitat. As Rutberg et al. (2004) noted, given current technology and plausible limits on the efficiency of dart delivery, it seems unlikely that populations of deer occupying large blocks of rural and wild habitat would be effectively controlled by dart-delivered contraception agents. Rudolph et al. (2000) noted that as a greater proportion of female deer in a population are treated, the cost and effort needed to treat additional female deer increases exponentially. Before widespread application of short duration contraceptive vaccines is possible or appropriate, NPS managers must consider the likely magnitude of population reduction and minimum densities that can be achieved; long-term behavioral, genetic and health effects on deer; and the cost and effort needed to maintain a long-term contraception program.

Sterilants and Long-Acting Contraceptives

A sterilant is defined, for the purposes of this discussion, as a drug that would prevent reproduction for a doe's reproductive life with one administration and would not require yearly "boosters." A long-acting contraceptive would prevent reproduction for multiple breeding seasons, or years. Because no such drugs have been registered for use in wildlife with EPA, studies on safe and efficacious use of candidate drugs would have to be conducted before they could be used for management and population control. Any long-acting contraceptive considered for use would have to satisfy the requirements for safety, specificity and practicality listed above (in Required Characteristics of Fertility Control Agent).

As described above there are legal requirements for use of contraceptive drugs in wildlife by a federal agency. There would be three primary agencies involved, CDFG, NPS, and the EPA. State departments of wildlife or agriculture may have their own regulations regarding the use of fertility altering pharmaceuticals in wildlife species. Whenever possible, NPS units are mandated to cooperate and coordinate with state agencies to manage cross boundary wildlife resources (43 CFR part 24). The EPA currently regulates immunocontraceptive vaccines. To register a chemical with EPA, the registrant must show effectiveness, safety to non-targets, safety to target animals, provide an environmental assessment, and provide information on manufacturing procedures.

Until recently, there were two long-duration products available with Investigational New Animal Drug permits issued by the Food and Drug Administration, Spayvac®, a long-acting formulation of porcine Zona Pellucida (pZP), and GonaCon®, a long-acting Gonadotropin Releasing Hormone (GnRH) vaccine. Curtis et al. (2002) demonstrated approximately 85-90% efficacy for both GnRH and pZP immunocontraceptive vaccines in white-tailed deer (*Odocoileus viginianus*), but deer required booster treatments at least every second year to maintain effectiveness. Currently only one product, Spayvac®, a long-acting formulation of porcine Zona Pellucida (pZP), has been tested in fallow deer (Fraker et al. 2002). Preliminary results indicated that 3 years after a single inoculation, Spayvac® prevented pregnancy in 100% of a small number of fallow does tested (n=5). The anti-Zona Pellucida antibodies required to prevent pregnancy were still high in test animals at that time (Fraker, personal communication), indicating the effectiveness of Spayvac® was likely to continue beyond 3 years. Spayvac®'s efficacy in axis deer is unknown. As of the writing of this document, Spayvac® is no longer available for use in deer trials because it was withdrawn by the manufacturer (M. Fraker, Terramar, personal communication). It is unknown whether Spayvac® would again become available for experimental use during the life of this management plan (20 years).

The National Wildlife Research Center is in the process of obtaining a patent for GonaCon® and may apply for registration with EPA (K. Fagerstone, USDA, personal communication). GonaCon® works by causing an immune reaction that inhibits activation of Gonadotropin Releasing Hormone (GnRH), thus preventing the production of other hormones required for reproduction (Miller et al. 2000a, 2000b; National Wildlife Research Center 2004). National Wildlife Research Center researchers documented reduced fawning for 1–4 years for female white-tailed deer treated with both PZP and GnRH immunocontraceptive vaccines (Miller et al. 2000a and 2000b). Both products were effective for multiple years when a single injection was given to white-tailed deer in the late summer. The wildlife contraception researchers consulted for this document communicated to NPS that multi-year efficacy (2–5 years) could be anticipated to occur in fallow deer with a single shot of the pZP or GnRH vaccine (D. Baker, K. Fagerstone, personal communication). It is unknown whether GonaCon® would be as effective in axis deer since this species has no defined breeding season and does treated at any time of year could be pregnant.

Successful field application of a fertility control program would require both an effective agent and a practical delivery system (Cowan et al. 2002). The alternatives in this EIS assume the use of either a long-acting formulation of pZP or the currently available GnRH vaccine and, for purposes of analysis, assume the duration of action to be 4 years. If it is longer, deer may either need to be treated less frequently, fewer deer may need to be treated or the same number treated with fewer culled over time. If the tested product's duration of action is shorter, the converse would be true. The alternatives also assume that an effective dose of the contraceptive can be delivered to a certain number of does, in this case approximately 25% of all the fertile does. See the detailed monitoring and management plan, attached as Appendix C, for a description of the adaptive management approach to modification of plan actions should these assumptions be invalid.

Modeling Results Using Lethal Controls and Contraception

Axis Deer

As noted above, no long acting contraceptive has been tested in axis deer. In addition, because axis deer breed throughout the year, any prospective agent would have to be effective in pregnant does. Therefore under Alternatives C and E, lethal controls would be used to maintain the axis deer population at 350 or remove all axis deer. To predict axis deer response to culling using the Barrett model, and assuming the constant carrying capacity of 455 for PRNS axis deer proposed by Gogan et al. (2001), the current population of approximately 250 axis deer would reach 350 in a few years. At this point, culling 25–50 axis deer per year would allow the population to remain stable at 350. See Appendix B for an illustration of the axis deer population trajectory under this scenario.

As described above and in the Alternatives and Actions Considered but Rejected section, annual contraception would be ineffective in limiting the population of axis deer to 350. Should long-acting contraceptive technology for axis deer become available, its practicality and effectiveness in controlling PRNS axis populations at 350 animals would be evaluated, as it would be in fallow deer, in light of the requirements for safety, specificity and practicality listed above. Use of long-duration contraceptives in axis deer would reduce the number of axis deer that would require culling in order to achieve control.

Fallow Deer

Estimated fallow deer numbers in 2003 were approximately 860, and 43% of animals observed in a January 2002 census were adult females (NPS 2002). As with axis deer, numbers of fallow deer treated would depend on: (1) drug efficacy in preventing pregnancy, (2) the relative proportion of reproductive females in the population, and (3) the rate of population growth. Efficacy is unknown, and fecundity, sex ratios, and population growth are subject to change. Using assumptions about each of these factors, Hobbs modeled the effect of treating large numbers of fallow does with long-acting contraceptives.

Hobbs modeled four different scenarios that differ in the percentage of deer treated for three different durations of effectiveness. These were 1 year, 4 years, and lifetime (10–12 years). The percentages of fertile females treated were assumed by Hobbs to be 0%, 25%, 50%, and 75%. If 75% of all fertile female deer were treated with 4-year contraceptives, it would reduce the number shot to 93 over the 15-year period of this plan. However, it would require the capture, treatment, and marking of a total of about 740 deer over 15 years. Permanent marking of treated animals would be needed to ensure accurate monitoring of contraceptive effectiveness and to prevent inadvertent culling of treated does. If 50% of fertile female deer were given contraception, the number that would require lethal removal would rise to about 250 and the number captured, treated with a contraceptive and marked over 15 years would be about 360. If 25% of fertile female deer were treated with contraceptives, Hobbs' model indicated about 150 would be treated over the 15-year period, and about 360 would be shot. In other words, modeling showed that although combining fertility control with culling meant fewer deer would be shot, it also showed an increase in the total management effort and number of animals that required handling by humans. The Seashore staff believes that logistics, the ruggedness of the wilderness and natural areas, costs and deer behavior would make capture and treatment of more than 25% unlikely.

Because the goal of this alternative would be to control axis and fallow deer at a specified level and not to eradicate them from PRNS, annual culling and fertility control would continue indefinitely. Because of the long time period involved, the total numbers of deer removed with lethal controls and treated with contraceptives could be very high. Given current fallow deer estimates, the estimate of carrying capacity, and the need to continue removals indefinitely beyond the 15-year lifetime of this plan, at least 3,000 (2,200 axis and 750 fallow) would be lethally removed by 2050 should Alternative B be implemented, using a 4-year duration contraceptive. If current numbers and true carrying capacities are higher than postulated by Gogan et al. (2001) and Hobbs (2003), or if the contraceptive lasts less than 4 years, total numbers of non-native deer given contraception and removed would be higher.

If a lifetime contraceptive, rather than the modeled 4-year contraceptive, becomes available, the number of fertile does treated by 2050 would be 200–300. The number would vary depending on overall sex ratios and density dependent factors.

Alternative D: Removal of All Non-Native Deer by Agency Personnel

In Alternative D, all axis and fallow deer inhabiting the Seashore and the GGNRA lands administered by the Seashore would be lethally removed by shooting by 2021. The management actions included in this alternative would continue until both species were extirpated, with a goal of full removal within 15 years. This time frame minimizes the total number of deer removed (a longer period of removal would mean more fawns born and more total deer killed) and is reasonable from a cost and logistics standpoint.

Because of their current large numbers (approximately 250 axis deer and approximately 860 fallow deer), it is expected that total removal of both species would require a minimum of 13 years. Monitoring during program implementation would be conducted to assess success of the program and to guide adjustments in the location, and intensity of removal. Such monitoring programs are integral components common to all alternatives and are listed in the Actions Common to All Alternatives section and in Appendix C. Alternative D would include some or all of the previously described monitoring.

Seashore staff or contractors would remove non-native deer. Resource managers would determine timing and location of culling as well as age, sex, and numbers of deer culled. Although complete removal would take longer than controlling the population to 700 total as in Alternatives B and C, removing as many deer as quickly as possible: (1) minimizes impacts non-native deer are currently having on native species, (2) reduces the risk of non-native deer ranging beyond the Seashore boundaries, (3) minimizes the total number of deer killed over the lifetime of the management plan, and (4) increases overall culling efficiency. The latter is true because, as deer become less numerous and more wary, culling success per unit effort typically decreases. Herds may split and deer densities throughout the Seashore may change, also slowing removal efforts.

Culling would be conducted by NPS staff or contractors specifically trained in wildlife sharpshooting. Efforts would be made to deliver immediately lethal shots to target animals and sharpshooters would be required to complete NPS range qualifications specifically designed for ensuring humane and effective wildlife removal.

As in other alternatives, culling would take place year-round, weather permitting, and throughout the Seashore, with the exclusion of areas requiring special resource protection, such as northern spotted owl nesting areas and beaches. Shooting would be limited to non-peak times in high-visitation areas— ideally, early and late in the day.

Any deer control program involving lethal removal of animals with firearms has the potential to scatter deer herds and push deer out of the Seashore into adjacent lands. Provisions described in Alternative B that specify removing animals from the edges of the Seashore before culling animals deeper within the park would mitigate such scattering. However, fallow deer on the Vedanta Society property, a private inholding within the Seashore, would remain outside NPS management authority.

Sharpshooters would occasionally need to use vehicles to access deer for culling and carcass removal, but would attempt to remain on roads and trails whenever possible. Particularly in wilderness and sensitive areas, cross-country use of vehicles would take place only if absolutely necessary.

Both Hobbs (2003) and Barrett (2000) modeled the effect of culling fallow deer over time, although Hobbs assumed a higher initial rate of removal than Barrett. Both modelers extrapolated removal over a period of 15 years.

Barrett incorporated the age and sex-specific survival and reproductive rate assumptions described in Gogan et al. (2001) (see Appendix B for an explanation of Barrett's model). As noted in other sections of this EIS, because current fallow deer numbers can only be estimated and carrying capacity fluctuates with changing climate and vegetation patterns, projections should be interpreted as general trends rather than as specific numerical predictions. Assuming a 2005 fallow deer population of approximately 860 (PRNS unpublished data (f)) and a carrying capacity of 775 (Gogan et al. 2001), the model predicts that the annual removal of 150 to 200 animals over the 15-year life of the plan would result in the eradication of the fallow deer population from the Seashore (see Appendix B). Over the 15-year management period, the total number of fallow deer removed in this scenario would be approximately 1,400.

Hobbs analyzed the effect of culling on fallow populations using a simulation model (Hobbs 2003; see Appendix D for an explanation of the model) that assumed an initial removal of 300 reproducing fallow female deer and 50% of all remaining fertile does each year after that. He assumed a carrying capacity of 1,000 and found the total number of fallow deer removed over the 15-year management period would be less than half the slower removal scenario described above, or about 650 (Hobbs 2003).

The comparison of the results of each of these eradication models demonstrates the effect of pace. In other words, initially removing fertile females in larger numbers reduces the total number of deer culled over the lifetime of the plan.

Barrett also developed a model to study the effects of harvesting on axis deer and the number of deer that would require lethal removal to eradicate the population from the Seashore (Barrett 2000). He used the age and sex-specific survival and reproductive rate assumptions for PRNS axis deer described in Gogan et al. (2001). The model assumes that the Seashore carrying capacity for axis deer is 455. Given an estimated 2005 axis deer population of 250, removal of 50–100 deer per year beginning in 2005 would result in eradication by 2017. Under this scenario, a total of 800 axis deer would be removed over the management period (Appendix B).

In summary, culling approximately 250–300 non-native deer per year (or, following Hobbs' model, up to 300 fallow deer initially and 50–100 axis deer each year) would likely result in eradication of both axis and fallow deer by 2021. Total numbers of deer removed in this alternative would depend on variables such as carrying capacities for each species, year-to-year program effectiveness, and starting population size and composition. Continued monitoring, as described in the Actions Common to All Alternatives section would refine population estimates and account for changes in carrying capacity. Total numbers of non-native deer removed could range from 1,400 to 2,200.

Where deer carcasses could be moved with reasonable effort, they would be donated to charitable organizations as food for the needy or for endangered species recovery plans. In remote or sensitive locations where removal of a carcass is difficult, it would be left to recycle nutrients into the ecosystem.

Alternative E (Preferred Alternative): Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility Control

In Alternative E, all axis and fallow deer inhabiting the Seashore and the GGNRA lands administered by the Seashore would be removed by 2021 through lethal removal and fertility control (long-lasting contraception or sterilization of deer). Both actions would continue until both axis and fallow deer have been extirpated. Because of their current large populations (approximately 250 axis deer and approximately 860 fallow deer), it is expected that total removal of both species would require a minimum of 13 years, regardless of the technique(s) used. This alternative proposes to use both lethal removal and fertility control to eradicate both axis and fallow deer within 15 years. Monitoring during program implementation would be conducted to assess success of the program and to guide adjustments in the management techniques used. Provisions for monitoring are listed in the Actions Common to All Alternatives section and in Appendix C. Alternative E would include some or all of these measures.

As in other alternatives, Seashore sharpshooters or contractors would conduct the lethal removal of deer. Natural resource managers would determine timing and location of culling as well as age, sex, and numbers of deer culled. As with Alternative D, the Seashore would initially attempt to reduce the populations as quickly as possible to initially minimize impacts on native species, minimize the risk that axis and fallow deer would expand their ranges outside the park, minimize the total number of deer removed, and maximize the overall culling efficiency. With time, as deer become less numerous and more wary, culling success per unit effort typically decreases. Herds may split and deer densities throughout the Seashore may change, also slowing removal efforts.

Culling would be conducted by NPS staff or contractors specifically trained in wildlife sharpshooting. Efforts would be made to deliver immediately lethal shots to target animals and sharpshooters would be required to complete NPS range qualifications specifically designed for ensuring humane and effective wildlife removal.

Culling would take place year-round, weather permitting, and throughout the Seashore, with the exclusion of northern spotted owl breeding areas during owl nesting season (February 1–August 1) and a ¼-mile coastal buffer zone, to minimize disturbance to marine mammals and protected shorebirds. Shooting would be limited to non-peak times in high-visitation areas—ideally, early and late in the day.

Any deer control program involving lethal removal of animals with firearms has the potential to scatter deer herds and push deer out of the Seashore into adjacent lands. Provisions described in Alternative B that specify removing animals from the edges of the Seashore before culling animals deeper within the park would mitigate such scattering. However, fallow deer on the Vedanta Society property would remain outside NPS management authority.

Sharpshooters would occasionally need to use vehicles to access deer for culling and carcass removal, but would attempt to remain on roads and trails whenever possible. Particularly in wilderness and sensitive areas, cross-country use of vehicles would take place only when necessary.

Where fallow and axis deer carcasses can be easily moved, they would be donated to charitable organizations as food for the needy or for endangered species restoration programs. In remote and sensitive locations where removal of a carcass is difficult, it would be left to recycle nutrients into the ecosystem. As in Alternative C (Control of Non-Native Deer at Pre-Determined Levels by Agency Shooting and Fertility Control), the contraceptive program would incorporate the latest contraceptive technologies to safely prevent reproduction for as long as possible with minimal treatments per animal. The following summarizes characteristics required for any chosen fertility control agent:

- The agent should have few adverse effects, other than inhibition of reproduction, on non-native deer.
- The agent should act specifically on the target species, in this case non-native deer. The agent should not cause any adverse impacts to non-target species (i.e., predators or scavengers) or humans that might consume non-native deer or otherwise share their environment.
- The agent should have a multi-year duration or act irreversibly to prevent reproduction in non-native deer.
- The agent must be registered for use in wildlife by the EPA or must have an EPA-approved “experimental use” or “Section 18” request permit which would allow its use as an experimental drug with wild fallow or axis deer.
- Use of the agent must be logistically and economically feasible. An agent that requires frequent boosters in order to remain effective or is exorbitantly expensive to produce and procure would result in an unsustainable program.

As noted in the description of Alternative C, male contraception is inefficient and impractical (Warren 2000). Surgical sterilization, because of the time and cost required to accomplish safely, is impractical for large numbers of wild ungulates and is discussed in the Alternatives and Actions Considered but Rejected section. Therefore, the focus of any contraception effort would be fertile female deer using the best technology available. The options that are available or are likely to become available during the life of this plan for female deer are described under Alternative C and summarized below, and include contraceptive vaccines, synthetic steroids, and hormonal agonists. Information about contraceptives and contragestives that would last for only one season is presented only as background, since the cost and logistics of applying short-term contraceptives are likely to limit or prevent their use at PRNS. In addition, modeling has indicated that the population cannot be feasibly reduced using such short duration products (Hobbs 2003).

As noted in Alternative C, there is currently no EPA-registered contraceptive for wild deer. Registration of the first prospective long-duration contraceptive for deer chemical could be completed by mid-2007 (M. Laws, EPA, personal communication). Unregistered chemicals for use in animals are would have to be used experimentally with an “experimental use” permit issued by EPA. Alternatively, unregistered chemicals could be used as part of a Federal Insecticide, Fungicide and Rodenticide Act Section 18 emergency request to EPA.

Contraceptives with Short (1 year or less) Duration

Reversible contraceptive drugs, as used experimentally in female deer, have been shown to prevent pregnancy in one of several ways: (1) by causing the treated animal to mount an immune response to its own ovum or egg (immunocontraceptive vaccines), (2) by acting as a hormonal agonist or tissue-specific toxin and thereby directly acting to prevent the secretion of an animal's own reproductive hormone (GnRH agonists, pituitary toxins), and (3) by mimicking a reproductive hormone and thereby blocking secretion of the animal's own hormones (synthetic steroids). In addition, contragestives are products that terminate pregnancy either prior to or after maternal recognition of pregnancy.

The synthetic steroids are generally not considered a practical and safe option because of the potential for entry into the food chain via scavengers and predators.

A GnRH agonist, leuprolide, has been tested in elk and deer and has been found to cause infertility for one breeding season (Baker et al. 2002, 2004, and 2005). Its effectiveness in axis or fallow deer is currently unknown.

Immunocontraception with the porcine Zona Pellucida (pZP) vaccine has also been shown to prevent conception for 1 year in a variety of deer species, including fallow and axis deer (Kirkpatrick et al. 1996a; Deigert et al. 2003). PZP is a protein that would be destroyed by digestion in predators or scavengers and thus would not enter the food chain. Freund's adjuvant, a compound added to the pZP vaccine to increase the immune response, has potential for carcinogenicity in humans. The Food and Drug Administration requires that all treated deer be marked permanently with a "Do Not Consume" eartag or collar. Such marking would require capture of the deer. Formulations of pZP that do not contain Freund's adjuvant are currently in development (Fagerstone et al. 2002).

Contragestives, such as PDF2α (Luteolyse®), which interrupt pregnancy and induce abortion, have been shown to be effective in deer. Luteolyse®, is commercially available and has no withdrawal period for use in domestic food producing species, but must be administered to pregnant does during each pregnancy.

For reasons described under Alternative C and in the Alternatives and Actions Considered but Rejected section, contraception or contragestion that only provides annual or short term prevention of pregnancy is unworkable as a solution by itself. Even as an adjunct to lethal controls, cost and logistic difficulties of capturing, holding, injecting, and marking treated animals would likely make annual fertility control infeasible.

Sterilants and Long-Acting Contraceptives

As noted in Alternative C, a sterilant is defined, for the purposes of this discussion, as a drug that would prevent reproduction for a doe's reproductive life with one administration and would not require yearly "boosters." A long-acting contraceptive would prevent reproduction for multiple breeding seasons, or years. Because no such drugs have been registered for use in wildlife by the EPA, studies on safe and efficacious use of candidate drugs would have to be conducted before they could be used for management and population control. Any long-acting contraceptive considered for use would have to satisfy the requirements for safety, specificity and practicality listed above.

Until recently, there were two long-duration products available with Investigational New Animal Drug permits through the Food and Drug Administration, Spayvac®, a long-acting formulation of porcine Zona Pellucida (pZP), and GonaCon®, a long-acting Gonadotropin Releasing Hormone (GnRH) vaccine. Curtis et al. (2002) demonstrated approximately 85–90% efficacy for both GnRH and pZP immunocontraceptive vaccines in white-tailed deer (*Odocoileus viginianus*), but deer required booster treatments at least every second year to maintain effectiveness. Neither product has been tested in axis deer and only one product, Spayvac®, a long-acting formulation of porcine Zona Pellucida (pZP), has been tested in fallow deer (Fraker et al. 2000). As noted above, Spayvac® is no longer available for use in deer trials because it was withdrawn by the manufacturer (M. Fraker, Terramar, personal communication). It is unknown whether Spayvac® would again become available for experimental use during the life of this management plan (20 years).

The National Wildlife Research Center is in the process of obtaining a patent for GonaCon® and currently holds the Investigational New Animal Drug permit through the Food and Drug Administration for it. GonaCon® works by causing an immune reaction that inhibits activation of Gonadotropin Releasing Hormone (GnRH), thus preventing the production of other hormones required for reproduction (Miller et al. 2000a, 2000b; National Wildlife Research Center 2004). National Wildlife Research Center researchers documented reduced fawning for 1–4 years for female white-tailed deer treated with both PZP and GnRH immunocontraceptive vaccines (Miller et al. 2000a and 2000b). Both products were effective for multiple years when a single injection was given to white-tailed deer in the late summer.

Successful field application of a fertility control program would require both an effective agent and a practical delivery system (Cowan et al. 2002). The alternatives in this EIS assume the use of either a long-acting formulation of pZP or the currently available GnRH vaccine and, for purposes of analysis, assume the duration of action to be 4 years. If it is longer, deer may either need to be treated less frequently, fewer deer may need to be treated or the same number treated with fewer culled over time. If the tested product's duration of action is shorter, the converse would be true. The alternatives also assume that an effective dose of the contraceptive can be delivered to a certain number of does, in this case approximately 25% of all the fertile does.

Modeling Results Using Lethal Controls and Contraception

Fallow Deer

Hobbs (2003) analyzed a scenario in which long-acting contraceptives (sterilants) were combined with lethal removal to remove all the non-native deer populations in the Seashore. As with axis deer, numbers of fallow deer treated would depend on: (1) drug efficacy in preventing pregnancy, (2) the relative proportion of reproductive females in the population, and (3) the rate of population growth. Efficacy is unknown, and fecundity, sex ratios, and population growth are subject to change. Using assumptions about each of these factors, Hobbs modeled the effect of treating large numbers of fallow does with long-acting contraceptives.

Hobbs modeled four different scenarios that differ in the percentage of deer treated for three different durations of effectiveness. These were 1 year, 4 years, and lifetime (10–12 years). The percentages of fertile females treated were assumed by Hobbs to be 0%, 25%, 50%, and 75%. As noted in Alternative C, Hobbs concluded that including long-acting fertility control would reduce the total number of animals that would need to be culled to achieve extirpation. However it also increased the total number of deer that would require handling or treatment of some kind over the scenario involving only lethal removal. In other words, if 25% of the fertile females were treated with a long lasting contraceptive, 567 deer would need to be culled and 129 treated over the 15-year life of the plan. This is fewer than the 653 deer that would need to be culled without any fertility control (using Hobbs' assumptions and model rather than Barrett's Alternative C), but requires the capture, treatment, or culling of a total of 696 animals. Permanent marking of treated animals (requiring capture) would be needed to ensure accurate monitoring of contraceptive effectiveness and to prevent inadvertent culling of treated does. The trends shown by Hobbs' model hold true if more deer were given contraception; with 75% of does treated with contraceptives, only 374 deer would require lethal removal over the lifetime of the plan, but a total of 914 would require capture, treatment, handling or shooting. Because of the logistic difficulty of capturing free-ranging deer in the 92 sq. km. range they are known to inhabit, it is unlikely that treating more that 25% of all existing fertile fallow does in the Seashore is feasible. If the contraceptive effect was shorter than 4 years (requiring more treatments during an animal's life), more fallow does would require treatment and culling to achieve eradication by 2021. Use of long-duration contraceptives in axis deer would reduce the number of axis deer that would require culling in order to achieve eradication. If no long-acting or sterilant technology should prove effective in eradicating axis deer within the lifetime of this management plan, lethal control would be used as described in Alternative D.

The treatment of more fertile does early in the planning effort, whether by culling or chemical sterilization, would mean the ultimate treatment of fewer animals over the lifetime of the plan, as well as an earlier final date of eradication. For example, giving contraception to a young doe at the end of the 15-year plan would mean she would be able to live her full lifetime, which could extend well beyond the intended end of the management effort. Therefore, to achieve the goal of eradication by 2021, the bulk of deer contraception would need to occur as early as possible.

Axis Deer

Because the effectiveness of long-term contraceptives on axis deer is unknown, and because of the difficulty of preventing pregnancy in animals capable of breeding as fawns and year-round, similar models have not been developed for this species. As in Alternative C, should long-duration contraceptive technology become available, its practicality and effectiveness in eradicating axis populations would be experimentally evaluated in light of the requirements for safety, specificity and practicality listed above. If no long-acting or sterilant technology should become available within the lifetime of this management plan for use in axis deer, lethal control would be used as described in Alternative D.

If only lethal removal is available as a tool for eradication of axis deer, the modeling results described above under Alternative D would apply. In this case, modeling by Barrett (2000) shows that, assuming a carrying capacity for axis deer of 455 and an estimated 2005 axis deer population of 250, removal of 50–100 deer per year beginning in 2005 would result in eradication by 2017. This scenario would require the removal of a total of 800 axis deer over the lifetime of the management effort (Appendix B).

As noted in other alternatives, current non-native deer numbers are estimates and carrying capacity for both species fluctuates with changing climate and vegetation patterns, therefore projections should be interpreted as general trends rather than as specific numerical predictions. Given the assumptions stated in the Hobbs and Barrett models (see Appendixes B and D), the total numbers of both species of non-native deer that would be removed by culling over the lifetime of this management plan under Alternative E would be about 1,300 (800 axis and 550 fallow deer).

Total numbers of fallow does treated by 2021 with a lifetime contraceptive, should one exist, would vary depending on overall sex ratios and density dependent factors, but would likely approach 150 over the life of the plan. The number of fertile females either treated with contraceptives or culled early in the program would markedly affect the final date of eradication. If the contraceptive technology used is effective for less than the lifetime of a treated animal, retreatment of these individuals or treatment of more animals would be necessary. If current numbers and true carrying capacities were higher than postulated by Gogan et al. (2001) and Hobbs (2003), total numbers of fallow deer given infertility agents and removed would be higher.

TABLE 1: ESTIMATED CUMULATIVE TOTAL DEER REMOVALS FOR ALTERNATIVES A–E (BASED ON POPULATION MODELS BY BARRETT 2000 AND HOBBS 2003)

Estimate										
Year	Alternative A		Alternative B		Alternative C[1]		Alternative D		Alternative E[1]	
	Fallow	Axis	Fallow	Axis	Fallow	Axis	Fallow	Axis	Fallow	Axis
2006	0	0	0	0	0	0	0	0	0	0
2021	0	0	2,400	650	350	650	1,400	800	550	800
2036	0	0	3,900	1,400	550	1,400	1,400	800	550	800
2051	0	0	5,500	2,200	750	2,200	1,400	800	550	800
2066	0	0	7,100	3,000	1,000	3,000	1,400	800	550	800

[1] These numbers for Alternatives C and E assume that no lifetime duration contraceptive has been developed for axis deer and that up to 50% of all fallow does can be removed yearly. If axis deer can be effectively given contraception with a long duration treatment, the total number of axis deer lethally removed would decrease. If fewer than 50% of all fallow does can be removed yearly, the total number of fallow deer removed would increase.

Alternatives and Actions Considered but Rejected

Some alternatives were considered and dismissed from detailed study. In general, reasons for dismissing these actions included:

- Technical or economic infeasibility.
- Inability to satisfy guidance criteria, meet project goals, or resolve park planning needs.

Public Hunting to Control or to Eliminate all Non-Native Deer

Under this alternative, reduction of non-native deer numbers would have been accomplished by opening the Seashore to public hunting. Public hunting could have been either the sole control method or used in combination with ranger shooting of deer year-round. The deer-hunting season for Marin County (zone A) begins the second Saturday of August and extends for 44 consecutive days thereafter (California Department of Fish and Game 2002 Hunting Regulations http://www.fgc.ca.gov/2005/ mammalregs05.html#zonea). All hunters would have been required to receive a deer-hunting permit from CDFG and to abide by California deer hunting laws.

This alternative was rejected for several reasons. First, although the Point Reyes National Seashore Act (PL 87-657, 76 Stat. 538, 16 U.S.C.) allows for public hunting, the Compendium of Superintendent's Orders for Point Reyes National Seashore and Golden Gate National Recreation Area (36 CFR 1.7 (b)) specifies that the taking or hunting of wildlife by members of the public is prohibited within the boundaries of the park. There is also no provision in GGNRA legislation allowing public hunting, and public hunting within GGNRA is prohibited. Second, the limited hunting season and restricted hunting zone, along with the large number of non-native deer, make it extremely unlikely that reduction of the population to a manageable number (like 350) or eradication of either species could be accomplished solely by public hunting. Hunting could theoretically be used in combination with agency sharpshooting if it were something the public was highly interested in, but it would require changes in legislation for GGNRA. In addition, the logistics of providing a safe hunt in a national park with such high visitation would be difficult. Third, public comments received during the initial scoping process and public comment period for the DEIS do not indicate that the public favors increased hunter access to the park. Historically, local communities have responded unfavorably to any PRNS wildlife management plans that included public hunting (NPS 1976).

In summary, public hunting conflicts with applicable laws pertaining to PRNS and GGNRA and is unlikely to resolve the objectives of substantially reducing numbers of non-native deer. Because of its inability to satisfy guidance criteria, meet project goals, or resolve park planning needs, this alternative was eliminated from further consideration.

Control or Extirpation Using Only Contraceptives

Control by Yearly Contraception

This alternative would have used annual contraception by itself to control populations of axis and fallow deer to 350 each. Because of the logistical difficulties of treating such large numbers of animals and the uncertainty of effectiveness, wildlife biologists overwhelmingly agree that controlling large free-ranging populations of wild ungulates solely with annual contraception is impractical and unlikely to succeed (McCullough 1996; Garrott 1991and 1995; Curtis et al. 1998; Warren et al. 1992 and 2000; Rudolph et al. 2000; Cowan et al. 2002; Merrill et al. 2003). The following discussion explains why this is so.

Breeding in both axis and fallow deer is accomplished by a small number of bucks; therefore, male contraception would need to be applied to nearly all or all males in a population to be effective, as even one or a few remaining males could impregnate a very large number of females. The current research in female deer contraception has focused on immunocontraceptive vaccines, hormone agonists, pituitary toxins and synthetic steroids administered by injection to female deer and/or elk (Fagerstone et al. 2002). There is currently no EPA-registered contraceptive for wild deer. Unregistered chemicals for use in animals would have to be used experimentally with an "experimental use" permit issued by EPA. Alternatively, unregistered chemicals could be used as part of a Federal Insecticide, Fungicide and Rodenticide Act Section 18 emergency request to EPA. The NPS would need to partner with an agency or organization that has data on the effectiveness and safety of a proposed contraceptive.

Use of most steroid contraceptives (such as melangestrol acetate, megestrol acetate, or diethylstilbestrol), because of the potential for entry into the food chain via scavengers and predators, is not considered a practical and safe option. However, Norgestomet, a synthetic progestin approved for use in food animals, has minimal potential for food chain effects and has been found to prevent pregnancy in black-tailed deer for 1 year when used in a biobullet form (Jacobsen et al. 1995). Its effectiveness in fallow or axis deer is unknown.

Contragestives, such as PDF2α (Luteolyse®), which interrupt pregnancy and induce abortion, have been shown to be effective in deer. Lutalyse®, is commercially available and has no withdrawal period for use in domestic food producing species, but must be administered to pregnant does during each pregnancy.

Immunocontraception with porcine Zona pellucida (pZP) has been shown to prevent conception for 1 year in a variety of deer species, including axis deer and fallow deer (Kirkpatrick et al. 1996a; Deigert et al. 2003). The formulation of pZP with 1-year duration requires 2 injections, at least 3 weeks apart, during the first year. This formulation of pZP has been available with an Investigational New Animal Drug permit from the Food and Drug Administration for experimental use. Both pZP and Norgestomet, should they indeed prove effective in preventing pregnancy in axis or fallow deer, would require yearly re-inoculations prior to the reproductive season to remain effective. This means all treated does would need to be captured and permanently marked with eartags or radio collars, and that these same individuals would need to be relocated each time a booster is administered. Use of Luteolyse®, the contragestive, would require administration to pregnant does on a yearly basis.

Because current estimates suggest axis deer now number approximately 250, control of the axis population would entail use of pZP or Norgestomet only in future years to prevent numbers from exceeding the 350 level (NPS 2002a). It has been estimated that 60–80% of adult females would require effective annual contraceptive treatment in order to stabilize wild ungulate populations below their biological carrying capacity (Garrott 1995; McCullough 1996; Merrill et al. 2003). In field monitoring by Seashore staff between January and May 2002, an average of 50% of observed axis deer were adult females (PRNS unpublished data (a)). If this demographic picture persists over the near future, a minimum of 80–110 axis does per year would have to be given contraception in order to stabilize the axis deer population at 350 animals. Actual required numbers of treated animals may be up to 15% higher because 15% of axis deer fawns have been found to breed at the Seashore (Gogan et al. 2001). In addition, because axis deer breed year-round, a substantial but unknown proportion of does treated at any one time would already be pregnant and therefore would be treatment failures. A larger number of does would need treatment to account for these treatment failures.

Estimated fallow deer numbers in 2003 were 859 (90% CI = 547 - 1170), and 43% of animals observed in a January 2002 census were adult females (NPS 2002). In order to reduce the population to 350 animals solely with yearly contraception, the total number of fawns produced would have to be less than the total number of animals dying each year. As in axis deer, numbers of fallow deer treated would depend on: (1) drug efficacy in preventing pregnancy, (2) the relative proportion of reproductive females in the population, and (3) the rate of population growth. Efficacy of available contraceptives is unknown, and fecundity, sex ratios, and population growth are subject to change. This means any predictions using models are not precise, but give only an idea of trends. Using current estimates for population size, along with the assumptions of a fallow population model developed by Barrett (see Appendix B for a detailed explanation of the model), approximately 80% of all fallow does would have to be effectively given contraception yearly in order to reduce the fallow population to 350 within 25 years[1]. This would require treatment of at least 300 fallow does per year for at least 6 years, and fewer each year after. A minimum total of 400–500 fallow and axis does would require yearly contraception over the next decade in order to control total numbers to 350 within 25 years, in the absence of any other control method (see Barrett model, Appendix B).

Another fallow population model developed by Hobbs used simulations to project the results of treatment, every 4 years, of large numbers of fallow does with contraceptives, including agents lasting only 1 year. For economic and logistic reasons, Hobbs assumed treatment (even with contraceptives that provide only one season or year of pregnancy prevention) only every 4 years. Simulations revealed that treatment of 75% of all fertile does with single year duration agents every 4 years “allowed the population to *increase* slightly” and would be unsuccessful in reducing the population (Hobbs 2003). Further complicating this scenario is the knowledge that although yearling fallow does breed less often that older does (50% of yearlings versus 75% of older does were found to be pregnant in 1976–1980 [Gogan et al. 2001]) they cannot be reliably differentiated in the field and both age classes would have to be treated without discrimination.

Past experience with contraception of tule elk at Point Reyes National Seashore indicates that, excluding the substantial costs of the first year’s capture and marking of treated animals (up to $1,500/animal depending on the capture and marking method), yearly re-inoculations of each elk cow with pZP requires at least 6 hours of labor and costs approximately $340 (Point Reyes National Seashore unpublished data (b)). Elk at Tomales Point are found in relatively open habitat, are limited in their movements by an elk-proof fence, can be located with radio-transmitter collars and present a relatively large target for remote inoculation via dart gun. It is expected that annual re-inoculations of fallow and axis does, particularly if

[1] According to the same model, if 99% of all fallow does were effectively contracepted, it would take only 20 years to reduce the total population to 350. For a discussion of the Barrett fallow population model, see Appendix A.

they were not collared with radio telemetry collars, would be considerably more difficult. Therefore, the feasibility of treating 75% of does, as modeled by Hobbs, is extremely low.

If time and labor records for tule elk contraception are used, it is estimated that inoculation of the required minimum number of exotic deer would necessitate at least 300 man-days[2] and $136,000 per year for the first 6 years of the program. All does treated would have to be inoculated in the 2–3 months prior to the rut, or reproductive season. Timing would be particularly difficult or impossible for axis deer contraception, as this species breeds year-round at PRNS and blood or fecal tests would be required to determine the stage of reproductive cycle for a particular doe. Cost and difficulties of the initial capture and marking of treated animals plus additional effort to locate animals for yearly retreatment would add considerably to these minimum estimates.

As noted above, these logistical difficulties of treating such large numbers of animals and the uncertainty of effectiveness have led most wildlife biologists to conclude that controlling large free-ranging populations of deer solely with annual contraception is impractical and unlikely to succeed (McCullough 1996; Garrott 1991 and 1995; Curtis et al. 1998; Warren et al. 1992 and 2000). A number of prominent experts in the field of wildlife contraception were consulted during preparation of this document. Without exception, these experts concurred with NPS' assessment that yearly contraception alone would not control Seashore non-native deer at 350 of each species. Treating a minimum of 400 deer per year with even the most effective, remotely delivered contraceptive is beyond the logistic capabilities of most commercial deer ranching facilities or zoos. The capture, treatment, marking and retreatment of deer at the Seashore is much more difficult than this, and well beyond the financial, logistic and operational abilities of park staff, especially given the many concurrent demands of resource management placed on these individuals. Given the uncertainty of being able to deliver contraceptives to the required number of does in the 2–3 months prior to the rut every year (during pregnancy in the case of contragestives), the variable breeding seasons, and logistic and cost constraints, control of non-native deer at levels of 350 for each species solely with yearly contraceptives is very unlikely to succeed. This alternative has been eliminated from further consideration because of its technical infeasibility and inability to meet project goals.

Extirpation by Yearly Contraception

Contraception, by its very nature, prevents reproduction but does not remove adults from the population. In fact, life expectancy of treated females can increase as a result of reduced energetic costs of pregnancy and lactation (Warren 2000b; Hone 1992) and increased resources in populations with strong density-dependent responses (Garrott 1995). Therefore, only if at least 95% of females were treated and the yearly contraceptive was 100% effective for each year in the reproductive lifetime of each female (8–10 years), could a population size fall to 0 by attrition (see Barrett model, Appendix B).

It is impractical, for the reasons listed above, to expect that almost all of the free-ranging non-native does of reproductive age (estimated at approximately 470 animals) within 100 sq. km. of known non-native deer range, could be located and treated every year during the 2–3 months before rut season. It is also impractical, given current literature on porcine Zona Pellucida, to expect that any field-administered contraceptive would be 100% effective every year (Kirkpatrick et al. 1996b; Garrott 1995; Rudolph et al. 2000; Shideler et al. 2002; NPS 2002b; Curtis et al. 2002). Further, determining effectiveness of treatment would entail fecal or blood hormone analysis on all treated does during the second or third trimesters of pregnancy, again an impractical task with free-ranging deer in an area the size of the Seashore.

[2] One man-day is defined as 8 hours. (400 does X 6 hours per innoculation)/8 hours per man-day = 300 man-days. $340 per doe per year X 400 does = $136,000 per year.

This alternative was removed from further study because of its technical infeasibility and inability to meet project goals.

Control with Long-Acting Contraceptives ("Sterilants")

While the discussion above focuses on the reasons why it is not feasible to use yearly contraception to reduce non-native deer populations to a reasonable number (350), this discussion explains why long-lasting contraceptives or sterilants are not able to achieve this control without some lethal removals. A sterilant is defined, for the purposes of this discussion, as a drug that would prevent reproduction in a doe for its entire reproductive life with one administration and would not require yearly "boosters." Because no such drug has been registered for use in wildlife by EPA, unregistered chemicals for use in animals would have to be issued an experimental use permit. In order to register with the EPA or receive an experimental use permit, a sponsor is obliged to provide EPA with substantial evidence of the chemical's effectiveness through controlled studies and must demonstrate the safety of the agent on the target species. Environmental and human safety issues must be addressed as well. Until recently, only two products, Spayvac®, a long-acting formulation of porcine Zona Pellucida, and GonaCon®, a GnRH vaccine, were available for experimental use with an Investigational New Animal Drug permit from the Food and Drug Administration. Spayvac® has recently been withdrawn by the manufacturer and it is unknown whether it would again become available for experimental use within the lifetime of this plan (M. Fraker, Terramar, personal communication). GonaCon® has never been tested in either fallow or axis deer but according to USDA researchers at the National Wildlife Research Center, is likely to be effective in preventing breeding in fallow deer for 2–5 years (K. Fagerstone, USDA, personal communication).

Because the most likely prospective sterilant has never been tested in axis or fallow deer, it is not possible to predict with certainty the costs, impacts or likelihood of success of a program in which GonaCon® alone would be used to control non-native deer populations. Accurate estimates of the treatment effort needed to control the populations at 350 would require knowledge of reproductive rates, age, and sex composition of both species as well as known effectiveness of the treatment in preventing pregnancy in each species.

No population models incorporating sterilant treatment of axis deer populations have ever been developed. Hobbs (2003) analyzed the effect of culling and fertility control on fallow populations using a simulation model. In order to reduce the current PRNS fallow deer population to 350 animals, approximately 75% of fallow does, or approximately 270 animals, would initially require treatment with a lifetime-effect sterilant, should one exist (Hobbs 2003). With time, remaining fertile females would produce additional female fawns that would grow to adulthood and replace the sterilized females. At least 75% of these fertile does would also require treatment with a lifetime-effect sterilant to bring the population to 350. Sterilants would be periodically required as long as some fertile does remain to maintain the population at this size. If the contraceptive agent used was effective for less that a doe's lifetime, more animals would require treatment to control total numbers at 350 for each species.

The few known requirements of this alternative render it impractical. Initial treatment of 270 free-ranging fallow does with any sterilant would require capture and permanent marking of the animals to allow monitoring and to prevent inadvertent retreatment. Treatment would have to be repeated at regular intervals, and in perpetuity, as numbers of fertile does grew. Capture and handling of wild deer is difficult, risky for NPS staff, and would result in some unavoidable animal deaths. Such a large-scale capture and treatment operation is not feasible, or sustainable in perpetuity, for a population of wild deer that range over 100 sq. km. within the Seashore. No sterilant for axis deer has ever been tested and the efficacy of the one available long-duration contraceptive (GonaCon®) is unknown at this time. Should a long-duration product prove effective, the logistic difficulties associated with finding and capturing enough axis deer to apply the contraceptive so that the population is maintained at 350 would apply. All of the experts in wildlife contraception consulted for this plan, including researchers currently developing the most promising long-duration products, concurred with the NPS assessment on the likelihood of success of this alternative. Because even the minimum requirements of this alternative are technically infeasible and unlikely to meet project goals, control of non-native deer at 350 of each species with sterilant treatment alone has been eliminated from further consideration.

Extirpation Using Long-Acting Contraceptive Administration ("Sterilants")

This option would have used long-acting contraceptives or sterilants to eradicate both axis and fallow deer. As noted above, no approved sterilant exists for either species, although the apparently long-acting contraceptive GonaCon® is currently being studied for EPA registration. Because the only prospective sterilant ever tested in fallow deer has been withdrawn by the manufacturer and no prospective sterilant has ever been tested in axis deer, it is not possible to predict with certainty the costs, impacts or likelihood of success of a program in which GonaCon® alone would be used to control non-native deer populations. Accurate estimates of the treatment effort needed to eradicate the populations would require specific knowledge of reproductive rates, age, and sex composition of both species as well as known effectiveness of the treatment in preventing pregnancy in each species. No population models incorporating sterilant treatment of axis deer populations have ever been developed, although Hobbs analyzed the effect of culling and fertility control on Seashore fallow populations using a stage-based simulation model (Hobbs 2003).

In his simulation model of fallow deer populations at PRNS, Hobbs found that lifetime-effect sterilant treatment of 75% of all fertile females, along with treating missed females every 4 years, failed to achieve eradication in even 15 years (Hobbs 2003). Hobbs determined that it would not be possible to eradicate the PRNS fallow deer population in this time period using fertility control alone. He explained this lack of success in the following way: "The inability of fertility control alone to reduce the population is easy to understand. Even when 100% of the females are maintained infertile, the maximum rate of decline of the population is no greater than the maximum mortality rate, which, in a long-lived species like fallow deer, is quite small, approximately 10% per year" (Hobbs 2003, p. 12). Hobbs concludes that "…attempting to eradicate the population using fertility control alone is futile." Without exception, all the prominent experts in the field of wildlife contraception consulting in the development of this plan, agreed with this assessment.

Treatment of over 75% of all fertile axis and fallow females with a sterilant, should one exist, is infeasible because of the free-ranging and inaccessible nature of deer at PRNS and because of the size of their range. Difficulty delivering sterilants to sufficient numbers of animals in a population decreases the probability of complete extirpation (Hobbs et al. 2000). Additional delivery problems include: (1) does breeding as fawns[3] or yearlings, (2) inability to ensure treatment before breeding has occurred, especially with species such as axis deer that exhibit year-round breeding, and (3) the necessity of permanently marking all treated animals in order to avoid double-treating. A major proportion of axis and fallow does at PRNS have been found to breed as yearlings (Gogan et al. 2001). These yearling does would have to be included in the pool of potential treatment animals. Breeding occurs year-round in axis deer at PRNS; therefore, an unknown number of treated axis does might be pregnant, regardless of what time of year treatment was administered. Finally, because permanent marking requires capture, this alternative would require capture of all treated animals. Capture and handling of wild deer is difficult, risky for NPS staff and would result in some unavoidable animal deaths.

[3] Axis deer have also been found to breed as fawns at PRNS and elsewhere (Gogan et al. 2001, Wehausen and Elliott 1982, Graf and Nichols 1966, Kramer 1971).

In summary, even if a lifelong injectable sterilant for axis and fallow deer existed, capture, permanent marking and treatment of the minimum numbers required for the first year of an eradication program, using sterilants alone, are impractical for free-ranging deer in a 90,000-acre park. This alternative is eliminated from further consideration because of infeasibility and likelihood of failure in meeting project objectives or resolving park planning needs.

Surgical Sterilization

Surgical sterilization is defined, for purposes of this document, as the irreversible alteration of the male or female reproductive tract, via surgery, in order to prevent future conception. Surgical sterilization of wild ungulates, either castration or vasectomy for males, and ovariectomy or tubal ligation for females, would be performed in the field with animals restrained under general anesthesia. The surgical procedures are simpler, faster, and safer for males than females but as in all polygamous, polyestrous species, sterilization of axis or fallow bucks is inefficient and less effective for population control than sterilization of does. Although a small proportion of the bucks are responsible for a large proportion of the breeding, these "breeder" bucks are not readily identifiable. In addition, should these "breeder" males be sterilized, the polyestrous nature of deer would ensure that does would repeatedly return to estrus and the sterile bucks would eventually be replaced by a fertile male (Garrott 1995).

Ovariectomy and tubal ligation of does would entail surgical entry into the animal's peritoneal cavity and consequently would require aseptic conditions, often difficult to achieve outside a veterinary clinical facility. Does would have to be captured and treated with immobilization drugs and then permanently marked. Capture and handling of wild deer would result in some unavoidable deaths. General anesthesia would have to be induced and maintained for the duration of the procedure, which can last 2–4 hours from start to finish. Post-surgical recovery could take from 1–4 hours depending on the level of anesthesia (P. Curtis, personal communication). Surgery and anesthesia, administered by a trained veterinarian and staff, would entail life-threatening risks for the animal due to anesthetic, surgical or post-surgical complications (U.S. Geological Survey 1999).

Hobbs et al. (2000) found that, without lethal removals, at least 50% of breeding females in an ungulate population must be rendered infertile in order to achieve major reductions in population size. Surgical sterilization has been used to control a small herd of deer (less than 20 animals) in a Wisconsin zoo (Frank et al. 1993). Surgical sterilization of white-tailed deer was investigated in Cayuga Heights, New York (Curtis unpublished report). Although a population decline occurred within 2 years after treating 22 female deer with tubal ligations or ovariectomies in the single community, the program was not sustainable due to veterinary staff time and costs. Based on this effort, Merrill et al. (2003) estimated that a deer herd could be reduced by 30–60% in 4–10 years if a manager could sterilize 25–50% of fertile females annually. More rapid herd reductions could be achieved with higher sterilization rates.

Because of the time and labor involved with surgical sterilization of does, as well as the large number of does that would require treatment in order to control the axis and fallow deer populations at PRNS, the technique would be impractical at the scale required. It would be unlikely to be useful in limiting population growth or in eradicating either species.

This alternative is eliminated from further consideration because it is infeasible and unlikely to accomplish the objectives of the project.

Relocation

Relocation is the capture, transport, and release of non-native deer at one or more sites outside of PRNS and GGNRA. Fallow and axis deer are not native to California. Title 14 §671.6 of the Californian Code of Regulations states: “No person shall release into the wild without written permission of the commission any wild animal…which: (1) is not native to California.” In addition, paratuberculosis, or Johne’s disease, has been documented in non-native deer at PRNS (Riemann et al. 1979b; PRNS unpublished data (c)). Johne’s disease is a chronic, incurable, and transmissible diarrheal disease of domestic and wild ruminants. Culture of the causative organism, *Myocbacterium avium* ss. *paratuberculosis*, from feces, or from tissues on postmortem examination, is presently considered the best method for diagnosis (Riemann et al. 1979b; Manning et al. 2003). However, carriers can shed the organism sporadically and Johne’s disease can be difficult to diagnose in infected cervids. Because of the difficulty of accurately screening deer for Johne’s disease and the infection risk that carrier animals would pose to livestock, farmed deer, and other wildlife, the CDFG has stated that it would not support movement of non-native deer; permission to relocate non-native deer within California for any purpose requires a permit from CDFG (see CDFG letter in Chapter 5).

Before transfer of cervids out of California can occur, the USDA specifies that “whole herd” tuberculosis tests, of all cervids older than 12 months of age, must be performed (9 CFR Part 77). Such testing actually requires two individual single cervical tuberculin skin tests, at least 90 days apart, with the second test conducted at least 90 days prior to movement. Tuberculin tests for each animal entail intradermal injection of tuberculin and inspection of the injection site by an accredited veterinarian 72 hours later. Consequently, tested animals must be captured, permanently marked and held for two 72-hour periods in a corral or pen. In all, animals to be relocated out of state would require three separate captures, two for tuberculin testing and one final capture before transport. Alternatively, animals to be relocated would be marked and maintained in an enclosure for the required minimum of 180 days.

Estimated population sizes for axis and fallow deer as of 2003 are 250 and 860, respectively. Relocation would entail repeated captures of free-ranging or enclosed deer. Capture and handling of wild deer is risky for NPS staff and would result in some unavoidable animal deaths. In light of current numbers of both species, it is unlikely that enough deer could be captured and relocated to control or eradicate non-native deer at PRNS.

Finally, a steady supply of willing recipients would need to be located. These recipients would need to assure the public that the deer would not be sent to slaughter or hunted, as this would be equivalent to lethal removal and much more expensive for NPS. Deer farm owners, who are the only recipient able to take more than a few live deer, are also likely to eventually hunt or send deer to slaughter; therefore, private, non-commercial recipients would need to be located. Because capture would have to take place each year for several years, a large and steady supply of such recipients would be required. The likelihood of finding the needed number of willing recipients, as well as the likelihood of sustaining this type of “adoption” program, is considered very low.

This alternative is eliminated from further consideration because it is infeasible, unlikely to accomplish the objectives of the project, incompatible with state wildlife policy and poses risks to wildlife, livestock and farmed deer outside of the Seashore. It also provides no advantages over contraception, which serves as a more practical and efficient non-lethal deer control technique.

Restricting Deer to a Fenced Area

In this alternative, non-native deer would be restricted to a portion of PRNS in order to reduce impacts to wilderness areas and to prevent movement of deer outside NPS boundaries. Deer-proof fencing with gates allowing entrance to visitors, agricultural permittees, or NPS staff, measuring at least 8 feet high, would be required to entirely surround those areas containing non-native deer. Archaeological investigations and assessments would be required before ground breaking for fence construction to ensure no archaeological resources would be affected. Depending on the size of the non-native deer area and the density of non-native deer within, supplemental feeding as well as monitoring for overgrazing impacts would likely be required. As in any alternative that leaves a non-native deer population in the Seashore, future control of the enclosed herd, either by lethal means or with fertility control, would be required.

Although historic precedent exists for NPS maintaining enclosed wildlife (tule elk at Yosemite National Park from 1921–1935, bison at Yellowstone National Park from 1935–1943) the primary mission of NPS is: "…to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as would leave them unimpaired for the enjoyment of future generations." Although wildlife have been fenced in NPS units (including the Seashore) as a first step towards restoration of native species, maintaining wildlife in enclosed areas permanently is more in keeping with private game farms, game parks or zoological collections.

Tule elk were re-introduced to PRNS in 1978, after a century of absence, to the 2,600-acre Tomales Point elk reserve, bounded on three sides by water and to the south, by an 11-foot high, elk-proof fence. The purpose of this re-introduction was to restore the dominant native herbivore to the Tomales Point wilderness ecosystem. The fence was erected to prevent elk from wandering on to neighboring ranchlands where they might interfere with agricultural operations by feeding on silage or hay, or by damaging fences. In 1998, tule elk from Tomales Point were translocated to the Limantour wilderness area and released. This second step in the restoration of tule elk to the Seashore, as a free-ranging herd in unfenced wilderness, was made possible by 20 years of management and research on the Tomales Point elk herd. Fencing non-native deer would never constitute a first step in native species restoration because axis and native deer are exotic to the California coastal ecosystem.

Because of the large populations of both axis and fallow deer at PRNS and their extensive ranges (6 sq. km. and 92 sq. km. respectively), erection of fences around current non-native deer ranges is impractical. Confinement of only a portion of each population would allow continued growth and range expansion of the unconfined deer.

This alternative is eliminated from further consideration because it is infeasible, inconsistent with the mission of the NPS, and unlikely to accomplish the objectives of the project.

Trapping and Euthanasia by Lethal Injection

Euthanasia is the act of inducing death in a humane fashion. The means available to euthanize wild deer would be chemical immobilization with dart guns, or trapping in corral traps, Clover traps, or with net guns and manual restraint. Immobilized deer would then be injected intravenously with irreversible barbiturates. The purpose behind using euthanasia in domestic animals, usually pets, is to induce death without causing stress and pain. Pets, however, are by nature, comfortable being handled and approached by humans. According to the American Veterinary Medical Association *Report of the A.V.M.A. Panel on Euthanasia* (AVMA 2001), "aggressive, fearful, wild or feral animals should be sedated or given a nonparalytic immobilizing agent prior to intravenous administration of the euthanasia agent and collapse." Capture and anesthesia of wild deer prior to lethal injection, would result in stress to all handled animals and some unavoidable injuries due to trauma. Because of the time required to immobilize animals and induce death via intravenous injection, the humaneness of this alternative is debatable.

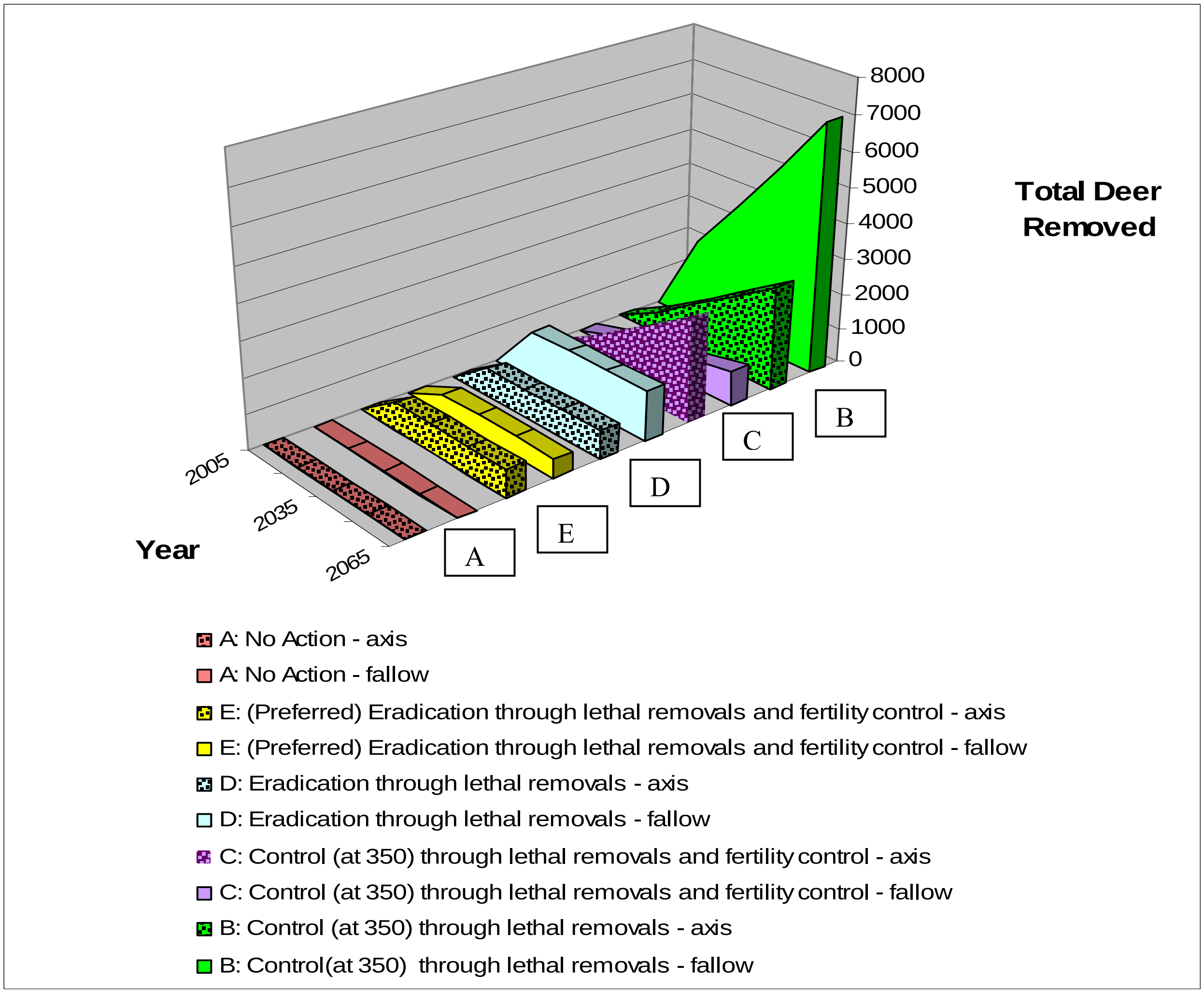
Administration of immobilizing and barbiturate euthanasia drugs renders deer carcasses unfit for human consumption and poses a risk to scavengers via the food chain. Carcasses would therefore require disposal by rendering or incineration. Capture of wild animals is difficult and poses safety risks to humans and wildlife. Because of the large populations of non-native deer at PRNS, capture and immobilization of sufficient numbers to eradicate them or control them at 350 of each species is infeasible.

This alternative is eliminated from further consideration because it offers no advantages, threatens safety of humans, is logistically very difficult and is unlikely to accomplish the objectives of the project.

Alternative Summary Matrices

At the end of this chapter, two tables summarize the impacts of each alternative, and the actions of each. The Summary of Alternatives table also summarizes how each alternative meets the laws and policies discussed in Chapter 1. Figure 1 shows estimated cumulative total deer removals for all alternatives based on population models by Barrett 2000 and Hobbs 2003.

FIGURE 1: ESTIMATED CUMULATIVE TOTAL DEER REMOVALS FOR ALTERNATIVES A–E (BASED ON POPULATION MODELS BY BARRETT 2000 AND HOBBS 2003)



Environmentally Preferable Alternative

The environmentally preferable alternative is the alternative that would promote national environmental policy as expressed in NEPA and cause the least damage to the biological and physical environment. Such an alternative should contribute to restoration of natural ecological processes and best protect, preserve, and enhance historic, cultural, and natural resources.

Alternatives A, B, and C would continue ongoing impacts to park natural and physical resources. These include trampling and browsing of riparian and woodland vegetation, with loss of soils, wildlife habitat and increased erosion and degraded water quality as a result. Large herds of fallow and axis deer would continue to return to certain pastures, riparian areas and forests, with locally severe losses of vegetation. Because the diets of fallow deer and axis deer overlap with native deer and fallow deer are thought to be more aggressive than native deer and elk, they would continue to compete for and occupy their habitat. Competition would result in reduced productivity and lower fawn survival in native black-tailed deer when forage is scarce. Fallow and axis deer would also serve as reservoirs of paratuberculosis, to which both black-tailed deer and tule elk are susceptible. Non-native deer also eat the same food as several native PRNS small mammal and bird species, and would indirectly affect other wildlife through the loss of habitat from deer browsing or trampling of vegetation.

Non-native deer compete for food with prey species of the federally threatened northern spotted owl. They are also known to occupy beach habitat used by western snowy plovers (federally threatened) as nesting habitat. In addition, fallow deer frequent riparian areas and trample, thrash and browse vegetation, resulting in the removal of habitat for threatened California red-legged frog, coho and Chinook salmon, steelhead trout, and the endangered California freshwater shrimp. Non-native deer may also browse plants used by the endangered Myrtle’s silverspot butterfly for nectar or as larval hosts.

Although they do not have special federal status, several rare or unique bird species in the park occupy habitat in brush or nest on the ground in areas where non-native deer browse or trample. Deer may eat or trample special status plant species as well.

Monitoring and managing exotic deer by park staff is expensive, and non-native deer also cause damage to private property.

Although eliminating axis and fallow deer would adversely affect some visitors, this adverse impact is not part of the natural or physical environment and so does not contribute to the environmental preferability of an alternative.

In contrast, either Alternative D or E would eliminate these impacts on natural and physical resources and either is considered environmentally preferred.

Section 101 of NEPA

The Council on Environmental Quality regulations requires that an EIS discuss how each alternative achieves the requirements of sections 101(b) of NEPA. This section states that federal agencies should, through the selection of the alternative to be implemented, attempt to:

1. Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
2. Assure for all visitors safe, healthful, productive, aesthetically and culturally pleasing surroundings;

3. Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
4. Preserve important historic, cultural and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice;
5. Achieve a balance of population and resource use which would permit high standards of living and a wide sharing of life's amenities; and
6. Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Alternatives D and E perform best on criteria 1–4, as each of these alternatives maximizes the potential for restoring the wilderness ecosystem at the Seashore and so promotes sustainability (criterion 1), reduces the degradation non-native deer cause now (criterion 3) and best preserves the important natural aspects of the national heritage represented by Point Reyes National Seashore and Golden Gate National Recreation Area. Criteria 5 and 6 are less applicable, although some visitors might believe that the viewing of axis or fallow deer in the park is one of life's amenities. For these visitors, Alternatives A, B, and C may be better. For others who prefer to recreate in the most natural environment possible, the elimination of non-native deer in Alternatives D and E would better represent one of life's amenities. Criterion 6 is not applicable to this planning effort.

Park's Preferred Alternative

NEPA requires an agency to identify its preferred alternative, if one exists, in the draft and final EIS. The park's superintendent, in consultation with park staff, makes this identification. It is the alternative that would best fulfill the park's statutory mission and responsibilities, considering economic, environmental, and technical factors. It is also the alternative that best accomplishes the purpose and need for federal action (as stated in Chapter 1, Purpose and Need).

Although both Alternatives D and E accomplish all four of the Seashore's stated objectives for non-native deer management, by removing all axis and fallow deer from the park by 2021, and complying with all relevant legislation and policies, Alternative E is NPS's preferred alternative. Through the use of experimental long-acting contraceptives, Alternative E may reduce the total number of deer requiring lethal removal. Lower levels of culling would mitigate some, though not all, of the concerns of animal rights proponents who consider the killing of animals to be morally offensive. This mitigation comes at the price of slightly increased safety risks to NPS staff responsible for capturing and treating animals with contraception.

Alternative E also results in increased costs to the park over Alternative D. However, Alternative E would expand current knowledge about long-term reproductive intervention in wild ungulates. The preferred alternative presents an opportunity for long-term study of the use of potential sterilants in controlling overabundant or unwanted deer under free-ranging conditions. Issues of wildlife overabundance often arise in areas where lethal removal is difficult or impossible because of firearms restrictions or public safety concerns. Information obtained from Alternative E could benefit land-management agencies and zoological parks nationwide.

TABLE 2: SUMMARY OF ALTERNATIVES

	Alternative A: No Action	**Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal**	**Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control**	**Alternative D: Removal of All Non-Native Deer by Agency Personnel**	**Alternative E (Preferred Alternative) : Removal of All Non-Native Deer by Agency Removal and Fertility Control**
Management Actions	No actions would be taken to control non-native deer numbers.	Yearly culling of deer by trained NPS staff or contractors would continue indefinitely in order to maintain non-native deer numbers at predetermined levels. These levels would be chosen by NPS managers to ensure that: (1) adverse impacts to resources were acceptable; (2) the risk of non-native deer expansion beyond NPS boundaries was minimized; and (3)neither species was likely to be extirpated. Carcasses would be donated to charity, used for endangered species recovery programs, rendered or left to recycle nutrients into the ecosystem.	Yearly culling and long-lasting contraception of deer by trained NPS staff or contractors would continue indefinitely in order to maintain non-native deer numbers at predetermined levels. These levels would be chosen by NPS managers to ensure that: (1) adverse impacts to resources were acceptable; (2) the risk of non-native deer expansion beyond NPS boundaries was minimized; and (3) neither species was likely to be extirpated. Carcasses would be donated to charity, used for endangered species recovery programs, rendered or left to recycle nutrients into the ecosystem.	Culling by trained NPS staff or contractors would occur over the next 15 years in order to eradicate both species of non-native deer from PRNS-administered lands. Carcasses would be donated to charity, used for endangered species recovery programs, rendered or left to recycle nutrients into the ecosystem.	Culling and long-lasting contraception by trained NPS staff or contractors would occur over the next 15 years in order to eradicate both species of non-native deer from PRNS-administered lands. Carcasses would be donated to charity, used for endangered species recovery programs, rendered or left to recycle nutrients into the ecosystem.
Duration of Actions	Indefinitely	Indefinitely	Indefinitely	Approximately 15 years	Approximately 15 years
Approximate Total Number of Animals Removed	None	Incalculable (culling continues indefinitely) By 2021: 650 axis, 2,400 fallow. By 2050: 2,200 axis, 5,500 fallow.	Incalculable (culling continues indefinitely) By 2021[a]: 650 axis, 350 fallow. By 2050[b]: 2,200 axis, 750 fallow.	800 axis, 1,400 fallow	800 axis, 550 fallow[a]

	Alternative A: No Action	**Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal**	**Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control**	**Alternative D: Removal of All Non-Native Deer by Agency Personnel**	**Alternative E (Preferred Alternative) : Removal of All Non-Native Deer by Agency Removal and Fertility Control**
Approximate Total Number of Animals Treated with Lifetime Duration Contraceptives	None	None	Incalculable (contraception continues indefinitely) By 2021: 200 fallow By 2050: 200-300 fallow	None	100–150 fallow
Relationship of Alternative to Purpose and Need	None of the four stated objectives would be accomplished.	Two of the four stated objectives would be accomplished, to some degree. Alternative B would curtail spread of non-native deer beyond NPS boundaries and reduce impacts to agricultural permittees.	Same as Alternative B.	All four of the stated objectives would be fully accomplished. Alternative D would prevent spread of non-native deer beyond NPS boundaries and eliminate impacts to agricultural permittees. It would also correct past and ongoing disturbances to Seashore ecosystems from non-native deer and contribute substantially to restoration of naturally functioning native ecosystems. Long-term diversion of staff and funds from other natural resource priorities would by prevented.	Same as Alternative D.
Relationship of Alternative to Federal and State Laws, Policies and Plans	Alternative A is in compliance with the National Environmental Policy Act (NEPA) of 1969 and the Wilderness Act of 1964.	Alternative B is in compliance with: NEPA, the Wilderness Act, the NPS Organic Act of 1916, NPS *Management Policies* 2001, EO 13112, and the 1980 PRNS GMP. The alternative is also in compliance with California Department of Food and Agriculture Code and CDFG Code.	Same as Alternative B.	Same as Alternative B. In addition, Alternative D complies with PL 94-544 and 94-567, amending the Seashore's enabling legislation, and NPS *Management Policies* 2001 regarding exotic species management.	Same as Alternative B. In addition, Alternative E complies with PL 94-544 and 94-567, amending the Seashore's enabling legislation, and NPS *Management Policies* 2001 regarding exotic species management.

	Alternative A: No Action	**Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal**	**Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control**	**Alternative D: Removal of All Non-Native Deer by Agency Personnel**	**Alternative E (Preferred Alternative) : Removal of All Non-Native Deer by Agency Removal and Fertility Control**
Management and Governance	NPS would provide management and oversight of continued resource monitoring within NPS boundaries. On lands outside of NPS jurisdiction, CDFG would manage all issues relating to non-native deer.	NPS would provide management and oversight of culling operations and resource monitoring within NPS boundaries. Agricultural permittees would be responsible for monitoring non-native deer depredation to ranches within PRNS boundaries. Outside of NPS jurisdiction, CDFG would manage all issues relating to non-native deer.	Same as Alternative B.	Same as Alternative B.	Same as Alternative B.
Legislative Authorities	No new legislation would be required.	No new legislation would be required.	No new legislation would be required.	No new legislation would be required.	No new legislation would be required.

a. These numbers assume that no lifetime duration contraceptive has been developed for axis deer and that up to 50% of all fallow does can be removed yearly. If axis deer can be effectively contracepted with a long duration treatment, the total number of axis deer lethally removed will decrease. If fewer than 50% of all fallow does can be removed yearly, the total number of fallow deer removed will increase.

b. These numbers assume the existence of a contraceptive treatment that is effective for 4 years. If a treatment is found that maintains infertility for the reproductive life of a doe (~10 years), the total number of animals treated and the total number of treatments will decrease. Again should an effective “sterilant” become available for axis deer, this species will also be treated under Alternatives C and E.

TABLE 3. SUMMARY OF IMPACTS OF EACH ALTERNATIVE

	Alternative A: No Action	**Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal**	**Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control**	**Alternative D: Removal of All Non-Native Deer by Agency Personnel**	**Alternative E (Preferred Alternative): Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility Control**
Water Resources and Water Quality	Reduced riparian vegetation would lead to increased stream bank erosion, banking, and sedimentation.	Short-term, lower total non-native deer numbers would reduce current adverse impacts.	All impacts, including cumulative impacts, would be the same as Alternative B.	Reductions would quickly result in hydrologic benefits relative to No Action.	Same as Alternative D.
	Ultimate results are moderate, long-term decreases in water quality and degraded aquatic habitat over larger areas of the Seashore and outside NPS boundaries.	Continued destruction of riparian vegetation, albeit at lower levels than currently observed, would lead to long-term stream bank erosion, banking and sedimentation.		Short-term expansion of deer populations into private inholdings with minor to moderate short term impacts to water quality could result from NPS culling operations.	
		Slight reduction in impacts to water quality from reductions in fallow deer population. Residual minor to moderate long-term adverse impacts in the form of decreased water quality and degraded aquatic habitat. Substantial benefits to water quality outside park through reduced risk of expansion.		Long-term, non-native deer eradication could result in moderate beneficial impacts on hydrologic process, aquatic habitat, and water quality in the Seashore. Substantial benefits to water quality outside park through eradication.	
	Adverse cumulative impacts throughout Marin and Sonoma Counties could possibly increase in intensity over time to major levels.	Benefits to cumulative effects relative to Alternative A by reducing the risk of expansion, but overall, cumulative impacts are adverse, long term and moderate to major		Cumulative impacts are minor to moderate short-term, mixed (beneficial and adverse) in the long term.	
Soil	In areas where deer congregate and return during the breeding season, moderate adverse impacts to soils from compaction and denuding	Short-term, lower total non-native deer numbers would reduce current adverse impacts , e.g. a negligible to minor beneficial impact relative to Alternative A.	Same as Alternative B.	Short-term, lower total non-native deer numbers would reduce current adverse impacts; e.g. a moderate beneficial impact relative to Alternative A.	Same as Alternative D.
		In areas of high deer density and traditional breeding areas, continued denudation and compaction would result in erosion with minor to moderate impacts.		Short-term movement of deer populations into private inholdings could result from NPS culling operations, with minor adverse impacts possible.	

	Alternative A: No Action	**Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal**	**Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control**	**Alternative D: Removal of All Non-Native Deer by Agency Personnel**	**Alternative E (Preferred Alternative): Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility Control**
				Vehicles used to access areas to remove deer may result in minor adverse impacts through compaction.	
	Long-term, compaction, erosion would continue to result in moderate adverse impacts to soils in and outside the park.	In the long term, some reduction in impact related to lower fallow deer numbers would result; residual minor to moderate impacts to soils would remain. Substantial benefits to soils outside the Seashore related to reducing the risk of expansion are likely.		Long-term, soils in the Seashore (and on private inholdings) would experience moderate benefits relative to No Action from non-native deer eradication. Residual adverse effects are not expected. Substantial benefits to soils outside the park are expected from eliminating the risk of expansion.	
	Adverse long-term cumulative impacts throughout Marin and Sonoma Counties would be major in intensity.	Benefits relative to No Action from reducing the risk of expansion would occur, but overall, cumulative impacts are adverse, long-term and major.		Cumulative impacts are minor to moderate in the short term: long term, they are mixed (both beneficial and adverse.	
Vegetation	Increased loss of understory woodland and riparian vegetation, and reduced vegetative biomass in areas of high deer density and traditional breeding areas would result in moderate to locally major, long-term adverse impacts over larger areas of the Seashore and outside NPS boundaries.	Because it would reduce total numbers and range of non-native deer in the Seashore in the short-term, Alternative B would result in some reduction of current major adverse impacts to vegetative processes, habitat, and plant diversity. Also, substantial benefits relative to Alternative A to vegetation outside the park from reduced risk of expansion are likely.	Same as Alternative B.	Immediate and long-term major localized beneficial impacts to vegetative processes, habitat, and plant diversity in the Seashore would occur. Also, substantial benefits relative to Alternative A to vegetation outside the park from eliminating the risk of expansion are likely.	Same as Alternative D.
		Long-term, maintaining non-native deer in the Seashore would result in persistence of these adverse impacts at a moderate level.		A short-term influx of non-native deer populations into the Vedanta Property from NPS lands as a result of the lethal removal program could cause minor adverse impacts to riparian and woodland vegetation there. These would be reversed in the long term.	

	Alternative A: No Action	**Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal**	**Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control**	**Alternative D: Removal of All Non-Native Deer by Agency Personnel**	**Alternative E (Preferred Alternative): Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility Control**
				Short term localized minor adverse impacts to vegetation from vehicle use and other deer removal activities would occur.	
	Adverse long-term cumulative impacts throughout Marin and Sonoma Counties could increase in intensity over time to major levels.	Potential relative cumulative benefits to resources outside park from decreasing the risk of expansion relative to No Action, but overall, cumulative impacts are adverse, long-term and moderate to major.		Cumulative impacts are minor to moderate and adverse in the short term: in the long term, they are moderate to major and mixed (both adverse and beneficial)	
Wildlife	Major long term beneficial impact to non-native deer from expansion of habitat	Beneficial impacts to axis deer from expansion of habitat similar to but less than in Alternative A. Adverse impacts to fallow deer from pain and suffering from culling.	This alternative would cause less pain and suffering to deer from culling than Alternative B. However, pain and suffering would result from some level of culling and the capture required for reproductive intervention.	The shooting of non-native deer would cause a measure of pain and suffering to culled animals.	This alternative would cause less pain and suffering to deer from culling than Alternative D.
	Increased resource and behavioral competition with native cervids would result in decreased herd growth and reduced range of native species. Impacts would range from moderate to major; impairment to black-tailed deer is likely to occur.	If chosen target levels are 350 for each species, axis deer populations and range would increase and fallow deer populations and range would decrease from current levels. Some benefits to native deer and elk would result from lower fallow deer numbers, but residual moderate adverse impacts to native cervids would persist.	Cumulative impacts are the same as Alternative B.	Alternative D would result in moderate to major, long-term beneficial impacts to native deer and elk species by reducing current levels of competition for food and habitat.	Cumulative impacts would be the same as with Alternative D.
	Increased resource competition with some small mammal species would lead to decreased numbers as well as reductions in predators dependent on those species. Moderate, long term adverse impact.	Benefits relative to No Action to small mammals and predators would occur, but residual minor to moderate impacts would remain.		.Minor to moderate beneficial impacts to small mammals and predators would occur, from decreased competition (small mammals) and increased prey for predators relative to No Action.	

	Alternative A: No Action	**Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal**	**Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control**	**Alternative D: Removal of All Non-Native Deer by Agency Personnel**	**Alternative E (Preferred Alternative): Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility Control**
	Localized reduction of forest understory, riparian and grassland cover would reduce nesting success in some bird species and adversely impact some herpetofauna. Moderate, long term adverse impact.	Because it would reduce total numbers and overall range of non-native deer in the Seashore, Alternative B would result in some short-term reduction in current impacts to native bird, amphibian and reptile species. Residual minor to moderate impacts would remain.		Moderate beneficial impacts to native rare bird species and to reptiles and amphibians relative to No Action from reductions in habitat degradation from non-native deer would occur.	
				Short-term, it is likely that non-native deer densities on the Vedanta Property would increase as a result of lethal removals in the Seashore.	Same as Alternative D
	Overall, long-term impacts would continue to moderate to major for most native species. Increased non-native deer range would have negligible or beneficial impacts on a few bird and small mammal species however; “losers” would substantially outnumber “winners”.	Long-term, maintaining non-native deer in the Seashore would result in persistence of moderate adverse impacts for a preponderance of species and beneficial for a few species. Overall, residual minor to moderate impacts to wildlife would persist		Long-term, eliminating non-native deer would result in moderate to major, long-term beneficial impacts to most native species by reducing current levels of competition for food, by decreasing direct behavioral competition and by reducing habitat destruction.	
	Adverse moderate long-term cumulative impacts throughout Marin and Sonoma Counties could possibly increase in intensity over time to major levels.	Residual adverse, moderate, long-term cumulative impacts would persist, although some benefits relative to No Action for wildlife in and out of the park would occur.		In the short term, cumulative impacts would be minor to moderate and adverse: in the long term, they would be mixed (both beneficial and adverse).	Same as Alternative D.

	Alternative A: No Action	Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal	Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control	Alternative D: Removal of All Non-Native Deer by Agency Personnel	Alternative E (Preferred Alternative): Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility Control
Species and Habitats of Management Concern	Adverse minor, long-term impacts to northern spotted owls are possible because of forage competition between non-native deer and owl prey species.	Because it would reduce numbers and range of fallow deer in the Seashore in the short-term, Alternative B would result in some reduction of current minor to moderate, localized adverse impacts northern spotted owls..	Same as Alternative B.	Alternative D would result in elimination of effects (due to habitat alteration and forage competition) from non-native deer spotted owls, e.g. minor beneficial impacts.	Same as Alternative D.
	Disturbance and alteration of habitat by deer could have minor adverse impacts on California freshwater shrimp, snowy plovers, California red-legged frogs, Coho and Chinook salmon, steelhead trout and moderate to major impacts on rare songbirds.	Because it would reduce numbers and range of fallow deer in the Seashore in the short-term, Alternative B would result in some reduction of current minor to moderate, localized adverse impacts. Disturbance and alteration of habitat by deer could have residual negligible impacts to California freshwater shrimp, minor adverse impacts on snowy plovers, California red-legged frogs, Coho and Chinook salmon, steelhead trout and moderate impacts on rare songbirds.		Because it would eliminate the impacts to them related to non-native deer, Alternative D would have minor beneficial impacts relative to No Action on snowy plovers, California red-legged frogs, Coho and Chinook salmon, and steelhead trout; moderate to major beneficial impacts on rare birds and is not likely to affect California freshwater shrimp. .	
	Increased grazing of larval host plants would have moderate to major adverse impacts on Myrtle's silverspot butterflies.	Adverse impacts to Myrtle's silverspot butterfly through destruction of larval host plants would likely continue if axis deer numbers increase (i.e., to 350), although they may be reduced by reduced numbers to moderate in intensity.		The elimination of non-native deer would also eliminate impacts from these species to Myrtle's silverspot butterfly, a relative moderate to major beneficial impact.	
	Trampling and grazing in high deer density areas could have moderate adverse impacts on rare plant species.	Impacts from reductions in fallow deer numbers would be slightly beneficial relative to No Action, with residual minor adverse impacts on rare plants likely.		Minor beneficial impacts to rare plant species from a reduction in trampling related to the elimination of non-native deer would occur.	

	Alternative A: No Action	Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal	Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control	Alternative D: Removal of All Non-Native Deer by Agency Personnel	Alternative E (Preferred Alternative): Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility Control
	Adverse long-term cumulative impacts throughout Marin and Sonoma Counties could possibly increase in intensity over time to major levels.	Long-term, maintaining non-native deer in the Seashore would result in persistence of minor to moderate adverse impacts to species of management concern.		Substantial benefits to species of management concern would occur to those populations both inside and outside the Seashore. Those outside the Seashore would benefit from eliminating the risk of expanding non-native deer populations.	
	Overall, impacts are adverse, moderate and long-term.	Depending on the species, adverse, long-term cumulative impacts could range from moderate to major.		In the short term, cumulative impacts to species of management concern would be minor to moderate and adverse; in the long term, they would be moderate to major and mixed (both adverse and beneficial).	
Human Health and Safety	Increasing densities of non-native deer could increase the risk of deer-vehicle collisions. Minor adverse impact	Decreased total numbers of non-native deer would decrease the risk of deer-vehicle collisions.	Decreased total numbers of non-native deer would decrease the risk of deer-vehicle collisions.	Removal of all non-native deer would decrease the risk of deer-vehicle collisions.	Same as Alternative D
	Use of aircraft to monitor deer numbers or range expansion would increase the risk of aircraft accidents. Negligible with mitigation.	Use of firearms to control deer could pose an increased risk of injury to staff and visitors.	Use of firearms to control deer could pose an increased risk of injury to staff and visitors.	Use of firearms to control deer could pose an increased risk of injury to staff and visitors.	Fewer deer would be shot, so risk of firearm injuries would decrease relative to Alternative D.
			Capturing deer for contraceptive treatment could result in injuries to park staff.		Capturing deer for contraceptive treatment could result in injuries to park staff.
	Impacts are adverse, minor and long-term.	Overall impacts are adverse, minor and short-term although they recur indefinitely.	Overall impacts are adverse, minor to moderate and short-term although they recur indefinitely.	Overall impacts are adverse, short-term and minor.	Overall impacts are adverse, minor to moderate and short-term.
	This effect of Alternative A is negligible when viewed incrementally with the effects detailed above and does not change the overall cumulative effect.	Cumulative impacts would be the same as those described for Alternative A. .	There are no known cumulative impacts associated with Alternative C when viewed incrementally with the projects and issues listed under Alternative A.	Alternative D does not measurably add to the impacts on health and safety of the projects or issues listed in Alternative A.	No cumulative impacts would occur

	Alternative A: No Action	**Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal**	**Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control**	**Alternative D: Removal of All Non-Native Deer by Agency Personnel**	**Alternative E (Preferred Alternative): Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility Control**
Visitor Experience	Native deer viewing opportunities would decrease while non-native deer viewing opportunities would increase.	Opportunities for viewing non-native deer would decrease while opportunities for viewing native deer would likely increase.	Same as Alternative B.	Opportunities for viewing non-native deer would decrease while opportunities for viewing native deer would likely increase.	Same as Alternative D.
		Loss of peace and quiet resulting from deer control operations may result.		Loss of peace and quiet resulting from deer control operations may result.	
		Temporary area closures may inconvenience visitors.		Temporary area closures may inconvenience visitors.	
		Visitors to wilderness may encounter deer carcasses.		Visitors to wilderness may encounter deer carcasses.	
	Viewsheds would be adversely impacted from increased non-native deer grazing.	Visitors adhering to belief in animal rights would be adversely affected, to varying degrees and for varying periods of time, by lethal removal of non-native deer.	In addition, visitors may object to seeing permanently marked deer in the wilderness.	Visitors adhering to belief in animal rights would be adversely affected, to varying degrees and for varying periods of time, by lethal removal of non-native deer.	In addition, visitors may object to seeing permanently marked deer in the wilderness.
	Continued minor adverse impact to wilderness character.	Beneficial impacts to wilderness character compared to No Action from the reduction in fallow deer numbers and unnatural ecological condition.	Same as Alternative B	Negligible to moderate adverse impacts to the wilderness character from removal activities would occur in the short term (15 years); this would be outweighed by a larger beneficial impact in the long term of returning a more natural ecological state to the wilderness.	Same As Alternative D.
	Minor adverse to minor beneficial impact to wilderness values.	Minor beneficial impacts to those who hold biocentric values toward wilderness; minor adverse impact to those with anthropocentric values toward wilderness.		Short term adverse impact to those with symbolic or intrinsic values as they might oppose removal activities in a wilderness area; Long term beneficial impacts to those with biocentric wilderness values.	
	Impacts are both adverse and beneficial, minor and long-term.	Impacts are both adverse and beneficial, minor and long-term.		Adverse impacts are minor and short-term. Beneficial impacts are minor and long-term.	

	Alternative A: No Action	Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal	Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control	Alternative D: Removal of All Non-Native Deer by Agency Personnel	Alternative E (Preferred Alternative): Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility Control
	The effect of Alternative A is negligible when viewed incrementally with the effects detailed above and does not change the overall cumulative effect.	Cumulative impacts are beneficial, long-term and major.	Cumulative impacts are similar to those described for Alternative B.	Cumulative impacts would be minor and adverse in the short term, major and beneficial in the long term.	Cumulative impacts would be the same as Alternative D.
Park Operations	Increased costs of monitoring non-native deer and their impacts to natural resources would greatly exceed current levels of $140,000 per year, indefinitely.	Costs of monitoring non-native deer and their impacts to natural resources would continue indefinitely at current levels of $140,000 per year.	Costs of monitoring non-native deer and their impacts to natural resources would continue indefinitely at current levels of $141,000 per year.	The costs of culling deer are estimated to be $115,000 per year until eradication in or before 2021.	The costs of culling deer are estimated to be $115,000 per year until eradication in or before 2021.
		The costs of culling deer yearly for the first 3–5 years of the program are estimated to be $187,000 per year. Thereafter, costs of removing up to 65 animals per year would be approximately $52,000 per year in perpetuity.	The costs of culling deer yearly during the first 3–5 years of the program are estimated to be $ 135,000 per year. Thereafter, costs of removing up to 25–50 animals per year could reach $ 45,000 per year in perpetuity.	The costs of monitoring non-native deer and mitigating their impacts ($141,000) would be incurred initially, then decrease to 0 as non-native deer are eradicated.	The costs of treating does with a lifetime-effect contraceptive (if available) in year 1 of the program are estimated to be $210,000.
	Continued costs of mitigating non-native deer impacts to natural resources are unknown and would continue indefinitely.	Continued costs of mitigating non-native deer impacts to natural resources are unknown and would continue indefinitely.	Continued costs of mitigating non-native deer impacts to natural resources are unknown and would continue indefinitely.		Costs of monitoring treated animals in future years would be approximately $45,000 per year for the next 6–12 years (lifetime of treated animals).
					Should contraceptive agents remain effective for less than the reproductive life of the does, the cost of treating animals would be substantially higher.
			Treating 176 does at 350 with a lifetime-effect contraceptive (if available) by 2021 would cost approximately $400,000. Thereafter, treatment of up to 25–50 does periodically (every 4-8 years indefinitely) would cost up to $105,000 per		The costs of monitoring non-native deer ($141,000) would be incurred initially, then decrease to 0 as non-native deer are eradicated.

	Alternative A: No Action	**Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal**	**Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control**	**Alternative D: Removal of All Non-Native Deer by Agency Personnel**	**Alternative E (Preferred Alternative): Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility Control**
			treatment period.		
	Because of limited resources, increased expenditures for deer management could adversely impact other natural resource programs. Increased risk of litigation due to expansion of non-native deer outside park boundaries could cost at least $50,000.	Because of limited resources, increased expenditures for deer management could adversely impact other natural resource programs.	Because of limited resources, increased expenditures for deer management could adversely impact other natural resource programs.	Because of limited resources, increased expenditures for deer management could adversely impact other natural resource programs.	Because of limited resources, increased expenditures for deer management would likely adversely impact other natural resource programs.
	Minimum total cost = $2.1 million by 2021. Thereafter, minimum yearly costs = $140,000 to $280,000, indefinitely.	Minimum total cost = $3.5 million by 2021. Thereafter, yearly costs > $190,000, indefinitely	Minimum total cost = $3.6 million by 2021. Thereafter, yearly costs > $200,000, indefinitely.	Minimum total cost = $3.8 million by 2021. Thereafter, yearly costs = 0.	Minimum total cost = $4.5 million by 2021. Thereafter, yearly costs = 0.
	Costs would increase to 5% of total PRNS budget.	Costs would constitute an increase of 3–6% of total PRNS budget.	Costs would constitute an increase of 3–12% of total PRNS budget.	Costs would constitute an increase of 4.6 % of total PRNS budget.	Costs would constitute an increase of 5–9% of total PRNS budget.
				Short-term impacts are minor and adverse.	Short-term impacts are moderate and adverse.
	Impacts are adverse, long-term, and moderate.	Impacts are adverse, moderate and long-term.	Impacts are adverse, moderate, and long-term.	Long-term impacts are minor and beneficial.	Long-term impacts are moderate and beneficial.
	Cumulative impacts are adverse, long-term, and moderate.	Cumulative impacts are adverse, long-term and moderate.	Cumulative impacts are similar to those described for Alternative A and B.	Cumulative impacts would be short-term, moderate and adverse.	Cumulative impacts are adverse, short-term and moderate.

	Alternative A: No Action	Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal	Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control	Alternative D: Removal of All Non-Native Deer by Agency Personnel	Alternative E (Preferred Alternative): Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility Control
Regional Economy	Costs to ranchers and farmers within and outside NPS boundaries would exceed current levels due to increased forage competition with livestock, damage to fences and increased risk of disease transmission from high deer densities.	Adverse impacts of fallow deer to agricultural operations inside and outside of NPS boundaries could be expected to decrease.	Same as Alternative B.	Current adverse impacts of fallow deer to agricultural operations inside and outside of NPS boundaries could be expected to decrease until eliminated.	Same as Alternative D.
	Depredation of crops outside the Seashore would increase.	Conversely, if axis deer numbers increase (i.e., to 350), increased competition for pasture forage with livestock, damage to fences and depredation of agricultural products would result.		The elimination of forage competition with livestock, damage to fencing, and disease transmission risk would constitute minor, long-term, beneficial impacts to agricultural permittees within and adjacent to NPS boundaries.	
	Impacts are adverse, moderate, and long-term.	Impacts are both adverse and beneficial, long-term, and minor.			
	Adverse long-term cumulative impacts throughout Marin and Sonoma Counties could possibly increase in intensity over time but overall cumulative impacts are beneficial and major.	Cumulative impacts would be similar to those described for Alternative A		Overall cumulative impacts would be long-term, major and beneficial.	

Chapter 3. Affected Environment

Introduction

This chapter provides an understanding of both the general environmental setting of the project area and a focused description of those resources that could be affected by the implementation of the FEIS alternatives. The Affected Environment is required (by the Council on Environmental Quality NEPA regulations, sec. 1502.15) to succinctly describe the environment of the areas likely to be affected by the alternatives under consideration, and focus efforts and attention on important issues.

The project area encompasses all of Point Reyes National Seashore (PRNS) and the northern lands of Golden Gate National Recreational Area (GGNRA) administered by PRNS.

Project Site Description

The project area is located in central California, in western Marin County, approximately 40 miles northwest of the City of San Francisco (see Figure 2). It is comprised of federal lands managed by the Point Reyes National Seashore, a unit of the National Park System, and is within 50 miles of the nine-county San Francisco Bay Area, the 5th largest metropolitan area in the United States.

Generally, the more developed regions of the bay area surround the bay itself, with smaller cities, towns, open space, and agricultural areas in an outer ring around the urban core. Forty-eight percent (159,044 acres) of the 332,800 acres in Marin County is held as parks, open space, and watershed (Marin County 2002). Thirty-six percent (119,808 acres) is in agricultural use. Developed lands constitute only 11% of the county while 5% of the county has future development potential.

While eastern Marin is heavily developed along the Highway 101 corridor, western Marin is primarily rural with scattered small, unincorporated towns that serve agriculture, local residents, and tourism. Roughly 90% of the quarter of a million residents of Marin County live in the eastern half of the County along the major transportation corridor, State Highway 101.

Regional Context and Surrounding Communities

The project area consists of 71,000 acres of the Point Reyes National Seashore and 19,265 acres of Golden Gate National Recreation Area, as well as 86 miles of shoreline on both the Pacific Ocean and Tomales Bay (see Figure 2). The Seashore includes beaches, coastal cliffs and headlands, marine terraces, coastal uplands, woodlands, and forests on the Point Reyes Peninsula.

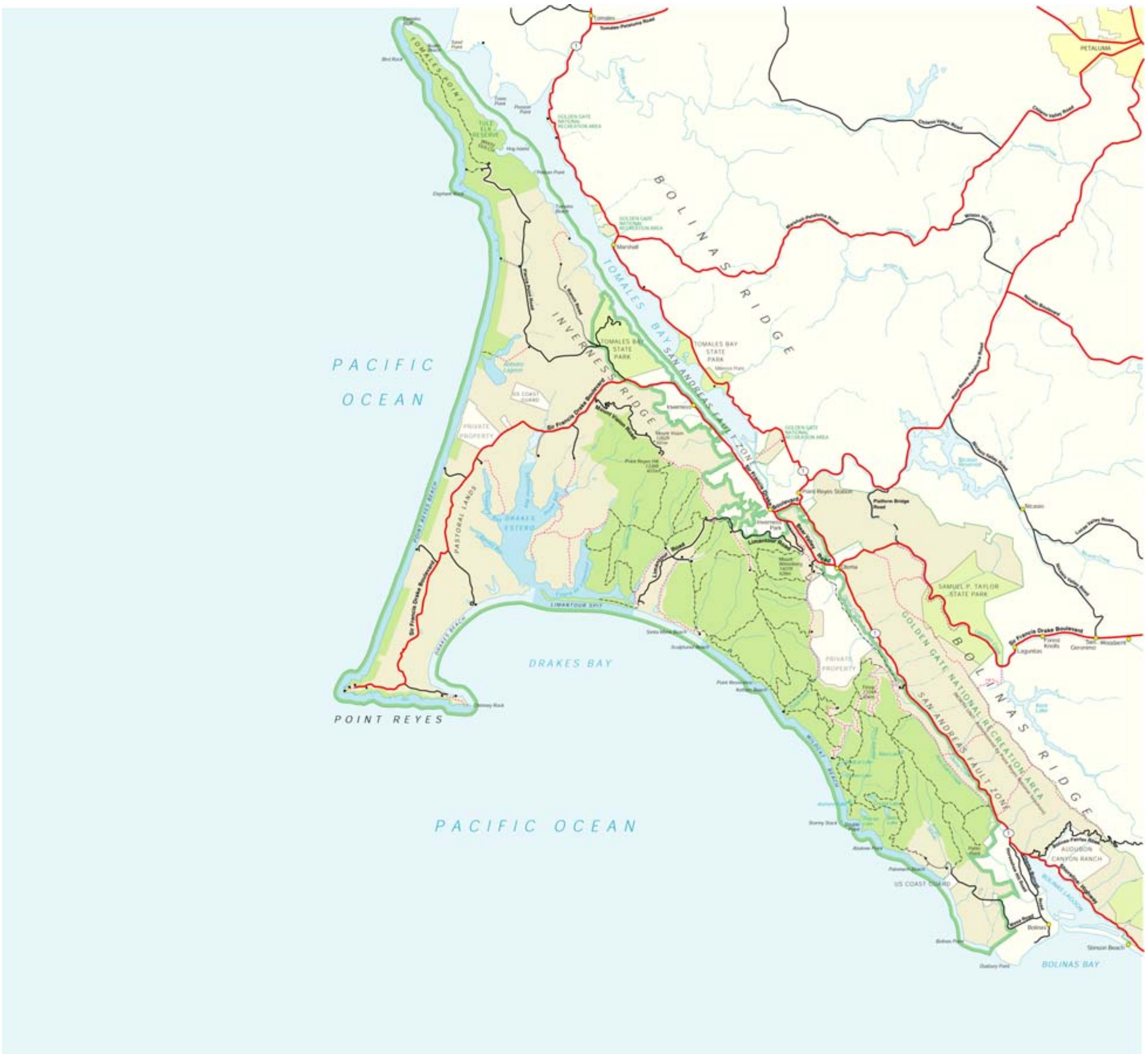
PRNS is bounded to the north, west, and southwest by the Pacific Ocean and to the east by the residential communities of Inverness, Inverness Park, Point Reyes Station, Olema, and Dogtown (see Figure 2). The town of Bolinas is south of PRNS at the southern tip of the Peninsula. An estimated 3,800 permanent residents live in the towns and communities close to the project area from the tip of Tomales Bay in the north to Stinson Beach in the south (U.S. Census Bureau 2000). The census population figure does not count the many part-time residents of western Marin who maintain second homes in the project area.

Through a memorandum of agreement between the two national parks, PRNS manages the 19,265 acres of Bolinas Ridge for GGNRA (NPS 1988b) . Bolinas Ridge is a northwest/southeast trending ridge paralleling the Olema Creek valley and the San Andreas Fault zone. The northwest-facing slope of the

Ridge is primarily grassland and shrub with east facing slopes forested with Douglas fir and coast redwood.

A number of private inholdings exist within the Seashore, including 2,143 acres in Olema Valley, owned and managed by the Vedanta Society. East of the project area, land use is a mix of private residential and agricultural lands, publicly held watershed, and parks and open space. Adjacent to the park are areas managed by Audubon Canyon Ranch, Marin Municipal Water District, Tomales Bay and Samuel P. Taylor State Parks, and Marin County open space lands. Marine boundaries are shared with the Gulf of the Farallones and the Cordell Bank National Marine Sanctuaries, and Tomales Bay State Park. Some agricultural parcels are part of the Marin Agricultural Land Trust to which the owners have deeded development rights to protect rural agriculture from development pressures.

FIGURE 2: MAP OF THE PROJECT AREA



Park Management Zoning

PRNS and GGNRA share a general management plan (NPS 1980), which uses the following zoning designations to guide park management.

Project area lands fall under one of two management zones: Natural Resource Zones or Historic Resource Zones. The Natural Resource Zone covers pastoral lands, natural landscape areas, sensitive resources, designated wilderness, and marine reserves. Historic ranches, the Point Reyes lighthouse, and the lifesaving station are included in the Historic Resource Zone.

Natural Resource Zones

Pastoral Lands (northern Olema Valley and northern Point Reyes peninsula). Approximately 17,000 acres of PRNS have been retained in agricultural production supporting beef and dairy production. The Northern District of GGNRA contains an additional 10,500 acres leased for cattle grazing. Pastoral operations presently include seven dairy and ten beef cattle ranches. The general management plan (GMP) for the Seashore indicates that at a minimum, agricultural buildings and open grasslands would be retained in these areas, and where feasible, livestock grazing would continue within the limits of carefully monitored range capacities (NPS 1980, p. 18). The GMP also indicates that future resource management studies could substantially alter the configuration of this zone.

Natural Landscape Areas (southern Olema Valley and Bolinas Ridge, Limantour Road corridor and Limantour Beach, Tomales Bay shoreline north of the State Park, Bear Valley, recreational beaches, road corridors, and select trail corridors). Natural Landscape Areas contain important natural resources that are not within the designated wilderness of PRNS. The largest track is the southern half of the Bolinas Ridge, lands buffering Limantour Road and Limantour Beach, and the Marshall Beach area north of Tomales Bay State Park. GMP direction for these areas is that natural resources and processes remain as undisturbed as possible given a relatively high level of park use (NPS 1980, p. 18). The Olema Valley is managed to maintain the visual contrast between woodland and open grassland (NPS 1980, p. 96).

Special Protection Areas (Philip Burton Wilderness Area, Gulf of the Farallones National Marine Sanctuary, State of California Marine Reserves, shorelines, and riparian corridors). Special Protection Areas includes lands that have received legislative or special administrative recognition of exceptional natural qualities requiring strict protection measures. They include wilderness and areas of particularly sensitive natural resources.

Wilderness

The purpose of wilderness in the national parks includes the preservation of wilderness character and wilderness resources in an unimpaired condition, as well as for the purposes of recreational, scenic, scientific, educational, conservation, and historical use. Management includes the protection of the areas, the preservation of the wilderness character, and the gathering and dissemination of information regarding their use and enjoyment as wilderness.

The Wilderness Act requires that, except as necessary to meet the minimum requirements for the administration of a wilderness area, "there shall be no temporary roads, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, or no other form of mechanical transport, and no structure or installation" within the wilderness (16 U.S.C. 1131). As required by the Wilderness Act, actions necessary to prepare and execute resource enhancement projects must be examined to assure that they are necessary. If the park deems a project necessary, it is required to use the least intrusive methods possible to carry out the needed actions. This "minimum requirement" process is designed to ensure the least disturbance and disruption of wilderness values and maximum protection of natural and cultural resources. At PRNS, the examination of minimum requirements is undertaken and documented by the interdisciplinary team reviewing projects for compliance to the National Environmental Policy Act. The procedure for determining the minimum requirement for each alternative is described in Appendix A (Wilderness Minimum Requirement Guide) and in the section Actions Common to All Alternatives.

The laws that established the Point Reyes Wilderness Area (90 Stat. 2515 and 90 Stat. 2692; 16 U.S.C.) mandated that it be managed "…without impairment of its natural values, in a manner which provides for such recreational, educational, historic preservation, interpretation, and scientific research opportunities as are consistent with, based upon, and supportive of the maximum protection, restoration, and preservation of the natural environment within the area."

The majority of the Wilderness is in the southern half of PRNS, from Mount Vision south to Palomarin, including Inverness Ridge. The wilderness supports primarily Douglas fir and mixed hardwood forests, riparian areas, coastal bluffs, and beaches. Elevations range from sea level to 1,407 at Mt. Wittenberg. While axis deer are currently not believed to inhabit wilderness areas in the study area, about one-third of the known fallow deer range (or about 8,000 acres) is inside wilderness boundaries.

More than half of PRNS is designated or proposed wilderness, and must be managed in conformance with the 1964 Wilderness Act, NPS *Management Policies* 2001 (Chapter 6), the Director's Order, and Reference Manual 41 for Wilderness Preservation and Management. As directed in NPS *Management Policies* 2001 (Section 6.3), natural resources management activities in wilderness areas:

- must conform to the basic purposes of wilderness,
- must apply the principle of non-degradation; each wilderness area's condition would be measured and assessed against its own unimpaired standard, and
- should seek to sustain the natural distribution, numbers, population composition, and interaction of indigenous species.

The NPS *Management Policies* 2001 also confirm that scientific activities in wilderness areas must use the "minimum requirement" concept, a process of identifying the least damaging tools or activities, to protect natural and cultural resources, and minimize any lasting impacts. Analysis of transitory effects upon wilderness values are focused on determining whether they are outweighed by the benefits to be derived for the long-term preservation of wilderness character.

Some lands at PRNS are particularly sensitive to human use or are especially valuable from an ecological or scientific point of view. Most of the areas are watercourses or bodies of water recognized for their importance in sustaining wildlife and vegetation. The GMP states that use and development in these areas would be either discouraged or mitigated sufficiently to avoid major levels of deterioration.

Other Significant Area Designations

Due to the interface of the Seashore with the Pacific Ocean and its importance to wildlife, the Seashore coordinates and cooperates with an increasing number of agencies and organizations including the National Marine Fisheries Service (NMFS), U.S. Geological Survey (USGS), Gulf of the Farallones National Marine Sanctuary, Golden Gate Biosphere Reserve members, U.S. Fish and Wildlife Service (USFWS), the Audubon Society, California Department of Parks and Recreation, Point Reyes Bird Observatory, Marine Mammal Center, and CDFG.

In 1988, UNESCO Man in the Biosphere program designated the Central California Coast Biosphere Reserve under the International Biosphere Program. The Central California Coast Biosphere Reserve includes the entire Seashore, the Golden Gate National Recreation Area, and other public lands in the region. In addition, the State of California designated three "Areas of Special Biological Significance" within the Seashore: Tomales Point, Point Reyes Headlands, and Double Point. These designations add to the need to maintain or return the Seashore to as natural state as possible.

Climate

Cool wet winters and warm dry summers, influenced by low-lying fog and strong sea breezes, characterize the coastal Mediterranean climate of the study area. The climate is unusual in that temperatures remain fairly consistent throughout the year. Temperatures rarely exceed 90° or drop below 40° F. Thick, rapidly moving fogbanks shift from offshore to on shore in a predictable pattern throughout the summer. The approach of the fogbank can cause temperatures to change rapidly dependent on proximity to the ocean and elevation. The ocean temperature averages 55° year-round. The cold ocean waters and low fog mitigate the summer heat common in eastern Marin County where temperatures are often in the 90s. Typically, as one moves away from the coast the climate usually becomes warmer and drier, especially in the summer.

On average, ninety-one percent of the annual precipitation falls between October and March. Precipitation at the Lighthouse or near the Pacific shore may be less than half of that recorded on Inverness Ridge, Olema, or in Inverness. The 1,000 to 1,500-foot Inverness Ridge provides an orographic effect – wringing the clouds of their moisture. Annual rainfall averages range from 18 inches at the Point Reyes Lighthouse to 40 inches at Inverness Ridge and Bear Valley (Evens 1993)

The summer months are prone to fog as the vacuum created by warming air and low pressure in the Central Valley draws the moist marine air inland. Fog drip is most prevalent at the higher elevations where wind blows the saturated air over the ridgeline and into the Olema Valley. The needles of Douglas fir and Bishop pine trees capture moisture, which accumulates and drops to the soil below. Research shows that fog drip is proportional to the surface area of the individual trees. In some areas of PRNS as much as 20 inches of precipitation can be extracted annually from the fog by individual trees, with that water supporting the lush understory and growth of the woody vegetation. Fog drip augments the groundwater supply, reducing stress on the aquifers, and possibly increasing the baseflow of the streams. Summer winds are usually from the northwest and often are strong and steady at 10 to 20 knots (12–23 miles per hours).

Fall weather patterns are typically dryer, with onshore high pressure resulting in an offshore, reverse flow. Winds blowing from the hot desert interior of the west and south, similar to the infamous Mono and Santa Ana winds, bring hot, dry conditions and high fire hazard.

Air Resources

By virtue of the presence of the Phillip Burton wilderness, PRNS is a Class 1 Air Quality Area and is to be managed to protect and preserve clean air values. The Clean Air Act (42 U.S.C. 7401-7671q) provides a legal framework for the NPS to preserve and protect parks' air quality related values from pollution sources emanating from within and outside park boundaries. Class I park areas, those containing legislated wilderness, are to be provided the highest level of protection to prevent significant deterioration of air quality related values.

Air quality at PRNS is generally excellent throughout much of the year due to a stationary marine high-pressure system. During fall, as high pressure systems move off the coast, stagnant polluted air from the metropolitan San Francisco Bay Area can affect the Point Reyes area for a number of weeks. The NPS began air quality monitoring for criteria (O_3) gasses, particulate matter, and visibility in 1987. Criteria monitoring was discontinued in 1992 due to lack of funding. An IMPROVE sampler and visibility camera remain in operation. Long-term vista monitoring is accomplished every five years.

Geology and Topography

The character of the Point Reyes Peninsula has been shaped and defined by its association with the San Andreas Fault. The Peninsula, lying west of the fault, is a fragment of the Pacific Plate that is shifting northwest in relation to the continental North American plate. It is now widely accepted that the total slip on the San Andreas and its main branches in Southern California is about 205 miles. The Salinian granite bedrock of the Peninsula is most closely related to that observed at Montara Mountain in San Mateo County. Bolinas Ridge and lands east of the fault are underlain by Franciscan formation sedimentary rock. The geomorphology, hydrology, weather, soils, and plant communities east of the fault zone differ in many ways from that of the Peninsula.

Granite bedrock commonly called granodiorite underlies the entire Peninsula and is exposed in areas of the Inverness Ridge, Tomales Point, and the Point Reyes Headlands. Granite is overlain by Monterey Shale in the southern part of the Peninsula and is exposed along the coastline from Drakes Bay southward. Coastal wave cut benches and flooded valleys are the result of sea level fluctuations during the Pleistocene and tectonic uplift. The Point Reyes Plain extending from Inverness Ridge west to the Headlands is underlain by siltstone and mudstone of the Drakes Bay Formation. The Headlands present the most unique exposed formation within the park – the Point Reyes Conglomerate – comprised of cobbles of chert, volcanic rock, and granite. It is best exposed along the Lighthouse steps, and is most similar in composition to a conglomerate that occurs on the Monterey Peninsula, 100 miles to the south (Evens 1993). It is thought that the Point Reyes conglomerate was carried northward by the San Gregorio fault (Kingsmark 1998).

The Olema Valley, extending from Bolinas Lagoon to Tomales Bay, is associated with movement along the San Andreas Fault. The fault zone is 0.5 to 1.0 mile wide in the valley. Past movements have created fault topography, including linear ridges, offset stream drainages, offset rows of trees, and sagponds. The surface rupture caused by the 1906 earthquake ran from Bolinas Lagoon to Tomales Bay with a maximum displacement of 14 to 16 feet in the Point Reyes area.

Bedrock east of the fault (generally east of Highway 1) is a Franciscan assemblage that underlies much of California's Coast Range. Franciscan rocks consist primarily of shale and sandstone with occasional beds of limestone and chert along with intrusions of igneous serpentine (Evens 1993). The Franciscan formation is highly unstable, and known for slope instability, thin soils, and high runoff rates.

The current topography of the project area is also defined by numerous stream courses. Drainage patterns are primarily dendritic, resembling the pattern made by the branches of a tree or veins of a leaf. Dendritic drainages may develop in areas with consistent soil types such as the Bolinas Ridge. A number of drainages, however, have drastically altered courses attributed to the combination of stream capture and alterations of the topography caused by fault movement. In the Olema Valley, Olema Creek and Pine Gulch Creek run parallel, but in opposite directions for over two miles. Near the north end of the Valley, Bear Valley Creek runs at an acute angle through the ridge line, then makes an abrupt ninety degree turn to run parallel to Olema Creek until they discharge into the Lagunitas Creek.

Inverness Ridge forms the backbone of the Point Reyes peninsula, reaching a height of 1,407 feet at Mount Wittenberg. The ridge is characterized by relatively consistent upland elevation with sharp precipices dropping down into the river valleys. The only interruption in the ridge, between Bolinas and Tomales Point is the 400-foot pass between Bear Valley and Coast Creek drainages. Most of the perennial streams within PRNS originate from the ridge. South of Laguna Creek, the ridge merges with the Bolinas Mesa, an uplifted, wave-cut Monterey Shale bench. This terrace is intersected by a number of steep ravines caused by drainages cut down to the current sea level. Some of the most spectacular landmarks in PRNS, including Arch Rock and Alamere Falls, are on this terrace.

Bolinas Ridge to the east rises to approximately 800 feet in elevation. Due to soil type and climate, conditions are far drier on these west-facing slopes. Ridges are primarily grasslands with the steep tributary valleys dominated by oak and bay laurel.

Resources that May be Affected

This section describes the type of resources that may be affected or changed by actions in any of the alternatives and their current condition.

Water Resources and Water Quality

The water resources within the project area include a substantial number of perennial and intermittent streams, human-made impoundments, wetlands, natural lakes, and sag ponds. A general map of the watersheds within the project area is shown above. The water resources support a variety of threatened and endangered species including coho salmon, steelhead trout, California freshwater shrimp, and California red-legged frog.

Tomales Bay Watershed. The Tomales Bay watershed includes over 200 square miles, much of which is managed as public land by the NPS, Marin Municipal Water District, California State Parks, and Marin County Open Space. Though it accounts for only 50% of the Tomales Bay Watershed, Lagunitas Creek, including Olema and Bear Valley creeks, contributes more than 65% of the freshwater flow to Tomales Bay. Walker Creek accounts for approximately 1/3 of the watershed area and 35% of the freshwater inflow to Tomales Bay. The remaining watersheds east and west of the Bay make up more than 15% of the land area but contribute only 10% of the freshwater inflow (Fischer et al. 1996) to the west. Small watersheds draining from the east and west sides of the Bay account for only 10% of the overall freshwater contribution to the Bay.

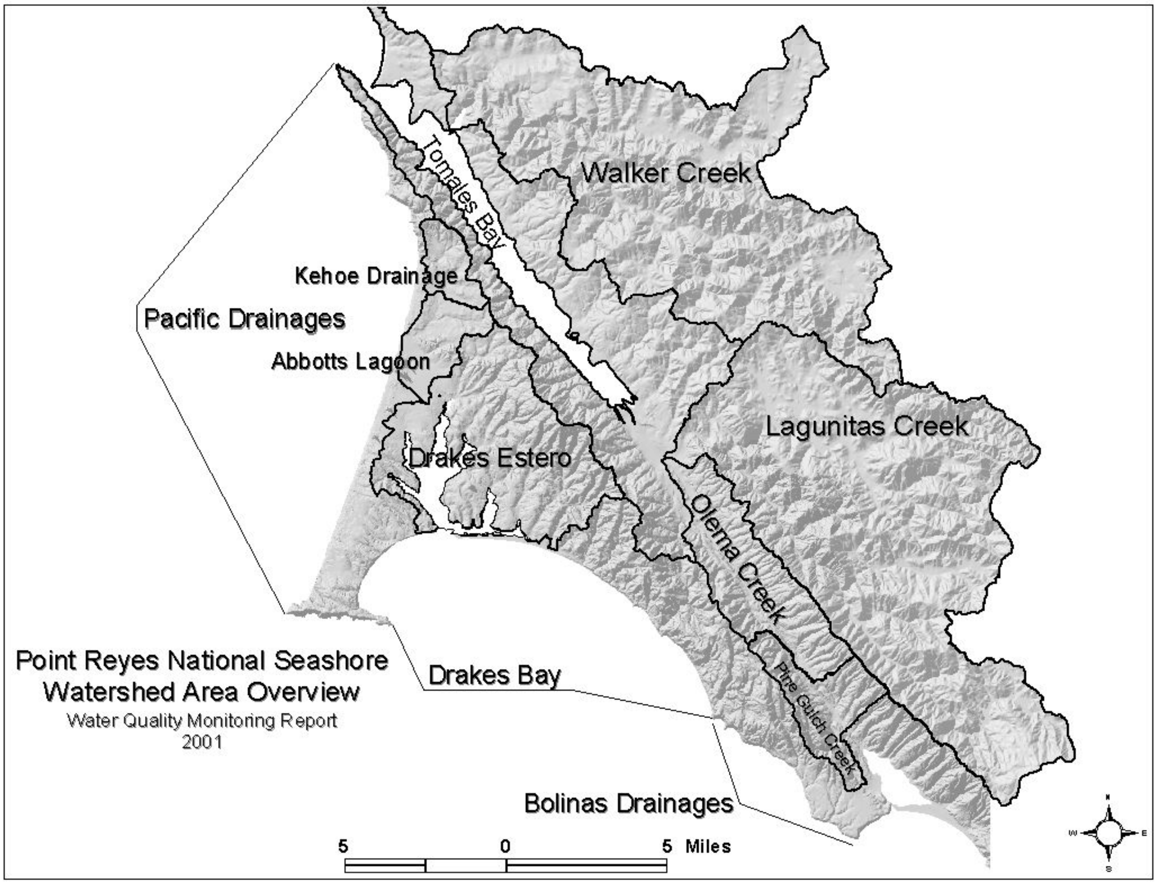
Tomales Bay and Drakes Estero are home to a number of oyster production operations accounting for nearly 35% of the oyster production in the state of California. In 2000, Tomales Bay was identified as impaired by sediment, nutrients, and fecal coliform by the San Francisco Bay Regional Water Quality Control Board. The Board also identified Lagunitas Creek as impaired by the same constituents.

Lagunitas Creek Watershed. Lagunitas Creek drains to the head of Tomales Bay. The 88 square mile watershed is the major supplier of water to most of Marin County through the Marin Municipal Water District. Four dams with storage in excess of 60,000 acre-feet have substantially altered both the hydrology and condition of anadromous populations. The damming of Lagunitas and Nicasio creeks has eliminated nearly two thirds of the spawning habitat of these threatened populations.

The major undammed tributaries heading upstream include Bear Valley Creek, Olema Creek, McIsaac Gulch, Cheda Creek, Devils Gulch, and San Geronimo Creek. The watershed is important as it supports viable populations of federally endangered coho salmon (*Oncorhynchus kisutch*) and steelhead trout.

Other federal threatened and endangered species including California red-legged frog (*Rana aurora draytonii*) and California freshwater shrimp (*Syncharis pacifica*) occur in the watershed.

FIGURE 3: MAP OF THE WATERSHEDS LOCATED WITHIN THE PROJECT AREA.



The 14.5 square mile Olema Creek watershed supports viable populations of federally Endangered coho salmon and steelhead trout. Olema Creek has been the subject of extensive monitoring to determine the effectiveness of various stream protection measures – including riparian exclusion fencing and habitat restoration.

Drake's Bay Watersheds. Drake's Estero and the Estero de Limantour comprise a complex estuarine system capturing flow from more than 35 square kilometers and draining through the Estero inlet. Major watersheds contributing to this system are Laguna, Muddy Hollow, Glenbrook, Home Ranch, East and North Schooner Creek, also support populations of steelhead trout. Other watersheds flowing to the system, but not likely to support salmonids include Creamery Creek, Limantour Creek, North Home Ranch, and Berries Bay Creek. The Estero is susceptible to nutrient and other inputs from adjacent ranches and dairies.

Other Drake's Bay watersheds are characterized as rather small, steep drainages, discharging directly to the beach. In most cases, the wave action forms a seasonal lagoon at the mouth of the stream. The primary watersheds south of Drakes Estero include Coast Camp, Santa Maria (Machado), Coast, Wildcat, and Alamere Creeks. Minor watersheds include Elk Gulch, Woodward Valley, and Kelham Creek. Watersheds east of the Estero include Horseshoe (D Ranch), Drakes Beach, C Ranch, B Ranch, and A Ranch.

Pacific Ocean Watersheds. The primary watersheds draining to the open ocean are from the north, and include McClures, Kehoe North, Kehoe South, E Ranch and Lighthouse. There are a large number of drainages north of Kehoe Beach that drain to the ocean including Elk Fence, White Gulch East, and others. There are also a number of intermittent dune watersheds that are not included in this list but occasionally drain to the ocean across the ten-mile beach. North and South Kehoe Creeks converge approximately ¼ mile upstream of Kehoe Lagoon.

The Abbott's Lagoon watershed drains across gently sloping terrain and into a unique lagoon environment. A human-made pond and a dual chambered lagoon separated by a bedrock sill provide a unique combination of brackish and freshwater environments in a system that often has the same surface water elevation. The lagoon does not breach regularly, remaining closed for years at a time.

Bolinas Drainages. The Bolinas drainages include Double Point, Arroyo Hondo, and RCA. In the late 1970s, arrangements regarding water supply to the town of Bolinas were made with the NPS. To protect streamflow of the Pine Gulch Creek watershed, an agreement with the Bolinas Community Public Utilities District was made that transferred water rights to the Arroyo Hondo Creek. The sole Bolinas Community Public Utilities District water supply, the Arroyo Hondo watershed is the most remote in the Seashore.

Pine Gulch Creek. Pine Gulch Creek is the largest watershed draining to the Bolinas Lagoon. Within the project area, the watershed was the most heavily logged with impacts spread over approximately 100 years. The lagoon is the subject of an intensive study, and a restoration plan coordinated through the US Army Corps of Engineers. Of greatest concern in this watershed is the protection of the stream and lagoon from excess sediment mobilization and deposition, along with the documented return of coho salmon to the watershed.

Impoundments, Natural Lakes, and Sag Ponds

The project area contains more than 125 impoundments or sag ponds known to support the California red-legged frog. Most of these facilities were constructed by former landowners for stock watering or development. The condition of these ponds is not well known although the stability of many is likely compromised by the presence of brush and trees on the dam structure.

Within the Olema Valley, a number of sag ponds associated with the San Andreas Fault provide unique aquatic habitat. The southwestern part of the project area, from Palomarin to Double Point is dotted with ponds and lakes derived from massive slope failure events. These water bodies, such as Bass, Pelican, and Crystal Lake are naturally occurring. A number of smaller ponds occur along Coast Trail from Palomarin.

Soils

The soils of the project area west of the San Andreas Fault are broadly classified with relation to underlying lithology (Evens 1993) as described below:

The Kehoe-Sheridan soils are about three feet deep, well drained, strongly acidic, and are derived from sandstone and quartz diorite. Located on the north flank of Inverness Ridge from Tomales Point south to Tomales Bay State Park, these soils support the bishop pine forests.

The Palomarin-Wittenberg complex is five feet or more deep, well drained, strongly acidic, and is derived from sandstone and shale. These soils occur on the southern half of Inverness Ridge, and support primarily Douglas fir forest.

The Tomales-Steinbeck soils are comprised of fine clays or silts, are slightly to moderately acidic, and are derived from the soft sandstone of the Drake's Bay Formation. They occur from outer Point Reyes south to Point Resistance, and surround Drake's and Limantour Esteros. They support primarily grassland and coastal scrub.

The Pablo-Bayview soils are well drained, shallow (10–20 inches deep), and are derived from weathered shale and sandstone. They occur in a narrow band at the base of the western slope of Inverness Ridge.

The Dune-Sirdrak soils are the wind-blown sands that comprise the dunes. They can be up to six feet deep and have little ability to hold water.

The Cronkhite-Dipsea-Centissima soils are approximately five feet deep and are derived from sandstone and shale. They occur at the Bolinas Mesa at the southern end of the peninsula.

Sand dunes border the ocean around much of the Seashore. In some areas the dunes may extend inland for up to a mile. This soil type is highly susceptible to wind and water erosion, although these processes are part of the natural environmental forces. In the last few decades, European dunegrass was planted in an attempt to control the expansion of dunes into grasslands used for grazing. There is currently a large-scale restoration project to remove this dunegrass and restore natural dune function to the system.

Soils east of the San Andreas Fault (primarily in GGNRA North District) are derived of Franciscan lithology. The Tocaloma and Sheridan soils are moderately deep, well-drained soils. Though well drained, there is no underlying lithology to store the water.

Vegetation

PRNS owes much of its distinctive character to the assemblage of plants that occur on the peninsula. Plant communities create patterns over the Seashore's landscape that reflect the underlying influences of geologic formations and soils, and the overlying influences of a moist, maritime climate. The location of the project area at the midpoint of the Pacific Coast places it at a boundary of two climatic provinces, which results in abundant and varied plant life. The Seashore is known to support over 900 plant species, including approximately 300 non-native species, and 50 species of concern to park managers. The latter include the federally endangered beach layia (*Layia carnosa*), Tidestrom's lupine (*Lupinus tidestromii*), Sonoma alopecurus (*Alopecurus aequalis* var. *sonomensis*), Sonoma spineflower (*Chorizanthe valida*), and robust spineflower (*Chorizanthe robusta*).

Vegetation in the project area has been subject to human activities for 7,000 – 10,000 years, since the Coast Miwok first occupied the land. Although data are not available on the effects of Miwok activities on vegetation, it is assumed that they gathered plants for food and shelter materials, and probably used fire to manipulate the growth of plant species (Cook 1943). Beginning in the mid-nineteenth century and continuing into the present, activities such as land clearing, logging, cultivation, cropping, road building, commercial development, and livestock grazing have markedly affected the vegetation.

For purposes of analysis, the project area has been divided into 9 broad vegetation types. Acreage estimated for each type in the project area and brief descriptions are presented below. Acreage was estimated from the Point Reyes vegetation map and is rounded to the nearest 100 acres. Vegetation types correspond most closely to the community level in the vegetation map classification hierarchy.

Forest/Woodland Types

1. Bishop Pine (3,700 acres) – Bishop pine (*Pinus muricata*) is the dominant tree in the forest canopy. Madrone (*Arbutus menziesii*), tanoak (*Lithocarpus densiflorus*), coast live oak (*Quercus agrifolia*), or California bay (*Umbellularia californica*) are often present in substantial cover. Huckleberry (*Vaccinium ovatum*) is important to dominant in the shrub layer. Other species common in the understory include salal (*Gaultheria shallon*) and swordfern (*Polystichum munitum*). Stands of bishop pine tend to be even-aged, usually originating after stand destroying fires. The bishop pine forests in the project area are mature forests except for those that burned in the Vision Fire of 1995. Bishop pine forests occur on the northern portions of Inverness Ridge. Approximately 35% of these forests burned in the Vision Fire. These burned bishop pine forests are characterized by a patchwork of extremely dense stands of 12-15 ft. tall trees, as of this report, regenerating pines alternating with extremely dense stands of blue blossom (*Ceanothus thrysiflorus*) and Marin manzanita (*Arctostaphylos virgata*).

This vegetation type also includes a small amount of non-native Monterey pine/Monterey cypress stands; less than 5% of total acreage. These stands are characterized by planted groves dominated by either Monterey pine (*Pinus radiata*) or Monterey cypress (*Cupressus macrocarpa*), invasive in some areas, usually with sparse to low shrub and herbaceous cover. Understory species are often non-native.

2. Douglas fir/Coast Redwood (18,700 acres) – These are forests of giant pointed-crowned conifers with a maximum height approaching 50-70 meters dominated by Douglas fir (*Pseudotsuga menziesii*) or coast redwood (*Sequoia sempervirens*). Approximately 90% of these forests are dominated by fir, with redwood forests making up the remaining 10% or so of this type.

Douglas fir forest in the project area is characterized by Douglas fir dominant canopy often with a strong component of hardwood trees, usually California Bay (*Umbellularia californica*), but tanoak (*Lithocarpus densiflorus*) or individual coast live oaks (*Quercus agifolia*) may be present. Fir is the most common forest in the project area with a highly variable tree canopy cover that may be as low as 15%. The shrub understory is also highly variable, but is usually moderate to very dense. Coffeberry (*Rhamnus californica*), huckleberry (*Vaccinium ovatum*), California hazel (*Corylus cornuta*), poison oak (*Toxicodendron diversilobum*), and coyote brush (*Baccharis pilularis*) are the most common shrubs. Swordfern (*Polystichum munitum*) often dominates the herbaceous layer.

Where redwood is dominant in the forest canopy, tanoak is often a major component, sometimes co-dominating with redwood. California bay or Pacific madrone (*Arbutus menziesii*) are also often present in substantial cover. California hazel and huckleberry are the most common understory shrubs, with shrub cover usually sparse to moderate. Sword fern often dominates the herbaceous layer.

3. Hardwood Forest (7,500 acres) – This type includes forests dominated by hardwood species such as California bay (*Umbellularia californica*), coast live oak (*Quercus agrifolia*), eucalyptus (*Eucalyptus globulus*), tanoak (*Lithocarpus densiflorus*), madrone (*Arbutus menziesii*), or giant chinquapin (*Chrysolepis chrysophylla*). California bay is by far the most abundant forest comprising roughly 75% of this type. Coast live oak makes up about 20% of the type, with the two species often associating with each other. Of the remaining forest, eucalyptus is less than 5% and tanoak, madrone, and giant chinquapin are each less than 1% of this type.

California bay forest canopy is dominated by California bay or co-dominated by bay and coast live oak with each species comprising 30-60% relative canopy cover. Tanoak, Douglas fir (*Pseudotsuga menziesii*), or California buckeye (*Aesculus californica*) may have substantial cover. The understory is variable; it can be a moderately dense shrub understory often dominated by hazel (*Corylus cornuta*), coffeeberry (*Rhamnus californica*), elderberry (*Sambucus racemosa*), and/or poison oak (*Toxicodendron* *diversilobum*). If there is no substantial shrub cover, swordfern (*Polystichum munitum*) usually dominates understory.

Coast live oak woodlands are dominated by coast live oak usually with a major component of California Bay, sometimes co-dominating with bay. Douglas fir individuals may be present. Understory is usually open to moderate with poison oak being the most commonly found shrub, often fairly high in cover. Coffeeberry, coyote brush (*Baccharis pilularis*), toyon (*Heteromeles arbutifolia*), and hazel can be present. Herb cover is usually low.

Eucalyptus forests are dominated by the non-native blue gum eucalyptus. These have been planted or have invaded native communities. Eucalyptus is usually very dominant in the canopy. Monterey pine (*Pinus radiata*)/Cypress (*Cupressus macrocarpa*) or individuals of Douglas fir, California bay, or coast live oak may be present. Understory is usually sparse, often including remnants of the native community. Poison oak and non-native or native berry (*Rubus spp.*) are common shrubs. Other non-native shrubs and herbs are often present in low cover. Eucalyptus forests are characterized by a thick litter layer formed by this species distinctive peeling bark, and tendency to drop seedpods, twigs, and branches.

4. Riparian Forest/Shrubland (2,300 acres) – These are streamside forests and shrublands dominated by broad-leaved deciduous trees or shrubs: red alder (*Alnus rubra*), mixed willows, and arroyo willows (*Salix lasiolepis*). Red alder forest is the most abundant of this type; it makes up approximately 70% of riparian areas. Red alder dominates the canopy with California bay (*Umbellularia californica*) often present in substantial cover. Arroyo willow may form a subcanopy to the alder. Understory is usually moderate to dense. Berry species (salmonberry—*Rubus spectabilis*, thimbleberry—*R. parviflorus*, California blackberry—*R. ursinus*), and red elderberry (*Sambucus racemosa*) are the common shrubs. Hedgenettle (*Stachys ajugoides*), sedges (*Carex spp.*), rushes (*Juncus spp.*), small-fruited bulrush (*Scirpus microcarusp*), and ferns (sword fern—*Polystichum munitum*, lady fern—*Athyrium felix-femina*) dominate the herbaceous layer.

Other forested riparian areas are dominated by mixed willow forest, which in the project area is represented by yellow willow (*Salix lucida*), often associating with other willows. Mixed willow forest makes up less than 5% of riparian areas.

Arroyo willow shrublands make up approximately 25% of the riparian type. Arroyo willow in its shrub form, usually 5-7 meters in height, strongly dominates the canopy. Other taller willows, or alder may be present in small quantities. The understory is usually extremely dense because of the thicket-forming growth habits of this species. Shrubs such as berry species (*Rubus parviflorus, R. spectabilis, R. ursinus*) are most commonly found woven through the understory. Wax myrtle (*Myrica californica*) or poison oak (*Toxicodendron diversilobum*) may be present. Sedges, rushes, small-fruited bulrush along with hedgenettle, beeplant (*Scrophularia californica*) and the ferns (Lady fern, bracken fern—*Pteridium aquilinum*) dominate the herbaceous layer.

Scrub Types

5. Coastal scrub (17,800 acres) – This vegetation type is highly variable and includes all of the shrublands of the study area as well as a small amount of chaparral. Approximately 90% of coastal scrub is dominated by coyote brush (*Baccaris pilularis*), a small-leaved evergreen shrub. Coyote brush scrub is highly diverse and variable, ranging from fairly low open areas where coyote brush associates with grasses, to tall dense multi-species scrubs. Coyote brush scrub can be roughly equally divided in the project area between these open and dense variations. In its more open variation coyote brush commonly associates with non-native and native grasses and California blackberry (*Rubus ursinus*). It may also be found in association with sedges (*Carex spp*.) and rushes (*Juncus spp*.). In its taller, denser variation, poison oak (*Toxicodendron diversilobum*) is the most commonly associating shrub, often in fairly high cover. Coffeeberry (*Rhamnus californica*), thimbleberry (*Rubus parviflorus*), California blackberry, and California sagebrush (*Artemisia californica*) are also common associates in dense coyote brush scrub. An additional 5% or so of coastal scrub is dominated by a diverse list of shrub species that includes coffeeberry, yellow bush lupine (*Lupinus arboreus*), hazel (*Corylus cornuta*), and blue blossom (*Ceanothus thrysiflorus*).

Chaparral accounts for less than 5% of the coastal scrub type. The manzanitas (*Arctostaphylos spp.*), primarily Eastwood manzanita (*Archtostaphylos glandulosa*), and chamise (*Adenostoma fasciculatum*) are the dominant shrubs here. These evergreen species tend to be in the hotter, drier areas with the largest occurrences in the project area found on the western slope of Bolinas Ridge and within the Vision Fire burn area on Inverness Ridge.

Herbaceous Types

6. Grassland (20,300 acres) – This variable vegetation type is dominated by non-native or native grasses, much of which are grazed by cattle, and may have up to 15% shrub cover. Roughly 80% is dominated by non-native grasses, the remaining 20% or so by native grasses. Purple velvet grass (*Holcus lanatus*) is the dominant non-native perennial grass in the project area. Italian wild rye (*Lolium perenne*) is also important. Non-native European dunegrass (*Ammophila arenaria*) is included in the coastal dune type. Dominant non-native annuals are annual Italian wild rye (*Lolium multiflorum*), Farmer's foxtail (*Hordeum murinum*), and rattail fescue spp. (*Vulpia spp.*). Non-native grasses are usually found in association with coyote brush (*Baccharis pilularis*), California blackberry (*Rubus ursinus*), native and weedy herbs, and often remnant native grasses.

Pacific reedgrass (*Calamagrostis nutkaensis*) is the most common native grass in the project area, along with tufted hairgrass (*Deschampsia cespitosa*), California oatgrass (*Danthonia californica*), meadow barley (*Hordeum brachyantherum*), and California brome (*Bromus carinatus*). Where Pacific reedgrass is in association with rushes (*Juncus spp.*) and sedges (*Carex spp.*) it is included in the wetland vegetation type. Native grasses are often found in association with annual non-native grasses, coyote brush, California blackberry, and a variety of native and weedy herbs.

7. Pasture (3,900 acres) – These areas are used as enclosed pastures to graze cattle or horses and are managed to produce silage for cattle; or are fields used for other agricultural purposes. This is an artificial vegetation type and is distinguished from grazed grasslands and other grazed naturally occurring vegetation types in the project area.

8. Coastal Dunes (1,900 acres) – The majority of dune habitat has been completely dominated by the non-native species European beachgrass (*Ammophila arenaria*), consisting of roughly 50% of this type, or iceplant (*Carpobrotus edulis*), consisting of roughly 25% of this type. In areas where these two species dominate, they form dense monocultures, with little to no other species present.

The remaining 25% of this type are remnant patches of native habitat, which commonly support primarily dune sagebrush (*Artemisia pycnocephala*), coast buckwheat (*Eriogonum latifolium*), dune lupine (*Lupinus chamissonis*), or goldenbush (*Ericameria ericoides*), often with substantial cover of the two invasive species, European beach grass and/or iceplant. Total vegetation cover is often low and interspersed with bare sand.

9. Wetlands (2,900 acres) – This is a varied group that includes moist herbaceous wetlands, salt marshes, and freshwater marshes. Moist herbaceous wetlands, dominated by rushes (*Juncus spp.*), sedges (*Carex spp.*), small-fruited bulrush (*Scirpus microcarpus*), and Pacific reedgrass (*Calamagrostis nutkaensis*) in association with these wetland species, make up approximately 70% of this type. Any of these species may dominate, however they are often found in swales in a patchwork pattern. Common dominants are rush (*Juncus effusis*), slough sedge (*Carex obnupta*), small-fruited bulrush, and Pacific reedgrass often associating with other rush or sedge species. Other associating species include purple velvet grass (*Holcus lanatus*) and California blackberry (*Rubus ursinus*) in the drier areas, potentilla (*Potentilla anserina*), hedgenettle (*Stachys ajugoides*), lady fern (*Athyrium felix- femina*), and horsetail (*Equisetum spp.*) in the moister areas.

Salt marshes make up roughly 30% of wetlands in the project area. Pickleweed (*Salicornia virginica*) is the most common dominant, as well as saltgrass (*Distichlis spicata*); these species often co-dominate. Jaumea (*Jaumea carnosa*) is the most common associate. Sea lavender (*Limonium californicum*), arrow-grass (*Triglochin concinna*), alkali heath (*Frankenia salina*), and bird's beak (*Cordylanthus maritimus*) are often associates as well.

Freshwater marshes account for less than 5% of this type. Dominant species are the tall California bulrush (*Scirpus californicus*) and cattails (*Typha spp.*). These species are found in the wettest areas in or at the edge of standing water such as marshes or stock ponds. Bur-reed (*Sparganium spp.*) and water parsley (*Oenanthe sarmentosa*) are common associates.

Wildlife

The project area supports a wide diversity of wildlife species, including 28 species of reptiles and amphibians, 65 species of mammals, over 470 bird species (representing 45% of the avian fauna documented in the United States), and uncounted invertebrates. The waters of the Pacific Ocean and Tomales Bay support rich and diverse fisheries. The US Fish and Wildlife Service and/or the State of California list many of the wildlife species present in the study area. The Marine Mammal Protection Act and the Migratory Bird Treaty Act afford additional protection.

Mammals. A rich diversity of terrestrial mammals occupies the many habitats of the project area. These include mountain lion *(Felis concolor),* bobcat (*Lynx rufus),* gray fox *(Urocyon cinereoargenteus),* black-tailed deer *(Odocoileus hemionus columbianus*), raccoon *(Procyon lotor),* striped skunk *(Mephitis mephitis),* mink *(Mustela vision),* and the Point Reyes mountain beaver *(Aplodontia rufa phaea).* Some large mammals have been extirpated, including grizzly bear *(Urus horriblis)* and wolf *(Canis lupus),* while others such as the coyote *(Canis latrans)* are beginning to reappear. Some extirpated species, such as the tule elk (*Cervus elaphus nannodes*) have been reintroduced. See below for a more detailed description of native ungulates.

Marine mammals, many of which are endangered under the Marine Mammal Protection Act (e.g., southern sea otter [*Enhydra lutris nereis*], and Steller sea lion [*Eumetopais jubatus*]), inhabit or transit the waters off of Point Reyes. Twenty percent of California's breeding population of harbor seals (*Phoca vitulina*) occur at Point Reyes. In 1981, northern elephant seals (*Mirounga angustirostris*) colonized the Point Reyes Headlands and the colony is growing. Gray whales (*Eschrichtius robustus*) are numerous during winter and spring migrations, and humpback (*Megaptera novaeangliae*), and blue (*Balaenoptera musculus*) whales are frequently observed in summer and fall.

Amphibians and Reptiles. Federally threatened California red-legged frogs (*Rana auroura draytonii*) occur within the project area, as do bullfrogs (*Rana caesbeiana*), California newts (*Taricha torosa*), and rough-skinned newts (*Taricha granulosa*). It is not uncommon to find the Pacific giant salamander (*Dicamptodon enstatus*) near streams.

Birds. Located along the Pacific Flyway and prominently jutting from the coast, the Point Reyes Peninsula supports a large number of resident and migratory birds. Of the 470 bird species that have been documented, 246 are listed as rare in the *Field Checklist of Birds for Point Reyes National Seashore* (1992).

Fisheries. Anadromous fish present in the watersheds of the study area include federally Endangered coho and Chinook salmon (*Oncorhynchus kisutch and Oncorhynchus tshawytscha*), steelhead trout (*Oncorhynchus mykiss*), Pacific lamprey (*Lampertra tridentata*), sturgeon (*Acipenser medirostris*), California roach (*Hesperoleucus symmetricus*), and Pacific herring (*Clupea pallasi*).

Non-Native Wildlife. Several species of non-native wild and feral animals also occur in the project area. Non-native deer were released in the 1940s and 1950s by a local landowner for hunting. See below for a more detailed description of non-native deer. Non-native and feral predators, such as red fox (*Vulpes vulpes*) and house cats (*Felis domesticus*) are present, as well as several non-native bird species including brown-headed cowbirds (*Molothrus ater*), European starlings (*Sturnus vulgaris*), wild turkeys (*Meleagris gallopavo*), and common peafowl (*Pavo cristatus*). A number of non-native marine invertebrate species and fishes have been introduced into the marine and estuarine systems over the past 100 years at the seashore. Examples include the European green crab (*Carcinus maenas*), Sacramento perch (*Centrarchus macropterus*), and the mosquitofish (*Gambusia affinis*). Most of these were introduced by oyster farming operations, fish introductions or from bilge water pumped from visiting vessels.

Ungulate Biology

Native Tule Elk

Tule elk, one of six subspecies of the North American elk or wapiti (*Cervus elaphus*), are endemic to California, and were almost extirpated at the end of the 19th century by market hunting. They exist today in 22 California herds in a fraction of their historic range, with numbers totaling less than 4000. Tule elk were reintroduced to a fenced, 2600-acre reserve at Tomales Point, in the Seashore, in 1978. Total numbers of tule elk in the Seashore are currently estimated to be 450-500. PRNS is the only National Park unit that supports tule elk.

Tule elk are the largest native herbivore in the California coastal ecosystem, with adult bulls weighing 500 pounds. They are fawn-colored with distinctive white rump patches (Figure 4). They are considered grazers, eating predominantly grasses, and favor non-forested habitat in the Seashore, such as open grassland and coastal scrub. Tule elk mating season is fairly prolonged at PRNS and lasts from August through November. Cows give birth to single calves in the spring and early summer.

Following an initial period of slow growth after re-introduction, the herd showed rapid growth in the late 1980s and early 1990s. Because of concern that the expanding herd might cause irreversible damage to the range and multiple species of concern, a Tule Elk Management Plan was completed in 1998 (NPS 1998). The document, in the form of an Environmental Assessment, was compiled with input from the public as well as recommendations from a “blue ribbon” panel of wildlife biologists and scientists (McCullough et al. 1993). The plan included recommendations for: (1) monitoring tule elk and their environment, (2) research on the feasibility of using immunocontraception in tule elk as a population control method, and (3) relocation of 35-70 animals to the Limantour area.

From 1995-1998, a $300,000 monitoring program was conducted by U.S. Geological Survey (USGS) researchers, and funded jointly by USGS and NPS. During the project, 25 elk cows and 66 elk calves were marked with radio telemetry transmitters and observed for up to 3 years. In 2004-2006, another 60 animals will be collared and monitored in another joint USGS-NPS project designed to model elk population dynamics over the next 6-10 years.

From 1997-2001, 40-50 elk cows were given contraception annually for a cooperative NPS-University of California, Davis, study. The contraceptive used, porcine Zona Pellucida (pZP), effectively prevented pregnancy in treated individuals but had only a minor population-wide effect in curtailing herd growth (NPS 2002b). The 1998 translocation of 45 elk to the Limantour area of the Seashore established a free-ranging herd and temporarily slowed growth of the Tomales Point herd. Population counts since 1999 indicate that numbers at Tomales Point may have stabilized at approximately 450. Currently the Limantour herd consists of 45 animals, with 9 new calves born in 2003 (see map, Figure 5).

Forage availability, closely tied to annual precipitation, is likely the most important determinant of elk population growth in the Seashore. Other regulating factors, such as inbreeding, disease and trace element deficiencies, have all been documented in the Tomales Point herd. PRNS tule elk are thought to be among the most inbred in California, with an estimated loss of 80% of their retained genetic variability (McCullough et al. 1996). Paratuberculosis, or Johne's disease, is an exotic, incurable diarrheal wasting disease of livestock and wild ungulates, and has been diagnosed in several elk at Tomales Point since reintroduction (Jessup et al. 1981, PRNS unpublished data (d)). Incidence of the disease, as evidenced by confirmed infection in animals culled before release at Limantour, may be at least 22% in adult Tomales Point animals (Manning et al. 2003). Copper deficiency was evident in the herd in the early 1980s and in 2004 and can cause anemia, decreased reproductive rates, and bone and antler deformities (Blood et al. 1983; Gogan et al. 1989; PRNS unpublished data (e)). How much these stressors account for current herd growth patterns is unknown.

FIGURE 4: TULE ELK (*CERVUS ELAPHUS NANNODES*)

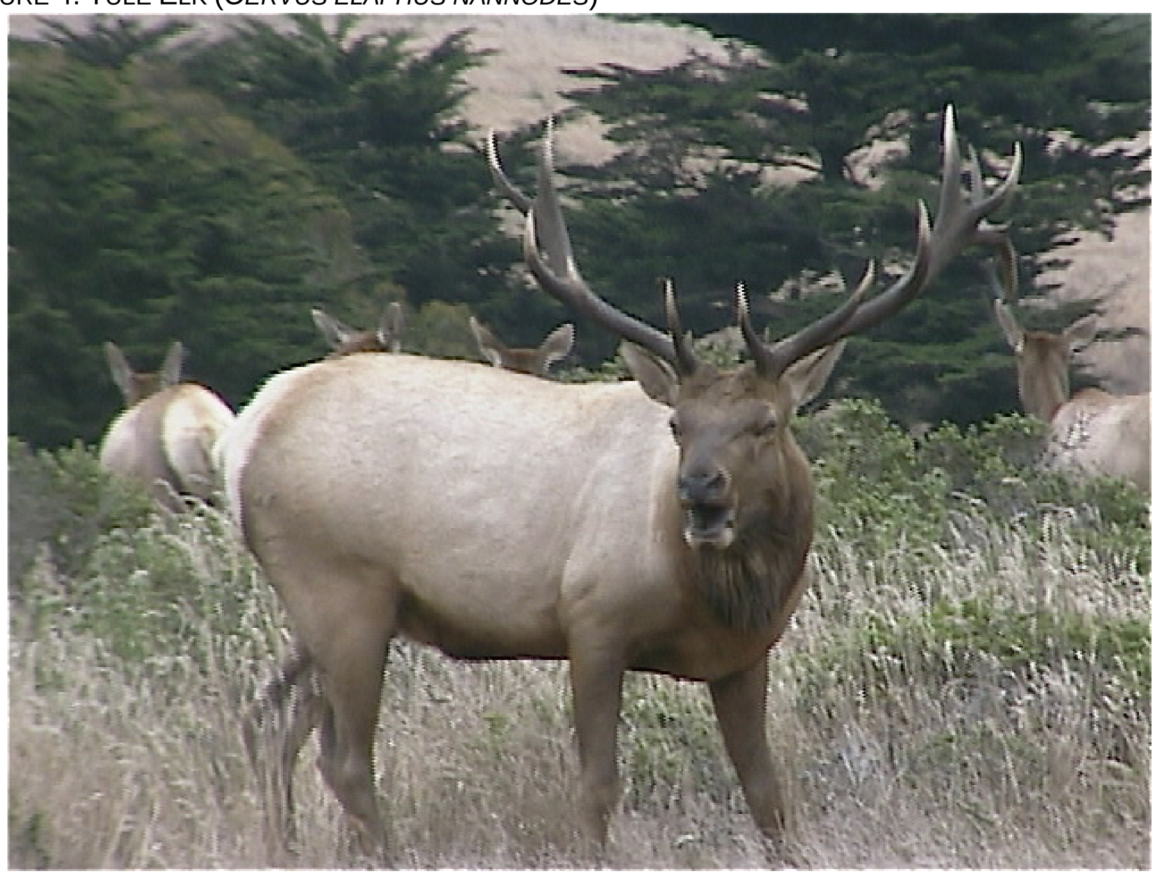
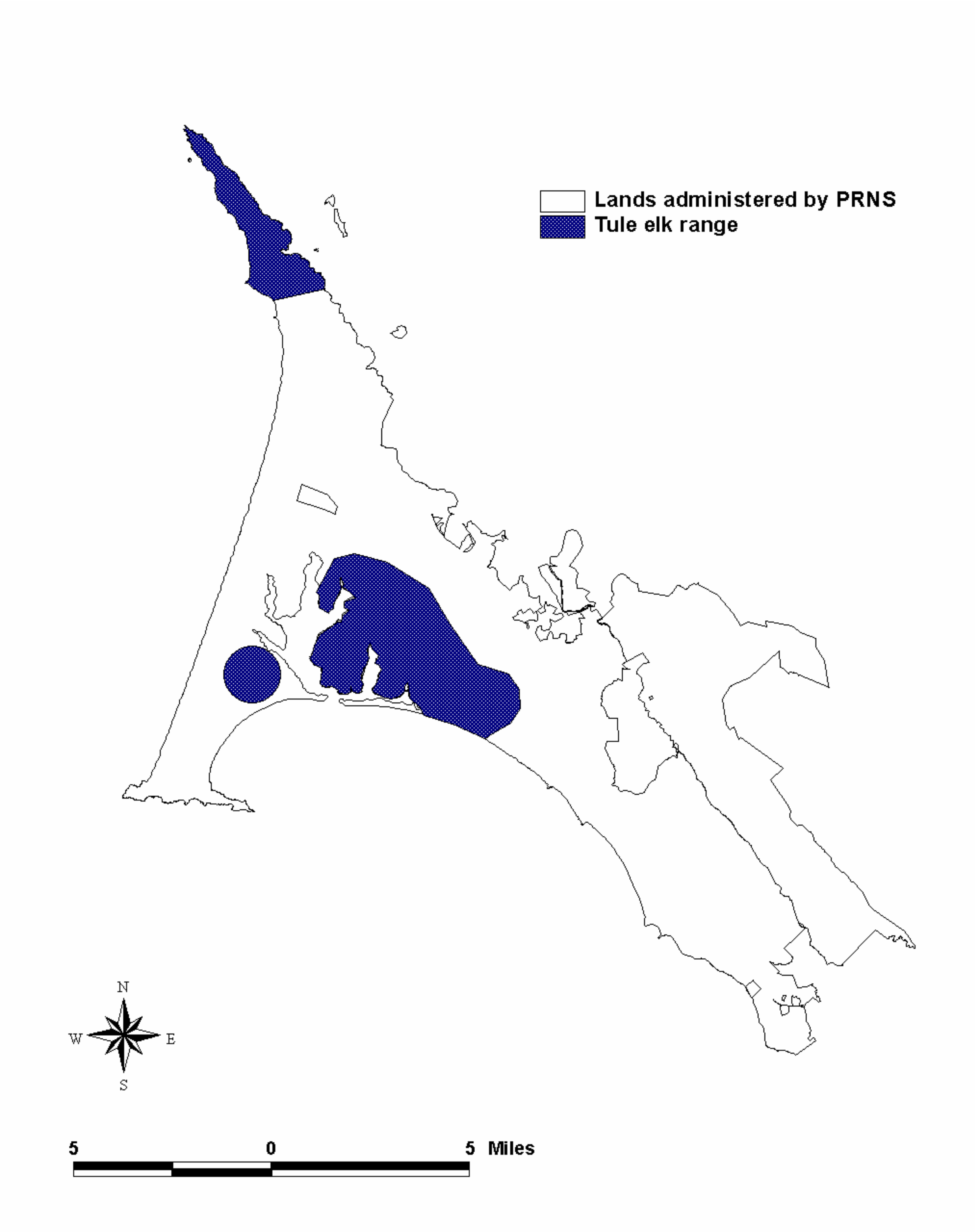


FIGURE 5: TULE ELK RANGE (2005), (BASED ON PRNS ELK GIS DATABASES)



Native Black-Tailed Deer

The Columbian black-tailed deer is one of 9 subspecies of *Odocoileus hemionus*, a species that includes mule deer and Sitka black-tailed deer. Its geographic range spans the coast from southern British Columbia to Santa Barbara County in California, and as far east as the Cascade and the northern Sierra Nevada mountain ranges.

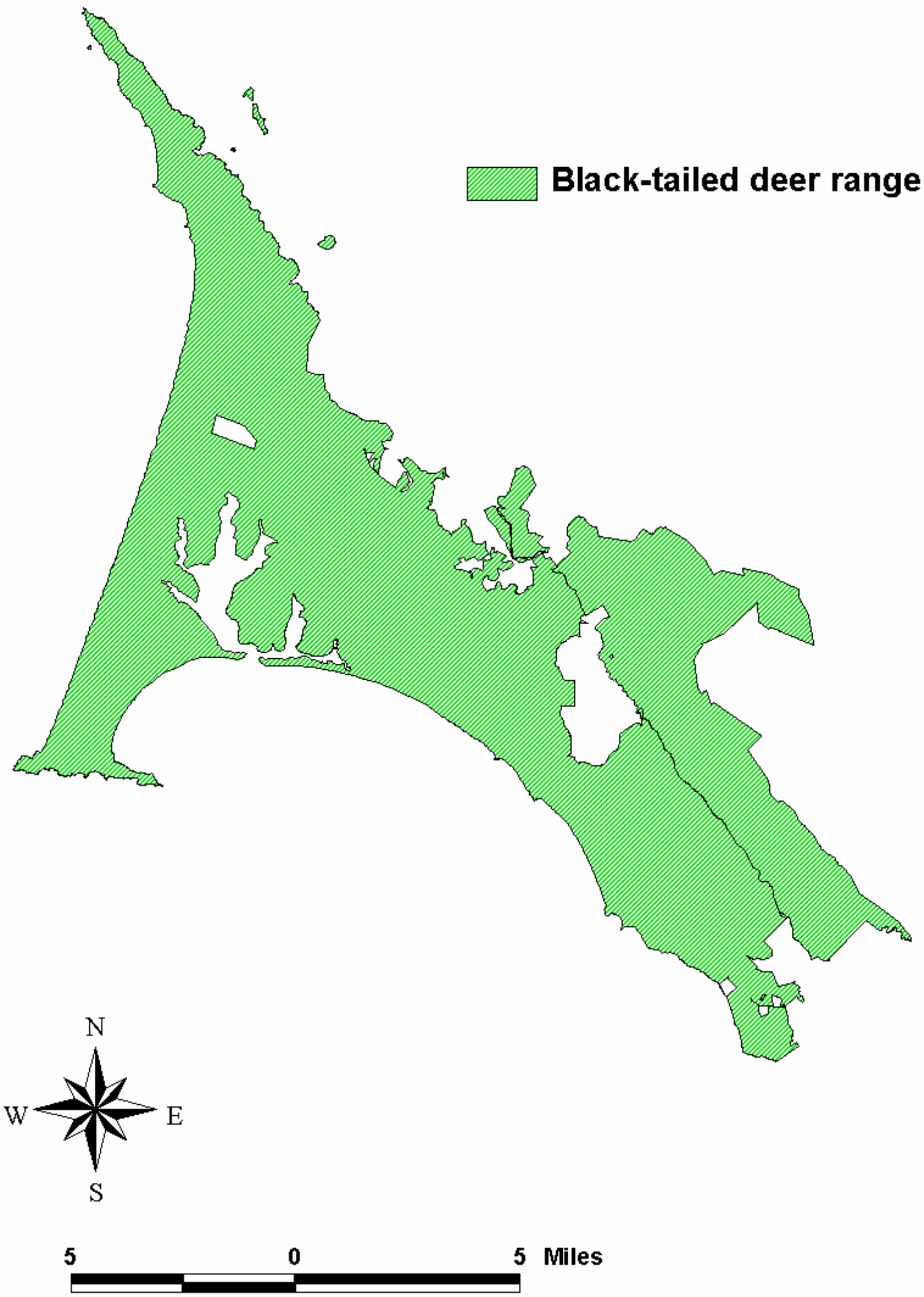
Black-tailed deer are taupe-colored, medium-sized cervids, with adults weighing up to 250 pounds (Figure 6). They are found throughout the Seashore, in coniferous forests as well as coastal scrub and agricultural fields (see map, Figure 7). They are characterized as browsers, consuming some grasses but a preponderance of forbs and shrubs year-round (Gogan and Barrett 1995). Although black-tailed deer can occasionally be found in groups of up to 20-30 animals, they tend to be more solitary than the other Seashore species and are typically found in small familial groups of 2-4 animals. Black-tailed deer mating season, or rut, is confined to the fall and does give birth to single fawns or twins.

The number and population dynamics of black-tailed deer at PRNS have not been extensively documented. In 1980, Thompson estimated a density of 33.9 black-tailed deer per square mile and a population of 1133 $\pm$ 459 animals in the pastoral zone (Thompson 1981). A minimum of 415 were counted during a 2002 park wide aerial census (NPS 2002a).

Various disease and dietary studies of PRNS black-tailed deer have been conducted. California Department of Fish and Game collected 53 black-tailed deer in 1976, along with 118 axis and 119 fallow deer. CDFG scientists concluded that black-tailed deer were in poor physical condition and showed serious effects of disease and parasitic infestation. The study concluded that all 3 deer species competed for similar food items (Brunetti 1976). Elliott also found evidence of dietary overlap between black-tailed deer and non-native deer, especially in times of low forage availability (Elliott 1982). A University of California, Davis researcher tested 134 black-tailed deer fecal samples for the organism that causes Johne's disease. No positive results were obtained and the researcher concluded that the upper limit for Johne's disease incidence in black-tailed deer in the Seashore was 6.2%. Black-tailed deer were judged to pose minimal risk to future Johne's-free elk herds (Sansome 1999). In a review of Elliott's dietary study, Fellers, a USGS researcher, concluded that non-native deer had major adverse impacts on black-tailed deer productivity and survival (Fellers 1983 and 2006). During times of low forage availability, for every 1.2 non-native deer present in the Seashore, the review concluded, one black-tailed deer was lost and at a minimum, the PRNS black-tailed deer population was likely suppressed by at least 40%.

FIGURE 6: COLUMBIAN BLACK-TAILED DEER (*ODOCOILEUS HEMIONUS COLUMBIANUS*)

FIGURE 7: COLUMBIAN BLACK-TAILED DEER RANGE (WITHIN NPS BOUNDARIES)



Axis Deer (Introduced)

Axis deer (*Axis axis*), also called chital, are native to India and Sri Lanka. They are medium-sized deer, weighing up to 200 pounds as adults. They can be distinguished from other deer in PRNS by their coats, fawn or chestnut in color with white spots, and simple, non-palmate antlers (Figure 8). Axis deer are considered grazers, with grasses making up the bulk of their diet, but they eat increased amounts of forbs during the dry season. They are typically found in large herds of up to 150 animals, in open grasslands and agricultural pastures, intermixed with low, open scrub. Because axis deer rut is not confined to a particular season, herds year-round typically contain animals both in velvet and hard antler, pregnant and non-pregnant does, as well as fawns of different sizes. Axis does have been observed breeding as young as 4 months of age and typically give birth to single fawns (Graf and Nichols 1966; Gogan et al. 2001).

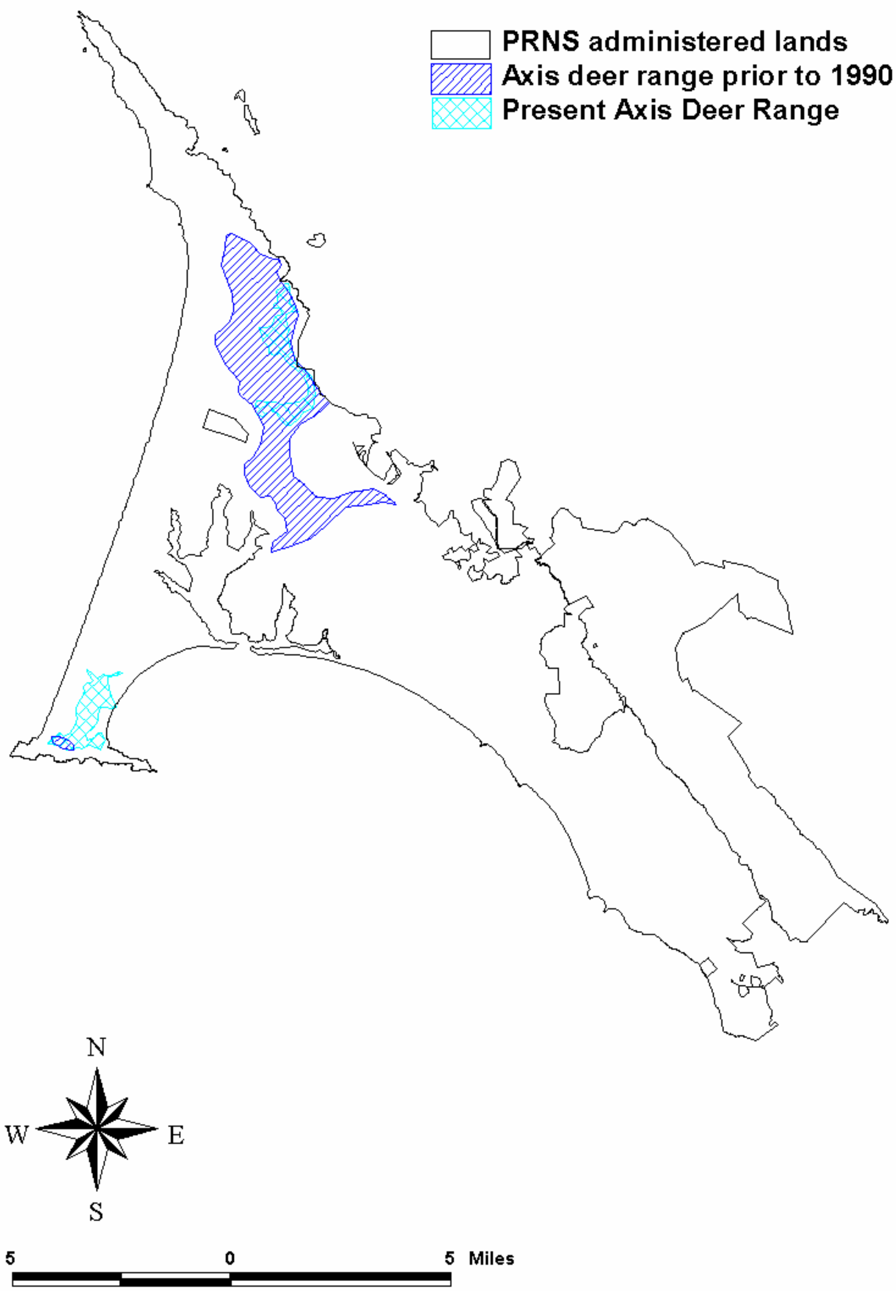
Axis deer have been introduced to many continents, including North and South America, Australia, and Europe. In the United States, large numbers of axis deer exist in a free-ranging state in Hawaii and Texas. Axis deer are frequently found in game ranches throughout the U.S. In their native range, axis deer are considered sufficiently abundant to warrant no special conservation status.

Eight axis deer were purchased from the San Francisco Zoo by a local landowner and released on the western slope of Inverness Ridge in 1947 and 1948 for hunting purposes. When NPS assumed management authority of the parklands in 1962, the axis deer population was well established, with an estimated 400 animals counted in 1973 (Elliott 1973). Currently, their numbers are estimated to approach 250 (NPS 2003). See below for a summary of research on axis deer population, ecology and disease at PRNS.

Axis deer are currently found in largest numbers in the Lighthouse, Chimney Rock, and L Ranch areas of the Seashore (see map, Figure 9). Axis deer are not currently found in designated wilderness. They have been sighted outside of NPS borders, in Tomales Bay State Park and as far east as the Nicasio Reservoir area (PRNS unpublished data (a)).

FIGURE 8: AXIS DEER (*AXIS AXIS*)

FIGURE 9: AXIS DEER RANGE (2003), (BASED ON PRNS NON-NATIVE DEER LOCATION OBSERVATION DATA)



Fallow Deer (Introduced)

Two species of fallow deer are thought to exist: the Persian fallow deer (*Dama mesopotamica*) and the European fallow deer (*Dama dama*). The species found in PRNS, European fallow deer, is thought to be native to Asia Minor, the southern Mediterranean region, and possibly northern Africa. Since Phoenician times, they have been widely introduced throughout Europe, South Africa, Australia, North and South America, and elsewhere. Approximately 28 fallow deer were released from 1942 to 1954 into the Point Reyes area by a local landowner, who purchased them from the San Francisco Zoo for hunting purposes (San Francisco Zoo unpublished records; Wehausen 1973). In 1973, they were estimated to number 500 animals (Wehausen 1973). Currently, fallow deer in the Seashore are thought to number approximately 860 animals (PRNS unpublished data (f)). See below for a summary of research on fallow deer population, ecology, and disease at PRNS.

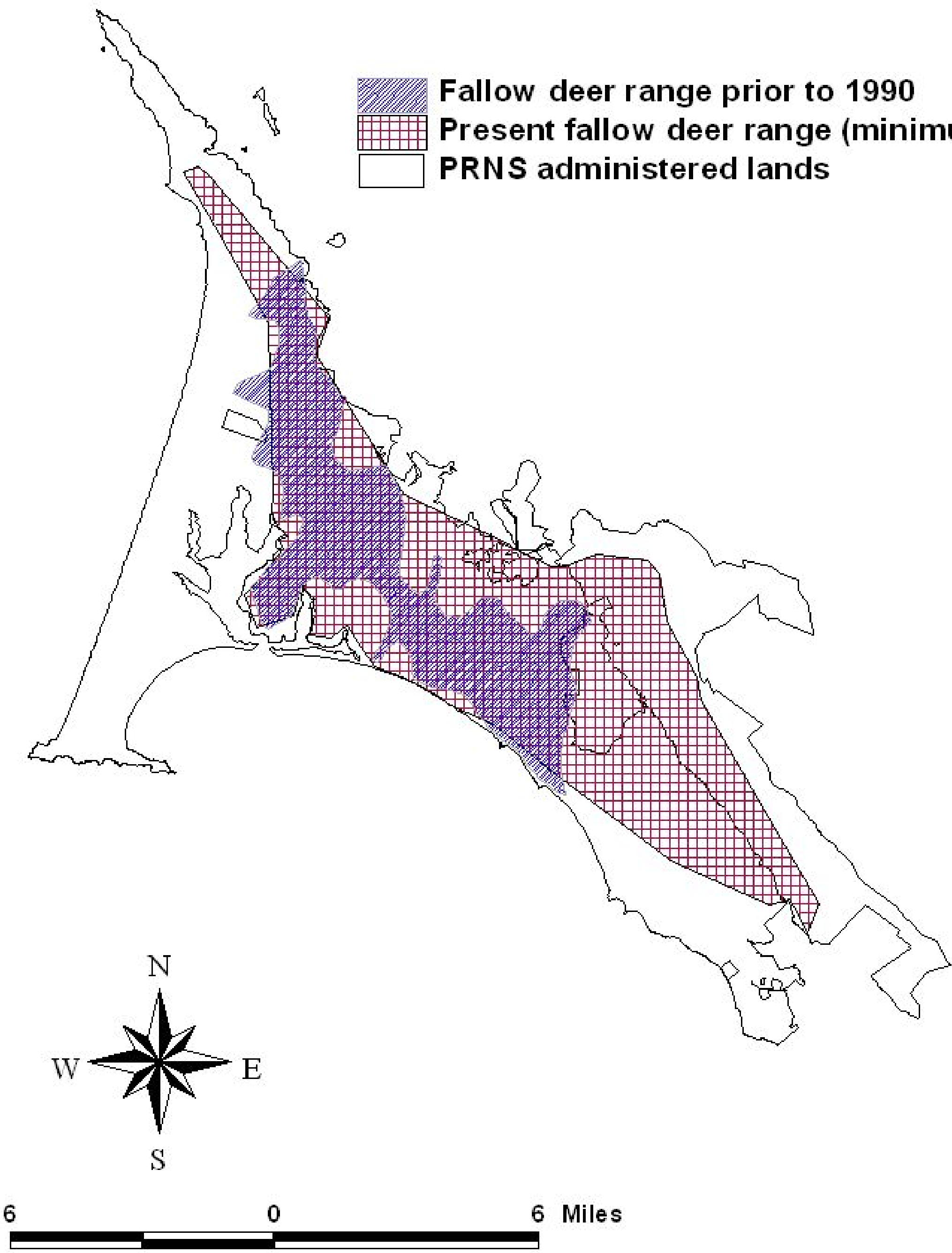
Fallow deer are medium-sized deer, weighing up to 230 pounds. They are found in 4 color variants at PRNS: white, common (taupe colored), black, and menil (brown with white spots) (Figure 10). European fallow deer are distinguished from Persian fallow deer and other deer in the Seashore by their various colors and palmate antlers (D. Saltz, Ben Gurion University, personal communication; C. Penny, San Diego Zoo, personal communication). Fallow deer congregate in mixed or same sex groups of up to 140 animals, depending on the season. Like axis deer, fallow deer are considered grazers, eating predominantly grasses during most of the year and increasing their intake of forbs during times of low forage availability.

Fallow deer at PRNS mate during a well-defined rut season in the fall. They are thought to use a "lekking" breeding system in which bucks remain on small, defended territories (leks). Receptive does are attracted to these leks. At PRNS, lekking behavior has been observed, particularly in Olema Valley where groups in excess of 50 animals return to the same areas each year to mate. Mature bucks mark leks by thrashing vegetation, scraping the ground and urinating, while smaller, younger males wait outside lek boundaries and attempt to mate with stray does. A small minority of males in a population are responsible for the majority of the breeding (Connolly 1981). Fallow does give birth to single fawns in the spring (Wehausen 1973).

Fallow deer are found throughout the Seashore, except in the pastoral areas near Chimney Rock and the coastal scrub near Palomarin (see map, Figure 11). Thirty-five percent of their current range in the Seashore consists of designated wilderness. They are routinely observed outside NPS boundaries in the Vedanta Property, where fallow deer densities can exceed 80 deer / sq. km. (NPS 2002a). They have also been observed in small numbers in Samuel P. Taylor State Park, Paradise Valley near Bolinas, and as far east as the Nicasio reservoir area and Woodacre (PRNS unpublished data (a)).

FIGURE 10: FALLOW DEER (*DAMA DAMA*)

FIGURE 11: FALLOW DEER RANGE (2005), (BASED ON PRNS NON-NATIVE DEER LOCATION OBSERVATION DATA)



History of Research on Non-Native Fallow and Axis Deer at Point Reyes National Seashore and Golden Gate National Recreation Area

Monitoring of non-native deer in the Seashore began after all rancher hunting was discontinued in 1971. The research that followed can be divided into three categories: population, disease, and ecological studies. All publications and unpublished reports are described in the References section.

Population Studies

1972–1973: Wehausen (1973) studied fallow deer demographics and natural history. Through field observations he concluded the 1973 population was 479 and was below carrying capacity levels. He also concluded that the population was increasing at 11% per year (NPS 1984). Elliott (1973) used field observations of axis deer during the same year to conclude that the axis deer population of 401 was also below carrying capacity. He concluded the population was increasing at 22% per year. The main reason for the difference in herd growth rates for the two species was thought to be the age of first breeding, approximately 6 months earlier in axis than in fallow females (Elliott 1973).

1974: California Department of Fish and Game deer collections yielded estimates of population growth rates of 18% and 14.5% per year for fallow and axis deer, respectively. Such high growth rates were thought to be irruptive in nature and the result of a cessation of all hunting in 1972 (Brunetti 1974). Minimum population estimates, based on area ground counts in 1973–1974, were 600 fallow deer and 620 axis deer. Stabilization of both populations at these levels would require yearly removal of 360–420 animals (Brunetti 1975).

1975–1976: Elliott (1976a, 1976b) surveyed axis and fallow deer from the ground and by helicopter during the fall and winter of 1975–1976. He found a minimum of 492 fallow deer and 461 axis deer.

1977: Elliott (1977b) conducted a census of the entire Seashore by helicopter and with area counts and found a minimum of 523 fallow deer and 364 axis deer. He concluded that the deer control program at the time was effective in limiting only the axis deer to the target of 350 per species.

1979: Nystrom and Stone (1979) counted axis deer from the ground and estimated a total Seashore population of approximately 253 with an estimated 25% annual rate of increase.

1980–1982: A line transect census method was attempted but failed to adequately count exotic deer in the pastoral zone (Thompson 1981). Line transect censusing of fallow deer in the southern wilderness zone suggested higher densities of fallow deer (52.6 per square mile or 20 per square kilometer) than previously recorded there (Gogan et al. 1986).

1985: Ground censuses in the pastoral zone were conducted and total numbers of axis deer in the park were estimated to be 328. Fallow deer numbers, in the pastoral zone only, were estimated to be 114 (Ranlett 1985).

2001: Gogan et al. (2001) reviewed PRNS and CDFG data from 1976 through 1980 on non-native deer collections. Based on this data and on the published literature, a population model was developed to predict deer numbers with and without lethal removals. A carrying capacity of 455 for axis deer and 775 for fallow deer was postulated. Researchers concluded that axis deer are relatively vulnerable to eradication by ground shooting. Other conclusions were that NPS control of 1,873 fallow deer from 1968 to 1996 was unsuccessful in reducing numbers to less than 350 and that cessation of control would result in return of both populations to carrying capacity within 13 years (Gogan et al. 2001).

2000–2002: Concurrent helicopter and ground censuses were conducted throughout the Seashore (NPS 2001, 2002a). Minimum estimates of total populations were 475 and 623 for fallow deer in 2001 and 2002 respectively. Using a double survey method in 2002, in which ground and aerial censuses were conducted concurrently, the total fallow population size was estimated to be 771 with a 95% Confidence Interval of 636 to 2,272 animals. Fawn/doe ratios, similar to those of the 1970s, indicated that the fallow population might be below carrying capacity and might continue to increase. Fallow deer densities ranged from 0 to 210 deer per square mile (up to 81 deer per square kilometer) in different parts of the Seashore. Minimum estimates for axis deer were 211 and 229 in 2001 and 2002 respectively and were considered to approximate real population numbers.

Also in 2001, Barrett created a population model based on his previous modeling work in Gogan et al. (2001). In the new model, the effects of yearly contraception in fallow deer could be predicted (Barrett unpublished report 2001). Using the same assumptions of age and sex dependent mortality rates and the same carrying capacity as in Gogan et al. (2001), it was estimated that stabilization of fallow deer populations at 350 could only occur with contraception of approximately 80% of all does of reproductive age with a contraceptive that was 100% effective. Eradication of fallow deer from the Seashore and GGNRA lands by 2050 would require yearly contraception of 99% of all fallow does of reproductive age with a contraceptive that was 100% effective (Barrett unpublished report 2001).

2002–2003: During the winter of 2002–2003, NPS and USGS researchers conducted a mark-resight study of fallow deer at PRNS, using 29 radio-collared deer to evaluate the proportion of animals missed on aerial censuses. The study resulted in an estimate of 859 fallow deer (90% Confidence Interval = 547 - 1170) (PRNS unpublished data (f)). A ground count of axis deer by NPS staff in May 2003, resulted in an estimated population size of 230–250 animals and an observed fawn/doe ratio of 1 fawn for every 3 adult does (NPS 2003).

Also in 2003, Hobbs created a stage-based simulation model to examine the effects of culling and fertility control on fallow deer numbers in PRNS (Hobbs 2003). Using similar assumptions as Gogan et al. (2001), and assuming that density dependence in the population causes a linear decrease in herd growth as it approached a carrying capacity of 1000 animals, Hobbs found that:

- Attempting to eradicate the population in 15 years, using only fertility control (either yearly contraception or longer duration agents), would be futile.

- Approximately 620 fallow does would need to be culled to eradicate the population in 15 years, in the absence of any fertility control.

- Treating animals with contraceptives that are effective for at least 4 years with one dose could reduce the number of animals that would need to be culled in order to eradicate the population.

- Fertility control would not reduce the total number of animals that would need to be handled (either treated or culled).

For a detailed explanation of the assumptions and conclusions of the Barrett and Hobbs population models, see Appendixes B and D.

TABLE 4: SUMMARY OF EXOTIC DEER POPULATION ESTIMATES FROM INTRODUCTION TO 2003

Year	Fallow Deer Numbers	Axis Deer Numbers	Reference
1942 (first introduction of fallow deer)	15		Wehausen 1973
1947 (first introduction of axis deer)	11	4	Elliott 1973, San Francisco Zoo unpublished records
1948		4	San Francisco Zoo unpublished records
1954	2		San Francisco Zoo unpublished records
1973	479		Wehausen 1973
1973		401	Elliott 1973
1974	600*	620*	Brunetti 1975
1976	492*	461*	Elliott 1976a, 1976b
1977	523*	364*	Elliott 1977b
1979		253	Nystrom and Stone 1979
1985		328	Ranlett 1985
2001	475*	211	NPS 2001
2002	623*	229	NPS 2002a
2003	859	230–250	Unpublished PRNS data (f); NPS 2003

* These are minimum counts. True numbers are likely higher.

Disease Studies

1974–1975: During this time, California Department of Fish and Game (CDFG), with assistance from NPS, collected a total of 290 native and non-native deer and performed complete necropsies (Brunetti 1976). The primary purpose of the study was to determine population dynamics, forage habits, and disease prevalence. A secondary purpose of the study was to directly reduce non-native deer numbers. Serological testing in fallow deer showed high exposure to livestock diseases such as bovine viral diarrhea and infectious bovine rhinotracheitis. On necropsy, 54.2% of fallow deer carried liver flukes. A low incidence of lungworm and intestinal parasites were found in both species. CDFG researchers concluded that both populations were relatively healthy and in good condition (Brunetti 1976).

1976–1977: Researchers analyzed serological titers and kidney fat indices (an indication of body condition) on 150 native and exotic deer collected by NPS and CDFG (Elliott 1977a; Riemann et al. 1979a). As in previous studies, they found that the non-native deer were in good physical condition but found evidence of exposure to: bluetongue, Q fever, infectious bovine rhinotracheitis, bovine viral diarrhea, anaplasmosis, toxoplasmosis, leptospirosis, and parainfluenza 3 (Elliott 1977a; Riemann et al. 1979a). Another study on paratuberculosis, or Johne's disease, was conducted with the same collected deer and on cows from 10 dairy herds in and around the Seashore. The causative organism for Johne's disease was found in 8.1% of fallow deer, 9.6% of axis deer, and 8.7% of cows tested (Riemann et al. 1979b).

2000: NPS biologists culled 7 axis deer and 9 fallow deer for disease testing (NPS unpublished data (g)). Lung and intestinal parasites were found and serology showed exposure to anaplasmosis and leptospirosis in one axis and one fallow deer, respectively. One axis deer tested positive for Johne's disease.

2005**:** USDA researchers culled 7 fallow deer and 5 axis deer for a comprehensive survey of ectoparasites occurring on non-native deer ectoparasites. *Bovicola tibialis*, an exotic chewing louse typical of fallow deer, was found on PRNS fallow deer. USDA researchers believe this parasite could transfer from PRNS fallow deer to native elk and black-tailed deer and potentially cause disease in the native cervids (J. Mortensen, USDA, personal communication). *B. tibialis* has been found in a population of symptomatic black-tailed deer in British Columbia during the 1940s (Bildfell et al. 2004) and in large numbers on captive black-tailed deer in Mendocino County, CA, in the 1970s (Westrom et al. 1976). Introduced fallow deer were associated with both of these incidences on black-tailed deer. More recently, *B. tibialis*, evidently originating from local fallow deer, has been found on wild mule deer in poor condition in Washington State (Bildfell et al. 2004; J. Mertins, USDA, personal communication). There is a considerable likelihood of this parasite being responsible for the documented pathology in Canadian and US black-tailed deer (J. Mertins, USDA, personal communication).

Another chewing louse, *Damalinia (Cervicola) forficula*, was found on PRNS axis deer. *D.c. forficula*'s native typical hosts are axis and hog deer and they have been documented in the deer's native range (India, Indochina, Nepal, Pakistan, and Sri Lanka). These lice have never before been identified in North America, and the risks they pose to native deer are unknown.

Finally, *Damalinia (Tricholipeurus) odocoilei*, a chewing louse native typically found on native black-tailed deer, was found on a PRNS fallow deer. Again, the likelihood of this parasite causing disease in either black-tailed, fallow or axis deer is unknown, but it is not usually pathogenic to black-tailed deer.

Ecological Studies

1973–1974: Collection and necropsy of 290 native and non-native deer by California Department of Fish and Game yielded information on food habits. The primary food item for both axis and fallow deer was found to be similar to that of elk and consisted of grass with some use of forbs (Brunetti 1974 and 1975).

1976–1979: Growing concern from ranchers within the park's pastoral zone regarding forage competition between exotic deer and livestock prompted studies on dietary overlap (Elliott 1982; Elliott and Barrett 1985; Wehausen and Elliott 1982). Data were collected in the western and southern portions of the deer ranges but not in the Olema Valley or PRNS-administered GGNRA lands. These studies revealed some dietary overlap between non-native deer and both cows and native black-tailed deer, especially during times of low forage availability. Diets of exotic deer consisted mainly of grasses and forbs and overlapped more with each other than with black-tailed deer except in summer when forbs were an important part of all deer diets. Both exotic and native deer had diets deficient in energy from May through October (Elliott 1982). Elliott and Wehausen found that both axis and fallow deer preferred areas used by livestock (Wehausen and Elliott 1982). Habitat preferences of all three deer species in the pastoral zone were similar, namely, open grassland. Because of insufficient sample size, Elliott could not detect statistically significant effects of non-native deer on black-tailed deer fawn production or survival. He suggested that densities of exotic deer present in 1973 ($\leq$17 deer / sq. km. or 350 of each species) would not negatively affect the density of black-tailed deer (Elliott 1982).

1983: A review of Elliott's 1982 dietary overlap study by Gary Fellers, a U.S. Geological Survey scientist, suggested that exotic deer at levels of 350 for each species could reduce the native black-tailed deer population size by up to 30%. If native deer numbers are strongly influenced by the energy content of their diet, the reduction in their population could be as much as 40% below carrying capacity (Fellers 1983). Recently, further analysis of Elliott's data by Fellers (Fellers 2006) has indicated that the impacts of non-native deer on native black-tailed deer may be more significant than previously thought. At currently estimated population levels for all three species, and during seasons of low forage availability, such as summer, for every 1-2 axis or fallow deer present in the Seashore, one black-tailed deer is lost.

2000: Diets of fallow deer and tule elk were compared in 2000-2001 (Fallon-McKnight 2006). The researchers found that elk and fallow deer in the Limantour area used similar forage species throughout the year. The study concluded (p. 5) that: “Fallow deer, present at Limantour but not at Tomales Point, may impact sympatric elk at the Limantour site in their foraging for *Plantago* spp. (a high energy and high protein forage). Competition for forbs likely remains throughout spring and summer, which is a time that both species are nursing young. This hypothesis requires further testing. Increased grazing pressure on this and other important forage items by fallow deer could potentially deprive Limantour elk of the nutritional benefits of these food resources at a critical time.”

2006: USGS researchers studied the impacts of fallow bucks on riparian and woodland soils and vegetation during the breeding season or rut (Fellers and Osbourn 2006). Unlike other cervids, fallow deer form “leks”, traditional mating territories revisited yearly and defended by bucks. Researchers sampled two areas within the fallow deer range, the Bear Valley area of Olema Valley, and the Estero trail, and documented a total of 159 leks (see map, Figure 12). The leks were recognizable as areas of bare ground with excavated pits and consisting of compacted, disturbed soils. Leks were up to 32 meters across and included as many as 30 individual pits. The disturbance resembled that of feral pigs, however the soils appeared more compacted than tilled. Over 700 scraped out pits, averaging 2.5 square meters across and up to 0.6 meters deep, were documented in the two areas studied. Vegetation damage included complete removal of understory plants, shredded foliage, damaged tree bark, broken tree branches, exposed roots, and girdling of young trees and saplings. The density of leks in the Estero Trail and Bear Valley area was 28.4 and 78.8 per square kilometer respectively. In Bear Valley, over 1% of the total land area surveyed was impacted with lek damage and riparian areas were disproportionately affected. USGS researchers concluded that fallow deer are having a significant impact on the soils and vegetation in the Seashore. Lekking impacts are shown in Figures 13-16 (note: Figures 13-16 are photographs of fallow deer leks in Olema Valley, taken during the fall and winter of 2005 (Fellers and Osbourn 2006)).

FIGURE 12: MAP OF FALLOW DEER LEK SITES, BEAR VALLEY AREA, POINT REYES NATIONAL SEASHORE (EACH POINT REPRESENTS ONE LEK, COMPRISED OF UP TO 30 EXCAVATED PITS AND AVERAGING 115 SQUARE METERS.) (FELLERS AND OSBOURN, 2006)

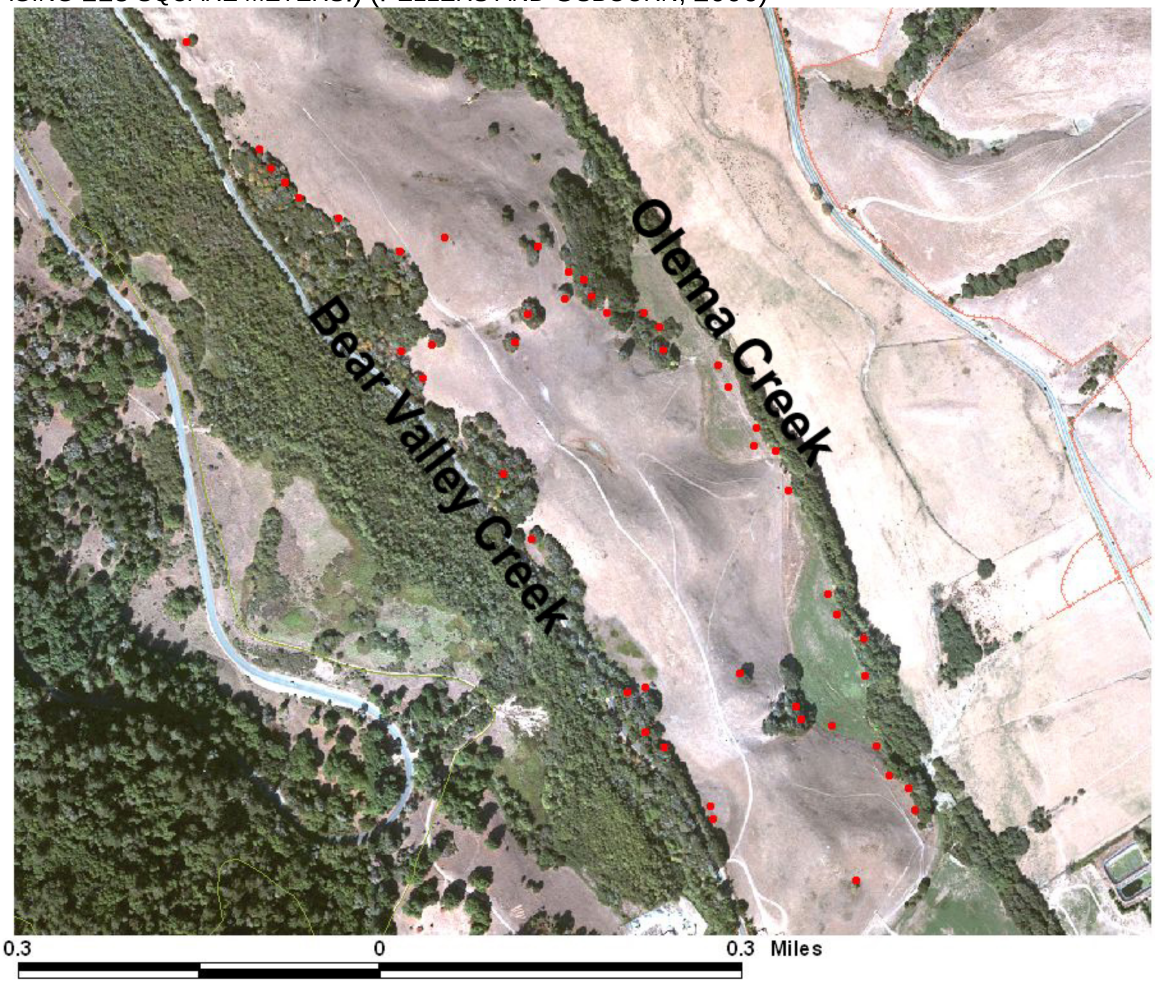


FIGURE 13: BARK DAMAGE (GIRDLING) OF SAPLING DOUGLAS FIR IN A LEK

FIGURE 14: EXCAVATED PIT WITHIN A LEK

FIGURE 15: FALLOW BUCK ON SMALL LEK

FIGURE 16: DISTURBED SOIL AND DENUDED VEGETATION AT LEK SITE, OAK WOODLAND-PASTURE INTERFACE

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Species and Habitats of Management Concern

The U.S. Fish and Wildlife Service (USFWS) and/or the State of California list many of the plant and wildlife species, and habitats present in the project area. The Marine Mammal Protection Act and the Migratory Bird Treaty Act afford additional protection.

Species of Management Concern

The study area supports 47 listed animal species – 14 are federally listed as endangered, 8 as threatened, and 24 as Species of Concern. Among these listed species are the endangered brown pelican (*Pelecanus occidentalis*) and Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*). Federally threatened species include Northern spotted owl (*Strix occidentalis caurina*), Western snowy plover (*Charadrius alexandrinus nivosus*), and red-legged frog (*Rana aurora draytoni*). Nineteen federally listed plant species (seven of which also are state listed) and an additional 25 species are listed or proposed for listing by the California Native Plant Society and have been documented in the study area**.** For purposes of this document, all of these species are considered as "Species of Management Concern." The Species of Management Concern that may be affected by implementation of the Non-Native Deer Management Plan are discussed below.

Northern Spotted Owl (*Strix occidentalis caurina*) – Federal Threatened Species

Habitat within the project area supports one of the densest populations of Northern spotted owl in the world. In Marin County, the owls live in second growth Douglas fir (*Pseudotsuga menziesii*), bishop pine (*Pinus muricata*), coast redwood (*Sequoia sempervirens*), mixed conifer-hardwood, and evergreen hardwood forests as well as remnant old-growth stands of coast redwood and Douglas fir. The habitat types for the northern spotted owl are defined as multi-layered, multi-species with >60% total canopy cover for nesting/roosting with large overstory trees, large amounts of down woody debris, presence of trees with defects or signs of decadence in the stand.

Preliminary pellet analyses indicate that spotted owls in Marin forage primarily on dusky-footed woodrats (*Neotoma fuscipes*) as well as other small mammals and forest-dwelling birds (Chow 1998). The Northern Spotted Owl is found throughout Olema Valley and the western and southern wilderness areas of the Seashore.

The Northern spotted owl was federally listed as threatened in 1992 (USFWS 1993). A ¼-mile radius buffer zone must be protected around active nest sites to protect the birds from the impacts of noise. The parks contains approximately 35,000 acres of potential northern spotted owl habitat. Extensive surveys of habitat use, distribution, and abundance have been conducted since 1993 by the NPS and these surveys will continue. A recent census estimated a population of approximately 49 owl activity centers (Chow 1998; Fehring and Adams 2001; NPS 2002b). The park initiated a demographic study of owls in 1998 and has been banding owls annually under permit from the USFWS (Permit # 842449). The overall population trend is unknown, but is believed to be stable because the number of activity centers has been similar among years since 1998 when an inventory of the park was completed.

Western Snowy Plover (*Charadrius alexandrinus nivosus*) – Threatened

Western snowy plovers use the Point Reyes peninsula as both wintering and nesting habitat. Wintering birds occur around Drake’s Estero and Abbott’s Lagoon, and along Limantour Spit and the Great Beach. During the 1980s nesting took place along the entire Great Beach, Drake’s Beach, and at Limantour Spit. In recent years, erosion along the southern portion of the Great Beach has diminished the upper beach area such that the entire beach can be washed by waves. Nesting is occurring on the northern portion of this beach, between the North Beach parking area and Kehoe Beach, which is backed by extensive dunes. Snowy plovers also nest along the western edge of Abbott’s Lagoon. Although it had historically been used as nesting habitat by plovers, erosion has affected Limantour Spit and it no nests have been seen since 2000. In 2001 and 2002, all snowy plover nests observed were located on the northern portion of the Great Beach.

Monitoring of nesting snowy plovers in 1986-1989 and 1995-2002 indicates a decline in the number of nesting birds through 1996, followed by a gradual rebound. The Point Reyes Bird Observatory monitored individual nests at all nesting areas during this period. On the Great Beach, where most nesting took place, the number of chicks fledged per egg laid during 1986-89 and 1995 ranged from 1%-7%.

California Red-legged Frog (*Rana aurora draytonii*) – Threatened

The California red-legged frog (*Rana aurora draytonii*) is federally listed as threatened. This subspecies of red-legged frog occurs from sea level to elevations of about 1,500 meters (5,200 feet). It has been extirpated from 70 percent of its former range and now is found primarily in coastal drainages of central California, from Marin County, California, south to northern Baja California, Mexico. Potential threats to the species include elimination or degradation of habitat from land development and land use activities and habitat invasion by non-native aquatic species.

The California red-legged frog is threatened by human activities, many of which operate synergistically and cumulatively with each other and with natural disturbances (i.e., droughts or floods). Factors associated with declining populations of the frog include degradation and loss of its
habitat through agriculture, urbanization, mining, overgrazing, recreation, timber harvesting, non-native plants, impoundments, water diversions, degraded water quality, use of pesticides, and introduced predators. The reason for decline and degree of threats vary by geographic location.
California red-legged frog populations are threatened by more than one factor in most streams.

PRNS and GGNRA support one of the largest known populations of California red-legged frogs. This frog frequents marshes, slow parts of streams, lakes, stock ponds, and other usually permanent waters. The frog is generally found near water but disperses during rain events and after breeding season to non-breeding habitat adjacent to water bodies. The non-breeding habitat is usually a moist area with some cover such as a willow or blackberry thicket.

The U.S. Geological Survey Biological Resources Division has conducted surveys of aquatic habitats in PRNS and GGNRA since 1993 under the direction of Dr. Gary Fellers. Surveys have been conducted on virtually all sites containing aquatic habitat that could support amphibians. Field data includes information on habitat type (permanent or seasonal, natural or created), water characteristics, (depth, flow, turbidity, etc.), vegetation (emergent, floating, and surrounding the site), disturbance, including current grazing, and the age classes and physical condition of amphibians found.

Field surveys have led to documentation of numerous sites used by the California red-legged frog; sites have been mapped in a geographically related database. Approximately 76 sites are located on ranch lands, with a large proportion located at stock ponds. Several new breeding sites have recently been found along tributaries of Olema Creek. Several large bodies of water, are expected to yield new sites during a planned boat survey, which would allow more thorough coverage than has been attained by foot surveys.

Creation of stock ponds and other small impoundments on ranches over the past 100 years has likely resulted in increased numbers and an expansion in range for red-legged frogs in the PRNS area. Frogs appear to move readily between these ponds during periods when the ground is moist, which is prolonged on the foggy PRNS peninsula. Numerous wet swales, seasonal springs, and ephemeral pools provide dispersed travel and feeding habitats. In GGNRA, riparian habitat along creeks provides corridors for travel along the Olema Valley and its tributaries.

Coho Salmon (*Oncorhynchus kisutch*) – Endangered [state endangered]; Steelhead Trout (*Oncorhynchus mykiss*) – Threatened; and Chinook Salmon (*Oncorhynchus tshawytscha*) – Threatened

Central California coast coho salmon, Central California coast Chinook salmon and Central California steelhead (hereafter referred to as coho, Chinook and steelhead) occur in several creeks on the Point Reyes peninsula and in the Lagunitas Creek watershed that drains portions of PRNS and GGNRA. Coho salmon and steelhead trout occur in the Olema, Lagunitas, and Pine Gulch Creek watersheds. Steelhead trout also occur in the Tomales Bay, Drakes Bay, and Bolinas watersheds. Chinook salmon occur in the Lagunitas Creek watershed.

Designated critical habitat for coho in PRNS includes all accessible estuarine and stream areas in the coastal watersheds of Marin County except areas above longstanding, naturally impassable barriers or above Peter's Dam on the mainstem of Lagunitas Creek and Seeger Dam on Nicasio Creek (NOAA Fisheries 1996). Although critical habitat has not been established for central California steelhead or Chinook salmon, it is likely to be the same as that for coho in Marin County.

Most historic information on salmonid numbers is anecdotal, while quantified data are lacking. Accounts by local residents of "excellent trout fishing" along Lagunitas and Olema creeks may refer to young steelhead, which are indistinguishable from rainbow trout during the three-year period they typically spend in fresh water. Similarly, early accounts of "salmon runs" may refer to both coho and steelhead, which may not have been distinguished by fishermen. Such anecdotal information suggests that salmonids were abundant in the Lagunitas/Olema Creek drainage before extensive alteration by dam-construction, logging, and channelization. On its 1996 federal listing, the Lagunitas watershed, including Olema Creek, was documented to support 10% of the Central California Coast coho population (Brown et al. 1994; NOAA Fisheries 1996). In their 2001 Status Review, NOAA-Fisheries acknowledged that within the Central California Coast Evolutionarily Significant Unit, the decision to list coho salmon as threatened may have been overly optimistic, concluding that the evolutionary significant unit population was presently endanger of extinction (NMFS 2001). As a result of these and further findings, NOAA-Fisheries completed a rulemaking process in June 28, 2005, which downgraded the coho status (upgraded listing protection) in the evolutionary significant unit to Endangered (Federal Register 2005a).

Adult Chinook salmon have been observed within Lagunitas Creek in increasing numbers since 2000 (MMWD 2003). The increasing frequency of Chinook salmon within Lagunitas Creek may indicate the development of a self-sustaining population, but whether this would persist is unclear (NOAA Fisheries 2004). Because of the proximity of these fish to the southern boundary of the evolutionary significant unit, NOAA Fisheries has treated this watershed population as part of the California Coastal listed population for the purposes of other consultations on the lands of Point Reyes National Seashore and Golden Gate National Recreation Area (NMFS 2004).

Historic and current data on coho and steelhead populations for Lagunitas, Olema, and Pine Gulch Creek watersheds have been gathered as part of the PRNS coho salmon and steelhead trout restoration program and the Marin Municipal Water District monitoring programs. Through the program, the NPS has established a detailed fisheries monitoring program that is carried out through support from the Natural Resource Challenge Inventory and Monitoring Program, as well as monitoring support through California Department of Fish and Game managed grant programs.

For most drainages, monitoring has focused on coho salmon, but includes equivalent information for steelhead trout. Differences between steelhead trout and coho salmon life cycles are pertinent to conservation efforts. While virtually all coho in project area watersheds have an 18-month freshwater life cycle, steelhead juveniles may migrate to the ocean after 18 months or extend freshwater residence for up to three years. Most coho return to spawn after 18 months, but steelhead may spend several years in the ocean before returning to spawn. Additionally, steelhead may make several spawning migrations while all coho spawn once and die. The variable life cycle of steelhead makes population analysis more difficult, but also makes them more resilient to adverse environmental conditions. In general, if the habitat requirements for coho are met, steelhead habitat requirements would also be met.

Chinook salmon typically enter watersheds from October through December. Chinook are typically big river fish, with adults spawning in the mainstem, and are more likely than coho to stray from their natal watershed. Chinook fry emerge from the gravels in early spring and begin growing. They smolt the same year as they emerge and head to estuarine and marine waters in May and June. Their presence in Lagunitas Creek is indicative of offshore productivity and is likely opportunistic.

Salmonid species on the west coast, including coho salmon, steelhead trout, and Chinook salmon have experienced dramatic declines in abundance during the past several decades as a result of human-induced and natural factors. There is no single factor solely responsible for this decline. Factors that threaten these species include water storage, withdrawal, conveyance, and diversions for various purposes. Modification of natural flow regimes have resulted in increased water temperatures, changes in fish community structures, depleted flows necessary for migration, spawning, rearing, flushing of sediments from spawning gravels, gravel recruitment and transport of large woody debris. Natural resource use and extraction leading to habitat modification can have major direct and indirect impacts to salmon populations. Direct and indirect effects of land use activities associated with logging, road construction, urban development, mining, agriculture, and recreation have substantially altered fish habitat quantity and quality. Other factors contributing to the decline of salmonids in the Pacific include commercial fishing, introduction of non-native species and modification of habitat, and long-term operation of production hatcheries.

California Freshwater Shrimp (*Syncaris pacifica*) – Federal Endangered Species

The California freshwater shrimp was listed by the USFWS as endangered (55 FR 43884) in 1988. The shrimp is endemic to 17 coastal streams in Marin, Sonoma, and Napa counties north of San Francisco Bay, California (Fong 1999). This species is the only extant member of the genus (Fong 1999). The shrimp is found in low elevation (less than 116 m), low-gradient (generally less than 1% slope) perennial freshwater streams where banks are structurally diverse with undercut banks, exposed roots, overhanging woody debris, or overhanging vegetation (Fong 1999). As its name would suggest, California freshwater shrimp is believed to occur only in freshwater conditions (less than 0.5 ppt) within streams in the watershed, although it may be able to temporarily tolerate increases in salinity of up 16 to 17 ppt (USFWS 1998).
Threats to existing populations of freshwater shrimp include "introduced fish, deterioration and loss of habitat resulting from water diversion, impoundments, livestock and dairy activities, agricultural activities and developments, flood control activities, gravel mining, timber harvesting, migration barriers, and water pollution" (USFWS 1998). All of these threats have historically occurred along Lagunitas and Olema Creeks.

A study was recently conducted in PRNS and GGNRA to determine the distribution of California freshwater shrimp within streams in the parks, to evaluate the effectiveness of three survey methods for the shrimp, and to provide recommendations for survey techniques for long-term monitoring (LoBianco and Fong 2003). These shrimp reside in the Lagunitas and Olema Watersheds and depend on overhanging vegetation along the creek's banks for habitat. The shade provided by this vegetation is also important to the protection of rare fish species.

The current range of the shrimp within Lagunitas Creek extends from Shafter Bridge in Samuel P. Taylor Park to roughly 1.6 km. below the confluence with Nicasio Creek (Serpa 1991). Shrimp habitat along the main stem of Lagunitas Creek within the Parks is generally protected from agricultural activities occurring within the watershed. Small numbers of shrimp were collected in 1996 and 1997 near the confluence of Olema and Lagunitas creeks (Fong 1999).

California Freshwater shrimp surveys detected small numbers in lower Olema Creek in 2001. The USGS–Biological Resources Division Dixon Field Station is conducting investigations of California freshwater shrimp habitat, survival, and predation within lower Olema and Lagunitas Creeks. This three-year investigation is looking at habitat and flow characteristics supporting the species and has found that native sculpin are a major predator of the shrimp. Shrimp have not been found in the lower Olema Creek sections during this USGS investigation (LoBianco and Fong 2002).

Myrtle's Silverspot Butterfly (*Speyeria zerene myrtleae*) – Endangered

Myrtle's silverspot butterflies inhabit coastal dune, coastal prairie, and coastal scrub habitats at elevations ranging from sea level to 300 meters, and as far as 5 kilometers inland (Launer et al. 1992). It was federally listed as endangered in 1992. Its historic distribution is believed to have extended from near Fort Ross south to Punta Ano Nuevo. By the 1970s populations south of the Golden Gate were believed to be extinct and populations of the butterfly were believed to exist only within PRNS. Reasons for this decline include urban and agricultural development, changes in natural fire patterns, successional changes in plant communities which have reduced availability of host plants, invasive non-native plants, livestock grazing, over collecting, and other human impacts.

Following discovery of a population near the Estero de San Antonio in the early 1990s, field surveys were conducted by the Center for Conservation Biology at Stanford University. Two additional, apparently separate, populations in PRNS were located and fieldwork was done to estimate population sizes. One population, centered on North Beach, extended from Abbotts Lagoon to South Beach and east to Drakes Estero and Drakes Beach. The highest numbers were found along the dune-scrub interface in the back dune area of the central peninsula on F and G ranches and the AT&T property, and on the bluffs on either side of the Drakes Beach visitor center. The population was estimated to number in the low thousands in 1993. Survey work in 1998 put the population estimate at 50-200 individuals, with no silverspots being found in portions of the 1993 range. The other population was found on the Tule Elk Reserve, with small numbers on the adjacent J Ranch. In 1993, the number of individuals in this population was estimated to be in the mid-hundreds. The 1997 survey of this northern Point Reyes population gave a population estimate of 250-500 (Launer et al. 1998).

Silverspot numbers in the area outside of parklands around the Estero de San Antonio were estimated at 2,000-5,000 individuals in 1991. Other nearby areas with potentially suitable habitat was not surveyed. Together with those found at PRNS, estimated numbers for the three known populations of the species total less than 10,000 individuals (USFWS 1998).

Known Myrtle's silverspot nectar plants include curly-leaved monardella (*Monardella undulata*), yellow sand verbena (*Abronia latifolia*), seaside daisy (*Erigeron glaucus*), bull thistle *(Cirsium vulgare*), gum plant (*Grindelia* spp.), and mule ears (*Wyethia* spp.).

Populations of Speyeria butterflies experience large population fluctuations, and population increases of tenfold or more in a single year has been observed. In 1994/95, California's central coast experienced a very wet winter that reduced numbers of many late-spring and summer-flying butterflies (silverspots are among the latter). Another wet winter occurred in 1997-98, which may have resulted in the low numbers for the central Point Reyes population observed in summer, 1998.

Due to the lack of historic data previous to the 1990s, it is not known if the silverspot has declined at Point Reyes.

Habitats of Management Concern

Numerous habitat types are afforded protection under various laws and regulations within the project area. Through the 1997 Magnesun-Stevens Act, the National Marine Fisheries Service (NMFS) has designated Essential Fish Habitat supporting a variety of species. Within the project area, the Essential Fish Habitat designation applies to all streams within NPS lands. The USFWS has designated critical habitat for the protection of the California red-legged frog, which includes nearly all of the land within the project area.

Human Health and Safety

In a national park, wild animals can potentially cause disease transmission, vehicular accidents, or bodily injury to visitors or staff that come in direct contact with them. These risks are present whether or not wildlife is actively managed or not. Existing deer management activities are confined to disease research and population studies, occasionally with the use of aircraft.

Deer management proposals analyzed in this document include the use of firearms, aircraft, and chemical sterilant drugs, all of which can affect health and safety of visitors and staff. Existing regulations including the NPS *Management Policies* 2001 and several Director's Orders address the above activities (see NPS *Management Policies* 2001, Policies and Regulations, sec. 4.5.6) and would be implemented to ensure human health and safety during project implementation. Among other things, these policies and regulations contain specific language regarding how to ensure public health and safety within areas of NPS jurisdiction and specify when appropriate certifications related to it are required (e.g., use of firearms and aviation).

Visitor Experience

The project area is unique not only in its assemblage of natural and cultural features, but also in its proximity to a major urban population. This juxtaposition makes the PRNS resources and recreational opportunities readily accessible to a large number of people, and enhances the importance of the special qualities for which it was set aside. PRNS is one of the 30 most visited parks in the National Park System and is visited by over 2.3 million people annually. Seventy percent of these visitors came from the 9 San Francisco Bay Area counties, with the remaining 30% traveling from across the state, the country, and around the world (Sonoma State University 1998). The park is a destination park for national and international visitors and a regularly visited resource for the 5 million residents of the 9 counties of the greater San Francisco Bay Area. In 2002, over 700,000 visitors went to the 3 park visitor centers (PRNS visitor use data 2002). Yearly, over 70,000 visitors have extended contacts with park interpretive staff through ranger-led programs.

Visitor facilities and recreational opportunities include 4 backcountry campgrounds, 147 miles of trails, numerous beaches, 3 visitor centers, and 2 environmental education centers. Activities include hiking, water sports, horseback riding, fishing, camping, wildlife viewing, and interpretive opportunities. The highest visitation occurs during the months of July – October and is primarily on weekends (National Park Service, Monthly Public Use Reports). A survey conducted in 2005 indicated that 100% of visitors were "satisfied overall with appropriate facilities, services, and recreational opportunities" (University of Idaho Cooperative Parks Studies Unit for the National Park Service, Department of the Interior, 2005).

Hiking is primarily a day-use activity. Approximately 50 trails are designated throughout the Seashore, and they encompass a range of habitat types from wooded mountains to sandy beaches. Overnight accommodation is available at hike-in campgrounds or local hotels and inns. Dozens of visitors bring horses to ride on designated horse trails, and hundreds rent horses every week from commercial stables.

Water sports include kayaking, canoeing, boating, and swimming. The majority of paddle crafts use Tomales Bay as it provides protection from the Pacific waves and surf, while power boaters more freely use the ocean. Surfers have been known to use the waters off the Seashore, but most surf south of the Seashore closer to population centers with better beach access.

Nature study and wildlife viewing, including the viewing of exotic deer species, are important activities at Point Reyes. Park visitors have been observing wildlife in the Seashore since its inception. Visitors commonly comment to NPS staff on the park deer, including fallow and axis deer. Most often, the comments relate to the white color variants of the fallow deer. Typically, the average park visitor does not distinguish fallow deer from native black-tailed deer (John Dell'Osso, NPS, personal communication). Visitors often confuse fallow deer with "elk," "moose," and "albino deer." Winter whale migrations off the coast bring many visitors and commercial whale watching operations into the area. Sea lions, tule elk, shorebirds, and spring wildflowers all attract their share of observers.

The NPS gathers standardized annual surveys for each park unit to determine the percent of visitor satisfaction based on park facilities, visitor services, and recreational opportunities. Sonoma State University conducted visitor surveys in 1997 and 1998 (Sonoma State University 1998). Results showed that park visitors spend an average of 2-6 hours at the seashore in a variety of seasonal activities. Those activities range from whale watching and kayaking to hiking and bird watching.

In 2003, the Point Reyes National Seashore Association, a non-profit organization, funded a telephone survey of 418 residents within Marin, Sonoma, San Francisco, Alameda, and Contra Costa counties (Responsive Management 2003). Respondents were asked questions on general management, recreation, and the founding principles for the Seashore. They were also given a brief overview of the history of non-native deer in the park and asked to respond to a number of questions concerning deer management. Sampling error was $\pm$ 4.8 percentage points. Survey results, as they relate to management of non-native deer, are as follows:

Almost all respondents (97%) felt that preserving native ecosystems was a very or somewhat important reason to have a National Park.

Most respondents (77%) said they would support reducing numbers of non-native deer if they were determined to be causing damage to native wildlife, vegetation, or other natural resources.

53% of respondents opposed (41% strongly and 12% moderately) the use of lethal methods to reduce numbers of non-native deer while 35% supported (14% strongly and 21% moderately) lethal control. Respondents who had not visited the park were slightly more likely than visitors to oppose lethal control.

65% of respondents supported (37% strongly and 28% moderately) the use of "an injection that would cause permanent sterilization and not allow them to produce any further offspring." Twenty percent of respondents opposed sterilization (14% strongly and 6% moderately). Respondents who had visited the Seashore were more likely to support sterilization than non-visitors.

61% of respondents who had visited PRNS and 87% of non-visitors felt they knew nothing about the non-native deer in the park before the survey.

As park staff continues to educate and inform visitors of native versus non-native species issues and the impacts that non-native species can cause, park visitors would have greater appreciation for preserving native ecosystems. A pilot survey conducted by Sonoma State University in 2002 (Sonoma State University 2003) showed respondents didn't think the park should ignore detrimental impacts of non-native species to native species. Restoration of native ecosystems in the Seashore would provide high quality visitor experiences to those members of the public seeking a view of what coastal California fauna once was.

Social Values

Social values, a part of the visitor experience, include general public attitudes toward wildlife management and issues of humaneness as it relates to proposed actions (lethal removal and contraception). The interpretation of what constitutes harm or suffering to an animal varies from person to person, with different people perceiving the humaneness of any given action differently (USDA 1997). Kellert (1976) identified a number of distinct attitudes toward wildlife including naturalistic, ecological, humanistic, moralistic, scientific, aesthetic, utilitarian, dominionistic, and negativistic (see Table 5 for definitions). As with wilderness values, while people typically possess more than one view of animals, most people hold a predominant view.

TABLE 5: PERCEPTIONS OF ANIMALS IN AMERICAN SOCIETY

Attitude	Key Identifying Terms	Highly Correlated With	Most Antagonistic Toward
Naturalistic	Wildlife exposure, contact with nature	Ecologistic, humanistic	Negativistic
Ecological	Ecosystem, species interdependence	Naturalistic, scientific	Negativistic
Humanistic	Pets, love for animals	Moralistic	Negativistic
Moralistic	Ethical concern for animal welfare	Humanistic	Utilitarian, dominionistic, scientific, aesthetic, negativistic
Scientific	Curiosity, study, knowledge	Ecologistic	None
Aesthetic	Artistic character and display	Naturalistic	Negativistic
Utilitarian	Practicality, usefulness	Dominionistic	Moralistic
Dominionistic	Mastery, superiority	Utilitarian, negativistic	Moralistic
Negativistic	Avoidance, dislike, indifference, fear	Dominionistic, utilitarian	Moralistic, humanistic, naturalistic

SOURCE: S. Kellert (1976)

At the Seashore and other park units, objections have been raised by some individuals and interest groups to certain of the management techniques proposed by NPS units for management of non-native wildlife, notably lethal control (Sellars 1997). A number of animal rights and welfare organizations and private individuals also raised a range of issues during public scoping for this document (see Chapter 5, Consultation and Coordination). These objections were presumably raised on moralistic or humanistic grounds, e.g., that inflicting of pain and/or death to animals is unethical.

Animal welfare advocates promote the minimization of pain and suffering to animals and their organizations promote the well–being and quality of life of individual animals, irrespective of the animals' role in an ecosystem. In contrast to the animal welfare movement, the animal rights movement is premised on the equality of humans and animals. The proposed equality exists because of the capacity for suffering in both humans and non-human animals. Singer states: "No matter what the nature of the being, the principle of equality requires that its suffering be counted equally with the like suffering – in so far as rough comparisons can be made – of any other being" (Regan and Singer 1989). Because of the deemed equivalent capacity for suffering, the killing of animals, whether for meat production or for sport, as well as the use of animals in scientific research, are considered as offensive as such practices would be if they were conducted on humans. The moral focus of the animal rights viewpoint is, as with animal welfare, the individual animal. As Warren states: "the needs and interests of individual beings (are) the ultimate basis for conclusions about right and wrong" (Warren 1992). Regan describes the animal rights view of wildlife management as: "In general the (animal) rights view's position is to let wildlife be. Wildlife management ought to be designed to protect wild animals against hunters, trappers, and other moral agents (human beings)" (Regan 1983).

Other visitors to the Seashore are perhaps more naturalistic or aesthetic in their attitudes about non-native deer. As noted in other sections of the document, as visitors are educated on the natural ecosystem of the Seashore and the impact fallow and axis deer have on it, their attitudes sometimes shift more to the ecological described on Table 5 above.

There are no specific federal directives for NPS in regards to animal welfare or animal rights. NPS management of wildlife, as described in the NPS *Management Policies* 2001, is based on a biocentric ethic and not on single animals. In addition, NEPA does not consider animal rights or animal welfare to be an environmental issue or resource element. However, animal welfare issues were raised during public scoping. As an ethic held by a certain segment of the public, belief in animal rights and animal welfare can be considered part of the human environment and are therefore discussed as a part of the visitor experience.

In addition, as a matter of general policy in all wildlife management activities, Seashore managers always endeavor to minimize animal suffering, eliminate unnecessary pain to every extent possible and comply with the recommendations of the American Veterinary Medical Association (see Actions Common to All Alternatives). For a detailed description of these recommendations, consult the American Veterinary Medical Association website: www.avma.org/resources/euthanasia.pdf.

Wilderness

The Wilderness Act

The Wilderness Act, passed on September 3, 1964, "provides a degree of protection to the resources of the National Park System that the NPS Organic Act does not." The House Report accompanying the act, which helps to clarify congressional intent in passing legislation, states that its purpose is to establish a National Wilderness Preservation System made up of designated wilderness areas "because of the undeveloped character of their lands and the need to protect and manage them in order to preserve, as far as possible, the natural conditions that now prevail" (House Report No. 1538, 88th Congress, 2nd session, July 2, 1964).

The Wilderness Act includes a lengthy definition of wilderness, including phrases such as:

- An area where earth and its community of life are untrammeled by man
- An area where man himself is a visitor who does not remain
- An area of underdeveloped land retaining its primeval character and influence
- An area protected and managed to preserve its natural conditions
- An area that generally appears to have been affected primarily by the forces of nature
- An area with the imprint of man's work substantially unnoticeable
- An area with outstanding opportunities for solitude or a primitive and unconfined type of recreation

What the Wilderness Act apparently did not anticipate was a condition where lands were either not in a natural state when they were designated as wilderness or where large-scale changes in environmental conditions (invasion of exotic species, acid rainfall, etc.) occurred such that the natural state was altered. When either of these conditions occur, intervention in the form of "intentional control or manipulation" may be required. Although this is perhaps "trammeling" in that human, rather than "natural" activities are conducted, it also returns the wilderness to an "untrammeled" or "natural" pre-impact state in the long-term.

Wilderness Character

NPS policies indicate that environmental impact statements should evaluate wilderness character and values, including the primeval untrammeled character and influence of the wilderness; the preservation of natural conditions (including the lack of man-made noise); and assurances that there would be outstanding opportunities for solitude and the public would be provided with a primitive and unconfined type of recreational experience.

Wilderness character has multiple components, including naturalness, wildness, the lack of man-made noise, and conditions for a specific kind of visitor experience where people are able to find solitude, a primitive and unconfining environment, and an escape from the modern day world. For the most part, visitors to the backcountry in PRNS can usually expect few encounters with other visitors and natural quiet.

Like most wilderness areas in the National Wilderness Preservation System, the Point Reyes National Seashore Wilderness was not pristine when it was designated due to the history of Euro-American land use practices described in the Park Management Zoning section of this chapter. These practices include agricultural use, introduction of non-native ungulates, and fire suppression over the past century. As a result, "unnatural" conditions exist today. Because scientific evidence indicates adverse ecological impacts are occurring, these conditions would continue to reduce the park's biological productivity without human intervention. In other words, the requirement of the Act to "preserve natural conditions" is unattainable without overt management.

Wilderness Values

People who use wilderness, as well as those that do not, all have opinions about why it is valuable. These perceptions about the benefits of wilderness are referred to as "wilderness values" and change from person to person and from wilderness to wilderness. No surveys of wilderness users at PRNS have been conducted, therefore it is unknown what particular values visitors ascribe to Seashore wilderness. Instead, this section describes values users have placed on wilderness in general.

The values applied to wilderness are wide-ranging, and have been grouped into biocentric and anthropocentric categories. The biocentric includes the existence of natural, ecologic conditions. These include protecting natural ecological processes, wildlife habitat, habitat for rare and endangered or unique plants and animals, protecting watersheds and water quality, and protecting air quality.

Anthropocentric values include experiential benefits from recreating in wilderness, educational values, generating tourism revenue for adjacent or nearby gateway communities, aesthetic and spiritual values, the knowledge that wilderness areas exist and would exist in the future, and intrinsic or symbolic values.
Agencies, academics, recreational users and the general public may also hold strong and varying opinions about whether intervention in a wilderness to restore its naturalness is warranted or advisable. The literature suggests that most people typically hold more than one attitude towards an issue and react differently in different situations. Nonetheless, it is possible to identify in most people predominant characteristics of a primary attitude toward an issue. For example, ranchers tend to have a utilitarian attitude towards the environment (value measured in terms of usefulness), while conservationists may have an ecological or preservationist view (Kellert 1976).

Park Operations

Currently the park has about 90 permanent, 23 term and 47 temporary employees working on a variety of projects and programs. This represents about 116 FTE (full time equivalents). During the peak visitation (summer) months, the park staff increases to about 160 employees, including Youth Conservation Corps enrollees. The year-round work force is supplemented by 20,000 hours of Volunteers-in-Parks service, three Student Conservation Assistants, and AmeriCorps volunteer work groups and special project and program funds distributed by the NPS regional and Washington offices.

Financial resources available to achieve the park's annual goals include a base-operating budget of approximately $5.6 million. In addition, the park receives supplemental support for fire operations, cyclic maintenance, special natural resource projects, and repair and rehabilitation of structures.

The park expects to receive fees revenues and special national park funding of about $1.6 million in a one-time funding round this year for cyclic maintenance of historic structures and other natural resource projects. The park would also receive about $625,000 in fee revenues for other maintenance projects and operation of the whale shuttle system and campground reservation system. As part of the San Francisco Bay Network, the National Seashore would have access to approximately $810,000 for natural resource challenge inventory and monitoring funds. The park receives approximately $1,000,000 in FirePro and Wildland Interface funding for hazardous fuel reduction and fire prevention activities.

The operating budget for the PRNS deer management program in FY 2002 was $113,000. An additional $100,000 was made available through fee funds and grants earmarked for specific management projects. Staffing for the deer management program is 3.0 FTE's.

Until 1994, the Seashore maintained the populations of the two non-native deer species under guidance received by the Point Reyes National Seashore and Golden Gate National Recreation Area Citizen's Advisory Commission. This recommendation called for controlling the herds of axis and fallow deer at a population level of 350 animals each through direct ranger culling. A research program of collection and necropsy to study animal nutrition, health, parasite loads and disease was conducted between 1976 and 1979. Beginning in 1980, the Seashore implemented a management program to control population size at the stipulated herd size. Between 1984 and 1994, 1412 fallow and axis deer were removed at a total cost of $30,200 (including personnel costs, ammunition costs and vehicle mileage) at an average cost of $21.39 per animal (NPS unpublished data ((h)). These costs do not include administrative, training, interpretive or equipment costs. An estimate of all costs associated with this reduction program average $20,736 per year (Wates 2003). Since the end of the direct management program in 1994, the axis deer population has rebounded to 1973 levels. Fallow deer numbers have grown considerably, and now exceed any previously recorded numbers (NPS 2002a).

PRNS (including GGNRA North District) maintains the necessary infrastructure to support an annual park visitation of 2.25 million people, provide offices, support structures and provide limited housing for the permanent and seasonal park staff. Park structures include:

- 3 visitor centers
- 2 environmental education centers
- 30 restroom complexes
- 4 backcountry campgrounds
- 17 water systems
- 147 miles of trails
- Over 100 miles of roads
- Over 100 public and administrative structures

- 27 sewage treatment systems

PRNS also manages and protects park cultural resources including:
- 297 historic structures
- 127 recorded archaeological sites
- 11 identified cultural landscapes
- 498,000 museum objects

Regional Economy (Socioeconomics)

Marin County has a $450 million annual tourist industry. It is estimated that PRNS contributes over $150 million to the regional economy with visitor expenditures on dining, fuel, gifts, groceries and lodging (National Parks Conservation Association 2002). According to a visitor survey conducted by Sonoma State University (1998), 74% of visitors travel to the Seashore as their main destination, 30% of visitors remain in the park overnight, and 40% of visitation comes from Marin, Sonoma, and San Francisco Counties (16.5% comes from outside of California).

Point Reyes National Seashore received 2.3 million visitors in 2001. The average visitor party spent $95 per party per night in the local area. This spending from visitors from outside the local region generated $83.6 million in sales for local businesses, yielding $39.3 million in personal income and supporting 2,000 jobs (NPCA 2002). Each dollar of tourism spending yielded another $0.63 in sales through the circulation of spending within the local economy. Including these secondary effects, the total economic impact was $113 million in sales, $42 million in wages and salaries, and 1,800 jobs (Michigan State University 2001).

The 165,000 acres of Marin County farmland produced olives, hay and silage, wine grapes, and organic produce earning in excess of $4 million in 2001 (Marin Agricultural Land Trust data 2003). Dairy and beef cattle produced about $40 million. Twenty percent of the Bay Area's milk supply is produced in Marin dairy farms. Countywide, two hundred farms and ranches employ 1,400 people.

Commercial Operations within the Pastoral (Agricultural) Zone

Commercial, agricultural, and aquaculture production occurs within the Seashore, including the following:
- 7 dairies
- 19 beef cattle ranches
- Silage production on approximately 1,000 acres of land
- Oyster production in Drakes Estero
- Water supply to Bolinas Community

PRNS contains approximately 18,900 acres currently used for traditional agriculture, including the 17,040-acre Pastoral Zone and other lands on which ranching takes place. PRNS-administered GGNRA lands include approximately 10,000 acres currently in ranching use. The legislation establishing both PRNS and GGNRA included provisions for continuing the historic ranching uses on some of the lands acquired for these parks. As agricultural lands were purchased, sellers were allowed to continue dairying or beef ranching under one of two arrangements. They could retain a Reservation of Possession, under which they would forego a portion of the purchase amount in exchange for the right to continue ranching activities for up to 25 years. Alternately, they could sell outright and enter into Special Use Permit agreements of up to five years with NPS. Some sellers retained a Reservation of Possession on part of their land, and entered into Special Use Permit agreements for the rest, while others have entered into more than one Special Use Permit agreement with NPS.

The 24 ranchers currently operating within the project area hold 11 Reservations of Possession and 30 Special Use Permits. Most of the Reservations of Possession expire in the next decade. It has been the policy of PRNS in the past to allow ranchers whose Reservation of Possession terms expire to continue ranching operations under Special Use Permits. Together these permittees and Reservation of Possession holders support approximately 6,013 cattle on a year-round basis.

Current impacts to those ranchers who see non-native deer year-round include:

- Fence repair costs. Ranchers report that non-native deer damage fences by passing under them repeatedly in large numbers. Bucks have also been reported to break fence wires with their antlers.

- Cost of lost pasture forage. A number of ranchers indicated that loss of pasture forage, through consumption by non-native deer, was causing a major reduction in the number of cattle that could be supported on leased pastures. It is estimated that there are about 250 axis and 860 fallow deer in the park. Their total food intake on the ranches is unknown but the average deer consumes approximately 3% of its body weight in forage per day, or between 3 and 6 lb. per adult doe or buck.

- Cost of lost supplemental feed put out for livestock. One rancher indicated that non-native deer, at a substantial cost to the rancher, were eating supplemental feed put out for livestock during the dry summer season.

- Cost of reseeding pastures. One rancher indicated that in recent years, non-native deer have overgrazed fallow (ungrazed) fields. These pastures are seasonally removed from livestock grazing by the rancher in order to allow natural grass reseeding. Because of heavy grazing of the new seed heads by non-native deer, purchase of seed was required.

- Veterinary costs. One rancher attributed an increase in "moon blindness" in ranch horses to increased densities of fallow deer in recent years. Ranch horses also tested positive for exposure to leptospirosis, a bacterial disease, which can cause ophthalmic disease and abortions in livestock. The disease can be carried by a number of mammalian species, including rodents, skunks, raccoons and deer. Two of 16 non-native deer culled and necropsied for disease testing in 2000 showed serological evidence of exposure to leptospirosis (NPS unpublished data (g)). On the advice of a veterinarian, the rancher has subsequently vaccinated all the ranch livestock for the disease. Animals affected by the opthalmic form of the disease ("moon blindness") were treated by a veterinarian.

The following table lists approximate numbers of Seashore ranches in which various impacts, attributable to non-native deer in the past 3 years, have been observed. Cost estimates are approximate and encompass only those directly attributed to non-native deer by the ranchers themselves. Information in this table was collected through conversations with ranchers in April, 2003.

TABLE 6: CURRENT ECONOMIC COSTS OF NON-NATIVE DEER TO SEASHORE RANCHERS

Cost Category	Number of Ranches Reporting	Approximate Cost per Rancher (2002)
1. Increased fence repairs	4	$500 - $1,000 per year
2. Loss of pasture forage to non-native deer	4	unknown
3. Loss of supplemental feed (hay or grain) to non-native deer	1	unknown
4. Required reseeding of pastures due to non-native deer	1	$9,000 per year
5. Increased veterinary costs	1	$1,200 in 2001

Cattle ranchers outside the park boundaries have also experienced damages from similar impacts caused by non-native deer estimated at approximately $3,500-4,000 per year. An organic produce farmer outside NPS boundaries has experienced noticeable depredation of planted vegetables during the fall from fallow deer migrating out of the Seashore. In addition, damage to ornamental plants/gardens in neighboring private gardens has also been attributed to fallow deer.

Chapter 4: Environmental Consequences

Introduction

This chapter provides detailed discussion of the probable environmental consequences, or impacts, of implementing each of the five alternatives. The chapter begins with an explanation of how the impact topics were chosen, which impacts were dismissed from consideration and why. Terms used to define impact levels are defined. This is followed by a discussion of methods used to conduct the analyses and a description of the methods used to assess impacts for each impact topic (e.g., soils, visitor experience, etc.), including relevant policies, regulations, and assumptions. Individual analysis of the impacts related to each alternative (A, B, C, D, and E) include:

- identification of impacts associated with the various actions comprising the alternative;
- characterization of impacts, including their duration and intensity;
- available mitigation measures and the effectiveness of these measures on reducing impacts;
- assessment of cumulative impacts; and
- a summary of the impacts and an assessment of the potential for an alternative to impair resources (based on the NPS definition of and policy on impairment).

Impact Topics and Their Derivation

Resources for analysis were selected primarily because the actions in the alternatives have the potential to affect them, both in adverse and beneficial fashion. The impact topic is a very short summary (see Chapter 1) of the relationship between an action in a given alternative (capturing deer to treat them with a contraceptive, for example) and a resource (water, air, etc.). Although impact topics are initially presented in the first chapter, the extent of damage or benefit from this relationship is analyzed in this chapter. Seashore staff develops impact topics, but laws, regulations, and policies may require discussion in an impact topic, and/or the public may have raised topics during scoping. Impacts to the following resources are addressed for each of the five alternatives:

- Water Resources and Water Quality
- Soils
- Vegetation
- Wildlife
- Species and Habitats of Management Concern (e.g., threatened, endangered, rare or sensitive species)
- Human Health and Safety
- Visitor Experience
- Park Operations
- Regional Economy

All of these topics, with the exception of Human Health and Safety, were raised during public scoping from May 4, 2002 to July 5, 2002. For details about public concerns, see Chapter 5.

Definition of Terms

The environmental analysis in this chapter includes the direct, indirect, and cumulative effects of the alternative actions on the environment.

Direct impacts **-** occur as a result of the alternative in the same place and at the same time as the action.

Indirect impacts - are reasonably foreseeable impacts that occur in a time or space removed from the proposed actions. These are "downstream" impacts, future impacts, or the impacts of reasonably expected connected actions.

Cumulative impacts - are actions that, when viewed with other actions in the past, the present, or the reasonably foreseeable future, regardless of who has undertaken or would undertake them, have an additive impact on the resource this project would affect.

Impacts are described in three ways for each alternative: by impact type, impact duration, and impact intensity. For purposes of this analysis, these impact characteristics are defined as follows:

Type of impact - describes the specific elements that could be subject to impacts and the nature of those impacts. Impacts can be either beneficial or adverse.

Duration of impact - describes the relative length of time the impact would affect a given resource. Impacts can be either short-term or long-term, and are defined for some impact topics by a range of years. It is important to note that an action that has short-term adverse impacts on a resource may have long-term beneficial impacts on the same resource.

Intensity of impact - The intensity of impact provides a way to assess the relative importance of the impact. Each impact is described as negligible, minor, moderate, or major. These four qualitative designations are used for beneficial as well as adverse impacts.

Resource impairment - At the end of each impact topic assessment is a statement regarding whether or not implementing the alternative would cause resource impairment. The NPS Organic Act of 1916 and the NPS General Authorities Act 1970, as amended, require park managers to ensure that park resources and park values remain unimpaired. The term "impairment," although usually defined in common usage as a worsening or diminishment in ability, value, or excellence, has specific definitions when used in an NPS Environmental Impact Statement. Section 1.4.5 of the NPS *Management Policies* 2001 states: "The impairment that is prohibited by the Organic Act and the General Authorities Act is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values." The NPS *Management Policies* 2001 further state:

> "An impact to any park resource or value may constitute an impairment. An impact would be more likely to constitute impairment to the extent that it affects a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- Key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- Identified as a goal in the park's general management plan or other relevant NPS planning documents.

> An impact would be less likely to constitute an impairment to the extent that it is an unavoidable result, which cannot reasonably be further mitigated, of an action necessary to preserve or restore the integrity of park resources or values."

Regulations, Policies and Methodology

The sources of information, assumptions, and application of information in the analysis of each affected resource is described in the Assessment Methodology sections below. These sections also define intensity thresholds and duration. A summary of relevant laws, policies, and regulations is also included.

Water Resources and Water Quality

The water resources within the project area include a substantial number of perennial and intermittent streams, human-made impoundments, wetlands, natural lakes and sag ponds. They support a variety of threatened and endangered species including coho and Chinook salmon, steelhead trout, California freshwater shrimp, and California red-legged frog. Watershed storage capacity and water quality can be impacted by soil erosion and compaction caused by non-native deer and their management. Off road vehicles and stream or pond usage by large concentrations of deer can cause altered drainage patterns, degraded water quality, and increased sedimentation.

Policies and Regulations

The Clean Water Act (33 U.S.C. 1251 – 1376) requires the NPS to "comply with all Federal, State, interstate, and local requirements, administrative authority, and process and sanctions respecting the control and abatement of water pollution." The NPS Freshwater Resource Management Guidelines (found in NPS-77) requires the NPS to "maintain, rehabilitate, and perpetuate the inherent integrity of water resources and aquatic ecosystems."

NPS *Management Policies* 2001 state: "The Service will manage watersheds as complete hydrologic systems, and will minimize human disturbance to the natural upland processes that deliver water, sediment, and woody debris to streams. These processes include runoff, erosion, and disturbance to vegetation and soil caused by fire, insects, meteorological events, and mass movements…The Service will achieve the protection of watershed and stream features primarily by avoiding impacts to watershed and riparian vegetation, and by allowing natural fluvial processes to proceed unimpeded."

Assessment Methodology

The following three primary aspects of water resources were assessed when considering potential impacts:

- hydrology of the project area
- aquatic habitat within the project area
- water quality

Hydrology refers to hydrologic processes such as flooding, erosion, deposition, and maintenance of channel patterns. Aquatic habitat refers to the attributes that support or provide habitat within stream or pond systems. Water quality refers to the suitability of surface water for beneficial use, including cold-water or warm-water aquatic wildlife habitat and recreational use. Relative to water quality, Tomales Bay and Lagunitas Creek have been listed as impaired (impaired has a different meaning in the National Park Service) by the San Francisco Regional Water Quality Control Board for sediment, nutrients and pathogens. Particular consideration was given to actions with potential to affect the natural hydrology, aquatic habitat features, and surface water quality of cold-water streams. Specific watersheds supporting cold-water aquatic habitat include Lagunitas Creek, Olema Creek, Pine Gulch Creek, and most coastal drainages originating from Inverness Ridge. Also of concern are pond features that are considered breeding habitat for the California red-legged frog. Ponds are located throughout the project area.

Generalized information from the literature regarding the types of effects and their magnitude to water quality and streamflow characteristics from ungulate grazing were used to estimate impacts to park water quality or hydrology from non-native deer. Observational information from park staff on the impacts of non-native deer congregating near streams was also used. Data on the presence or absence of species sensitive to sedimentation in Seashore streams was integrated into the analysis to show where particular concerns to water quality or aquatic habitat from grazing by non-native deer are likely.

Type of Impact

Adverse: would alter natural hydrologic conditions (e.g., impede flood flows, cause unnatural erosion or deposition, etc.), degrade water quality (e.g., increase pollution or bacteria levels from recreational use), or degrade aquatic habitat.

Beneficial: would restore natural hydrologic conditions (e.g., remove impediments to flood flows, stabilize riverbanks, etc.), improve water quality (e.g., reduce non-point source pollution), or improve or maintain aquatic habitat

Duration of Impact

Short-term: would last two years or less.

Long-term: would last longer than two years.

Note: Since full implementation of an alternative would take place over a number of years, this section considers the duration of individual actions within each alternative (e.g., control of non-native deer by lethal means or reproductive control) as well as full implementation of the alternative (e.g., removal of all non-native deer from the Seashore).

Intensity of Impact

Negligible: would be imperceptible or not detectable.

Minor: would be slightly perceptible, without the potential to expand if left alone; and would be localized (i.e., would occur in the immediate vicinity of an action).

Moderate: would be apparent locally and would have the potential to become larger or regional.

Major: would be substantial, highly noticeable, and regional (i.e., would occur over a large area, such as the Tomales Bay watershed, or Point Reyes National Seashore).

Soils

Soils might be affected through direct disturbance, mechanical compaction, and indirectly through reduction of overlying vegetation.

Policies and Regulations

NPS *Management Policies* 2001 state: “The Service will actively seek to understand and preserve the soil resources of parks, and to prevent, to the extent possible, the unnatural erosion, physical removal, or contamination of the soil….” In addition, NPS-77 (Natural Resource Management Guidelines) lists the following objectives for the protection of soils within different management zones:

Natural zone: preserve natural soils and the processes of soil genesis in a condition undisturbed by humans.

Cultural zone: conserve soil resources to the extent possible consistent with maintenance of the historic or cultural scene and prevent soil erosion wherever possible.

Development zone: ensure that developments and their management are consistent with soil limitations and soil conservation practices.

Special use zone: minimize soil loss and disturbance caused by special use activities, and ensure that soils retain their productivity and potential for reclamation.

In addition, soils that are identified as “hydric,” which often are a feature of wetlands, are protected by policies such as Director’s Order 77-1, Wetland Protection. Hydric soils usually form under wet conditions sufficient to develop anaerobic conditions and support hydrophytic vegetation.

Assessment Methodology

The methodology for assessing impacts to soils was to use scientific literature and information about soils in the Seashore that might be affected by non-native deer. Information on the specific impact of fallow deer on soils in the Seashore has recently become available (Fellers and Osbourn 2006). In addition, information on impacts of other species of deer or ungulates on soils was used. Soil types and characteristics of soil in the area of the Seashore occupied by fallow and axis deer was information folded into the analysis to determine broadly where erosion or compaction might be more likely.

Type of Impact

Beneficial: would protect or restore chemical, physical, abiotic, or biotic soil components.

Adverse: would result in degradation of chemical, physical, abiotic, or biotic soil components.

Duration of Impact

Short-term: could be restored when project activities are completed and would last 10 years or less.

Long-term: would last more than 10 years.

Intensity of Impact

Negligible: would be imperceptible or not detectable.
Minor: would occur on less than 100 acres of ground.

Moderate: would occur on 100-500 acres of ground.

Major: would occur on more than 500 acres of ground.

Vegetation

Non-native deer management can directly impact vegetation; as a result of trampling, grazing, or browsing by deer or as a result of human or vehicular trampling in large-scale deer capture or culling operations. Deer can also cause indirect effects, such as competition between plant species, dispersion of weeds via deer gastrointestinal tracts, and changes in grazing pressure that might alter vegetative landscapes. Recent research indicates that exotic herbivores facilitate the abundance and species richness of non-native plants while native herbivores provide biotic resistance to invasion by non-native plants (Parker et al. 2006). Indirect impacts from capture or culling operations would also include increased potential for the dispersal of non-native plant seed and vegetative propagules.

Policies and Regulations

NPS *Management Policies* 2001 (Section 4.4.1) state: "The National Park Service will maintain as parts of the natural ecosystems of parks all native plants and animals." The policies go on to state that the above statement includes flowering plants, ferns, mosses, lichens, algae, fungi, and microscopic plants. The NPS is mandated to preserve and restore the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of these native species. In addition, the NPS is mandated to prevent the introduction of exotic (non-native) species into units of the national park system. The policy manual NPS-77 (Natural Resource Management Guidelines) also provides general guidelines on vegetation management.

Assessment Methodology

Vegetation in the park was digitally mapped using aerial photographs in 1999/2000 as part of the development of a park-wide vegetation map. Field data on plant species composition were subsequently collected to characterize and classify the plant communities delineated in this mapping effort. The classification describes the vegetation alliances and associations found in the park (including all acreage delineated as non-native deer range), and are based on the classification system under National Vegetation Classification Standards. For purposes of this document, alliances and associations found in the study area have been grouped together into 10 broad vegetation classes that are described in Chapter 2.

Vegetation communities utilized by axis and fallow deer were calculated using the park vegetation map Geographic Information System (GIS) coverage in combination with the most recent non-native deer range maps. The current range maps were developed using non-native deer sightings from 2000 to the present. By overlaying each coverage, each vegetation community could be quantified by acreage. Again, this does not provide any temporal information specific to how intensely each community is used, only the types of communities where non-native deer have been observed.

In addition, in a study conducted by Humboldt State University since 2000, analysis of deer fecal pellets allowed description and comparison of tule elk and fallow deer diets in the Limantour area of the Seashore. Description of the vegetation types used as forage by these species, as well as information obtained in the literature, allowed a determination of impacts to vegetation.

Beyond this site-specific information, the literature was consulted for information generally about the impacts of deer on vegetation communities.

The following parameters were used in the evaluation of impacts on vegetation:

- the vegetation class that would be affected (e.g., Bishop pine forest);
- the abundance or rarity of the vegetation class in the study area and in the region; and
- the presence, abundance, and species richness of non-native plants within, or adjacent to the vegetation classes affected.

The abundance, or areal extent, of the vegetation class is important when considering project impacts because the Seashore is mandated to protect and maintain all native plant communities. If a vegetation class is very rare in the project area or the region, such as riparian woodland, adverse impacts to the vegetation class become more intensive.

Type, duration, and intensity of vegetation impacts are described as follows:

Type of Impact

Beneficial: would increase the size, continuity, or native species richness of a plant community, or would decrease invasive non-native plant species abundance or richness.

Adverse: would decrease the size, continuity, or native species richness of a plant community, or would increase invasive non-native plant species abundance or richness.

Duration of Impact

Short-term: would be measurable for less than two years; plant composition, productivity, and reproduction would change initially, then return to pre-project conditions.

Long-term: would be detectable for longer than two years; plant composition, productivity, and reproduction would change and these changes would persist post-project.

Intensity of Impact

Negligible: would result in no measurable or perceptible changes in plant community size, continuity, or native or non-native species richness.

Minor: would be measurable or perceptible but would be localized within a relatively small area; the overall viability of the plant community would not be affected.

Moderate: would cause a measurable and perceptible change in the plant community (e.g., size, continuity, or native or non-native species richness), but the impact would remain localized and the change could be reversed.

Major: would be substantial, highly noticeable, and could irreversibly change (i.e., be permanent) plant community size, continuity, or species richness.

Wildlife

Wildlife can be impacted in a number of ways by non-native deer management. Directly, wild animals can be injured or killed during deer capture, monitoring or management operations. Indirectly, through destruction of habitat and competition for required resources, animals can be impacted by changes in the abundance and range of non-native deer.

Policies and Regulations

NPS *Management Policies* 2001 state: "The National Park Service will maintain as parts of the natural ecosystems of parks all native plants and animals." The policy statement includes bacteria, mammals, birds, reptiles, amphibians, fishes, arthropods, worms, and microscopic animals. The NPS is to preserve and restore the natural abundance, diversities, dynamics, distributions, habitats, and behaviors of these native species. Maintaining of genetic diversity "to increase the variability of the park gene pool" is required. In addition, the NPS is mandated to prevent the introduction of exotic (non-native) species into units of the national park system.

The policy manual NPS-77 (Natural Resource Management Guidelines) also provides general guidelines on wildlife management. Management should strive to perpetuate natural ecosystems through maintaining or restoring natural processes to the extent practically feasible. Specifically, "maintaining, restoring, or simulating natural processes is a more realistic goal than is the pursuit of a hypothetical static situation that is unachievable and may even be undesirable."

The NPS also is required to comply with the Fish and Wildlife Coordination Act; the Marine Mammal Protection Act; the Bald and Golden Eagles Protection Act; the Wilderness Act; the Convention on International Trade in Endangered Species; and maritime and other international agreements. The NPS also is required to comply with The Migratory Bird Treaty Act (1918), which prohibits taking, killing or possessing migratory birds, nests or eggs. And, as a refuge for tule elk, Point Reyes National Seashore is directed to participate in a Federal/State cooperative program for preservation and enhancement of tule elk in California under the Tule Elk Preservation Act (1976, 16 U.S.C. 673d). The Act requires the Secretary of the Interior to "cooperate with the State of California in making lands under (his/her jurisdiction) reasonably available for the preservation and grazing of tule elk in such manner and to such extent as may be consistent with Federal Law."

Assessment Methodology

Impacts on wildlife, within Point Reyes National Seashore have been assessed in terms of the following:

- changes to wildlife habitat, including food source, water source and cover or nesting habitat;
- changes in the number of wildlife species (species richness);
- changes in the number of individuals in a wildlife species;
- changes in the productivity or growth of a species;
- changes in the range of a species; and
- changes in the genetic variability within a population or sub-population.

Some information specific to this analysis has been collected for wildlife at the Seashore; for example, dietary overlap information for non-native deer and black-tailed deer is available. However, the literature was consulted for information about the effects of fallow and axis deer on wildlife and wildlife habitat when site-specific data were not available.

Type of Impact

Adverse: would result in unnatural changes in survival or reproduction, viability of a population or species, unnatural distribution of available resources or habitat.

Beneficial: would result in protection or restoration of viability of a population or species, or natural distribution of available resources or habitat.

Duration of Impact

Long-term: would last two years or longer. This represents two breeding cycles for native wild ungulates, many bird species and most medium and large carnivores in the Seashore, all of which would be considered in the impact discussion. Two years represents at least two breeding cycles for most small mammals, amphibians and reptiles, which would be considered in the impact discussion. An impacts to more than two breeding cycles is considered long-term.

Short-term: would be expected to last for less than two years or two breeding cycles. See rationale for the two-year definition above.

Intensity of Impact

Negligible: would not be measurable or perceptible.

Minor: would be measurable or perceptible and would be localized within a relatively small area or portion of the species range within the Seashore. The overall viability of the resource or population would not be affected. After the initial occurrence, the adverse effects would be fully reversible.

Moderate: would be sufficient to cause a change in the resource or population (e.g., abundance, distribution, quantity, or quality); however, the impact would remain localized in the Seashore. The change would be measurable, but negative effects could be reversed with active management, and the resource or population could recover within the Seashore.

Major: would be substantial, highly noticeable, measurable, and potentially irreversible (permanent). The resource or population would be unlikely to recover within the Seashore with or without active management.

Species and Habitats of Management Concern

Numerous species of plants and animals have undergone local, state, or national declines, which has raised concerns about their possible extinction if they are not protected. Many of the plant and wildlife species, and habitats present in the project area are granted special protection through listing by the U.S. Fish and Wildlife Service (USFWS) and/or the State of California. The Marine Mammal Protection Act and the Migratory Bird Treaty Act afford additional protection.

Policies and Regulations

The USFWS and the CDFG have established lists that reflect the species' status and the need for monitoring, protection, and recovery. In addition to federal and state-listed species, potential impacts to plants listed by the California Native Plant Society also are considered for all programs and activities that the Seashore undertakes. The Seashore also recognizes a number of species as locally rare or of special concern, even though they are not officially listed. Collectively, species in all of these categories are referred to in this document as "special-status species."

The Federal Endangered Species Act, as amended, requires federal agencies to consult with the USFWS before taking actions that (1) could jeopardize the continued existence of any federally listed plant or animal species (e.g., listed as threatened or endangered) or species proposed for listing, or (2) could result in the destruction or adverse modification of critical or proposed critical habitat. The USFWS provided upon request a list of species that must be considered for this FEIS. In Appendix E is a letter from USFWS confirming their concurrence with the NPS determination that the Preferred Alternative would not adversely affect listed species within the project area.

The Council of Environmental Quality Regulations for Implementing the National Environmental Policy Act (Section 1508.27) also requires federal agencies to consider if an action could violate federal, state, or local laws or requirements imposed for the protection of the environment. For this reason, species listed under the California Endangered Species Act (i.e., those considered endangered or threatened) by the California Department of Fish and Game are included in this analysis. Species proposed for listing in either of the two categories are also included.

NPS *Management Policies* 2001 state: "The National Park Service will identify and promote the conservation of all federally listed threatened, endangered, or candidate species within park boundaries and their critical habitats… The National Park Service also will identify all state and locally listed threatened, endangered, rare, declining, sensitive, or candidate species that are native to and present in the parks, and their critical habitats… All management actions for protection and perpetuation of special status species will be determined through the park's resource management plan."

In addition, park managers are to ensure that park operations do not adversely impact endangered, threatened, candidate, or sensitive species and their critical habitats, within or outside the park and must consider federal and state listed species and other special-status species in all plans and NEPA documents (NPS-77, Natural Resource Management Guidelines).

NPS-77 states: "The following legislation, policies, and agreements provide the authority for NPS policies on management of threatened and endangered species: the Endangered Species Act; state-specific endangered species acts; other state wildlife statutes or agreements pursuant to Section 6, Endangered Species Act; the Migratory Bird Conservation Act; the Fish and Wildlife Coordination Act; the Wild and Scenic Rivers Act; the Marine Mammal Protection Act; the Bald and Golden Eagles Protection Act; the Wilderness Act; the Convention on International Trade in Endangered Species; and maritime and other international agreements."

The USFWS usually takes lead Departmental responsibility for coordinating and implementing provisions of the Endangered Species Act for all listed endangered, threatened, and candidate species, particularly for all terrestrial plants and animals and freshwater aquatic species. The NMFS is responsible for listed marine mammals such as Cetacea (all whales and porpoises), Pinnipedia (Steller sea lions, Hawaiian monk seals, etc.), and anadromous fish (steelhead, coho and Chinook salmon, etc.). In each instance discussed below, where the listed species in question is a fish, whale or pinniped, the term "USFWS" might more accurately read "NMFS" or "NMFS and USFWS." This is particularly true for any activity that may involve the "taking" of a marine mammal of special status fish species such as endangered salmon and steelhead trout. See Appendix E for the letter from NMFS stating their concurrence with the NPS determination that the preferred alternative would not adversely affect listed species in the project area.

The federal, state, and California Native Plant Society categories for special-status species are defined as:

Federal endangered: Any species that is in danger of extinction throughout all or a significant portion of its national range.

Federal threatened: Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its national range.

California endangered: Any species that is in danger of extinction throughout all or a significant portion of its range in the state.

California threatened: Any species that is likely to become an endangered species with the foreseeable future throughout all or a significant portion of its state range.

California rare (plants only): A native plant that, although not currently threatened with extinction, is present in small numbers throughout its range, such that it may become endangered if its present environment worsens.

California Native Plant Society List 1A	Presumed Extinct in California
California Native Plant Society List 1B	Rare or Endangered in California and Elsewhere
California Native Plant Society List 2	Rare or Endangered in California, More Common Elsewhere
California Native Plant Society List 3	Need More Information
California Native Plant Society List 4	Plants of Limited Distribution

Assessment Methodology

Grazing by wild ungulates plays a role in the life history of many special-status species by removing understory and maintaining open habitat, encouraging reproduction in some species, and affecting competing species. Grazing can be detrimental to native plant species, especially when timing, frequency, and intensity are outside of the natural cycle to which the species is adapted (Archer and Smeins 1991). Grazing in California grasslands has been found to differentially affect various native life-history guilds such as annual or perennial forbs and grasses (Hayes and Holl 2003). Grazing can also indirectly affect protected wildlife at the Seashore by trampling vegetation and increasing the potential for siltation of waterways.

The following parameters have been used to evaluate the consequences of the various alternatives on special-status species:

- The species affected and its degree of local, regional, national, and global rarity.
- The rarity of the genotype or subspecies, regionally, nationally, or globally.
- The numbers of animals or proportion of the species range affected by the action.

Type of Impact

Adverse:	likely to result in unnatural changes in the abundance or distribution of a special-status species. This could occur through direct disturbance, mortality, decreased reproduction, or through destruction or alteration of habitat.
Beneficial:	likely to protect and/or restore the natural abundance and distribution of a special-status species. This could occur through increased survival, reproduction, or through increased availability of habitat or required resources.

Duration of Impact

Short-term: would immediately affect the population or species, but would have no long-term effects to population trends or species viability and a return to the original condition would occur within two generations of that species.

Long-term: would result in changes in the abundance and distribution of a special status species that persist for greater than two generations of that species or would lead to a loss in population or species viability—exhibited by a trend suggesting decline in overall species aerial extent or abundance.

Intensity of Impact

Negligible: imperceptible or not measurable (undetectable). For purposes of Endangered Species Act compliance, a negligible impact is equivalent to a finding of no effect.

Minor: slightly perceptible and localized in extent; if inciting stimulus ceased (i.e., browsing of riparian vegetation by non-native deer), adverse impacts would reverse and the resource would recover.

Moderate: apparent, measurable, or sufficient to cause a change in the resources (e.g., abundance, distribution, quantity, or quality). Less localized within the Seashore than a minor impact. Adverse impacts would eventually reverse with cessation of inciting stimulus and the resource would recover.

Major: substantial, highly noticeable, or with the potential for landscape-scale effects and major irreversible population effects with or without cessation of inciting stimulus.

Human Health and Safety

Management of park wildlife, whether on federal lands or on private property, can involve inherent risks to the health and safety to both visitors and staff. In a national park, wild animals can potentially cause disease transmission, vehicular accidents, or bodily injury to visitors or staff who come in direct contact with them. These risks are present whether or not wildlife are actively managed. These risks vary with the wildlife management technique used. The proposals analyzed, ranging from capture, immobilization and treatment of animals to use of aircraft and culling with firearms, can cause increased safety risks to managers and visitors. Management of deer also influences their population numbers and could contribute to the increase or reduction of auto/deer collisions.

Policies and Regulations

The NPS has a continuing concern about the health and safety of its employees and others who spend time in the parks. Several proposed deer management actions have the potential to increase risk to human health and safety. NPS *Management Policies* 2001 provide general guidance related to providing safe facilities and experience for the visiting public and park employees. The policy of the NPS is (1) to protect the health and well-being of NPS employees and park visitors through the elimination or control of disease agents and the various modes of their transmission to man, and (2) to ensure compliance with applicable Federal, State, and local public health laws, regulations and ordinances. Implementation of this policy would be qualified by the Organic Act's requirement that the NPS conserve the scenery and natural and historic objects and the wildlife therein in such manner and by such means as would leave them unimpaired for the enjoyment of future generations.

Various NPS director's orders (described below) provide policy guidance for specific components of park operations and management, some of which are expressly related to risk management (occupational safety and health of employees and visiting public) (see http://data2.itc.nps.gov/npspolicy/DOrders.cfm).

The primary focus of Director's Order 50B is the occupational safety and health of NPS employees. Visitor safety and health is the focus of Director's Order 50C.

Director's Order 83 outlines what the NPS will do to ensure compliance with prescribed public health policies, practices and procedures. This order establishes NPS policy with respect to all public health activities within areas of NPS jurisdiction, regardless of whether those activities are carried out by NPS or other Federal employees, or by other organizations, including the U.S. Public Health Service. Public health includes illnesses associated with drinking water, wastewater, food safety, animal vectors, animal reservoirs, hazardous wastes, indoor air pollution, institutional sanitation, radiation safety, medical wastes, solid wastes, air pollution, and other related areas of environmental health.

Use of firearms by NPS Law Enforcement and Resources Management staff is directed by Director's Order 9, Law Enforcement Program, and Director's Order 77, Natural Resources Management Guidelines, respectively. NPS requires firearms training and certification for all employees authorized to use firearms in the performance of their natural resource management duties. Firearms training must include safety, marksmanship, maintenance, storage, accountability, control, and security. Risk to human safety is further mitigated by the limiting of shooting operations to non-peak times in high-visitation areas—ideally, early and late in the day, and potentially, area closures.

The use of chemical sterilant drugs in wildlife has safety implications for staff that administer the drug and humans that inadvertently consume treated animals. Use of chemical sterilants and other experimental drugs is outlined in Director's Order 77, Natural Resources Management Guidelines, regulated by 21 CFR 511ff, and allowed only after New Animal Drugs for Investigational Use permits have been issued by the Food and Drug Administration. NPS staff administering the drugs must receive a course of training as specified in Director's Order 77.

Director's Order 60 provides park managers direction on conducting a legal, safe, and cost effective aviation program, while minimizing adverse impacts that NPS aviation activities may impose on park resources and visitor enjoyment. In addition, the use of aircraft in national parks for wildlife monitoring or management activities is in accordance with Federal Aviation Administration regulations, as described in the 350-354 Department of the Interior Departmental Manuals.

Assessment Methodology

The effects of each alternative are evaluated by analyzing potential impacts to the health and safety of park visitors and employees. Specifically, the analysis assesses risks to human safety from the use of capture techniques, aircraft, firearms, contraceptive drugs and deer/vehicle collisions. The analysis does not review impacts to water systems that may be affected by sedimentation caused by increased numbers of non-native deer or decaying carcasses that result from management action. These impacts are discussed under the heading of Impacts on Water Resources and Water Quality.

Type of Impact

Beneficial: result in a reduction in human health and safety risks; or would improve human health or safety.

Adverse: result in additional or exacerbated human health and safety risks.

Duration of Impact

Short-term: are temporary (less than one month) and are associated with transitional types of impacts (e.g., safety concerns related to risks of helicopter overflights of ranches or dwellings).

Long-term: have a permanent effect on human health and safety (i.e., contamination of a water source for domestic use).

Intensity of Impact

Negligible: would not be detectable; increased safety risks are not measurable.

Minor: would be slightly detectable; increased safety risks are measurable but small and limited to few individuals.

Moderate: would be clearly detectable; increased safety risks could have an appreciable effect on human health and safety, in terms of magnitude of risk and number of people affected.

Major: would be clearly introducing a severe health hazard to large numbers of people, such as the introduction of a new disease or source of water pollution to a community.

Visitor Experience

This impact topic concerns not only the recreational opportunities at Point Reyes National Seashore (visitor access, permitted types of recreation) but also the character of the visitor experience as it pertains to what visitors perceive during their time at the Seashore. This experience can be affected by noise, visual distractions or other sensory intrusion resulting from project actions. Visitor experience can also be affected by perceived conflict between NPS management of resources and the social and ethical values of some visitors. An example of such a conflict is NPS wildlife control activities offending visitors who are animal welfare or animal rights proponents.

Visitor experience is also directly affected by actions influencing natural resources that constitute scenic resources (e.g., degradation of native plant communities could impact the visitor experience). Though impacts to these resources are not repeated in the analysis of visitor experience, enhancement or degradation of these resources also enhances or degrades the quality of the visitor experience. Impacts to viewsheds are discussed under this impact topic. Grazing or the absence of grazing can change the vegetation in an area, affecting the visual appearance of a landscape.

Policies and Regulations

Soundscape preservation and noise management activities are subject to the policies contained in NPS *Management Policies* 2001. The portions of the NPS *Management Policies* 2001 that are most pertinent to this topic are: Chapter 1, Introduction; Chapter 4, Natural Resource Management; Chapter 5, Cultural

Resource Management; Chapter 6, Wilderness Preservation and Management; and Chapter 8, Use of the Parks. Policies in the form of regulations covering general audio requirements are published in 36 CFR 2.12.

Director's Order 47, Soundscape Preservation and Noise Management, addresses the problem of excessive/inappropriate levels of noise. It directs park managers to: (1) measure baseline acoustic conditions, (2) determine which existing or proposed human-made sounds are consistent with park purposes, (3) set acoustic management goals and objectives based on those purposes, and (4) determine which noise sources are impacting the park and need to be addressed by management. Furthermore, it requires park managers to evaluate and address self-generated noise.

NPS *Management Policies* 2001 also specify that visitor activities that are appropriate to the park environment will be encouraged, whereas those that would impair park resources or are contrary to the purposes for which the park was established, will not be permitted. In reference to area closures, the NPS *Management Policies* 2001, as well as 36 CFR 1.5, allow superintendents to temporarily or permanently close a specific area to prevent unacceptable impacts to park resources and to protect visitor safety. Section 8.4 of the NPS *Management Policies* 2001 mandates that all necessary steps be taken to avoid or mitigate adverse effects from aircraft overflights in order to reduce adverse effects on resources and visitor enjoyment.

The issue of social values is a component of the visitor experience, as it relates to wildlife management actions ranging from behavior modification techniques to capture or killing of animals. It is an important and complex topic as the interpretation of what constitutes harm or suffering to an animal varies from person to person, with different people perceiving the humaneness of any given action differently (USDA 1997). In the past, some individuals and interest groups have objected to certain management techniques proposed by NPS units for management of non-native wildlife (Sellars 1997). A number of animal rights and welfare organizations and private individuals raised issues during public scoping for this document (see Chapter 5, Consultation and Coordination). All action alternatives contain options for proposed management of non-native deer within the Seashore and include either lethal removal through the use of firearms or the combination of the use of contraceptive and lethal removal techniques. Some members of the public may find proposed options objectionable for a variety of reasons related to social values (e.g., techniques are inappropriate; techniques are inhumane; management is not necessary). All alternatives considered in this FEIS require measures to minimize animal suffering and eliminate unnecessary pain and suffering to every extent possible (see Actions Common to All Alternatives).

There are no specific federal directives for NPS regarding social values related to animal welfare or animal rights. NPS management of wildlife, as described in the NPS *Management Policies* 2001 is based on a biocentric ethic and not on individual animals. The role of animal populations and species within the ecosystem, rather than individuals, is the focus. This "land ethic," as described by Aldo Leopold, can be seen as: "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise" (Leopold 1970). NPS *Management Policies* 2001 mandate that NPS will maintain all native plants and animals as parts of the natural ecosystems of parks. In addition, rather than managing to preserve individual species, NPS will try to maintain all the components and processes of naturally evolving park ecosystems while keeping all intervention to the "minimum necessary" to achieve stated management goals (NPS *Management Policies* 2001, sec. 4.1).

NEPA does not consider animal rights or animal welfare to be an environmental issue or resource element. However, animal welfare issues were raised during public scoping. As an ethic held by a certain segment of the public, belief in animal rights and animal welfare can be considered part of the human environment and are therefore discussed as a part of the visitor experience. In addition, pain and suffering caused by proposed actions to individual animals are considered in the analyses of impacts to wildlife.

Wilderness experience and values are important to the a number of Seashore visitors who utilize its trails and enjoy its solitude and natural soundscapes. The regulations and policies governing the management of wilderness are discussed in detail in other sections of this EIS (see Chapter 1, Purpose and Need, and the Wilderness section of Chapter 3, Affected Environment, for example). Wilderness areas are to be administered "in such a manner as to leave them unimpaired for future use and enjoyment." This same language is part of the Organic Act of 1916, which created the National Park Service, and guides the management of all NPS resources and values. The Department of the Interior (NPS is a bureau of the Department) has interpreted this and other sections of the Act to mean that wilderness designation of national park system lands "should, if anything, result in a higher…standard of unimpaired preservation."

PRNS has completed a required assessment to determine whether actions in the proposed alternatives are consistent with this "minimum requirement concept." The assessment both evaluates whether intervention in wilderness is warranted, and whether the techniques proposed to conduct the needed activities would have the minimum impact to wilderness resources. The results of this assessment are included as Appendix A.

Assessment Methodology

The effects of each alternative are evaluated by analyzing potential impacts to visitor experience. The analysis assesses impacts to visitor recreation and enjoyment of the Seashore from the use of aircraft, firearms, and various wildlife management techniques. The essential features of wilderness and wilderness character as defined by the Wilderness Act and other sources (see Affected Environment) are its "wildness" and its "naturalness." These are both features that can be subjective and lend themselves to a qualitative discussion rather than a quantitative analysis. Therefore, the methods used in this EIS are primarily descriptive.

Type of Impact

Beneficial: result in an increase in visitor enjoyment and recreational opportunities.

Adverse: result in a decrease in visitor enjoyment and recreational opportunities.

Duration of Impact

Short-term: are temporary (less than one month) and are associated with transitional types of impacts (e.g., temporary area closures).

Long-term: have a permanent effect on visitor enjoyment of the Seashore.

Intensity of Impact

Negligible: would not be detectable by the vast majority of visitors.

Minor: would be detectable by a few visitors; impacts to the visitor experience are measurable but considered mild.

Moderate: would be clearly detectable by many visitors; impacts to the visitor experience are measurable and considered mild to moderate.

Major: would be clearly detectable by many visitors; the impacts to the visitor experience are considered to be major and would clearly affect visitation rates at the Seashore.

Park Operations

This topic addresses the effects on PRNS from the costs and staffing requirements of the proposed actions. It also addresses energy consumption and conservation potential of each alternative. Direct impacts are due to changes in funding and personnel while indirect impacts are caused by requirements for administrative support, office space, vehicles and energy use. PRNS currently has about 116 full-time equivalents (FTEs) and a total operations budget of $5.67 million

The operating budget for the PRNS deer management program in FY 2004 was $113,000. An additional $100,000 was made available through fee funds and grants set aside for specific management projects. Staffing for the deer management program is 3.0 FTEs.

Policies and Regulations

Congress established the NPS in 1916. To fulfill its mission, the NPS receives funding from both the federal appropriations process and other federal revenue sources.

Like most federal agencies, the NPS relies on federal appropriations to fund its core activities, although there is increasing use of alternative revenue sources, such as fees, to supplement operations. The NPS requests direct congressional funding and reports on the use of other federal funds through an annual budget document submitted to Congress entitled "Budget Justifications," or more popularly called, the “Green Book.”

The implementing regulations of NEPA require that environmental impact statements address the energy requirements and conservation potential of project alternatives. The NPS *Management Policies* 2001 require that all facilities be managed, operated, and maintained to minimize both energy consumption and consumption of nonrenewable fuels. The policies also require that new energy-efficient technologies be used where appropriate and cost effective.

Assessment Methodology

Impacts were evaluated by assessing changes that would be required to meet the operational requirements outlined in each of the alternatives. Relative costs were generated using staff estimates of funding, labor, and energy required to implement these actions. These effects were compared to existing operations, staffing, funding, and energy requirements at the Seashore.

Existing staffing levels were inventoried and assessments were made of current park operations. In addition, professional judgments by individuals who are most knowledgeable about various activities were used to anticipate the operational changes that would be needed under each action alternative.

Between 1972 and 1994, non-native deer were lethally removed by NPS staff as part of a control program intended to limit each species to 350 animals. From 1995 to 1998, a small number of animals were removed yearly for Native American festivals. Records of costs per deer culled, based solely on staff time and vehicle mileage, are available for 1984–1998 (NPS unpublished data (h)).

Estimates were made of the personnel and energy required to:

- provide education and information services to the public regarding deer management activities;
- provide law enforcement and aviation safety services during deer management activities;
- provide administrative support for deer management activities;
- provide training in deer management techniques and aviation safety; and
- conduct deer management activities.

These assessments were compared to existing staffing levels and energy use. It should also be noted that staffing funding and energy impacts for the action alternatives are difficult to project until final plans are completed. Thus, the estimates are intended to provide a general description of potential effects, considering the variability within the range of possible operational scenarios.

The discussions of impacts are for operations that would be new, undergo major change, or show susceptibility to increases or decreases in operational activity.

Type of Impact

Adverse: would represent an increase in operating costs and/or energy usage.

Beneficial: would represent a decrease in operating costs and/or energy usage.

Duration of Impact

Short-term: would last only until all actions are completed.

Long-term: would have a permanent effect on operations.

Intensity of Impact

Negligible: there would not be a measurable difference in costs and/or energy usage from existing levels.

Minor: additions or reductions in cost and/or energy usage would be less than 5% of existing parkwide budget (currently $5.6 million in general funds).

Moderate: additions or reductions in cost and/or energy usage would be between 5% and 15% of existing parkwide budget (currently $5.6 million in general funds).

Major: additions or reductions in cost and/or energy usage would be more than 15% of existing parkwide budget (currently $5.6 million in general funds).

Regional Economy

This topic concerns impacts of proposed NPS actions on businesses and livelihoods in Marin County, California. One of the objectives of this non-native deer management plan is: "to reduce impacts of non-native deer to agricultural permittees within pastoral areas. Such impacts might include direct consumption of forage, transmission of disease to livestock and damage to fencing" (Chapter 1, Purpose and Need). Livestock ranches within PRNS have sustained documented impacts from non-native deer management in the past and it is reasonable to evaluate impacts of future management to these ranches, as well as to ranches and farms outside Seashore boundaries. Also evaluated are impacts to local hotels, bed and breakfast inns, restaurants and retail businesses from any anticipated park closures resulting from non-native deer management activities.

Policies and Regulations

The legislation establishing both PRNS and GGNRA included provisions for continuing the historic ranching uses on some of the lands acquired for these parks. As agricultural lands were purchased, sellers were allowed to continue dairying or beef ranching activities under one of two arrangements. They could retain a Reservation of Possession, under which they would forego a portion of the purchase amount in exchange for the right to continue ranching activities for up to 25 years. Alternately, they could sell outright and enter into Special Use Permit agreements of up to five years with the park. Some sellers retained an Reservation of Possession on part of their land, and entered into Special Use Permit agreements for the rest, while others have entered into more than one Special Use Permit agreement with the Park.

The 24 ranchers currently operating within the project area hold 11 Reservations of Possession and 30 Special Use Permits. Most of the Reservations of Possession expire in the next decade. It has been the policy of PRNS in the past to allow ranchers whose Reservation of Possession terms expire to continue ranching operations under Special Use Permits. Together these permittees and Reservation of Possession holders support approximately 6,013 cattle on a year-round basis.

Assessment Methodology

Alternatives were evaluated for their socioeconomic effects on local communities. Socioeconomic effects include potential direct effects of property loss and potential indirect effects in economic terms, resulting from deer depredation of livestock forage, damage to fences, reseeding pastures, and potential disease transmission to livestock. Also evaluated are direct effects of property loss and potential indirect effects of park closures. Alternatives were evaluated for their effects on minority and low-income populations and communities as well as their effects on the local community at large.

Estimates of economic impacts to ranchers within the Seashore were obtained from the ranchers themselves. A number of ranchers have no non-native deer on their ranches and others see a few fallow or axis deer seasonally. Four of the 13 ranching permittees see either or both species year-round, in varying numbers. One ranching operation leasing pasture on the Vedanta Society property in Olema also experiences large numbers of fallow deer year-round. Impacts to other agricultural operations outside NPS boundaries were determined through extrapolation of impacts within the Seashore and through conversations with ranchers and farmers.

Type of Impact

Adverse: degrades or continues to negatively affect the characteristics of the existing economic environment, as it relates to local communities including local ranchers and farmers, minority and low income populations, visitor population, regional economies.

Beneficial: improves characteristics of the existing social and economic environment, as it relates to local communities including local ranchers and farmers, minority and low-income populations, visitor population, regional economies.

Duration of Impact

Short-term: temporary and typically transitional; associated with implementation of an action.

Long-term: continues beyond the implementation of an action and may constitute permanent impacts on the social and economic environments.

Intensity of Impact

Negligible: undetectable and expected to have no discernible effect on the economic environment.

Minor: detectable for a few local businesses and not expected to have an overall effect on the character of the economic environment.

Moderate: detectable in a moderate to large number of local businesses or could have the potential to expand into an increasing influence on the economic environment.

Major: a substantial, highly noticeable influence on many local businesses, and could be expected to alter those environments permanently.

Environmental Consequences of Alternative A – No Action

No Action is the continuation of current management. As noted in Chapter 2, Alternatives, current management of non-native deer is restricted mainly to monitoring activities, with no attempt to reduce numbers or control distribution.

Historical deer counts, current population parameters and population models indicate that current population levels of both non-native deer species are below carrying capacity and consequently, the No Action alternative would likely result in increased numbers of both axis and fallow deer in the Seashore. Alternative A would also likely result in increasing numbers of non-native deer outside of the Seashore. Expansion rates of non-native deer would depend on a number of factors beyond the control of PRNS, namely, range conditions and hunting pressure.

Impacts on Water Resources and Water Quality

Analysis

Grazing animals primarily affect water quality through activities that increase the potential for erosion or stream destabilization. They may also increase bacteria or nutrients in water through defecation in or near streams. Fallow deer, because they form large groups and remain in certain areas for prolonged periods, cause impacts due to congregation. These impacts resemble those of confined animals, such as domestic livestock.

Some information is available in the literature about the extent of water quality effects resulting from deer populations. Unlike native black-tailed deer, both fallow and axis deer congregate in riparian areas in groups, as do cattle, because vegetation in riparian areas tends to be more succulent year round. Cattle and non-native deer are known to occupy riparian areas even when their preferred foods have been eaten, particularly in the summer when they seek shade under willows and other vegetation. Cattle seem to prefer streamside forests, and this has led to impacts, some of them severe, researched and noted in other parts of the country. Although the extent of impacts from much smaller and lighter axis or fallow deer are not likely to be as severe, they do have similar grazing styles (e.g., both graze on grass year round, although deer supplement their diet with forbs to a greater extent) and so may have similar types of impacts. Because the information about the specific impacts of non-native deer at the Seashore on water resources is limited, those known to result from grazing by cattle and other ungulates are described in order to understand the impacts of non-native deer. It should be noted that cattle are excluded from many sensitive areas of the Seashore (such as riparian areas), therefore the impacts discussed below, are mitigated within NPS boundaries.

When large numbers of cattle periodically graze in riparian areas, or when smaller numbers repeatedly or continuously graze near rivers and streams, trampling and consumption of vegetation reduce the ability of these forests or shrublands to trap sediment from upland runoff. Also, because riparian soils are wetter, and because these areas are flat bottomlands, soils there tend to be more vulnerable to compaction (Hubert et al. 1992). Compaction interferes with the water storage function of riparian zones and increases the potential for runoff, which in turn can alter the normal hydrology of a stream or creek. In one study, researchers found an increase of 210% in runoff volume in an area of pine and bunchgrass forest where moderate cattle grazing had occurred, and an increase of 325% in an area where heavy cattle grazing took place.

The amount of runoff is directly related not only to compaction of soil, but to the amount of unvegetated area. Fallow and axis deer are known to create trails and open areas in the Seashore and elsewhere (NSW Scientific Committee 2004; Fellers and Osbourn 2006), especially when they congregate. Fallow bucks, during the breeding season, commonly thrash riparian vegetation with their antlers and have been observed to girdle and destroy riparian saplings (Fellers and Osbourn 2006; see Figures 13-16) Twenty-five percent of fallow deer leks (breeding areas) were observed to be in riparian areas and over 80% of these leks contained bark damage to trees or shredded foliage. A study of cattle grazing found 51% more runoff, related to the degree of bare patches, after 3 years of moderate grazing. Fallow deer trails in the Seashore are heavily frequented and easy to distinguish from native deer trails because they are wide, cross creeks and their soils are easily destabilized and subject to erosion (see Figure 16). These areas have the potential to deliver soil directly to the stream channel without filtration by riparian vegetation and to increase runoff. Increases in runoff can translate to more frequent flooding, increased flows and downstream erosion, and changes in side channel or other aquatic habitat. The loss of riparian vegetation from trampling or consumption also means upslope flows and sediment run more freely into streams and rivers, increasing sedimentation and total suspended solids.

Both cattle and deer can have large-scale impacts on riparian areas by consuming vegetation. Cattle can eat virtually 100% of the vegetation in a riparian area if they remain in it long enough, or are numerous enough to do so. Under these conditions, they are known to eat lower branches of willows, and all palatable forbs or grasses. Although fallow deer are smaller than cattle, if they occupy a riparian area for a long period of time, as they do during the dry season or the breeding season, they have been observed to exert noticeable loss of vegetation in that area through grazing and browsing (Fellers and Osbourn 2006). Seashore riparian areas often provide the last remnants of green vegetation at the end of summer and during droughts. In addition, fallow deer bucks tend to aggressively rub and thrash their antlers during the reproductive season or “rut,” causing destruction of riparian vegetation. Impacts of fallow deer thrashing are most acute within the pastoral zone in Olema Valley, where many riparian areas have been deliberately excluded with fencing from livestock grazing to restore canopy and natural hydrologic processes. In these areas, revegetation efforts and natural regrowth have been severely retarded due to heavy grazing and antler rubbing by the non-native deer (B. Ketcham, NPS, personal communication). Seasonal thrashing and girdling by fallow deer kills young trees and prevents native riparian plants from growing beyond shrub height. Unlike cattle, non-native deer cannot be excluded from sensitive riparian areas by conventional fencing.

The removal of vegetation can indirectly affect water quality. Without the benefit of the root structures vegetation provides, soil is loosened and washed into nearby streams or rivers during the next rainy period. In addition, soils in the immediate vicinity are more likely to be washed into the water column, and as noted above, the ability of these riparian zones to trap upslope sediment and runoff is diminished. This increase in runoff and sedimentation is sometimes aggravated by the destabilization of streambanks caused by congregating animals. One study on cattle (Hubert et al. 1992) found 80% more stream channel instability in a grazed area in Montana than a similar one that had been ungrazed. Stream bank loss and increased erosion resulting from denuded areas, compaction of soils and increased runoff, can add enough silt to a stream to increase levels of total suspended solids and change stream morphology. For example, in one study in northeastern Utah, the depth of stream adjacent to an area where cattle grazed decreased from 33 cm to 8 cm; the width increased as banks destabilized; and the riffles and gravel used by fish to spawn were covered in silt (Hubert et al. 1992). Eventually, this caused a change in the fish populations along strips of stream where cattle were grazing. Another study of Rock Creek in Montana found a 317% greater fish biomass in sections along ungrazed areas. Sedimentation associated with grazing also changed fish species composition, with whitefish and suckers occupying sections where total suspended solid levels were higher and trout occupying areas without grazing.

These alterations have implications for watersheds and aquatic life at the Seashore. For example, in at least three of the park's watersheds, Olema, Lagunitas and Pine Gulch, four species of concern occupy streams and creeks. These species are coho and Chinook salmon, steelhead and California freshwater shrimp. As noted in Affected Environment (Chapter 3), these species are dependent on riparian vegetation for cover and shade, and would require uncovered gravel for spawning and specific stream conditions for habitat and spawning success. The loss of this vegetation, streambank failure and increased runoff and erosion would alter habitat for any or all of these species in these watersheds, as fallow deer are known to occupy all three watersheds. For example, at one riparian restoration area in particular, John West Fork of Olema Creek, the park has erected fences to keep cattle out of riparian zones. Although livestock have been successfully excluded, fallow deer have found their way into the area (likely under the fences) and NPS staff has observed extensive damage to native willow in these areas (B. Ketcham, NPS, personal communication). As a result, it has taken five years since exclusion for willows to grow beyond waist height. Riparian restoration and planting projects conducted in wilderness and natural areas where densities of fallow deer are much lower (i.e., Muddy Hollow Culvert Restoration Site) have shown much more rapid vegetative recovery (NPS unpublished data (i)).

Cattle are known to also contribute fecal coliform and fecal streptococcal bacteria as well as increases in nitrates and phosphate to streams. If cattle are grazing close enough to a stream, their waste is washed into the water column during heavy rains. This is particularly true when animal density or grazing pressure is high. PRNS monitoring has shown that high levels of sediment and pathogens, resulting from livestock, may enter streams from localized sources and yet persist for 1–2 km. downstream (NPS 2001c). This is possible for non-native deer as well, as increased levels of indicator bacteria have been attributed to wildlife in published studies (Hubert et al. 1992) and fallow deer and axis deer (unlike native black-tailed deer) are found in large, high-density herds at PRNS (NPS 2002a).

The impacts described above to hydrology, stream morphology, aquatic habitat and water quality are currently considered minor to locally moderate, as defined in the Assessment Methodology section and depending on the area in the park. However, because fallow and axis deer would continue to be unmanaged in Alternative A, impacts would increase to moderate intensity and persist indefinitely. Over the 15-year period of time covered by this plan, impacts would spread in the park as the population spreads, and would worsen as axis and fallow deer continue to return to riparian areas.

It is highly likely that axis and fallow deer would expand their range outside the park within the next 15 years under Alternative A. Expansion of non-native deer populations beyond park boundaries could adversely impact riparian vegetation and water quality restoration activities occurring on private agricultural lands. Through various organizations, most notably the Marin-Sonoma Resource Conservation District, efforts to restore riparian corridors in the Walker and Chileno Creek watersheds have been made in conjunction with private agricultural operators. Long reaches of these streams have recently been excluded from cattle access with fencing and planted with willows and other riparian vegetation species. Expansion of deer populations outside Seashore boundaries would retard success or deter implementation of such riparian restoration projects due to reduced recovery rates and the perceived benefit associated with these projects.

In addition to affecting restoration efforts, the expansion of range for both axis and fallow deer would result in regional effects on water quality and hydrology. Alterations in fallow deer range in the past 10 years suggest that fallow deer would continue to expand southwards and eastwards, spreading beyond Seashore boundaries into private lands and lands administered by California State Parks and Marin Municipal Water District. Favorable non-native deer habitat (interspersed grasslands and forests) exists in close proximity to PRNS, GGNRA and throughout Marin and Sonoma Counties. The successful colonization and spread of axis and fallow deer within the Seashore suggest that range expansion throughout at least some of those counties is likely. Should non-native deer populations outside NPS boundaries reach or exceed densities currently seen in PRNS, adverse long-term impacts to water resources such as those described above could be much wider spread and approach major in intensity.

Unlike with livestock, where fencing and grazing limits may be enforced through permit authority, there are no means of mitigating for impacts of non-native deer to the water resources and water quality.

Cumulative Impacts

Cumulative impacts are those effects that could result when the impacts of Alternative A to a specific resource are added to the impacts of past, present and reasonable foreseeable future activities. As noted above, Alternative A could have direct and indirect moderate adverse effects on the water quality and hydrology of many of the park watersheds. An assessment of cumulative impacts on water quality and hydrology considers the potential impacts that Alternative A may have on water quality in conjunction with the impacts on this same set of water resources from past, present and reasonable foreseeable future actions. Actions listed in Appendix F that contribute to the cumulative impact scenario for water resources include:

- current dairy and beef grazing
- the Giacomini wetlands restoration project
- Fire Management Plan implementation projects
- coastal watershed restoration (geomorphic sites) in Drakes Estero watershed
- Drakes Estero watershed restoration projects
- sewage system improvements
- small restoration projects within the Seashore

(Further detail on these projects can be found in Appendix F, Projects Considered in Cumulative Impacts Analyses. Other wider-ranging issues that may contribute to the cumulative analysis are described below).

<u>Current and future livestock grazing and dairying.</u> Within the Seashore, livestock agriculture continues, as instructed by Congress in its Point Reyes Seashore implementing legislation, in the form of concentrated dairy and beef operations. Historically, heavy stocking levels were maintained that impacted hydrology, aquatic habitat and water quality within the Seashore.

The NPS grants to individual ranchers Special Use Permits which describe the terms of the lease. The Permits may contain requirements to modify agricultural operations in order to reduce the adverse impacts of livestock concentration. Whereas ranching operations once occupied the entire Point Reyes Peninsula, only 25% of the area remains currently in agriculture and the remaining 75% is managed as natural lands or wilderness areas. Within the 28,000 acres leased for agricultural, livestock has been successfully excluded (through fencing and other strategies) from 7,000 acres with sensitive resources, such as riparian zones and waterways. Cattle stocking has also been reduced by about 50% from approximately 12,045 head at the time of the park's establishment to 6,013 head at present.

The NPS shares management responsibility for the Tomales Bay Watershed, the Lagunitas Creek watershed, the Pine Gulch Creek watershed, Bolinas Drainages, Olema Creek watershed. Of these watersheds, the NPS manages the majority of lands in the Olema Creek and Pine Gulch watersheds (approximately 90% and 85% of the land is within the Seashore, respectively). The NPS has exclusive management responsibility for all of the Pacific Drainages (Kehoe, Abbotts Lagoon etc.), Drakes Bay, and Drakes Estero watersheds.

Tomales Bay, Walker Creek and Lagunitas Creek are all in the 45-square mile Tomales Bay Watershed, of which the NPS manages approximately 28%. These water bodies are listed by the State of California, under the Clean Water Act, as impaired by excessive levels of sediment, nutrients and pathogens. Waste from cattle is a primary contributor to the exceedences for nutrients and pathogens. Overgrazing and damage to channel banks from cattle is one of the contributing sources of high sediment levels, along with road failures, slope failures and landslides etc.

The State of California is required by the EPA to develop programs to reduce the Total Daily Maximum Load (TMDL) for each of the listed pollutants in these three water bodies by 2010. Actions to reduce pollutants and pollution within the Seashore, specifically in Lagunitas and Tomales Bay watersheds, have been developed to contribute directly to the State's restoration responsibilities.

The NPS and the Seashore's permittees have been working together, strategically modifying their operations to reduce impacts on water quality. For example, in the Kehoe Lagoon watershed (including North Kehoe and South Kehoe Creeks and tributaries), the beach monitoring program (in conjunction with the County of Marin), "posted" the area for exceedences of indicator bacteria (fecal coliform, *E.coli*, and *Enterococcus*) for water contact recreation several times in 2003. Kehoe Beach itself (saltwater) has consistently met the standards. The nearby dairy cattle operation undertook a barn expansion to increase the number of cows that are housed indoors to reduce pollution. Water quality data before and after the barn expansion will be monitored to determine the effect on water quality.

The Abbott's Lagoon watershed has recorded high fecal coliform levels in tributaries to the Lagoon during winter rains. The adjacent dairy built a barn in 2003 to house cattle and improve waste management. Preliminary results from the winter of 2004 indicate a marked decrease, compared to previous winters, in fecal coliform counts at two of the three monitoring sites. The average for the three sites was 8,700 MPN/100mL down from a high average of 10,000 MPN/100ml. Although this number still exceeds standards for non-contact recreation, additional decreases are anticipated in the next several years as operations become fine-tuned.

The Seashore has several other restoration projects planned or underway that would help improve water quality in Tomales Bay and other water bodies. Approximately, nine miles of fencing has been installed throughout the park to protect sensitive resources such as riparian corridors and wetlands and improve water quality. Focused monitoring of Kehoe Creek and Abbott's Creek has been initiated in order to differentiate sources and allow for more strategic siting of additional fencing (NPS 2004b).

When the effects of past, present and future ranching and dairying are viewed incrementally with the potentially adverse impacts of Alternative A, the impact results in exceedences for Tomales Bay and in smaller systems. The water quality impact is therefore apparent, local, and with the potential for regional effect. The impact is long-term, moderate and adverse on park and shared water resources.

<u>The Giacomini Marsh Restoration</u> would restore 550 acres of pasture and rangeland to coastal marsh habitat. The project would reverse the loss of 60% of Tomales Bay wetlands which occurred in the 1940s when the coastal marsh was diked for a dairy operations. Restoring connectivity between Tomales Bay and the dairy will improve water quality not only within the Project Area, but within the entire Bay. The project will increase filtering of nutrients, contaminants, and sediment coming into the Bay from Lagunitas, Olema, and Bear Valley Creeks. In addition, hydrologic modeling indicates that the proposed restoration alternatives would have a considerable beneficial impact to reduce flooding of adjacent properties and county roads, improving overall wetland functions such as floodwater retention. A project objective is to enhance water quality by creating a marsh filtration system to increase natural resource protection over a localized area while enhancing water quality throughout Tomales Bay and surrounding Pacific Ocean waters. With the potential to have apparent localized and possibly regional effects, the Giacomini Marsh Restoration, would have a beneficial, long-term moderate impact on water quality.

<u>Fire Management Plan for Point Reyes National Seashore</u>. Up to 3,500 acres annually could be burned or mechanically treated over the next decade as a result of the Fire Management Plan. The EIS for the Fire Management Plan concluded that impacts to water quality and watershed characteristics would be a long-term, beneficial moderate to major effect on park and shared watersheds by implementing project that reestablished natural hydrological processes and reduced fuel loads and the potential for catastrophic wildfire (NPS 2004). The annual work plan for the park is reviewed each year to ensure that annually no more than 10% of an individual watershed is disturbed by Fire Management Plan actions. At all phases of project implementation, erosion and sediment transport will be strictly controlled by erosion control techniques and avoidance of potentially high source areas. Over the short-term, the fire management plan would have minor, adverse, short-term impacts to water quality from ash or increases in erosion and suspended solids. Minor impacts to water quality and hydrology are defined as those that are slightly perceptible, without potential to expand and of localized extent.

<u>Coastal Watershed Restoration (Geomorphic Sites) in Drakes Estero Watershed</u>. The Coastal Watershed Restoration – Geomorphic Sites Project is currently in the planning stage. An Environmental Assessment on the proposal was circulated in 2004. The project would restore natural hydrologic function and increase estuarine habitat at Muddy Hollow Dam, Limantour Beach Dam and the Glenbrook Road Crossing by removing these barriers to tidal action. Impacts to hydrology and water quality under the selected alternative would have a short-term minor to moderate, localized adverse impact following project implementation. Though there would be shifts in water regime and channel and estuarine configuration following barrier removal, adaptive management measures such as installation of passive grade control would mitigate short-term impacts. The project actions would primarily have localized effects resulting in a beneficial, long-term minor to moderate impact on hydrologic and estuarine processes.

<u>Drakes Estero Road Crossing Improvement Sites.</u> This project proposes improvements to 6 culverted creek crossings within 3 coastal subwatersheds, all of which eventually drain to Drakes Estero and Drakes Bay. All are on perennial drainages or creeks that have flowing water throughout the year. The potential impacts associated with implementation of the project on hydrologic process, geomorphic process, and water quality are adverse, and minor to moderate in the short term. Short-term impacts include excavation of stream channel banks and beds, soil compaction and erosion due to heavy equipment traffic. Localized moderate impacts are expected at sites that would include installation of boulder cross-vanes or large-scale riprap armoring along with structure replacement. The restoration of more natural

hydrologic and geomorphic process to these watersheds would be beneficial in the long term. In the long term, there would be no adverse effect on water quality.

<u>Sewage Systems Improvements.</u> The NPS has completed sewage systems upgrades at visitor and staff structures throughout the park. All improved systems result in beneficial impacts to groundwater quality and to surface water in ponds, drainages and creeks by reducing the potential for leaching or leaking of contaminants. New, major septic systems are planned for the Home Ranch, the Point Reyes Lighthouse, the Point Reyes Hostel and upgrades are planned for the Drakes Beach system. These projects would have minor beneficial long-term effects on water quality by reducing sources of localized pollution.

Small creek restoration protection projects in Olema Valley for coho salmon and steelhead trout will include bank stabilization and fencing to exclude cattle. These projects would have a long-term, minor beneficial impact on the water quality of Bear Valley, Pine Gulch and Olema creeks.

Activities outside park boundaries that have an adverse effect on the same watersheds as those affected by non-native deer include four dams on Lagunitas and Nicasio creeks in the Lagunitas Creek watershed, and historic heavy logging on the Pine Gulch Creek watershed. Drake's Estero is also susceptible to nutrient inputs from grazed lands within the watershed and from increased sedimentation resulting from the Vision Fire. Beneficial cumulative effects on park watersheds have resulted from restoration planning for the Bolinas Lagoon (into which Pine Gulch Creek flows), riparian cattle exclusion fencing, and habitat restoration in the Olema watershed.

Based on the large geographic scope of the non-native deer effects on water in Alternative A, the adverse impacts on water resources would not be significantly offset by the beneficial impacts of some the above projects and, along with continued cattle ranching, would continue to present a long-term, adverse, moderate to major impact on the water quality and hydrology within the park and beyond the park boundaries.

Conclusion

Based on current and past data on fallow and axis deer, non-native deer populations would continue to increase, resulting in expanded range and higher animal concentrations within the Seashore and Marin County. While current direct and indirect impacts to water quality and hydrology from Alternative A would be minor to locally moderate, continued growth and expansion of the population would result in impact intensity increasing inside the park to moderate in the long term. This would not constitute an irreparable impairment of the park's water resources though impacts would be locally noticeable and with the potential to be apparent throughout the park. As the range of each species expands countywide, the potential for moderate to major impacts outside the park becomes greater.

Alternative A presents no means that would counter the expansion of the range and population of non-native deer nor any strategies to limit the direct and indirect impacts of non-native deer on water quality and hydrology. None of the projects described in the cumulative assessment of impacts to water quality would impede the continued, unlimited spread of non-native deer outside of the park. Though the cumulative impact scenario describes several restoration, rehabilitation and facility improvement projects that incrementally represent a substantial improvement to park and vicinity water resources, only the marsh restoration project would provide some treatment of water quality degraded by concentrations of non-native deer in Olema Valley. Non-native deer would continue to pass through the fences protecting sensitive resources from cattle. The adverse impacts of Alternative A on water resources would not be significantly offset by the beneficial impacts of some of the projects considered in the cumulative analysis and, along with continued ranching, would continue to present a long-term, adverse moderate to major impact on the water quality and hydrology within the park and beyond the park boundaries.

Type of Impact:	Adverse
Duration of Impact:	Long-term
Intensity of Impact:	Moderate in the park; potentially major outside the park
Cumulative Impact:	Adverse, long-term moderate to potentially major cumulative impacts to water resources and water quality within the park and beyond park boundaries.

Impacts on Soils

Analysis

Soils could be affected by non-native deer in several ways; through direct mechanical compaction or disturbance, through erosion related to the loss of overlying vegetation, through the addition of nutrients in waste products, and by more subtle changes in soil characteristics related to physiological responses of vegetation to grazing.

The project area includes lands both east and west of the San Andreas Fault. Soils to the east of the fault are derived from the Franciscan complex, which are typically dominated by clay-sized particles (loam) with a lower capacity for water infiltration and storage. Franciscan-derived soils are highly sensitive to compaction, resulting in more rills and gullies related to increased runoff rates. To the west of the San Andreas Fault, soils are more organic and typically have a sandier quality. These soils are usually deeper and have higher rates of infiltration. While somewhat less susceptible to compaction, these soils are highly erosive when disturbed. The soils are less cohesive and more subject to erosion associated with rainfall and surface runoff.

Soil compaction may occur when large numbers of non-native deer or other large animals congregate in one area for long periods of time, or when vehicles are driven off road for non-native deer management activities. As noted in other sections of this document, fallow deer are known to congregate in large herds and occupy areas for prolonged periods of time. This increases both the likelihood and the intensity of soil compaction. When soils are compacted, the bulk density increases and the rate of infiltration decreases, which ultimately means an increase in runoff. One study of cattle grazing in Colorado found bulk densities averaged 21% higher in areas grazed than in similar, ungrazed areas (Hubert et al. 1992).

Compaction may be more likely in the moist soils of flat bottomlands adjacent to riparian areas, but use of steeper areas by axis or fallow deer is also likely to increase the potential for erosion. Soils east of the San Andreas fault, which are more likely to experience compaction, would be particularly affected along bottomlands or riparian areas, while the organic soils west of the fault, along steeper slopes, would be subject to erosion. Axis deer on Lanai'i in the Hawaiian Islands are known to occupy both bottomlands and valleys and move up slope as browse disappears or the population expands (Dorman 1997). Axis deer were imported first to Moloka'i from India as a gift to King Kamehameha from the people of Hong Kong in 1868; in fewer than 100 years the population had expanded to 7,000 and have caused extensive documented loss of soils through grazing and breaking trails (Dorman 1997).

As described above in the Water Resources and Water Quality section, and below in the Vegetation section, non-native deer also affect soil indirectly by trampling and consuming vegetation. These deer can remove substantial quantities of vegetation, particularly when they congregate in large groups and remain in an area for a period of time. Studies have found that even moderate grazing by fallow deer can result in noticeable increases in open, unvegetated areas. For example, monitoring of a reintroduced herd of Persian fallow deer in northern Israel found that even low deer densities (less than 1 per acre) resulted in clear increases in the amounts of amount of open, unvegetated soil compared to a control area (Bar-David et al. 1998). This same population also created unvegetated open areas by breaking trails through chaparral.

A recent study of PRNS fallow deer lekking behavior during the seasonal rut documented that trampling and thrashing of riparian vegetation, trailing near streams and destruction of riparian trees is a common occurrence (Fellers and Osbourn 2006). Fallow deer trails in the Seashore are heavily frequented and easy to distinguish from black-tailed deer trails because they are wide, cross creeks, are easily destabilized and subject to erosion (B. Ketcham, NPS, personal communication). These areas have the potential to deliver soil directly to a stream channel without filtration by riparian vegetation. In seasonal rutting areas, fallow deer have been observed to denude, and then scrape and tear at the soil. Scraped areas as large as 32 meters across and ruts as deep as 0.6 meters have been observed inside the park (Fellers and Osbourn 2006). The extent of damage in late fall is severe in some forest and shrubland areas. Fallow deer leks, characterized by denuded and scraped areas, have been found in the Estero Trail and Bear Valley area in densities of 28.4 and 78.8 per square kilometer respectively (Fellers and Osbourn, 2006) (see Figures 13-16). It is estimated that at least 120 acres of park lands are affected by lekking damage.

When vegetation is removed through trampling, scraping and tearing, breaking trails, or consumption of vegetation, soils are no longer held in place by the subsurface root structure and are much more subject to erosion during precipitation events. Park biologists have observed more erosion along the trails and in the rutting areas of non-native deer than in similar undisturbed areas.

Once initiated, compaction and soil loss from erosion can last for a long period of time. This is because vegetation is less likely to grow in soil that has been compacted, or where top organic layers have been removed through erosion. This long-term or permanent cycle of erosion and vegetation loss occurs particularly when compaction or erosion is severe.

Deer and other herbivores can change the characteristics of soil through their urine and feces, which return carbon and nutrients to the soil in labile forms, and enhance the nutrients in the soil around roots. This can increase plant growth and net primary productivity at a landscape scale, although the loss of vegetation caused directly by grazing decreases productivity.

Grazing cause physiological changes as well, which can translate into chemical changes in soil. For example, in some forests where nutrients are often not readily available (because they are locked up in the litter, which decomposes very slowly), deer would browse selectively on the most nutritious plants and then leave, taking the nutrients with them and making the system more nutrient poor. This also, in turn, reduces the activity of soil microbial organisms. On the other hand, in large grasslands, herbivory at low or moderate levels can stimulate a short-term increase in carbon in plant roots. This can lead to increased soil microbial biomass and net production of nitrogen by these microbes, which then becomes available for uptake into the plant shoots. One study that mimicked grazing by clipping found short-term increases in biomass and increased nitrogen in grass stems (Ayres et al. 2004). Heavy grazing in grasslands reduces the concentrations of carbon and nitrogen in both roots and litter (Mapfumo et al. 2002).

The impacts of grazing and breeding behaviors, including denuding of sites, increased soil compaction and disturbance, runoff and loss, changes in nutrients and changes in chemical properties, are currently present on more than 120 acres and would only increase in geographic scope and intensity at the Seashore if Alternative A were implemented. Overall, the impacts to soil from these behaviors are currently considered to be adverse and moderate in intensity. Under Alternative A, these impacts in the park would continue into the foreseeable future and would be long-term.

Alternative A would likely result in increased range for both axis and fallow deer. Alterations in fallow deer range in the past 10 years suggest that fallow deer would continue to expand southwards and eastwards, spreading beyond Seashore boundaries into private lands and lands administered by California State Parks and Marin Municipal Water District. Favorable non-native deer habitat (interspersed grasslands and forests) exists in close proximity to PRNS, GGNRA, and throughout Marin and Sonoma Counties. The successful colonization and spread of axis and fallow deer within the Seashore suggest that range expansion throughout at least some adjacent counties is likely. Should non-native deer populations expand outside NPS boundaries, adverse long-term impacts to soils could occur on more than 500 acres of ground and would therefore be characterized as major.

Unlike with livestock, where fencing and grazing limits may be enforced through permit authority, there are no means of mitigating for impacts of non-native deer to soil resources.

Cumulative Impacts

Cumulative impacts are those effects that could result when the impacts of Alternative A to a specific resource are added to the impacts of past, present and reasonable foreseeable future activities. As noted above, Alternative A impacts to soils from non-native deer inside the park would likely remain moderate and expansion of the populations outside the park could result in major adverse impacts to soils through compaction and loss. An assessment of cumulative impacts on soils considers the potential impacts that Alternative A may have on soils in conjunction with the impacts on the same soils from past, present and reasonable foreseeable future actions. Actions listed in Appendix F that contribute to the cumulative impact for soils include:

- current and future livestock grazing and dairying
- the Giacomini Wetlands restoration project
- Fire Management Plan implementation projects
- coastal watershed restoration (geomorphic sites) in Drakes Estero watershed
- Drakes Estero watershed restoration projects
- sewage system improvements
- small restoration projects within the Seashore

(Further detail on these projects can be found in Appendix F, Projects Considered in Cumulative Impacts Analyses. Other wider-ranging issues that may contribute to the cumulative analysis are described below).

<u>Current and future livestock grazing and dairying.</u> Within the Seashore, livestock agriculture, as instructed by Congress in its Point Reyes Seashore implementing legislation, continues in the form of concentrated dairy and beef operations. Historically, heavy stocking levels had impacts on hydrology, aquatic habitat and water quality within the Seashore.

The NPS grants to individual ranchers Special Use Permits which describe the terms of the lease. The Permits may contain requirements to modify agricultural operations in order to reduce the adverse impacts of livestock concentration. Whereas ranching operations once occupied the entire Point Reyes Peninsula, only 25% of the area remains in agriculture with 75% managed as natural lands or wilderness areas. Within the 28,000 acres leased for agriculture, livestock have been successfully excluded (through fencing and other strategies) from 7,000 acres with sensitive resources such as riparian zones and creeks. The concentration of cattle has also been reduced by about 50% from approximately 12,045 head at the time of the park’s establishment to 6,013 head at present.

The primary impact to soils is through compaction, disturbance, erosion and addition of nutrients. These same types of impacts are caused by cattle in the form of dairy and beef operations on Seashore lands. Soil compaction and denudation is a concern related to both historic and current livestock operations. The

National Park Service conducts Residual Dry Matter surveys on pastoral lands to ensure that livestock do not denude the land through overgrazing. Techniques to mitigate overgrazing, including fencing, stocking rate reduction and rotational grazing, have been implemented with success.

Soil compaction is a problem associated with all concentrated animal operations. Soil compaction outside of the pastoral zone is likely a direct result of non-native deer, which unlike native black-tailed deer, are found in large herds. Within the pastoral zone, because deer can access areas fenced off to cattle, they would increase the level of compaction beyond that caused by cattle. Because the total number of acres heavily impacted by dairy and beef operations in the park is already approximately 1,300 acres, the adverse cumulative impact of deer in Alternative A, along with cattle gazing, is considered major. The acreage of soils impacted by ranching in the Seashore has been markedly reduced by active management and other mitigation measures such as fencing, stocking rate reductions and the removal of pastures from grazing and silage production. The current impacted area may be further reduced by further mitigation planned for the next 5 years.

<u>Fire Management Plan.</u> Impacts to soils from the anticipated fire management actions include changes in soil productivity and chemistry, as well as erosion following the removal of vegetation. The impacts on soils from increased erosion of prescribed burning and the average wildland fires (no more than about 30 acres per year), under the selected alternative, would be negligible to minor. Moderate to major, short to long-term, adverse cumulative impacts to the physical, chemical, and biological properties of soils from a very large or catastrophic wildland fire are possible under the selected alternative. Suppression activities could have additional adverse, short to long-term moderate to major impacts from soil compaction, mixing, reduced infiltration, loss of vegetation, and changes in soils that prevent quick revegetation. Actively suppressing wildland fires before they reach sensitive resources could keep impacts from becoming major and adverse. Because of the potential for a catastrophic fire, cumulative impacts of the fire management plan with Alternative A are considered major (the combined effects would be greater than 500 acres). However, normal fire activities in the Fire Management Plan —prescribed fire, mechanical treatment, and small wildfires—would have only a negligible to moderate effect on soil resources.

<u>Coastal Watershed Restoration (Geomorphic Sites) in Drakes Estero Watershed, Drakes Estero Watershed Restoration Projects, Coastal Dune Restoration, Giacomini Wetlands Restoration, Sewage System Improvements, and Small Restoration Projects within the Seashore.</u> These projects generally have short-term impacts to soils, but long-term beneficial impacts. The Giacomini and Coastal Dune Restoration projects will temporarily disturb a large number of acres (approximately 900), but the long-term effects will be beneficial to soil structure.

Based on the large number of acres with soil impacts in Alternative A, the adverse impacts on soil resources would not be significantly offset by the beneficial impacts of some of the above projects and, along with continued cattle ranching, would continue to present a long-term, adverse moderate to major impact on the soil resources within the park and beyond the park boundaries.

Conclusion

Based on current and past data on fallow and axis deer, non-native deer populations would continue to increase, resulting in expanded range and higher animal concentrations within the Seashore and Marin and Sonoma Counties. No impairment to soils would occur from implementing Alternative A. All of the impacts associated with the presence and/or expansion of these populations are characterized as adverse. Impacts to soils from non-native deer inside the park would likely remain moderate and expansion of the populations outside the park could result in major adverse impacts to soils through compaction and loss.

Based on the large number of acres with soil impacts in Alternative A and the larger number of acres affected by grazing (3,700), the adverse impacts on soil resources would not be significantly offset by the beneficial impacts of some of the projects described above and, along with continued ranching, would continue to present a long-term, adverse cumulative moderate to major impact on the soil resources within the park and beyond the park boundaries.

Type of Impact:	Adverse
Duration of Impact:	Long-term
Intensity of Impact:	Moderate inside and major outside the Seashore
Cumulative Impact:	Adverse, long-term moderate to major cumulative impacts to soils within the park and beyond park boundaries.

Impacts on Vegetation

The Seashore and northern district of GGNRA are known to support over 900 plant species. The project area can be divided into 10 broad vegetation classes, ranging from forests to grassland and dunes. Because non-native deer feed primarily on grasses and some forbs, they are found in highest numbers within 4 vegetation classes: riparian forests, coastal scrub, grasslands and pasture. To a lesser extent, they can be found in the other forested classes: Bishop pine, Douglas fir/coast redwood, hardwood, Monterey pine/Monterey cypress forests. Non-native deer are not found in the coastal dune or wetland/marsh vegetation classes. The following tables reflect the specific plant communities where each species of deer is currently found.

TABLE 7: VEGETATION COMMUNITIES USED BY FALLOW DEER AT PRNS (DATA BASED ON PRNS VEGETATION MAP DATA AND CURRENT PRNS FALLOW DEER RANGE DATA)

Plant Community	**Acres**	**% of Total Range**
Grassland	6259	28%
Coastal Scrub	5,683	25%
Douglas-fir/Redwood	5,530	24%
Hardwood Forest	2,177	10%
Riparian Forest/Shrubland	1,011	5%
Pasture	684	3%
Bishop Pine	489	2%
Unvegetated	341	1%
Other	476	2%
Total Acres	22,655	

TABLE 8. VEGETATION COMMUNITIES USED BY AXIS DEER AT PRNS (DATA BASED ON PRNS VEGETATION MAP DATA AND CURRENT PRNS FALLOW DEER RANGE DATA)

Plant Community	Acres	% of Total Range
Grassland	625	41%
Pasture	507	33%
Coastal Scrub	209	14%
Other Herbaceous	55	4%
Unvegetated	51	3%
Bishop Pine	41	3%
Hardwood Forest	22	1%
Riparian Forest/Shrubland	12	1%
Total Acres	1,523	100%

Analysis

Deer and other ungulates can cause a variety of impacts on vegetation. They consume vegetation, which can result in changes to physical structure, structural diversity, species composition and productivity in plant communities, as well as weed and nutrient dispersal. Deer can trample vegetation, particularly when they congregate in large groups, as they do during the rutting season or other times of the year at the Seashore. Deer can alter patterns of nutrient cycling both within plant communities and by transferring nutrients from one community to another, and can change the distribution of nutrients between plant shoot and root structures. Depending on the soil fertility, intensity of grazing and the vegetation being grazed, deer and other ungulates can stimulate or suppress vegetative productivity across a landscape.

Studies of the diets of fallow and axis deer at the Seashore have found that both species tend to eat grasses and some forbs in the fall, winter, and spring, and comparatively more forbs in the summer. The same studies found they ate more forbs and browse than cattle, and that native black-tailed deer ate mainly forbs throughout the year (Elliott and Barrett 1985; NPS unpublished data 1983; Elliott 1983). The diet of black-tailed deer overlapped with axis and fallow deer to some degree, particularly during the summer or during times of drought, when both ate forbs. A review of Elliott's 1982 dietary overlap study by Gary Fellers, a U.S. Geological Survey scientist, suggested that exotic deer at levels of 350 for each species could reduce the native black-tailed deer population size by up to 30% (Fellers 1983). If black-tailed deer numbers are strongly influenced by the energy content of their diet, the reduction in their population, when fallow deer number 350, could be as much as 40% below carrying capacity (Fellers 1983a, 1983b, 2006). Tule elk, another ungulate native to the Seashore area, were reintroduced to the park in 1978. The majority of tule elk are kept in a fenced area at Tomales Point, but a small group has been released into the remainder of the park. Studies of the diet of tule elk show that this species eats grasses year-round, particularly during the winter (Gogan and Barrett 1995). In the spring, they add considerably more forbs to their diet, and in summer, may add shrubs like willow.

A few species made up the bulk of fallow and axis deer diet. These are grasses *Danthonia californica* and of the genus *Agrostis* and *Bromus*, the forb *Plantago lanceolata*, and a legume *Lotus corniculatus* (Elliott and Barrett 1985). Black-tailed deer also consumed *Plantago* and *Bromus*. Other studies have characterized axis and fallow deer as primarily grazers, but opportunistic feeders that also eat shrubs, buds, shoots, and leaves of trees. They are classed as intermediate mixed grazers that can feed on a variety of shrub, understory, forb and grass species depending on availability (NSW Scientific Committee 2004).

A comparative study of tule elk and fallow deer diets in the Limantour and Tomales Point areas has shown that elk and fallow deer in the Limantour area use similar forage species throughout the year (Fallon-McKnight 2006). Fallow deer show a preference for native clovers (*Trifolium spp.*) and brome (*Bromus carinatus*) as well as *Plantago spp.* (a high energy and high protein forage). The author of this study concluded that, in areas where both species cohabit, competition for forbs likely remains throughout spring and summer, which is a time that both species are nursing young. Increased grazing pressure on *Plantago* spp. and other important forage items by fallow deer could deprive Limantour elk of the nutritional benefits of these food resources at a critical time and result in decreased female condition, juvenile survival, and ultimately, decreased recruitment.

The scientific literature is full of information about the effects grazing ungulates can have on vegetation, both in a particular forest or shrublands as well as across landscapes. In northern forests, where nutrients are often not readily available because they are tied up in slowly decomposing leaf and needle litter, selective grazing by deer can eliminate or retard the growth of young trees, shrubs and forbs, allowing grasses and unpalatable species to increase. Over time, and assuming browsing pressure is not high enough to eliminate all seedlings, deer bring about a change in the species composition of surviving seedlings and saplings. For example, in mixed hardwood forests monitored in one study, birch, alder and beech were resistant because they are unpalatable to deer while oak, ash and willows were vulnerable (U.K. Forestry Commission 2000). A similar study that modeled the effects of heavy white-tailed deer (*Odocoileus virginianus*) grazing on forests in Virginia found sapling recruitment of white ash and *Rubus* spp. saplings was suppressed 80–95% over control sites. Deer densities in that study were 30–40 deer/ sq. km. (Cross 1998) while deer densities in the Seashore can exceed 80 deer / sq. km. (NPS 2002a).

Grazing in woodlands can keep trees from reaching their full stature, or from becoming established at all. It can also reduce the height of shrubs, or nearly eliminate the shrub layer altogether (Putnam 1986). Axis and fallow deer eat some shrubs, but, during most of the year, primarily eat grasses and forbs. In riparian areas where fallow deer congregate in large herds of up to 150 animals, long-term browsing of forbs and grasses has led to a lack of understory vegetation (J. Rodgers, NPS, personal communication). This and an absent middle layer of shrub vegetation is not unusual where heavy grazing occurs, and can eliminate an important component of wildlife habitat, particularly for birds. On Moloka'i in the Hawaiian Islands, axis deer have created "browse lines" on standing vegetation, an obvious clearing of vegetation from the ground to the highest point the deer can reach (Dorman 1997).

Lighter grazing does not have this effect. One study of the effects of deer on mixed hardwood and deciduous forests in the U.K. found that densities below about 3–7 deer/ sq. km. allow regeneration of trees and shrubs (U.K. Forestry Commission 2000).

Heavy or sustained grazing in woodlands reduces species diversity. Although lighter grazing might leave some saplings, browse, and forbs in forests and actually result in increased species diversity, sustained heavy grazing eliminates virtually all individuals of palatable species, and can leave near monocultures of unpalatable species behind. For example, in England where fallow deer were introduced a thousand years ago by the Romans, moderate levels of grazing have resulted in the expansion and spread of holly, to the exclusion of forbs and browse. Grasses and rosette-style plants, which are able to withstand heavier grazing pressure, have also proliferated (Putnam 1986). In the Royal National Park in New South Wales, grazing by exotic Rusa deer (*Cervus timorensis)* have been shown to alter the structure, species abundance and composition of grassland communities. Areas with higher densities of deer show 30–70 % fewer plant species that those with lower densities. (New South Wales National Parks and Wildlife Service 2002; New South Wales Scientific Committee 2004) In Pennsylvania forests, variable densities of white-tailed deer were found to be linked with forest changes. Species richness and the height of saplings declined once density of deer exceeded 7–8 per sq. km., and seedlings of six species were missing altogether at these densities (deCalesta 1997).

Over time, heavy grazing of woodlands or shrublands can mean conversion to grassland dominated by unpalatable species. In grassland ecosystems, the natural progression to shrubland or forest is sometimes halted indefinitely by ungulate grazing (Putnam 1986; Deer Commission for Scotland 2004; Cross 1998). Fallow deer in England remove the tips of lateral and leading shoots of trees and shrubs, and would graze forbs and grasses to the point of creating a "lawn" only a few millimeters high and composed of a few grass species (Deer Commission for Scotland 2004). In some areas of the world, non-native ungulate grazing has devastated species richness and altered physical structures to the point that the forest no longer exists. In Hawaii, on the island of Moloka'i, very heavy grazing pressure from introduced axis deer on the Kalaupapa peninsula has resulted in landscape-scale adverse impacts on vegetation (Dorman 1997) On Lana'i, axis deer and feral pigs have stripped vegetation and eaten emergent plants of trees and shrubs to the point that they have converted the Ohia-Hapuu rainforest to a grassy scrubland (Dorman 1997).

Concern over the selective grazing by exotic Rusa deer on rare species or vegetation in unique vegetative communities has also prompted the National Parks System of New South Wales to declare them a "key threatening process" and a target for eradication under Australia's Threatened Species Conservation Act (NSW Scientific Committee 2004). The scientific committee making this finding listed the loss of 30% of the understory species in sandstone heath, 40% loss in sandstone woodland, and 70% loss in littoral rainforest. All three are protected and rare plant communities.

Recently, U.S. researchers, in a review of 63 past field studies conducted in a wide range of biomes, concluded that non-native ungulates (cattle, horses, exotic deer, sheep, etc.) selectively suppress the abundance of native plants in the field, promoting exotic plant dominance and richness (Parker et al. 2006). They hypothesized that non-native ungulates often originate in the same regions as the non-native plants and are co-adapted to them and therefore less able to limit their invasion or spread ("invasional meltdown" hypothesis).

In the Seashore, riparian areas account for 5–6% of the range occupied by fallow and axis deer but are used disproportionately by them. These are unique areas in the park, and offer habitat for a variety of wildlife species, some of them threatened or endangered. The Seashore is attempting to restore, with fencing, some of these riparian areas in the Olema Creek watershed that have been degraded by cattle. Park managers have been unsuccessful in keeping fallow deer out. In fact, fallow deer spend much of the rut season in these streamside forests and shrublands. Herds of up to 150 animals tend to remain faithful to certain pastures and woods and return to them frequently year-round (NPS unpublished data (j)). Densities can be as high as 80 deer/ sq. km., several times the densities at which the effects of heavy grazing have been documented for white tailed deer and other ungulates.

The effects of so many deer in a sensitive streamside habitat can be locally severe. Most small to mid-sized deer species are thought to consume 3–4% of their body weight in vegetation daily (Halls 1970). This means that, at a minimum, current non-native deer populations remove 1–2 tons of forage from the Seashore per day. Riparian vegetation is not extensive in the Seashore, and concentrating some portion of this consumption in it even for a short time would have highly noticeable effects. Because fallow deer return annually to these rutting ("lekking") areas, the effects could be wider in scope or be cumulative over time than if it were a single event. In addition to consuming vegetation, fallow deer damage and remove it through trampling, through breaking trails, and bucks through antler thrashing, digging or mating displays.

The impacts of such high densities have been increased denudation of areas, soil erosion, compaction of soils, destruction of understory and saplings and a reduced ability for vegetation to regrow. Where the park has fenced riparian areas to protect them from cattle grazing, revegetation efforts and natural regrowth have been severely retarded due to heavy grazing, girdling and antler rubbing by fallow deer

(PRNS unpublished data (i); Fellers and Osbourn 2006). In 2005, 64% of fallow deer lek sites exhibited shredded foliage, 45% exhibited trees with damaged bark and 19% exhibited exposed tree roots. Continual grazing of new shoots and seasonal thrashing by fallow deer can prevent native riparian plants from growing beyond shrub height. At one riparian restoration area in particular, John West Fork of Olema Creek, NPS staff has observed extensive damage to native willows (*Salix spp.)* in areas excluded from livestock access (B. Ketcham, NPS, personal communication). It has taken an unusually long time (5 years) since cattle exclusion for the willows to grow beyond waist height. Riparian restoration and planting projects conducted in wilderness and natural areas where densities of fallow deer are much lower (i.e., Muddy Hollow Culvert Restoration Site) have shown much more rapid vegetative recovery (NPS unpublished data (i)). Figures 13-16 illustrate fallow deer damage to riparian and woodland vegetation.

In addition to the effects deer have on the physical structure, species diversity and composition of vegetative communities, they can act as forces in the distribution of seeds and nutrients. For example, consumption of non-native seeds in one area and migration and dispersal into an unaffected area can add to the spread of invasive plants. This is true for native plants as well. Grazers can also exert a large-scale effect on the nutrient levels in soils through their waste products. While the high nitrogen content of urine may damage some species, others grow more quickly in nitrogen enriched soil. Feces and urine can stimulate soil microbial activity as well, which means the production of nitrogen is increased and available to plant roots. This is taken up by plant shoots and becomes available to herbivores as more nutrient rich forage (van derWal et al. 2004). The cycle of adding nutrients in the form of waste products and returning it in the form of more nutritious forage is one of the key mechanisms grazers manipulate their own food supply, particularly in grasslands, although the effect has been proven in tundra ecosystems as well (van derWal et al. 2004). Grazing or browsing can also stimulate carbon allocation to root systems. This increases microbial activity and stimulates the production of nitrogen, which in turn can increase productivity above ground. This cycle occurs readily in grassland ecosystems where grazing pressure is light, and can lead to a proliferation of grasses preferred by some ungulates (Wardle and Bardgett 2004).

Unmanaged and expanding populations of non-native deer would continue to impact vegetation communities throughout the Seashore. Non-native deer grazing, girdling and thrashing impacts would also reduce the success and effectiveness of plant conservation and restoration projects by affecting individual rare species as well as recovering native vegetation. Currently, the impacts of non-native deer to vegetation in the park remain localized and moderate. However, if Alternative A were implemented, herds would increase in size and the damage to vegetation would be more widespread inside the park. Over the 15-year lifetime of the plan, impacts inside the park would become moderate to locally major and would persist indefinitely or continue to worsen.

Alternative A would likely result in increased range for both axis and fallow deer. Alterations in fallow deer range in the past 10 years suggest that fallow deer would continue to expand southwards and eastwards, spreading beyond Seashore boundaries into private lands and lands administered by California State Parks and Marin Municipal Water District. Favorable non-native deer habitat (interspersed grasslands and forests) exists in close proximity to PRNS, GGNRA, and throughout Marin and Sonoma Counties. The successful colonization and spread of axis and fallow deer within the Seashore suggest that range expansion throughout at least some of those counties is likely. Should non-native deer populations outside NPS boundaries reach or exceed densities currently seen in PRNS, adverse long-term impacts to the plant species described above could be substantial, highly noticeable, and could irreversibly change plant community size, continuity, or species richness and would therefore be characterized as major.

Unlike with livestock, where fencing and grazing limits may be enforced through permit authority, there are no means of mitigating for impacts of non-native deer to vegetation communities.

Cumulative Impacts

Cumulative impacts are those effects that could result when the impacts of Alternative A to a specific resource are added to the impacts of past, present and reasonable foreseeable future activities. As noted above, the Alternative A could have direct and indirect moderate to major adverse effects on vegetation. An assessment of cumulative impacts on vegetation considers the potential impacts that Alternative A may have on vegetation in conjunction with the impacts on this same set of vegetation resources from past, present and reasonable foreseeable future actions. Actions listed in Appendix F that contribute to the cumulative impact scenario for vegetation include:

- current dairy and beef ranching operations
- the Giacomini Wetlands restoration project
- Fire Management Plan implementation projects
- coastal dune restoration
- coastal watershed restoration (geomorphic sites) in Drakes Estero watershed
- Drakes Estero watershed restoration projects
- small restoration projects within the Seashore

(Further detail on these projects can be found in Appendix F, Projects Considered in Cumulative Impacts Analyses. Other wider-ranging issues that may contribute to the cumulative analysis are described below).

<u>Current and future livestock grazing and dairying.</u> Within the Seashore, livestock agriculture, as instructed by Congress in its Point Reyes Seashore implementing legislation, continues in the form of concentrated dairy and beef operations. Historically, heavy stocking rates had impacts on hydrology, aquatic habitat and water quality within the Seashore.

The NPS grants to individual ranchers Special Use Permits which describe the terms of the lease. The Permits may contain requirements to modify agricultural operations in order to reduce the adverse impacts of livestock concentration. Whereas ranching operations once occupied the entire Point Reyes Peninsula, only 25% of the area is now in agriculture and 75% is managed as natural lands or wilderness areas. Within the 28,000 acres leased for agriculture, livestock have been successfully excluded (through fencing and other strategies) from 7,000 acres with sensitive resources such as riparian zones and creeks. Stocking has also been reduced by approximately 50% from 12,045 head at the time of the park's establishment to 6,013 head at present. However, based on the park's Geographic Information Systems (GIS) analysis, it is estimated that approximately 3,700 acres of vegetation are degraded by cattle (D. Schirokauer, personal communication). These impacts to vegetation vary in intensity, depending on the area, from moderate to major.

Cumulative impacts to park vegetation also affected by non-native deer include the impacts of grazing by other wildlife, cattle grazing, logging and development, and fire management activities. Logging precedes the establishment of the Seashore, but has removed forest vegetation and increased erosion of soils. Tule elk feed on grasses and forbs similar to axis and fallow deer, and there is evidence that fallow deer and sympatric elk compete in the Limantour area for *Plantago* spp. (a high-energy and high-protein forage) (Fallon-McKnight 2006). Black-tailed deer eat a high percentage of forbs year-round (Elliott and Barrett 1985). To the degree that they eat the same types of forage during the same season as tule elk or black-tailed deer, grazing by non-native deer at the Seashore adds to any impact that vegetation may be experiencing from native ungulates or cattle, resulting in a minor adverse cumulative impact through consumption, trampling and the other factors identified above. However, to the extent that non-native deer displace native species and suppress their populations, this impact on vegetation (but not on native wildlife species themselves) is compensatory and not additive.

In some restored areas of the park, without the “clearing” effects of livestock grazing, shrub and forest communities are returning. Increased numbers of non-native deer, because they are primarily grazers, would reverse this shift and would likely return natural and wilderness landscapes back to open non-native grassland communities. Adverse impacts from axis and fallow deer would be additive to impacts caused by livestock in facilitating the invasion and spread of exotic plants, as suggested by recent research into the “invasional meltdown” hypothesis (Parker et. al. 2006).

In areas that are managed for agriculture, tools to exclude livestock from sensitive areas, such as riparian zones and creeks, have been implemented with great success; approximately nine miles of sensitive area exclusionary fencing has been built. Restricting access for non-native deer populations with fencing is impractical for anything other than small areas. Persistence of non-native deer would maintain concentration-associated adverse impacts (not found with native black-tailed deer) to vegetation in areas no longer managed for agriculture. Alternative A may also reduce the success and effectiveness of riparian restoration projects because of continued grazing and thrashing pressure by non-native deer.

Fire Management Plan. In areas treated with prescribed fire, minor, short-term adverse impacts associated with loss of vegetation, as well as the possibility of introduction or spread of non-native plants, would occur. However, the burns also would result in minor to moderate beneficial impacts as burning would stimulate growth of many native plant species, and would eliminate non-native vegetation.

Mechanical fuel reduction would have minor short-term adverse impacts on native vegetation through crushing or other physical impacts, but clearing of dense vegetation would have long-term, minor to moderate benefits on most plant communities as well. In light of observed consumption by non-native deer of rare bulb species after the 1995 Mount Vision fire, grazing pressure on *Fritillaria sp.* and other rare species in burned areas would likely increase after prescribed burns.

The selected fire management alternative will result in minor to moderate localized benefits to native vegetation from the removal of non-native Monterey pine and cypress trees. The selected alternative will have short-term, minor adverse impacts from unintentional burning of vegetation, especially in dry years. However, research and observations at the Seashore indicate wetland vegetation can be thinned and stimulated to reproduce by low or moderate intensity fires. These same fires can destroy non-native plants in wetlands. Minor to moderate short to long-term benefits to wetland vegetation from prescribed burning or even small wildfires are therefore possible.

Overall the fire management program would have short-term minor adverse effects, but long-term beneficial effects on vegetation.Coastal Watershed Restoration (Geomorphic Sites) in Drakes Estero Watershed, Drakes Estero Watershed Restoration Projects, Coastal Dune Restoration, Giacomini Wetlands Restoration, and Small Restoration Projects within the Seashore. These projects generally have short-term adverse impacts to vegetation and long-term beneficial impacts. The Giacomini and Coastal Dune Restoration projects will temporarily disturb a large number of acres (approximately 900), but the effects will benefit native vegetation by removing exotic plants and allowing regrowth of native species.

Based on the potential effects of Alternative A on vegetation and the adverse cumulative effects of some of the above projects, the adverse impacts on vegetation resources would be moderate to major. Cumulative impacts could be irreversible and substantial. Beneficial impacts of some of the above projects would not significantly offset the adverse impacts.

Conclusion

Based on data on current and past population growth of fallow and axis deer at PRNS, this alternative would result in an increase in non-native deer numbers within the Seashore and throughout Marin County. No impairment to vegetation would occur from implementing Alternative A. Based on current reports of direct damage to over 120 acres of riparian and understory vegetation within the Seashore, the magnitude of these impacts to vegetation within NPS boundaries is currently considered moderate in intensity (as defined in Assessment Methodology section, Impacts on Vegetation). However, under this alternative, the impact intensity to park vegetation is expected to increase over time to a locally major level because of increasing deer densities and increasing geographical scope of effects. Impacts outside the park would therefore be major in intensity. All impacts from this alternative to vegetation are adverse and long-term. The cumulative impacts of implementing Alternative A with the above described projects would be moderate to major and adverse.

Type of Impact:	Adverse
Duration of Impact:	Long-term
Intensity of Impact:	Moderate to locally major inside Seashore; major outside
Cumulative Impact:	Adverse, long-term moderate to major cumulative impacts to vegetation within the park and beyond park boundaries.

Impacts on Wildlife

The project area supports a wide diversity of wildlife species, including 28 species of reptiles and amphibians, 65 species of mammals, and uncounted invertebrates. Over 480 bird species (representing 45% of the avian fauna documented in the United States) have been sighted and approximately 100 species breed within the park. Wildlife can be impacted in a number of ways by non-native deer management. Directly, wild animals can be injured or killed during deer capture, monitoring or management operations. Indirectly, through destruction of habitat and competition for required resources, animals can be impacted by changes in the abundance and range of non-native deer.

Wild animals are dependent on a multitude of ecosystem elements, ranging from specific habitats for reproduction to specific trace dietary minerals for growth and maintenance. Some of the elements, which constitute an animal's "niche," are known to scientists, some have yet to be discovered. If two species utilize the same resource, scientists describe the finding as "niche overlap." Such a finding implies, but does not definitively prove, that increasing numbers of one of the overlapping species would negatively impact the other. An example of such an overlap is Elliott's finding that in times of low forage availability, such as during droughts or at the end of summer, both non-native deer species feed on many of the same browse plants as native black-tailed deer (Elliott 1982). At this time of year, when the energy and protein content of available forage is at its lowest, axis and fallow deer switch from eating primarily grass to eating forbs, non-grass like herbs that constitute the bulk of the black-tailed deer diet year-round. Fallow deer may also impact sympatric tule elk in the Limantour area in their foraging for forbs, grasses and especially, *Plantago* spp. (a high energy and high protein forage). (Fallon-McKnight, 2006). Competition between elk and fallow deer for forbs likely continues throughout spring and summer, which is a time that both species are nursing young. Increased grazing pressure on this and other important forage items by fallow deer could deprive Limantour elk of the nutritional benefits of these food resources at a critical time (Fallon-McKnight 2006).This would decrease survival of calves and result in reduced recruitment for the Limantour herd, which currently consists of 45 animals.

Evidence of niche overlap, as demonstrated in dietary overlap studies, cannot automatically be interpreted as competition between two species (Gogan and Barrett 1995; Feldhammer and Armstrong 1993; Litvaitis et al. 1994). Conversely, lack of niche overlap does not necessarily rule out competition since competition for shared resources can force species to adopt different food or habitat preferences to avoid competitive conflict (Putman 1986). Scientists would require evidence that the overlapping resource, in this case forbs, was limited and not available in sufficient quantity to supply both species. Evidence of detrimental effects, such as decreased fawn recruitment in black-tailed deer or decreased survival of tule elk calves, would demonstrate that the overlap might be impacting one of the competing species. Intraspecific competition is notoriously difficult to demonstrate scientifically. In the absence of scientific evidence of competition between species in the context of evaluating impacts of non-native deer to wildlife, data collected from research elsewhere in the U.S. and abroad would be evaluated. In addition, degree of suspected niche overlap along with anecdotal and historical evidence and expert opinion would provide insights and guidance for the analysis.

Impacts to individual animals within a species would be considered in the context of pain and suffering caused by proposed actions to wildlife, specifically, non-native deer. All proposed alternatives include provisions to prevent unnecessary animal suffering (see Actions Common to All Alternatives). Recommendations for humane animal treatment developed by the American Veterinary Medical Association would be used for all alternatives. The American Veterinary Medical Association considers, in some circumstances, gunshot to be the only practical and acceptable method of euthanasia in wildlife, when delivered by personnel sufficiently skilled to be accurate and experienced in the proper and safe use of firearms (AVMA 2001). Because pain and suffering is not scientifically measurable in animals, it would be assessed for each alternative using best professional judgment of wildlife biologists, managers and veterinarians. Humaneness is a person’s perception of harm or pain inflicted on an animal. The concept, a uniquely human construct, is complex and can be interpreted in a variety of ways (USDA 1997). Consequently, impacts to visitors of animal pain and suffering caused by project actions would be discussed in Impacts on Visitor Experience.

Analysis

For this analysis, the best professional judgment of wildlife biologists, as well as research completed at the Seashore and elsewhere, have been used to determine impacts of increasing fallow and axis deer populations and range on other wildlife species. In general, more non-native deer would constitute an increase in magnitude and scope, both within and outside the Seashore, of current impacts to other species that share limited resources.

Non-native Cervids

The larger population sizes and ranges, which would result from this alternative would clearly benefit both axis and fallow deer. Their ranges would increase both within and outside of NPS boundaries, into other parts of Marin County. Axis deer have occasionally been sighted as far east as Nicasio Reservoir (PRNS unpublished data (k)). Current fallow deer range maps suggest that fallow deer have spread recently towards the south and eastward borders of the Seashore and they have been observed as far east as Woodacre. Fallow deer in New Zealand have spread at rates of up to 4.5 miles per year (Mungall and Sheffield 1994). Favorable non-native deer habitat (interspersed grasslands and oak woodlands) exists in close proximity to PRNS, GGNRA and throughout Marin County. Fallow deer were successfully introduced to an area of grassland/oak woodlands in central Mendocino County in 1949 and have persisted there. Their numbers and range are apparently restricted by surrounding coniferous forests, chaparral, and hunting (Jurek 1977). The successful colonization and spread of axis and fallow deer within the Seashore suggest that range expansion throughout at least some of the county is likely. Low levels of hunting in Marin suggest that population expansion might remain uncontrolled and irreversible[4].

[4] Fewer than 1% of all hunting licenses (type 110) sold in California in 1999 were purchased by Marin County residents (CDFG database, http://www.dfg.ca.gov/licensing/pdffiles/Reg_HuntingItems90s.pdf).

Expansion rates of non-native deer would depend on a number of factors beyond the control of NPS, namely, range conditions, and hunting pressure.

Impacts to non-native deer from Alternative A would be beneficial and long-term. Because the impacts have the potential to affect areas beyond Seashore boundaries and could be irreversible, impact intensity is considered major.

Native Cervids

In their study of axis and fallow deer introductions nationwide, Feldhammer et al. (1993) stated:

> "We may expect competition between exotic and native artiodactyls both intuitively, and on the basis of previous field experiments with a variety of animal groups from various trophic levels and habitats…"

Native black-tailed deer are primarily browsers while both axis and fallow deer have been shown to be grazers. However, studies at PRNS have demonstrated that, during times of low forage availability, non-native deer adapt their feeding habits and consume larger amounts of forbs and browse (Elliott 1983; Elliott and Barrett 1985). Higher numbers of non-native deer would result in increased competition with native black-tailed deer for forbs and browse during droughts, at the end of summer, and year-round on poor quality ranges (Connolly 1981; Elliott 1983; Fellers 1983). Fiercer competition for limited forage would result in diminished condition in black-tailed deer (Brunetti 1976; Fellers 1983). It has been repeatedly shown in the scientific literature that poor condition in adult female cervids results in decreased reproductive capacity (Verme 1962 and 1967; Thorne et al. 1976; Keech et al. 2000). Increased competition for forage would likely result in lowered black-tailed doe fertility, decreased fawn production and lower fawn survival over current levels. Fellers estimated that at current levels of non-native deer (approximately 250 axis and 860 fallow deer), for every 1-2 non-native deer in the Seashore, one black-tailed deer is lost (Fellers 2006). He also estimated that if non-native deer numbers increased to 1,500, there would be a 63% reduction in the black-tailed deer population. The magnitude of the impacts of Alternative A to black-tailed deer populations would depend on range conditions, precipitation patterns and non-native deer numbers but would be considered major and could be expected to last longer than two breeding cycles. It is important to note that impacts would occur throughout larger and larger areas of Marin as non-native deer range expanded in the future as a result of this alternative. Black-tailed deer are considered a "keystone " species in the native California coastal ecosystem because increases and decreases in their population numbers have repercussions throughout the park ecosystem. As noted above, units of the National Park Service are unable to allow park resources or values to become impaired, and NPS Management Policies (section 1.4.5) indicate an impairment of a resource is more likely when conservation of that resource is "key to the natural or cultural integrity of the park…."Given its status as a central or keystone species in the Seashore's ecosystem and the degree of impact non-native deer appear to exert on it, implementing Alternative A is likely to result in impairment of this park resource.

In addition to dietary overlap and competition, there may also be impacts to black-tailed deer related to habitat preferences of both it and non-native deer. Black-tailed deer prefer a mosaic of various-aged vegetation that provides woody cover, meadow and shrubby openings while non-native deer favor habitats containing >50% grassland (CDFG 1998; Elliott 1982). However, there is some interspecies habitat overlap during certain times of the day and seasonally. Black-tailed deer are thought to avoid large herds (consisting of more than 50 animals) of fallow and axis deer (NPS, PRNS unpublished data (l)). Alternative A would result in higher densities of non-native deer both within and outside of the Seashore. Consequently, native black-tailed deer would likely avoid high-density areas when non-native deer were present.

In addition to impacts on native deer, fallow and axis deer may adversely affect native elk populations at the Seashore. Biologists in New Zealand documented that established, high-density populations of fallow deer competitively excluded red deer (*Cervus elaphus scotticus*), an elk species native to Europe (Challies 1985). Red deer are considered the most widespread and successful of all deer species introduced to New Zealand except where their range overlaps with previously established fallow deer populations (Challies 1985). Increased densities of fallow deer in areas of the Seashore where free-ranging tule elk inhabit would likely inhibit expansion of the elk herd and may suppress elk numbers where the new free-ranging subpopulations are not well established. These areas include the southwestern wilderness areas of the park south of Drake's Estero and west of Inverness ridge.

In addition to inhibiting further expansion of tule elk herds, higher numbers of non-native deer could adversely impact current elk populations in the Seashore through increased competition for forage (Brunetti 1976; Fallon-McKnight 2006). Deer are thought to consume 3% to 4% of their body weight in vegetation daily (Halls 1970). At a minimum, current non-native deer populations consume 1-2 tons of forage per day. As a result of Alternative A, this total forage intake would increase and a substantial amount of vegetation would become unavailable for native grazers. Increased consumption by non-native deer of highly nutritious forage would remove an important food source for pregnant and nursing cows (Fallon-McKnight 2006). Such impacts would be reflected in lower elk calving rates, delayed onset of reproduction in tule elk cows and reduced elk calf survival.

Direct behavioral competition between fallow deer and tule elk currently exists at PRNS and would likely increase with Alternative A. Researchers in the Zehusice Deer Park in the Czech Republic have documented behavioral exclusion of red deer by fallow deer at high-density feeding sites (Bartos et al. 1996). Fallow deer at Zehusice were observed to: (1) be consistently more aggressive than red deer, (2) preferentially seek out feeding sites where red deer congregated, and (3) attack red deer from the rear as a strategy to overcome their larger opponents (Bartos 1996). In the Tomales Point Elk Reserve at PRNS, fallow bucks have been observed sparring with tule elk bulls (PRNS unpublished data (m)). In all observed instances, fallow bucks were successful in chasing away elk bulls in spite of a substantial size disadvantage. The consequences of increased behavioral competition are difficult to predict with certainty but could include exclusion of elk from higher quality forage or habitat, decreased condition of reproducing adults and ultimately, decreased population growth or population decline.

Paratuberculosis, or Johne's disease, is an infectious and incurable diarrheal wasting disease of wild and domestic ungulates. In a study conducted at PRNS in 1979, paratuberculosis was documented in 9.6% and 8.1% of axis and fallow deer, respectively (Riemann et al. 1979b). Johne's disease was confirmed in a PRNS axis deer as recently as 2000 (NPS unpublished data (g)). The disease has been documented in tule elk at Tomales Point Elk Reserve since 1980 (Jessup et al. 1981). In spite of their known susceptibility to the disease, and the 1999 testing of 120 Seashore black-tailed deer, deer have not been documented to carry paratuberculosis in PRNS (Williams et al. 1983; Sansome 1999 unpublished report). Over 120 black-tailed deer at PRNS have been tested for Johne's disease and it is possible that the disease causes rapid death in this species, thus precluding its diagnosis in randomly sampled deer (E. Manning, Johne's Testing Center, personal communication). In 1998, relocation of 45 adult tule elk from Tomales Point to the Limantour wilderness area included a 6-month quarantine and extensive testing for Johne's disease (Manning et al. 2003). Only those animals that consistently tested negative on all blood tests and fecal cultures were released in July 1999 to form a new free-ranging herd. This elk herd is currently made up of 45 animals. The goal of the relocation is to restore the dominant native herbivore to the Seashore's wilderness ecosystems.

Transmission of the organism that causes paratuberculosis (*Mycobacterium avium ss. paratuberculosis*) occurs primarily from infected adults to young animals. The period of greatest susceptibility for this infection appears to be the first 6 months of life. The organism is shed by infected animals into feces that may contaminate feed, water, and pastures. The prevalence of the infection and the incidence of clinical disease may climb when an affected population approaches carrying capacity. At these high densities, affected herds experience the stressors of reduced forage nutritional quality and reduced ability to fight disease. This immunosuppression can result in increased transmission of infection and progression to clinical illness as well as heavier parasite loads. (Manning et al. 2003). Animals in the clinical phase of Johne's disease shed the organism more often and in greater numbers. Premise contamination with this hardy and long-lived organism may thus increase, a factor relevant to the health of numerous species. All cervids are believed to be susceptible to this infection (Manning and Collins 2001).

Alternative A would result in higher densities of non-native deer in PRNS and outside of NPS boundaries, with populations of axis and fallow deer eventually reaching carrying capacity. Because non-native deer congregate in large herds, the prevalence of paratuberculosis would rise in these herds and the potential for transmission to the tule elk and black-tailed deer that share their habitat would increase. Exposed elk or deer, infected as juveniles, would spread the disease to their offspring. As has been observed at Tomales Point, infection would result in diarrhea, weight loss, lowered reproductive capacity and eventual death of individual deer. On a population level, introduction of paratuberculosis into the free-ranging tule elk herd could result in slower growth of the population. Black-tailed deer may be more susceptible than other species to natural infection and rapid onset of the disease (Williams et al. 1983). Transmission, should it occur, would adversely impact juvenile survivability and, in cases where large numbers of black-tailed deer were exposed, would cause eventual decline of native deer numbers.

Newly discovered ectoparasites, on fallow and axis deer pose an unknown but potentially significant risk of disease to native black-tailed deer and tule elk. In 2005, USDA researchers discovered 2 species of chewing lice on PRNS fallow deer and 1 species of chewing lice louse on PRNS axis deer (National Veterinary Services Laboratories communications). Of most concern was *Bovicola tibialis*, a chewing louse typical of fallow deer, but not native to either black-tailed deer or tule elk. USDA researchers are concerned that this parasite may transfer from fallow deer to native cervids and cause the disease pediculosis. Transfer of *B. tibialis* from fallow deer to black-tailed deer has been documented elsewhere in California and in Canada (Bildfell et al. 2004; Westrom et al. 1976). Disease resulting from the inter-species transfer of both chewing and sucking lice to cervids has been well documented in the literature (Brunetti et al. 1971; Foreyt et al. 1986; Westrom 1976; Bildfell et al. 2004). Pediculosis, or infestation with lice, causes alopecia, loss of body condition, and death in a variety of wildlife species (Bornstein et al. 2001). The more serious pediculosis outbreaks are generally associated with the exposure of a previously unexposed population to a new or exotic parasite. USDA researchers and NPS managers are concerned that clinical disease resulting from transfer of any non-native lice to native deer could cause increased morbidity, mortality and reduced recruitment of young. Alternative A would result in higher densities of non-native deer in PRNS and outside of NPS boundaries. As with Johne's disease, the prevalence of pediculosis would rise in these herds and the potential for transmission to the tule elk and black-tailed deer that share their habitat would increase.

Genetic variability assists populations in adapting to environmental changes and reduces vulnerability to catastrophic events such as disease, abnormal weather cycles, pollution etc. Fewer than 4,000 of the 500,000 tule elk historically present in California, currently remain. Tule elk at PRNS have passed through at least four severe population reductions or “bottlenecks”. With each bottleneck, the amount of genetic variability in the population has been reduced. It has been estimated that PRNS elk are among the most inbred in California, with a degree of relatedness equivalent to that resulting from three consecutive brother-sister matings (McCullough et al. 1996). Physical signs of inbreeding, such as cleft palate, have been observed in the Tomales Point herd (Gogan and Jessup 1985).

Management techniques to increase genetic diversity within and among wildlife populations include: (1) translocating animals between subpopulations, and (2) increasing the number of reproducing animals within each subpopulation (McCullough et al. 1996). For the past 5 years, NPS has cooperated with California Department of Fish and Game to transfer adult elk cows to Tomales Point, in order to increase genetic variability. One of the primary goals of the PRNS General Management Plan is to maintain viable populations of tule elk in the Seashore and to restore free-ranging elk to wilderness ecosystems. Alternative A would likely slow the growth of tule elk numbers required to increase genetic variability in the Limantour elk herd. Increased competition for resources with fallow deer and potential transmission of paratuberculosis could hobble herd growth. Smaller numbers of breeding animals would result in lower genetic variability and increased risk of catastrophic population downswings.

Alternative A would result in:

- decreased tule elk and black-tailed deer food availability;
- slowed growth or reduction of tule elk and black-tailed deer numbers;
- decreased tule elk range; and
- reduced potential for increased genetic variability within a the PRNS tule elk population.

Impacts to native cervids from Alternative A inside and outside of NPS boundaries would be adverse, moderate to major, depending on the species, and long-term. Major impacts to native black-tailed deer would be severe enough that an impairment of this park resource is likely to result from implementing this alternative.

Small Mammals

The impacts of increased non-native deer populations on small mammals would occur in two ways: (1) by beneficial or adverse habitat alteration, influencing food supply, and cover; and (2) by direct, adverse competition for resources, mainly, food (Flowerdew and Ellwood 2001). In order to definitively demonstrate impacts of growing deer populations on small mammals at PRNS, large-scale deer exclosure experiments would have to be used to investigate responses at varied deer densities. Impacts to small mammals are extrapolated from research completed in the U.S. and in the U.K. on fallow deer and white-tailed deer in lowland woodlands (Putman 1986; McShea 2000; Flowerdew and Ellwood 2001; Fuller 2001). Inventories of small terrestrial vertebrates, conducted at PRNS from 1998-2001 in agricultural and ungrazed areas of the Seashore, were also considered in this analysis (Fellers and Pratt 2001).

In the Britain, heavy grazing pressure (100 deer/sq. km.) by fallow deer in lowland forests caused reductions and even local extirpations of wood mice, bank voles and common shrews (Putman et al. 1989). The loss of palatable ground-level vegetation removes food sources for small herbivores and at the same time, changes microclimates and reduces protection from predators (Flowerdew and Ellwood 2001). Increased browsing of shrubs in forested habitat or on forest-grassland interfaces, as has been demonstrated in both axis and fallow deer at the end of summer and during droughts (Elliott 1982), would alter suitability of those areas for some species. Oak woodlands and riparian areas contain the most wildlife species of any habitat in California. Heavy or sustained grazing in woodlands reduces species diversity. High densities of fallow deer year-round as well as fallow bucks during the breeding season have been observed to alter woodland and riparian cover and vegetation at PRNS through browsing and antler thrashing (Fellers and Osbourn 2006; B. Ketcham, NPS, personal communication). Such high-density impacts would decrease cover and habitat for the dusky-footed woodrat (*Neotoma fuscipes*).

Inventories of small mammals in non-wooded areas of the Seashore revealed fewer western harvest mice (*Reithrodontomys megalotis*) and California meadow voles (*Microtus californicus*) captured in those pastures heavily grazed by cattle than in moderately grazed pastures or similar non-wooded areas (Fellers and Pratt 2002). Densities of fallow deer in the Olema Valley areas of PRNS currently approach 80 deer/ sq. km. (NPS 2002a) and could be expected to increase in Alternative A. Grazing pressure from non-native deer in many Olema Valley sites is currently considered heavy. Should this grazing pressure continue or increase with Alternative A, species that could be adversely affected are the: Pacific jumping mouse (*Zapus trinotatus*), dusky-footed woodrat (*Neotoma fuscipes*), western harvest mouse (*Reithrodontomys megalotis*), California vole (*Microtus californicus*), black-tailed jack rabbit (*Lepus californicus*), and brush rabbit (*Sylvilagus bachmani*). Increased fallow deer densities and range resulting from Alternative A would likely reduce habitat for these species in limited areas of the Seashore and throughout Marin County, for longer than 2 breeding cycles. The adverse impacts could therefore be considered moderate and long-term.

Not all species decline with increasing deer grazing pressure. Grazing at intermediate and low deer densities has been shown to increase or have no effect on some plant and animal species in Britain (Fuller and Gill 2001). At PRNS, deer mice (*Peromyscus maniculatus*) were found more often in pastures grazed by cattle than in pastures where cattle were excluded (Fellers and Pratt 2002). It is possible that with increased deer grazing pressure in PRNS, deer mouse abundance would increase. The Valley pocket gopher (*Thomomys bottae*), another small mammal species that thrives in open grassland environments, could also remain unaffected or increase.

Direct competition for food between non-native deer and small mammals is a potential adverse impact resulting from Alternative A. As stated before, definitive documentation of competition would require exclosure experiments. In the absence of such experimentation, evidence of dietary overlap between species has been evaluated. In California and elsewhere, fallow deer are known to feed on acorns, an important food source for many small mammals (Poli 1996; Jurek 1977). In addition, analyses of fallow and axis rumen and fecal samples have shown heavy use of many of the same species used by small mammals (Elliott 1982; Fallon-McKnight 2006). Small mammals likely to be adversely affected by increasing competition for food are the: Pacific jumping mouse (*Zapus trinotatus*), California vole (*Microtus californicus*), deer mouse (*Peromyscus maniculatus)*, western harvest mouse (*Reithrodontomys megalotis*), black-tailed jack rabbit (*Lepus californicus*), and brush rabbit (*Sylvilagus bachmani*).

Depending on local deer densities, weather patterns and the yearly mast crop, adverse impacts to small mammals from Alternative A range from minor to moderate throughout the Seashore and Marin County. Because they persist for longer than 2 breeding cycles, impacts are considered long-term.

Mammalian and Avian Predators

This category includes wildlife species, such as mountain lions (*Felis concolor*), coyotes (*Canis latrans*), grey foxes (*Urocyon cinereoargenteus*), bobcats (*Felis rufus*), badgers (*Taxidea taxus*), weasels (*Mustela spp.*), and the raptors that prey on small mammals.

Although no research at PRNS has been conducted to document the extent to which non-native deer are preyed upon by carnivores, anecdotal and historical evidence suggest low-level predation, especially on fawns. Since their introduction in the 1940s, there has been a decrease in the proportion of observed white fallow deer, from 75% to 21%, suggesting that white individuals may be preferentially selected by predators (Wehausen 1973; NPS 2002a). An anecdotal report exists of an axis doe defending her fawn from a bobcat (NPS unpublished data (n)). Ranchers have reported coyotes preying on axis fawns in the pastoral zone (N. Gates, NPS, personal communication). However, because non-native deer congregate in large groups and prefer open habitat, it is unlikely that they serve as a primary prey base for native mega- and meso-carnivores, which specialize on stalking black-tailed deer and small mammals. Alternative A would increase the prey base for mountain lions, coyotes and bobcats. This beneficial impact would likely be offset by a decrease in both the black-tailed deer and small mammal prey base for these carnivores, foxes, weasels and badgers.

In the New Forest in Britain, heavy grazing, mainly from fallow deer, was shown to result in lowered reproduction in tawny owls (*Strix aluco*) and kestrels (*Falco tinnunculus*), especially during severe weather cycles and poor mast crop years (Putman 1986). Because of the likely adverse impact on their rodent prey base, Alternative A would have an adverse impact on birds of prey such as great-horned owls (*Bubo virginianus*), short-eared owls (*Asio otus*), western screech owls (*Otus kennicottii*), long-eared owls (*Asio otus*), barn owls (*Tyto alba*), American kestrels (*Falco sparverius*), red-shouldered hawks (*Buteo* *lineatus*), red-tailed hawks (*Buteo jamaicensis*), Northern harriers (*Circus cyaneus*), black-shouldered kites (*Elanus caeruleus*), sharp-shinned hawks (*Accipiter striatus*) and Cooper's hawks (*Accipiter cooperii*).

Overall, the adverse impacts of Alternative to predators in the Seashore and in Marin County would be moderate and long-term.

Other Birds

Little is known about the impacts of grazing wildlife on birds in the Seashore. In 1997-1998, researchers at the Point Reyes Bird Observatory compared avian abundance and species richness in areas grazed by cattle and in ungrazed areas (Holmes et al. 1999). Results showed that in all habitat types except coastal scrub, cattle-grazed areas had lower diversity, lower species richness and lower relative abundance of passerines and near-passerines (hummingbirds, woodpeckers and doves). Only one species, the savannah sparrow (*Passerculus sandwichensis*), was found in higher numbers in grazed grasslands.
Deer exclosure studies in Pennsylvania hardwood forests indicate that high densities of white-tailed deer (*Odocoileus virginianus*) cause declines in intermediate canopy-nesting songbirds. This study showed complete absence of certain songbird species, including American robins (*Turdus migratorius*), at deer densities over 25 deer/ sq. km. (deCalesta 1994). These declines are thought to occur because high deer numbers alter the structure of woody and herbaceous vegetation 0.5 - 7.5 meters above the ground (deCalesta 1994). Studies of fallow deer, roe deer (*Capreolus capreolus*) and muntjac deer (*Muntiacus reevesi*) in British lowland forests suggested that some bird species, namely understory nesters, declined with high deer grazing pressure while other species, namely bark foragers, benefited from reductions in understory vegetation. Researchers in British lowland forests determined that "losers" substantially outnumbered "winners" and that breeding populations of migrant birds were especially vulnerable to adverse impacts from heavy deer grazing pressure (Fuller 2001).

Table 9 lists the ground or low nesting bird species (nesting at approximately 0.3–3 meters) found in the Seashore. These species are found in habitats where the greatest impacts from large herds of non-native deer would occur (T. Gardali, Point Reyes Bird Observatory, personal communication, Shuford and Gardali, in review). Impacts to the species listed would likely occur in a manner similar to the Pennsylvania study (deCalesta 1994). That is, there would be a decrease in abundance of low nesting species that depend on understory vegetation to place their nests. Impacts on reproductive success and survival are unknown. It should be noted that Table 9 primarily contains species breeding at PRNS and GGNRA and is not exhaustive. Three species that would likely be impacted, the San Francisco common yellowthroat (*Geothlypis trichas sinuosa*), the northern harrier (*Circus cyaneus*) and the California Swainson's thrush (*Catharus ustulatus oedicus*) are not listed in this table because they are either California Bird Species of Special Concern (CDFG) or Birds of Conservation Concern (USFWS) and are discussed in the section on Impacts on Species and Habitats of Management Concern.

TABLE 9: BIRD SPECIES LIKELY TO BE ADVERSELY IMPACTED BY ALTERNATIVE A (T. GARDALI, POINT REYES BIRD OBSERVATORY, PERSONAL COMMUNICATION, SHUFORD AND GARDALI, IN REVIEW)

Common Name	**Scientific Name**
Allen's hummingbird	*Selasphorus sasin*
American goldfinch	*Carduelis tristis*
Bewick's wren	*Thryomanes bewickii*
Brewer's blackbird	*Euphagus cyanocephalus*
California towhee	*Pipilo crissalis*
California quail	*Callipepla californica*
Hermit thrush	*Catharus guttatus*
Horned lark	*Eremophila alpestris*
Lark sparrow	*Chondestes grammacus*
Lazuli bunting	*Passerina amoena*
Marsh wren	*Cistothorus palustris*
MacGillivray's warbler	*Oporornis tolmiei*
Orange-crowned warbler	*Vermivora celata*
Oregon junco	*Junco hyemalis thurberi*
Red-winged blackbird	*Agelaius phoeniceus*
Spotted towhee	*Pipilo maculatus*
Western meadowlark	*Sturnella neglecta*
Wilson's warbler	*Wilsonia pusilla*
Winter wren	*Troglodytes troglodytes*
Wrentit	*Chamaea fasciata*

In increasing areas of PRNS, GGNRA and Marin County, it is expected that overall avian species richness, abundance and diversity would decrease measurably with the heavy grazing pressure resulting from Alternative A. Beneficial impacts to a few grassland species would be offset by larger adverse impacts to relatively more species that depend on understory shrub layers for nesting, especially in impacted riparian and woody-grassland interfaces. The adverse impacts to various species would be moderate and long-term within and outside NPS boundaries.

Reptiles and Amphibians

Some information is available on the impacts of large herds of grazing herbivores on reptiles and amphibians in the Seashore. During inventories of small vertebrates conducted at PRNS in 2001, northern alligator lizards (*Gerrhonotus coeruleus*) were not found in pastures grazed by cattle but were found in similar ungrazed sites (Fellers and Pratt 2002). Changes to woodland understory vegetation, especially in riparian areas, and grassland cover, as has been documented with high densities of fallow deer at PRNS, would alter microclimates and habitats for frogs, lizards and salamanders. Adverse impacts could be expected for: alligator lizards, California slender salamanders (*Batrachoseps attenuatus*), rubber boas (*Charina bottae*), western skinks (*Eumeces skiltonianus*), racers (*Coluber constrictor*), garter snakes (*Thamnophis elegans)*, and Ensatina salamanders (*Ensatina eschscholtzii*).

Because of expected minor to moderate adverse impacts of Alternative A on small mammal abundance (see above), concomitant decreases can be expected in reptiles that prey on shrews and rodents. Species in this category are the: western terrestrial garter snake, rubber boa, and gopher snake (*Pituophis melanoleucus*).

Studies of British lowland forests heavily grazed by fallow deer have shown that as a result of decreasing rodent numbers, kestrels relied preyed more heavily on lizards (Putman 1986). Inside and outside the Seashore, similar increases in predation by raptors and owls on lizards, frogs and snakes is likely to occur in areas of high non-native deer density.

Impacts to amphibians and reptiles in PRNS and throughout Marin County with Alternative A are expected to be adverse to a number of species. The impacts are moderate and long-term.

Alternative A would likely result in increased range for both axis and fallow deer. Alterations in fallow deer range in the past 10 years suggest that fallow deer would continue to expand southwards and eastwards, spreading beyond Seashore boundaries into private lands and lands administered by California State Parks and Marin Municipal Water District. Favorable non-native deer habitat (interspersed grasslands and forests) exists in close proximity to PRNS, GGNRA and throughout Marin and Sonoma Counties. The successful colonization and spread of axis and fallow deer within the Seashore suggest that range expansion throughout at least some of those counties is likely. Should non-native deer populations outside NPS boundaries reach or exceed densities currently seen in PRNS, adverse long-term impacts to the wildlife species described above could be substantial, highly noticeable, measurable, and potentially irreversible. The intensity of such impacts could therefore be characterized as major.

Cumulative Impacts

Cumulative impacts are those effects that could result when the impacts of Alternative A to a specific resource are added to the impacts of past, present and reasonable foreseeable future activities. As detailed above, the Alternative A could have direct and indirect moderate to major adverse effects on the wildlife. An assessment of cumulative impacts on wildlife considers the potential impacts that Alternative A may have on wildlife in conjunction with the impacts on this same set of wildlife resources from past, present and reasonable foreseeable future actions. Actions listed in Appendix F that contribute to the cumulative impact scenario for wildlife include:

- Tule elk Management Plan
- current and future livestock grazing and dairying
- the Giacomini Wetlands restoration project
- Fire Management Plan implementation projects
- coastal watershed restoration (geomorphic sites) in Drakes Estero watershed
- Drakes Estero watershed restoration projects
- Tomales Bay marine station
- Pacific Coast Learning Center
- small restoration projects within the Seashore

(Further detail on these projects can be found in Appendix F, Projects Considered in Cumulative Impacts Analyses. Other wider-ranging issues that may contribute to the cumulative analysis are described below).

Statewide deer estimates, which include all native subspecies of black-tailed deer, compiled by the California Department of Fish and Game (CDFG), suggest that deer numbers have decreased from record highs in the 1950s and 1960s. At that time, the population was estimated to be between 700,000-1,000,000; populations in late 1990s were estimated at 400,000-700,000. This decline is thought to have occurred because of declining deer habitat quality as a result of urbanization, fire suppression and changes in logging (CDFG 1998). Alternative A, along with these activities, would result in cumulative major adverse impacts to native black-tailed deer.

Sudden oak death, a fungal-type disease that kills tanoaks (*Lithocarpus densiflorus*), coast live oaks (*Quercus agrifolia*) and black oaks (*Quercus kelloggii*), was first discovered in 1995. Since then it has been documented in 12 California counties including Marin and was isolated in the Seashore in 2004 (A. Wickland, University of California, Davis, personal communication). The disease causes oak death and the loss of acorn crops, an important food source for many small native mammals and native deer. Non-native wild turkeys, which have existed in Marin County since their release by the California Department of Fish and Game in the 1970s, also feed on acorns. This species has been observed in western Marin and inside the PRNS boundaries (PRNS unpublished data (o)). The combination of feeding by this non-native species and loss of mast due to sudden oak death has and would continue to have combined (e.g., cumulative) moderate adverse impacts with feeding by non-native deer on wildlife that depend on acorns under Alternative A.

Current and future livestock grazing and dairying. Within the Seashore, livestock agriculture, as instructed by Congress in its Point Reyes Seashore implementing legislation, continues in the form of concentrated dairy and beef operations. The NPS grants to individual ranchers Special Use Permits which describe the terms of the lease. The Permits may contain requirements to modify agricultural operations so as to reduce the adverse impacts of livestock concentration. Whereas ranching operations once occupied the entire Point Reyes Peninsula, only 25% of the area is now in agriculture with 75% managed as natural lands or wilderness areas. Stocking rates have also been reduced by approximately 50% from 12,045 head at the time of the park's establishment to 6,013 head at present.

Agricultural practices (livestock grazing, silage production, manure spreading) can have adverse cumulative impacts to wildlife diversity and richness, with intensity of the impacts related to the timing, location and intensity of the practice. Inventories of small mammals in non-wooded areas of the Seashore revealed fewer western harvest mice (*Reithrodontomys megalotis*) and California meadow voles (*Microtus californicus*) captured in those pastures heavily grazed by cattle than in moderately grazed pastures or similar non-wooded areas (Fellers and Pratt 2002). The following species would be expected to decrease as a result of heavy livestock grazing: Pacific jumping mouse (*Zapus trinotatus*), dusky-footed woodrat (*Neotoma fuscipes*), western harvest mouse (*Reithrodontomys megalotis*), California vole (*Microtus californicus*), black-tailed jack rabbit (*Lepus californicus*), and brush rabbit (*Sylvilagus bachmani*) (Fellers, USGS, personal communication). In 1997-1998, researchers at the Point Reyes Bird Observatory compared avian abundance and species richness in areas grazed by cattle and in ungrazed areas (Holmes et al. 1999). Results showed that in all habitat types except coastal scrub, cattle-grazed areas had lower diversity, lower species richness and lower relative abundance of passerines and near-passerines (hummingbirds, woodpeckers and doves). Alternative A, when viewed incrementally with agricultural practices, would result in adverse cumulative impacts to wildlife, with intensities ranging from moderate to major.

Tule Elk Management Plan. The management of tule elk in Point Reyes National Seashore, as outlined in the 1998 *Tule Elk Management Plan Environmental Assessment*, will have beneficial impacts by contributing towards restoration of fauna to native ecosystems; by protecting habitats for endangered, threatened, and rare species; and by preventing impacts of elk overpopulation that could threaten biological diversity in native habitats.

Fire Management Plan. Some wildfire suppression activities or actions to control prescribed burns, such as spike camps, access or creating fire lines, would have minor short-term adverse impacts on wildlife. Other activities, such as creating helispots or the use of helicopter buckets of water or retardants, may have longer lasting adverse impacts. Overall, these activities are not expected to have more than minor adverse impacts to wildlife.

Treatment with prescribed fire and through mechanical means in the selected alternative would result in short to long-term, minor to moderate benefits to wildlife from the reestablishment of the natural fire cycle, reduction of fuel loads, and reduction of the potential for catastrophic wildfire. In the context of the entire study area, the FMP would result in minor short to long-term benefits to wildlife from creating open habitat.

Coastal Watershed Restoration (Geomorphic Sites) in Drakes Estero Watershed, Drakes Estero Watershed Restoration Projects, Coastal Dune Restoration, Giacomini Wetlands Restoration, Sewage System Improvements, and Small Restoration Projects within the Seashore. These projects generally have short-term adverse impacts to wildlife, but long-term minor to moderate beneficial impacts. The Giacomini and Coastal Dune Restoration projects will temporarily disturb a large number of acres (approximately 900), but the long-term effects will be beneficial to vegetation.

Tomales Bay Marine Station Rehabilitation and Pacific Coast Learning Center Rehabilitation. These two projects have an indirect minor beneficial effect on wildlife because they provide housing and office space for researchers to conduct ecological studies. The new information can guide park managers in making future decisions on wildlife management.

Overall, Alternative A, combined with the above projects and issues described, will have a long-term moderate to major cumulative adverse impact on wildlife. The effects would not be significantly offset by the beneficial impacts of any of the above projects.

Conclusion

Data on current and past population growth of fallow and axis deer at PRNS indicate that this alternative would result in an increase in non-native deer numbers within the Seashore and throughout Marin County. Adverse impacts of No Action to native ungulates, particularly native black-tailed deer, would be major. Black-tailed deer are considered a “keystone” species in the native California coastal ecosystem because increases and decreases in their population numbers have repercussions throughout the park ecosystem. Alternative A therefore affects a resource that is key to the natural integrity of the park or to opportunities for enjoyment of a park and as such, has potential to result in impairment. Based on research on impacts of non-native deer to wildlife in other countries as well as known impacts of grazing by cattle and white-tailed deer in the U.S., the impacts of Alternative A are expected to be beneficial to a few native species and adverse to a larger number of native species. Overall, moderate to major adverse impacts to native ungulates, moderate impacts to predators, birds and amphibians and reptiles, and minor to moderate impacts to small mammals inside the park are likely. Pockets of extremely high non-native deer density, such as those currently seen in Olema Valley, are likely to be found increasingly throughout Marin County. Native species richness and diversity would likely decrease in those high-density areas. Overall, the magnitude of impacts to native wildlife within NPS boundaries are considered moderate to major in intensity, adverse and long-term, and those outside the boundary have the potential to become major in intensity. The cumulative impacts of Alternative A with other projects and issues described would range from moderate to major and would all be adverse.

Type of Impact:	Adverse
Duration of Impact:	Long-term
Intensity of Impact:	Moderate to major inside Seashore; potential to become major outside the Seashore; impairment of Seashore black-tailed deer population is likely.
Cumulative Impact:	Adverse, long-term moderate to major cumulative impacts to wildlife within the park and beyond park boundaries.

Impacts on Species and Habitats of Management Concern

Analysis

Special Status Species

This category includes federally listed wildlife species. Other species of concern recognized by the state of California or Birds of Conservation Concern (USFWS) include several species of nesting land birds and raptors. The project area supports 47 listed animal species; 14 of these have federal status as endangered, 8 as threatened and 24 as species of concern. Nineteen federally listed plant species (seven of which are also state listed) and an additional 25 listed or proposed for listing by the California Native Plant Society have been documented in the project area.

Although no research at PRNS has been conducted to document the extent to which non-native deer affect federally and state listed species, anecdotal, historical evidence and expert opinion can provide insights and guidance. The federally listed species that are likely to be affected by non-native deer include northern spotted owls (*Strix occidentalis caurina*), western snowy plover (*Charadrius alexandrinus nivosus*), California red-legged frog (*Rana aurora draytonii*), Coho and Chinook salmon (*Oncorhynchus kisutch and Oncorhynchus tshawytscha*), steelhead trout (*Oncorynchus mykiss*), California freshwater shrimp (*Syncaris pacifica*), and Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*).

Northern Spotted Owl

The northern spotted owl is a federally threatened species that reaches the southern limit of its range within GGNRA, PRNS and Muir Woods National Monument in Marin County, California. Data collected by the NPS indicates that these parks may support the highest density of spotted owls known. However, the population is geographically isolated and subject to unique threats including urban development, intense recreational pressure, habituation of owls to humans, potential for catastrophic wildfires, and changes in hazardous fuel management practices. Owls occur throughout the forested lands in the Seashore and the population is likely stable; however, owls have been monitored for only 7 years in the Seashore (NPS and Point Reyes Bird Observatory unpublished data). Owls prey almost exclusively on small mammals, particularly dusky-footed wood rats (*Neotoma fuscipes*) in the Seashore (Chow 1998). Woodrats, in turn, are dependent on roots, stems, leaves, seeds and mast (Linsdale and Tevis 1951; Willy 1992).

Fallow deer have been recorded in areas where spotted owls nest and roost. To date, no direct effects have been noted on the productivity or survival of owls. However, deer compete with the prey species of owls, and therefore, likely have an indirect negative impact on food resources. By biting off buds and flowers they reduce the amount of seed and fruit available in autumn and winter. In California and elsewhere, fallow deer are known to feed on acorns, an important food source for many small mammals (Poli 1996; Jurek 1977). In the New Forest in Britain, heavy grazing, mainly from fallow deer, was shown to result in lowered reproduction in tawny owls and kestrels, especially during severe weather cycles and poor mast crop years (Putman 1986). Because of the likely minor adverse impact on rodent prey base due to competition for forage, Alternative A would have an indirect, minor, adverse impact on northern spotted owls. Overall, the adverse impacts of Alternative A to owls in the Seashore and in Marin County would be minor and long-term.

Western Snowy Plover

Western snowy plovers, federally listed as threatened by the U.S. Fish and Wildlife Service (USFWS), nest along the sandy beaches of the Seashore, primarily on Point Reyes Beach between North Beach and Kehoe Beach. Historically, plovers also nested at South Beach, Drakes Beach and Limantour. Plover nesting success has increased slightly over the past few years due to intensive management by the Seashore; however, the species is vulnerable to numerous activities in the park including predation by ravens and disturbance by recreationists. Fewer than 20 chicks fledged in 2004 (Peterlein 2004). Cattle roaming on the beaches in the past were a potential source for disturbance; however, the Seashore now intensively restricts cattle from beaches. A large herd of 60 axis deer has been seen on South Beach within the last five years, and where the herd occurred, the ground was heavily impacted (S. Allen, NPS personal communication). The frequency of this activity by axis deer is unknown but likely does not occur with regularity. Consequently, the overall adverse impact of Alternative A to plovers in the Seashore is likely minor, depending upon whether plovers nest again at South Beach or whether axis deer expand onto the North Beach to Kehoe Beach area.

California Red-legged Frog

The California red-legged frog is federally listed as a Threatened species. Red-legged frogs breed in ponds or pools during the wet season (December through March), and use ponds and/or riparian habitats during the rest of the year. Fallow deer regularly frequent riparian areas and vigorously rub and thrash their antlers during the rut, resulting in maiming and destruction of riparian vegetation (Fellers and Osbourn 2006). While engaged in this activity, fallow deer cause extensive trailing and may trample frogs. Damage to the vegetation could lead to degradation of non-breeding habitat. Overall, the adverse impacts of Alternative A to frogs in the Seashore and in Marin County would be minor and long-term.

Coho Salmon, Steelhead Trout, and Chinook Salmon

Anadromous fish, listed as endangered and threatened by the National Marine Fisheries Service (NOAA Fisheries), occur in many of the streams of the Seashore, particularly in Olema Creek and Lagunitas Creek

The Seashore contains 10% of the last remaining wild population of coho salmon within the Central California Coast Evolutionarily Significant Unit, and consequently, any loss of this population would have an impact on the evolutionary significant unit. The NPS, along with the NOAA Fisheries and the CDFG, have conducted intensive fish surveys and have funded and implemented numerous restoration projects along the streams that flow through the park and adjacent lands. Numerous culverts have been removed along with other blockages to fish passage. In addition, the agencies have installed fencing to restrict cattle from riparian areas. These fences, however, do not impede the movement of fallow deer.

Fallow deer regularly frequent riparian areas and damage the riparian vegetation, particularly during the rut when bucks thrash branches and leaves with their antlers and girdle small trees and saplings (Fellers and Osbourn 2006). While engaged in this activity, fallow deer indirectly affect coho, steelhead and Chinook by damaging riparian plants, resulting in: increased erosion and sediment delivery to the stream, reduced cover, and potentially warmer water in streams due to exposure to sunlight. Increased numbers of fallow deer would increase the scope and intensity of this impact to riparian vegetation. In addition, an unmanaged and expanding population of non-native deer would reduce the success and potential effectiveness of riparian restoration projects for salmon due to grazing and thrashing pressure on recovering native riparian vegetation. In restoration areas, revegetation efforts and natural regrowth would be severely retarded due to heavy grazing, trailing and antler thrashing. Different from browsing where leaves are plucked from a stem, this constant grazing and thrashing would prevent native riparian plants from growing beyond shrub height. In riparian areas where large numbers of fallow deer congregate or travel, fish redds could be trampled, adversely impacting reproduction in all 3 species. Overall, the adverse impacts of Alternative A to anadromous fish in the Seashore and in Marin County would be minor and long-term.

California Freshwater Shrimp

The California freshwater shrimp (*Syncaris pacifica*) is listed by the USFWS as Endangered. The shrimp inhabits lower Lagunitas Creek and lower Olema Creek, within the current fallow deer range at PRNS. Shrimp are highly dependent on overhanging riparian vegetation, under which they live year-round. Fallow deer have not been observed within known shrimp habitat. However, in other areas of both Lagunitas and Olema Creeks, which are potential future locations for this species, high densities of fallow deer have been observed to browse and trample riparian vegetation (Fellers and Osbourn 2006). An increase in fallow deer range, resulting from Alternative A would likely cause degradation of shrimp habitat with negligible to minor adverse impacts.

Myrtle's Silverspot Butterfly

Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*) is one of three coastal subspecies of *S. zerene* in the Western United States. The USFWS listed the subspecies as Endangered in 1992, citing habitat loss and degradation as the primary threats (USFWS 1992).

As of 1998, three populations are known to remain. The USFWS Myrtle's Silverspot Butterfly Recovery Plan (1998) estimated the three populations combined comprise 10,000 individuals. Two populations of Myrtle's silverspot butterfly occur within the Seashore and the third is on private land in northern Marin County. The Center for Conservation Biology at Stanford monitored distribution and abundance of the Myrtle's silverspot butterfly at Point Reyes National Seashore almost yearly from 1992 to 1998. The Stanford survey work shows a decline in Myrtle's silverspot butterfly population levels during the six-year period and the central population to be "barely existing" (Launer et al.1998). Grazing is believed to deplete the Myrtle's silverspot butterfly larval host plants. The Seashore is currently supporting an intensive survey of the habitat of the Myrtle's silverspot butterfly and research on the current abundance and distribution of the larval host plant and adult nectar sources.

The PRNS coastal dune system and coastal prairie provide critical habitat for the federally endangered Myrtle's silverspot butterfly. Many different plants are used by the Myrtle's silverspot butterfly as nectar sources; native plants (*Grindelia rubicaulis, Abronia latifolia, Monardella undulata, Erigeron glaucus,* and *Wyethia sp*.), as well as non-native bull thistle (*Cirsium vulgare*) and Italian thistle (*Carduus pycnocephalu*s). The only known larval host plant is the western dog violet (*Viola adunca*).

Axis and fallow deer frequent coastal prairie habitat. To date, it is not known whether they browse on the preferred nectar or larval host plants of the Myrtle's silverspot butterfly. Research in which deer-proof exclosures were monitored in the New Forest in England showed that fallow deer preferentially consumed a *Viola* species in a 1969 but not in a repeat survey in 1978 (Putman 1986). In Hawaii, the introduction of axis deer and mouflon sheep to Lana`i have likely played a major role in the disappearance of *Viola lanaiensis* (USFWS 1995a). Another Hawaiian species, *Viola kauaensis* var. *wahiawahensis,* is also listed as endangered by USFWS because of perceived threats of habitat degradation by feral animals and axis deer (USFWS 1995b). It therefore seems likely that non-native deer, given the opportunity, would graze on the Myrtle's silverspot butterfly's larval host plant.

Intensive grazing would further threaten the availability of these plants for the butterfly. If the fallow and axis deer populations continue to increase, the impact to the vegetation used by this butterfly would likely increase. Overall, the adverse impacts of Alternative A to Myrtle's silverspot butterfly in the Seashore and in Marin County would be moderate to major and long-term.

Bird Species of Concern

The Seashore has collaborated with the Point Reyes Bird Observatory over the past two decades to protect and restore habitat of nesting land birds within the boundaries of the Seashore. Many species of land birds are species of concern both under the California Bird Species of Special Concern (CDFG) and the Birds of Conservation Concern (USFWS). Examples of species include common yellowthroat *(Geothlypis trichas sinuosa*), California Swainson's thrush *(Catharus ustulatus oedicus),* and tricolored blackbird *(Agelaius tricolor).*

Numerous restoration projects and fire management actions have strived to improve nesting success in land birds, particularly in riparian areas. In addition, the park is an active member of the Partner-in-Flight program, collaborating with other agencies and organizations to protect and restore populations of neotropical migratory songbirds. The Point Reyes Bird Observatory has monitored the reproductive success and species composition of birds for more than 30 years. Monitoring has taken place in areas of the park (Palomarin) where fallow deer occur only rarely.

In areas where fallow deer are abundant, there often is a well-defined browse line on trees and shrubs between 1.5 and 2 meters above the ground. Studies of fallow deer, roe deer (*Capreolus capreolus*) and muntjac deer (*Muntiacus reevesi*) in British lowland forests have suggested that some bird species, namely understory nesters, declined with high deer grazing pressure (Fuller 2001). Similarly, ground or low nesting (approximately 0.0–3 meters) bird species found in the Seashore are vulnerable to heavy grazing by non-native deer. These species are found in habitats where the greatest impacts from large herds of non-native deer would occur (T. Gardali, Point Reyes Bird Observatory, personal communication, Shuford and Gardali, in review). There may be a decrease in abundance of low nesting species that depend on understory vegetation to place their nests. The potential impacts on reproductive success and survival are unknown. Overall, the adverse impacts of Alternative A to understory nesting songbirds of concern in the Seashore and in Marin County would be moderate to major and long-term.

Plant Species of Special Concern

This category includes federal, state, and California Native Plant Society listed plant species identified below. Grazing by wild ungulates plays a role in the life history of many special-status plant species by removing understory and maintaining open habitat, encouraging reproduction in some species, and affecting competing species. Grazing can be detrimental to native plant species, especially when timing, frequency, and intensity are outside of the natural cycle to which the species is adapted (Archer and Smeins 1991). Grazing in California grasslands has been found to differentially affect various native life-history guilds such as annual or perennial forbs and grasses (Hayes and Holl 2003).

Although no research at PRNS has been conducted to document the extent to which non-native deer affect plant species of special concern, anecdotal and historical evidence and expert opinion can provide insight and guidance. Rare plants have been inventoried at Point Reyes National Seashore over the past twenty years. The preponderance of this information is presence/absence data for species of concern, with some additional data describing distribution of select species. Given the substantial amount of plant distribution data, it is important to note that this information only describes known rare plant occurrences. Obviously there are many acres within the Seashore that have not yet been surveyed for rare plants. Impacts related to rare plants, therefore, can only be estimated in terms of limited best available information.

Rare plants known to occur within current axis deer range include:

- *Arabis blepharophylla*, coast rock cress
- *Campanula californica*, swamp harebell*
- *Ceanothus gloriosus* var. *porrectus*, Mt. Vision ceanothus
- *Cordylanthus maritimus ssp. palustris*, Point Reyes bird's beak *
- *Fritillaria liliaceae*, fragrant fritillary**
- *Grindelia hirsutula* var. *maritima* San Francisco Bay gumplant
- *Limnanthes douglasii* var. *sulphurea*, Point Reyes meadow foam*
- *Linanthus grandiflorus*, large-flowered linanthus
- *Triphysaria floribundus,* San Francisco owl's clover

Rare plants known to occur within current fallow deer range include:

- *Abronia umbellata ssp. breviflora*, pink sand-verbena
- *Agrostis blasdalei*, Blasdale's bent grass
- *Arabis blepharophylla*, coast rock cress
- *Arctostaphylos virgata*, Marin manzanita
- *Astragalus pycnostachyus var. pycnostachyus*, coastal marsh milk-vetch*
- *Calystegia purpurata* ssp. *saxicola*, coastal bluff morning-glory
- *Campanula californica*, swamp harebell*
- *Ceanothus gloriosus var. gloriosus*, Point Reyes ceanothus
- *Ceanothus gloriosus var. porrectus*, Mt. Vision ceanothus
- *Chorizanthe cuspidata var. cuspidata,* San Francisco bay spineflower
- *Cordylanthus maritimus ssp. palustris,* Point Reyes bird's beak *
- *Elymus californicus,* California bottlebrush grass
- *Fritillaria affinis var. tristulis,* Marin checkerlily**
- *Fritillaria liliaceae*, fragrant fritillary
- *Gilia capitata ssp. chamissonis,* dune gilia
- *Grindelia hirsutula var. maritima* San Francisco Bay gumplant
- *Lilium maritimum,* coast lily**
- *Linanthus grandiflorus* large-flowered linanthus
- *Microseris paludosa,* marsh microseris*
- *Perideridia gairdneri ssp. gairdneri,* Gairdner's yampah
- *Polygonum marinense,* Marin knotweed
- *Ranunculus lobbii,* Lobb's aquatic buttercup*
- *Sidalcea calycosa ssp. rhizomata,* Point Reyes checkerbloom*
- *Triphysaria floribundus,* San Francisco owl's clover

* These species occur in wetlands or saltmarsh habitats. It is highly unlikely that these species are affected by non-native deer activities.
** Denotes bulb species.

Non-native deer can impact rare plant species directly by consuming and trampling them. PRNS staff observed fallow deer digging up and eating *Fritillaria sp.* bulbs within the burned area after the 1995 Vision Fire (Sarah Allen, NPS, personal communication). It should be noted that damage to *Fritillaria sp.* and other lily species has been observed outside exotic deer range, presumably caused by black-tailed deer or other herbivores (Michelle Coppoletta, NPS, personal communication). Based on analyses of deer diets conducted in Point Reyes, it can be inferred that after a major vegetation-changing event such as a wildfire, both axis and fallow deer seek other food sources to supplement a depleted diet (Elliott 1983). This might include heavier foraging on bulb species.

Other species that may be impacted would be those occurring in areas of high-density herd congregations, where damage to plants through trampling would occur. Fallow deer herds have been observed often in grassland, evergreen scrub, and Douglas fir/redwood plant communities (NPS 2001b). These communities provide habitat for the plant species listed above. Adverse impacts to rare plants in the Seashore are currently considered to be minor and short-term. Alternative A would result in increased ranges and densities for both species and would likely lead to adverse impacts which were moderate and long-term.

There are no means of mitigating for impacts of non-native deer to the species of special concern of the Seashore.

Cumulative Impacts

Cumulative impacts are those effects that would result when the impacts of Alternative A to a specific resource are added to the impacts of past, present and reasonable foreseeable future activities. As detailed above, the Alternative A could have direct and indirect short-term levels of adverse impact intensity that are considered minor; however, continued growth and expansion of the non-native deer population would result in a long term increase of impact intensity to major. An assessment of cumulative impacts on special status species considers the potential impacts that Alternative A may have in conjunction with the impacts on the same special status species resulting from past, present and reasonable foreseeable future actions. Actions listed in Appendix F that contribute to the cumulative impact scenario for special status species include:

- current and future livestock grazing and dairying
- the Giacomini wetlands restoration project
- Fire Management Plan implementation projects
- coastal watershed restoration (geomorphic sites) in Drakes Estero watershed
- coastal dune restoration
- Drakes Estero watershed restoration projects
- small restoration projects within the Seashore

(Further detail on these projects can be found in Appendix F, Projects Considered in Cumulative Impacts Analyses. Other wider-ranging issues that may contribute to the cumulative analysis are described below).

Special Status Species

Northern Spotted Owl. The threatened status listing is based on historic and projected trends in loss of habitat, large areas of low owl abundance, and declining trends in survival rates (USFWS 1990 and 1993). The Marin County spotted owl population is subject to threats present in the region including: (1) urban development along open space boundaries, (2) disturbance due to intense recreational pressures, (3) hazardous wildland fuel management practices, (4) potential for catastrophic wildfires along the urban/wildland interface, (5) possible genetic isolation, (6) continued range expansion of the Barred Owl, and (7) West Nile Virus.

Visitor use in the park is expected to increase along with the projected human population increase in the San Francisco Bay Area. With increased visitor use of the park, the potential for human disturbance of owls along trails may increase. To reduce visitor impacts to owls, the park does not publish the location of owl activity centers and distributes a flyer on how to behave around owls.

Oaks in Marin and Sonoma counties have been dying suddenly over the past few years as a result of a fungus. The die-off, called sudden oak death, has spread throughout Marin County and occurs currently within owl habitat in the park. The death of the oaks results in local changes in percent cover and in food availability of the dusky footed woodrat, the primary prey of owls, at PRNS (Chow 1998). Widespread habitat conversion is not expected from SOD in the study area; however, park biologists are monitoring the distribution of the die-off.

An ongoing threat to spotted owls is development, which removes habitat and creates smaller blocks of forest, or forest that is discontinuous. Smaller isolated tracts of forest that would otherwise be suitable do not meet the needs of spotted owls, which require large contiguous blocks. Private land without conservation easements or other protection is most vulnerable to development. Several purchases of conservation easements, state parks and A-60 zoning (one house per 60 acres) has contributed positive cumulative impacts for owls.

The impact of a large wildfire on spotted owls would be habitat destruction. This species requires greater than 60% total canopy cover for nesting/roosting with large overstory trees, large amounts of down woody debris and the presence of trees with defects or signs of decadence in the stand. This old growth type forest in the park may have the high fuel loading and ladder fuels to feed a hot stand-replacing fire, which would eliminate the habitat for many years. In a large wildfire, such as the Vision Fire, the chances of directly destroying nests or habitat could be quite high. Suppression activities such as water and retardant drops would have an adverse effect on spotted owls if they occurred over nesting habitat and, especially, nests. Such events are less likely than direct destruction of nests or habitat to occur, and impacts would be mitigated if nest sites and probable nesting habitat could be avoided. Some impacts from fire management activities would be adverse and negligible to minor. Mitigations have been developed to avoid and eliminate any potential impacts.

Western Snowy Plover. Along the California coast, western snowy plovers have been extirpated from 33 of 53 nesting sites since 1970, and now number an estimated 1,387 plovers with 81 and 36 plovers recorded in Oregon and Washington, respectively (G.W. Page, personal communication) The 2002 estimate remains far below the populations size of 3,000 birds listed as the recovery objective. The USFWS Final Draft Pacific Coast Population of Western Snowy Plover Recovery Plan (2001) lists the main reasons for plover population decline as a combination of: human disturbance, urban development, introduced beachgrass (*Ammophila* spp.) and expanding predator populations.

Western Snowy Plovers have very specific feeding and nesting requirements associated with the rare coastal dune ecosystem. This limits their abundance and makes them vulnerable to continuing habitat loss. The association of snowy plovers to beach nesting areas has also made them susceptible to disturbance from recreational use and development. Increases in native and non-native terrestrial and avian predators associated with human development, such as Common Ravens (*Corvus corax*), raccoons (*Procyon lotor*), and Northern Harriers (*Circus cyaneus*) have also negatively impacted the plovers (USFWS 2001).

PRNS is 1 of only 20 remaining plover breeding areas in coastal California (USFWS 1993). The Point Reyes peninsula is one of the largest relatively undisturbed beach habitats on the California coast, providing a large area of potential snowy plover habitat free of threats that have degraded habitat elsewhere, such as development, off-road vehicle use, and heavy visitor use.

Fledging rates for snowy plovers before nest protection began were insufficient to maintain the species at PRNS, as indicated by declining numbers of nests and nesting adults in the period 1986-1995. Continuation of such low nest success rates could have resulted in loss of the PRNS breeding population of snowy plover. The current nest protection program has raised nest success rates to levels similar to those at other coastal California locations (USFWS 1999a), but would be costly to maintain indefinitely.

The Coastal Dune Restoration Project will increase breeding habitat for snowy plovers. This action and other Seashore's snowy plover management actions have benefited plover habitat and populations. Alternative A, with increased numbers and range of non-native deer, would reduce these beneficial impacts and result in adverse cumulative impacts.

California Red-legged Frog. As noted above, lands outside of PRNS and GGNRA offer substantial protection for wildlife through conservation easements, zoning, and low-impact land use practices. Extensive areas adjoining the study area preserve nearly 25,000 acres of public land, thousand of acres of conservation land privately held by non-profit groups, and over 30,000 acres of private land with conservation easements preventing development. In addition, much of western Marin is zoned at a very low density, particularly where it adjoins watersheds where red-legged frog habitat exists.

Additional impacts to frogs may come from restoration projects such as the Giacomini wetlands or fisheries in streams where frogs are known to occur. Impacts would be avoided, minimized, or mitigated however, and all project sites would be reviewed prior to implementation with the park GIS database. If there were potential for a take, the park would have staff specialists survey the site and provide recommendations for avoidance or mitigation. In the long-term, these fisheries restoration projects would benefit frogs by enhancing natural processes, including reduction of erosion and stream temperature and enhanced water quality.

Human activities may have had both direct and indirect effects on red-legged frogs. Development has removed habitat, and logging or other activities may have adversely affected geomorphological stability, erosion rates or river channels. For example, historic logging of parts of Inverness Ridge, channel alterations in the lower 2.8 km of Olema Creek, and the effects of highway culverting have removed suitable habitat along Olema Creek and its tributaries may have been. Areas of downcutting, bank cutting, and sedimentation are present along the mainstem and its tributaries, resulting in a probable reduction in numbers of backwaters and pools.

Ranching may also have adversely affected frog habitat, although since coming under NPS ownership and oversight, ranching practices on PRNS ranchland have been modified in ways that have likely benefited California red-legged frogs. Especially effective have been the reductions of cattle numbers on excessively grazed ranchlands and exclusion of cattle from a number of wetland sites. The species appears to be thriving under the current PRNS management of grazing lands, although cattle may be having adverse impacts in some locations. Fire can adversely affect frogs by removing riparian vegetation, and through the increase in sedimentation accompanying vegetation removal.

Coho Salmon, Steelhead Trout, and Chinook Salmon. Salmonid species on the west coast, including coho salmon, steelhead trout, and Chinook salmon have experienced dramatic declines in abundance during the past several decades as a result of human-induced and natural factors. There is no single factor solely responsible for this decline. Factors that threaten these species include water storage, withdrawal, conveyance, and diversions for various purposes. Direct and indirect effects of land use activities associated with human developments, agriculture, and recreation continue to alter fish habitat quantity and quality. As noted in other sections of this document, concentrated livestock agriculture in the form of dairy and beef operations persists inside Seashore boundaries. In areas that are managed for agriculture, tools to exclude livestock from sensitive areas, such as riparian zones and creeks, have been implemented with great success. While it is acknowledged that cattle have major impacts to resources, there are tools for restricting their access to sensitive areas. Restricting access for non-native deer populations with fencing is impractical for anything other than small areas. Persistence of non-native deer would maintain concentration-associated adverse impacts to vegetation in areas no longer managed for agriculture.

The mouth of Lagunitas Creek and adjacent floodplain supports activities associated with the Waldo Giacomini dairy. This 550-acre property, once tidal wetlands, was diked and drained in the early 1940s to create pastures. For many years, a gravel dam was constructed annually just below the confluence of Lagunitas and Olema creeks for irrigation and stock watering. The dam created an abrupt transition from fresh to saline water for smolts and spawning adults, eliminating the transition zone found in an unimpaired estuarine system. The transition zone allows smolting fish time to adjust to saline conditions and provides productive feeding zones where both freshwater and saltwater invertebrates are available (SWRCB 1995).

The dam and the levees concentrated the area where spawning fish could hold and smolts could feed, and increased the potential for predation. While the annual construction of the dam has been discontinued, the levees are still in place. The NPS acquired these lands in 2000 and has developed a restoration plan. Primary site restoration activities are anticipated to begin in 2007. Such restoration is expected to improve estuarine smolt and adult emigration habitat for coho, steelhead and Chinook salmon.

The two projects Coastal Watershed Restoration (Geomorphic Sites) in Drakes Estero Watershed and the Coastal Watershed Restoration – Drakes Estero Road Crossing Improvement Sites together propose for nine sites within the Drakes Estero Watershed to be restored in 2007. The activities proposed through this project would remove or replace facilities such as road culverts and impoundments that impede natural freshwater and estuarine process.

Small creek restoration protection projects in watersheds supporting salmonids (e.g. Olema Valley) for coho salmon and steelhead trout have been completed or are underway These projects include removal of fish passage impediments, bank stabilization, and installation of fencing to protect riparian areas on Bear Valley Creek, Pine Gulch and Olema Creek and their tributaries. These projects have a minor, beneficial, long-term effect on coho salmon and steelhead trout, two listed speciesThe effects would be perceptible, but localized.
Overall these projects are will have a cumulative moderate beneficial effect on the federally listed coho salmon and steelhead trout.

California Freshwater Shrimp. Threats to existing populations of freshwater shrimp include deterioration and loss of habitat resulting from water diversion, impoundments, livestock and dairy activities, agricultural activities and developments, flood control activities, migration barriers, and water pollution (USFWS 1998). All of these threats occur along Lagunitas and Olema Creeks due to continued agricultural activities and human development around these waterways. As noted in other sections of this document, concentrated livestock agriculture continues in the form of dairy and beef operations persists inside Seashore boundaries. In areas that are managed for agriculture, tools to exclude livestock from sensitive areas, such as riparian zones and creeks, have been implemented with great success. While it is acknowledged that cattle have major impacts to resources, there are tools for restricting their access to sensitive areas. Restricting access for non-native deer populations with fencing is impractical for anything other than small areas. Persistence of non-native deer would maintain concentration-associated adverse impacts to vegetation in areas no longer managed for agriculture.

None of the projects in Appendix F have any anticipated impacts on freshwater shrimp.

Myrtle's Silverspot Butterfly. The U.S. Fish and Wildlife Service listed the subspecies as endangered in 1992, citing habitat loss and degradation as the primary threats (USFWS 1992). Habitat loss has occurred within the historic range of the butterfly, which extended approximately from Jenner Beach in southern Sonoma County, California to Point Ano Nuevo in San Mateo County, California (USFWS 1998). Urban development, conversion of native coastal prairie to cattle grazing, and invasion of non-native species have constrained the range of the Myrtle's silverspot butterfly. Currently, two populations of Myrtle's silverspot butterfly occur within the Seashore, another small population exists in southern Sonoma County and a larger population in an area of northern Marin County between Dillon Beach and Estero de San Antonio (Launer et al. 1992). Habitat conversion by invasive, non-native plants such as European beach grass (*Ammophila arenaria*) and iceplant (*Carpobrotus edulis*) are a serious threat to the remaining Myrtle's silverspot butterfly coastal habitats.

The largest numbers of Myrtle's silverspot butterflies documented in the early 1990s occurred on private land in the vicinity of Estero de San Antonio in Marin County northeast of PRNS. A golf course development proposed at that time was withdrawn, and the area is currently ranchland grazed by cattle and sheep. It is given a measure of protection from development by Marin County's agricultural zoning and policies to maintain the integrity of ranchlands in the western half of the county. Several of the ranches in the habitat area have sold development rights to the MALT, an organization seeking to preserve agricultural land in western Marin County. Any proposed development would have to comply with requirements of the Endangered Species Act to protect the Myrtle's silverspot.

While it is difficult to determine the status of Myrtle's silverspot population at PRNS given current information, the species does not appear to be at risk of extinction in the near future. Cattle grazing has been identified as only one of a number of possible reasons for the species decline, but is also considered valuable in maintaining Myrtle's silverspot habitat. While several areas have been identified where grazing may be adversely affecting the species' habitat at PRNS, overall grazing management has helped maintain a variety of plant cover conditions in Myrtle's silverspot habitats. The Coastal Dune Restoration Project will have a minor beneficial effect on silverspot populations.

Unlisted Species of Concern

NPS has developed a Fire Management Plan to outline future management of the fire program at PRNS and the North District of Golden Gate National Recreation Area. This plan includes a number of action alternatives that call for increased use of prescribed fire as a management tool to enhance natural resources and guard against catastrophic fire. Up to 3,500 acres annually of additional park natural and wilderness areas could be burned or mechanically treated over the next decade as a result of the Fire Management Plan. In light of observed consumption by non-native deer of rare bulb species after the 1995 Mount Vision fire, grazing pressure on *Fritillaria sp.* and other rare species in burned areas would likely increase after prescribed burns.

Overall, Alternative A, combined with the above projects and issues described, will have a long-term moderate to major cumulative adverse impact on special status species. The effects of increasing deer populations and range would not be significantly offset by the beneficial impacts of the above projects.

Conclusion

Alternative A would likely result in increased range for both axis and fallow deer. Alterations in fallow deer range in the past 10 years suggest that fallow deer would continue to expand southwards and eastwards, spreading beyond Seashore boundaries into private lands and lands administered by California State Parks and Marin Municipal Water District. Favorable non-native deer habitat (interspersed grasslands and forests) exists in close proximity to PRNS, GGNRA and throughout Marin and Sonoma

Counties. Should non-native deer populations outside NPS boundaries reach or exceed densities currently seen in PRNS, impacts from deer to the species described above could become substantial, highly noticeable, or with the potential for landscape-scale effects. Because these species are already listed as threatened, endangered or of concern, the combined adverse effects of past and present activities have had an ongoing cumulative major impact. The spread of non-native deer outside the park with Alternative A would add to this adverse impact.

Based on current and past data on fallow and axis deer, the populations would continue to increase, resulting in expanded range and higher animal concentrations within the Seashore and Marin County. Ongoing impacts to species of special concern range from minor to major. Beneficial impacts to riparian species through habitat conservation and restoration activities are ongoing. The activities, pressures and trends which threaten the above species are ongoing cumulative adverse impacts. No impairment to special status species would occur from implementing Alternative A. All of the impacts associated with the presence and/or expansion of non-native deer populations are characterized as adverse. While short-term levels of adverse impact intensity are considered minor, continued growth and expansion of the population would result in an increase of impact intensity to major.

Type of Impact:	Adverse
Duration of Impact:	Mixed—both short-term and long-term
Intensity of Impact:	Minor in the short term, moderate in the long-term
Cumulative Impact:	Long-term moderate to major cumulative adverse impact on special status species.

Impacts on Human Health and Safety

Analysis

One of the actions common to all alternatives includes monitoring non-native deer numbers through ground or aerial surveys. Use of aircraft to monitor deer numbers or range expansion may result in minor, short-term adverse safety impacts to staff and visitors because of the risk of aircraft accidents. This risk is mitigated by strict adherence to Office of Aircraft Safety and Federal Aviation Administration regulations and policies for all NPS aerial operations (Director's Order 60).

In Alternative A, the numbers and range of both species of non-native deer are expected to increase, likely spreading beyond Seashore boundaries on to private and other public lands. A concomitant increase in deer-vehicle collisions over current levels, and throughout Marin County, is expected as a result. Such potential collisions constitute a minor, long-term adverse impact to human safety, both inside and outside Seashore boundaries.

Cumulative Impacts

Cumulative impacts are those effects that could result when the impacts of Alternative A to a specific resource are added to the impacts of past, present and reasonable foreseeable future activities. As noted above, the Alternative A could have minor adverse effects on public health and safety. An assessment of cumulative impacts on public health and safety considers the potential impacts that Alternative A may have on public health in conjunction with the impacts on this same set of public health and safety activities from past, present and reasonable foreseeable future actions. Actions listed in Appendix F that contribute to the cumulative impact scenario for public health and safety include:

- Fire Management Plan implementation projects
- current dairy and beef ranching
- Cultural Resource restoration projects
- historic Point Reyes lighthouse rehabilitation
- Point Reyes Hostel improvements
- sewage system improvements

(Further detail on these projects can be found in Appendix F, Projects Considered in Cumulative Impacts Analyses. Other wider-ranging issues that may contribute to the cumulative analysis are described below).

Tule Elk Management Plan. The plan's action would have a short-term adverse effect by the limited use of motorized equipment in wilderness under the minimum tool concept. The localized use of helicopters or motor vehicles for short duration may increase safety risks to staff and visitors.

Dairy and Beef Ranching. Based upon monitoring results, the Seashore considers conditions at nine sites (8 subwatersheds) as degraded. Data from water quality monitoring has provided impetus to conduct field reconnaissance and additional sampling aimed at determining direct sources of pathogenic bacteria (e.g., livestock with direct access to streams). Trouble-shooting, problem solving, and best management practices implementation plans are underway for septic systems and dairies. For example, fencing has been installed or repaired at locations throughout the park. Focused monitoring of Kehoe Creek and Abbotts Creek has been initiated in order to differentiate sources (NPS 2004b). In addition, the two OLM stations identified below, are part of the Grazing BO monitoring project. Discussions to improve conditions within these watersheds are ongoing. Additional monitoring sites have shown exceedence of fecal coliform standards. In most cases, these sites are downstream of the degraded sites, and the higher readings are a result pollutant persistence in the water column.

While the Seashore has not designated water bodies specifically for recreational use, sampling for fecal and total coliform was performed at three of the most heavily used sites during summers1999 and 2000 (Hagmaier Pond, Vision Pond, and Bass Lake). Results indicate that water bodies not influenced by cattle grazing, remained far below any level of concern for contact recreation (Vision Pond and Bass Lake). Monitoring at Hagmaier Pond, a cattle stock pond, indicated short-term spikes of fecal coliform associated with the presence of cattle. Of 29 samples collected over two summers at Hagmaier Pond, 14% (4 samples) exceeded contact recreational standards (400 MPN/100ml). The duration of these fecal coliform spikes was typically less than one week. In response the Seashore posted warning signs at the pond, and access points, indicating the use of the pond by livestock, and associated risks (Ketcham 2001). These actions may mitigate some of the safety risks, and adverse impacts, of higher coliform counts in Seashore waters used by recreationists.

Point Reyes Hostel and Historic Lighthouse Improvements. The action will bring the facility into compliance with state, federal and Marin County health and safety regulations. Because of utility, housing and septic improvements, there are beneficial long-term direct impacts to public health and safety.

Cultural Resource Projects. The projects have moderate beneficial impacts to public health and safety by the upgrade of the buildings to code and upgrades to septic and water system.

Fire Management Plan. The actions in the FMP will have direct adverse, short-term and minor impacts to the health and safety of both the public and firefighters, except during large, high severity fire events, when the proximity of people to smoke and flame would result in major, short-term, and unavoidable adverse impacts.

Sewage Systems Improvements. Sewage systems upgrades have been conducted at Tomales Bay Marine Station at Sacramento Landing, within Olema Valley, and along Lagunitas Creek. The NPS headquarters buildings at Bear Valley also have received a new sewage system. New, major septic systems are planned at the Home Ranch and Point Reyes Lighthouse, and upgrades are planned for the Drakes Beach system. The Home Ranch sewage leach system for three houses will be moved to a location away from the Home Ranch creek area to address a water quality issue. The new leach field is directly north of the main Home Ranch complex. These projects will have minor beneficial long-term effects on public health and safety by removing localized potential pollutions sources.

The above projects and issues described will have a long-term beneficial and adverse major cumulative impact on public health and safety. This effect of Alternative A is negligible when viewed incrementally with the effects detailed above and does not change the overall cumulative effect.

Conclusion

Because of increased risk of deer-vehicle collisions, the No Action alternative would result in minor adverse impacts to human safety for staff, Seashore visitors and Marin County inhabitants. Because such impacts can be expected to recur indefinitely, they are characterized as long-term. When compared to all other alternatives, the No Action alternative would result in the greatest level of risk to human safety in this regard, although the use of firearms and possibly of aircraft to manage deer in each action alternative (B, C, D, and E) would present a higher safety risk overall. Based on the cumulative analysis, the long-term cumulative impact is both beneficial and adaverse, with minor to moderate intensity.

Type of Impact:	Adverse
Duration of Impact:	Long-term
Intensity of Impact:	Minor
Cumulative Impact:	Long-term beneficial and adverse minor to moderate

Impacts on Visitor Experience

Analysis

As a result of Alternative A, fallow and axis deer would increase in number in areas throughout the Seashore and opportunities for viewing non-native deer would increase slightly, a negligible to minor, long-term benefit to the visitor experience for the park visitors who hold aesthetic views as described in Affected Environment. Conversely, for those visitors seeking to view native black-tailed deer or who have more ecologistic views, a minor, long-term adverse impact is expected. Native deer viewing opportunities would be fewer and might require more time and effort on the part of the visitor because of adverse effects of non-native deer on native ungulates (see above Impacts on Wildlife – Alternative A). Under all action alternatives, the opportunities to view native deer species would improve as a result of the reduction of non-native deer numbers.

Increased numbers and density of non-native deer grazing in pastoral, wooded and riparian areas could change scenic viewsheds by suppressing undergrowth vegetation, shrubs and brush. The areas where such changes are most likely to be apparent to visitors are in Olema Valley (from fallow deer) and in the western pastoral areas of the Seashore (from axis deer). In these areas, agricultural grazing is the primary determinant of scenic viewsheds. The contribution which non-native deer would make to altering viewsheds is likely to increase over time with increasing deer densities, a negligible to minor adverse, long-term impact to the visitor experience related to viewshed enjoyment.

Monitoring of non-native deer occurs via helicopter counts, which may take place annually. The noise associated with these overflights would have a negligible long-term impact to visitors under this alternative.

Wilderness Character

NPS policies define wilderness character and values as including the primeval untrammeled character and influence of the wilderness; the preservation of natural conditions (including the lack of man-made noise); and assurances that there would be outstanding opportunities for solitude and the public would be provided with a primitive and unconfined type of recreational experience.

Like most wilderness areas in the National Wilderness Preservation System, the Point Reyes National Seashore Wilderness was not pristine when it was designated due to the history of Euro-American land use practices described in the Chapter 3, Affected Environment, including agricultural practices, introduction of non-native ungulates and fire suppression over the past century. As a result, “unnatural” conditions, with adverse ecosystem impacts, exist today. These impacts include the competition for forage between native and non-native ungulates, potential for disease transmission to native wildlife and destruction of woodland and riparian habitats. Scientific evidence indicates these conditions would continue to reduce the park’s biological productivity without human intervention. Continuing current management (e.g., the No Action alternative) would result in continued impacts to wilderness natural resources further imprinting the effects of human uses. “Untrammeled” is a key word for wilderness management specialists and recreationists, and is most often defined both as showing no signs of external human influence and as offering an unconfined or unrestrained experience. If no changes to current management are made, ecological conditions in woodland and riparian habitats of the Seashore wilderness would worsen, and this portion of the wilderness would continue to show clear evidence of having been altered by external human influence, e.g. it would appear “trammeled.” Minor adverse impacts to both these elements of wilderness character would occur.

However, visitors to the backcountry at the monument are able to find a solitary and quiet experience that may feel “primitive” and “unconfined.” Because fewer people visit the backcountry, the chances of encountering other hikers is relatively low. The backcountry is quiet, with few sources of loud noise except commercial aircraft occasionally flying overhead. Unless these visitors are or have been made aware of the unnatural state of the Seashore’s wilderness, they may believe that the area has been “affected primarily by the forces of nature.”

Wilderness Values

Similar to the discussion of wilderness character, the values ascribed to wilderness are sometimes grouped in biocentric and anthropocentric categories. Those with biocentric values may most appreciate the natural or ecological conditions at PRNS, including protecting natural ecological processes, wildlife habitat, habitat for rare and endangered or unique plants and animals, protecting watersheds and water quality, etc. Anthropocentric values include experiential benefits from recreating in wilderness, educational values, generating tourism revenue for adjacent or nearby gateway communities, aesthetic and spiritual values, the knowledge that wilderness areas exist and would exist in the future, and intrinsic or symbolic values. Generally, the impact of continuing current management would have minor adverse impacts to those with biocentric values and impacts ranging from minor and adverse to minor and beneficial to those with anthropocentric values.

No impairment to this park resource would result from the No Action alternative.

Cumulative Impacts

Cumulative impacts are those effects that could result when the impacts of Alternative A to a specific resource are added to the impacts of past, present and reasonable foreseeable future activities. As noted above, the Alternative A could have minor adverse and beneficial effects on visitor experience. An assessment of cumulative impacts on visitor experience considers the potential impacts that Alternative A may have on visitor experience in conjunction with the impacts on this same set of public health and safety activities from past, present and reasonable foreseeable future actions. Actions listed in Appendix F that contribute to the cumulative impact scenario for visitor experience include:

- Tule Elk Management Plan
- Fire Management Plan implementation projects
- Cultural Resource restoration projects
- current dairy and beef ranching
- historic Point Reyes lighthouse rehabilitation
- Point Reyes Hostel improvements
- Red Barn classroom
- historic Lifeboat Station marine railway rehabilitation

(Further detail on these projects can be found in Appendix F, Projects Considered in Cumulative Impacts Analyses. Other wider-ranging issues that may contribute to the cumulative analysis are described below).

<u>Tule Elk Management Plan.</u> The proposed action would have a short-term adverse effect by the limited use of motorized equipment in wilderness under the minimum tool concept. The localized use of helicopters or motor vehicles for short duration may have effects on wilderness users. Such transitory effects are deemed negligible and are clearly outweighed by the long term enhancement of this key attribute of the Seashore's wilderness.

<u>Fire Management Plan.</u> Prescribed burning would have minor beneficial effects by opening and restoring scenic vistas, but also short-term adverse effects on some visitor activities from blackening of vegetation with prescribed fires. The impact would be adverse and moderate and may extend to up to 50 days out of the year. Mechanical treatment may adversely affect park visitors through noise and closures. Impacts would be short-term and moderate.

<u>Cultural Resource Restoration Projects, Dairy and Beef Ranching, Pacific Coast Learning Center, Tomales Bay Marine Station, North District Operations Centers, Historic Lighthouse Rehabilitation Project, Point Reyes Lifeboat Station Rehabilitation, Cultural Resource Projects, Point Reyes Hostel Improvements, and Red Barn Classroom.</u> These projects overall have a cumulative beneficial major effect of visitor experience by providing scenic and historic features to be viewed by park visitors. The affected number of visitors is large (over 2.0 million visitors annually) and the overall cumulative effect could increase visitation.

The above projects and issues described will have a long-term and beneficial major cumulative impact on visitor experience. The effect of Alternative A is negligible when viewed incrementally with the effects detailed above and does not change the overall cumulative effect.

Conclusion

Based on data on current and past population growth of fallow and axis deer at PRNS, this alternative would result in an increase in fallow and axis deer numbers within the Seashore and throughout Marin

County. When compared to action alternatives, the opportunities to view native deer would be notably decreased under alternative A, while the likelihood of viewing non-native deer increases. Impacts to both wilderness character and wilderness experience would also occur. Impacts would be mixed depending on the social value of the visitor, and would be negligible or minor in either case. In addition, implementation of alternative A would likely increase adverse impacts to viewshed enjoyment over time as vegetation is removed.

The above projects and issues described will have a long-term and beneficial major cumulative impacts on visitor experience. The effect of Alternative A is negligible when viewed incrementally with the effects detailed above and does not change the overall cumulative effect.

Type of Impact:	Mixed—both adverse and beneficial
Duration of Impact:	Long-term
Intensity of Impact:	Negligible to minor
Cumulative Impact:	Long-term beneficial major cumulative impact on visitor experience

Impacts on Park Operations

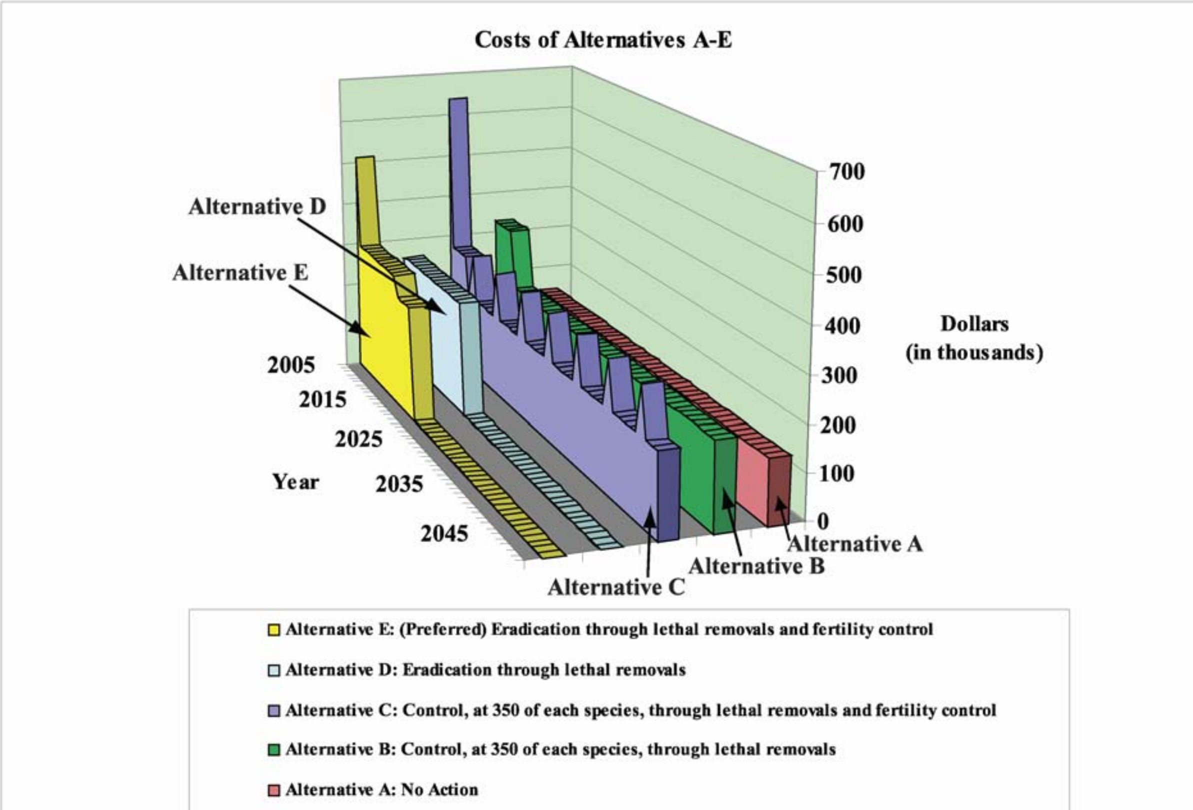
Under alternative A, potential effects associated with a growing population of non-native deer would result in increased allocation of funds and staffing to monitor and mitigate impacts to a broad spectrum of environmental, health and safety, and economic consequences analyzed elsewhere in this document. Operational costs and commitments would be expected to increase from both internal considerations and from increased coordination and cooperation outside the park. In addition, because this alternative results in presence of non-native deer in the Seashore in perpetuity, the costs would be incurred indefinitely.

Analysis

A growing population of non-native deer would result in increased allocation of funds and staffing to deal with and mitigate impacts to a broad spectrum of environmental, health and safety, and economic consequences analyzed elsewhere in this document. All impacts to park operations associated with continued monitoring of non-native deer and alleviation of impacts to natural resources and agriculture would be adverse.

Costs related to monitoring of large populations of non-native deer in the park are associated with impacts to natural and cultural resources. In FY 2003, personnel costs for 1.5 FTE (full time equivalents) and the costs of equipment, vehicles, supplies and staff for non-native deer monitoring (including one census yearly) totaled $126,000. Administrative and interpretive costs, excluding the costs of completing this document, comprised another $28,000. These costs, currently 2.9 % of the total PRNS annual budget, can be expected to double in the future with increasing non-native deer numbers and range. See Figure 17 for a comparison of the costs of the alternatives considered.

FIGURE 17: COMPARISON OF COSTS, ALTERNATIVES A-E, (BASED ON PRNS NON-NATIVE DEER COLLECTION DATA, 1984-1994 AND PRNS BUDGET DATABASES)



Note: Totals illustrated above, for comparison purposes, are minimum estimates of projected dollars spent by PRNS on monitoring or control programs. Costs of mitigating impacts to natural resources (as described in Chapter 4) could not be estimated and were not included.

Continuing costs to the park of mitigating impacts of non-native deer are unknown but would increase as their numbers increase under the No Action alternative. Such continuing adverse impacts include:

- Costs of disease monitoring and testing in areas of high deer density and where non-native deer are in close contact with livestock. Increased deer ranges and expansion into other areas in Marin County would require coordination and cooperation with state and federal regulatory agencies.
- Costs of erecting exclosures or deer-proof fencing in areas where high deer densities are adversely impacting sensitive resources, i.e., riparian areas or populations of rare plants.
- Costs of monitoring native species, such as native cervids, songbirds and special status species, adversely impacted by growing non-native deer numbers and range.

With increased densities and expansion of non-native deer beyond NPS boundaries likely under this alternative, the risk of costly litigation against the Seashore increases. Adverse impacts to agricultural lands outside the Seashore could engender suits against NPS from Marin County property owners. Increased numbers of deer-vehicle collisions, costly both in terms of human safety and material damages, as well as perceived risks to human health of aggressive non-native bucks during reproductive season, could engender suits against NPS from visitors and local inhabitants. All such litigation would result in substantial costs to the Seashore, in personnel time and potential monetary awards. Litigation costs are estimated at approximately $50,000.

Estimates for minimum cost for the implementation of the No Action alternative total approximately $2.1 million dollars by the year 2021. Thereafter, minimum annual costs could vary between $140,000 and $280,000 in perpetuity. The cost of implementing alternative A, a 5-15% increase in the total PRNS annual budget, can be expected to continue indefinitely.

Under the No Action alternative, non-native deer monitoring, mitigation of damage to natural resources associated with non-native deer, and potential litigation expenses could result in moderate, long-term, adverse impacts to park operations a result of increased budgetary commitments.

Cumulative Impacts

Cumulative impacts are those effects that could result when the impacts of Alternative A to a specific resource are added to the impacts of past, present and reasonable foreseeable future activities. As detailed above, Alternative A could have moderate adverse effects on the park operations. An assessment of cumulative impacts on park operations considers the potential impacts that Alternative A may have on park operations in conjunction with the impacts on this same set of park operational resources from past, present and reasonable foreseeable future actions. Actions listed in Appendix F that contribute to the cumulative impact scenario for park operations include:

- Tule Elk Management Plan
- the Giacomini wetlands restoration project
- coastal dunes restoration project
- dairy and beef cattle ranching
- Fire Management Plan implementation projects
- Tomales Bay marine station rehabilitation
- coastal watershed restoration (geomorphic sites) in Drakes Estero watershed
- Drakes Estero watershed restoration projects

(Further detail on these projects can be found in Appendix F, Projects Considered in Cumulative Impacts Analyses. Other wider-ranging issues that may contribute to the cumulative analysis are described below).

The projects listed above are those activities that will impact the park operating costs. Other projects listed in Appendix F are either funded by a private party (for example, Point Reyes Hostel) or from existing operation funds. Based on potential operating costs for the all projects considered, the staff of the Seashore estimated the cumulative cost of the projects, when viewed incrementally with Alternative A, would be less than $840,000 or 15% or the current operating budget of $5.6 million. Some future operating costs would be offset by fee increase, non-profit assistance, or special grants.

Increased energy, inflationary, and health care costs, cost-of-living increases, along with static Seashore base funding, all result in recent yearly budgets in which personnel costs take an increasing share. Consequently, base funding for resource management projects is expected to continue to shrink as a proportion of the Seashore's yearly budget. Competition for funds would intensify in coming years between resource priorities, ranging from endangered species protection and restoration of degraded natural areas, to non-native deer management. Along with intensified competition for natural resource funding, Alternative A would adversely impact other important resource management projects in the Seashore and would represent an adverse, cumulative impact to park operations.

Invasive non-native species are playing an ever-increasing role in threatening native biodiversity worldwide and in national parks. Species such as ice plant (*Carpobrotus edulis*), European beach grass

(*Ammophila arenaria*), the bullfrog (*Rana catesbeiana*), and the green crab (*Carcinus maenas)* all threaten rare native species in the Seashore and constitute a growing problem for resource managers charged with mitigating their impacts. Because the cost of mitigating impacts of increasing deer populations competes directly for funding and staff time with these projects, Alternative A would result in adverse, cumulative impacts to park operations related to the protection of sensitive natural resources.

Cumulative impacts of Alternative A with the above actions are characterized as adverse, long-term and moderate.

Conclusion

In addition to cumulative impacts, park operations would be affected under this alternative as a result of greater demand on park staff to deal with increasing monitoring, impacts/mitigation for natural resources, associated management costs and possible litigation costs. All of the impacts associated with the presence and/or expansion of non-native deer are characterized as adverse and long-term (in perpetuity). Because additions in cost and/or energy usage under the No Action alternative would constitute 5-15% of the total PRNS budget, the impacts are considered to be moderate. The No Action alternative, out of all the considered alternatives, represents the greatest level of potential adverse impacts to park operations as a result of the expected increase in financial commitments that would be required indefinitely. Cumulative impacts of Alternative A with other projects and activities are characterized as adverse, long-term and moderate.

Type of Impact:	Adverse
Duration of Impact:	Long-term
Intensity of Impact:	Moderate
Cumulative Impact:	Adverse, long-term and moderate

Impacts on the Regional Economy

The impacts of growing population size and range would constitute an aggravation and an increase in scope of current impacts to ranchers and other farmers, both within and outside of the Seashore. Because non-native deer could be expected to spread into other parts of Marin County for the foreseeable future under the No Action alternative, growing impacts to agriculture would be long-term.

Analysis

No Seashore ranchers have reported any beneficial economic impacts of non-native deer. Conversations and letters from permittees indicate that current impacts to those ranchers who see non-native deer year-round include (refer to Regional Economy in Chapter 3, for greater detail on existing conditions):

- Fence repair costs ($500-$1000/yr per ranch [4 reports])—damage by non-native deer.
- Costs of lost pasture forage (unknown costs [4 reports])—pasture forage consumption by non-native deer.
- Costs of lost supplemental feed (unknown costs [1 report])—supplemental food put out for livestock eaten by non-native deer.
- Costs of reseeding pastures ($9000/yr per ranch [1 report])—overgrazing of fallow fields by non-native deer.
- Veterinary costs ($1200 in 2001 [1 report])—leptospirosis possibly transmitted by non-native deer.

Several cattle ranchers operating outside the Seashore boundaries described similar types of impacts and related costs of $3500-$4000/yr. One organic farmer located outside the park has experienced noticeable depredation of planted vegetables during the fall from fallow deer migrating out of the Seashore. It should be noted that this depredation is described by the farmer as different and more severe than any depredation from native deer. Because the population of non-native deer would increase, and deer would very likely range to areas outside the park under the No Action alternative (no population management), long-term, moderate, adverse impacts to the regional economy are possible and could increasingly influence the economic viability of agricultural operations inside the park boundaries.

The No Action alternative could have a disproportionate socioeconomic effects on minority and low-income populations countywide if agricultural operations that hire low income farm workers were forced to downsize in the future because of losses due to expanding non-native deer populations. Such downsizing on low-income farm workers would have negligible to minor, long-term adverse effects on the regional economy.

Because the No Action alternative requires no park closures, there would be no anticipated effects to local tourist businesses.

Alternative A would likely result in increased range for both axis and fallow deer. Alterations in fallow deer range in the past 10 years suggest that fallow deer would continue to expand southwards and eastwards, spreading beyond Seashore boundaries into private lands and lands administered by California State Parks and Marin Municipal Water District. Favorable non-native deer habitat (interspersed grasslands and forests, including pasturelands) exists in close proximity to PRNS, GGNRA and throughout Marin and Sonoma Counties. The successful colonization and spread of axis and fallow deer within the Seashore suggest that range expansion throughout at least some of those counties is likely. Should non-native deer populations outside NPS boundaries reach or exceed densities currently seen in PRNS, impacts to agricultural operations in Sonoma and Marin Counties are likely. Because the impact could be quite widespread, it would be moderate or major in intensity and would persist indefinitely.

Cumulative Impacts

Cumulative impacts are those effects that could result when the impacts of Alternative A to a specific resource are added to the impacts of past, present and reasonable foreseeable future activities. As detailed above, Alternative A could have moderate direct and indirect adverse effects on the regional economy. An assessment of cumulative impacts on the regional economy considers the potential impacts that Alternative A may have on the regional economy in conjunction with the impacts on the regional economy from past, present and reasonable foreseeable future actions.

Actions and projects listed in Appendix F have been determined to all contribute to impacting the regional economy by providing a service, visitor experience, or facilities for the visiting public.
(Further detail on these projects can be found in Appendix F, Projects Considered in Cumulative Impacts Analyses. Other wider-ranging issues that may contribute to the cumulative analysis are described below).

Point Reyes National Seashore received 2.3 million visitors in 2001. The average visitor party spent $95 per party per night in the local area. This spending from visitors from outside the local region generated $83.6 million in sales for local businesses, yielding $39.3 million in personal income and supporting 2,000 jobs (NPCA 2002). Each dollar of tourism spending yielded another $0.63 in sales through the circulation of spending within the local economy. Including these secondary effects, the total economic impact was $113 million in sales, $42 million in wages and salaries, and 1,800 jobs (Michigan State University 2001).

The 165,000 acres of Marin County farmland produced olives, hay and silage, wine grapes, and organic produce earning in excess of $4 million in 2001 (Marin Agricultural Land Trust data 2003). Dairy and beef cattle produced about $40 million. Twenty percent of the Bay Area's milk supply is produced in Marin dairy farms. Countywide, two hundred farms and ranches employ 1,400 people.

A Biological Assessment was prepared in 2002 to review the proposed renewal of livestock grazing permits for areas managed by the Seashore and to determine to what extent renewing the permits might affect any of the federally listed threatened or endangered species (NPS 2002c). As mitigation for impacts of ranching operations on special status species, the Seashore is requiring permitees to alter some ranching practices which could result in added costs to permitees. Examples of such changes include increasing setbacks for livestock from riparian areas, delaying silage mowing, and improving drainage of livestock waste. Along with new requirements for agricultural permittees, increased numbers of non-native deer over a larger area of the Seashore resulting from Alternative A could constitute additional minor, adverse, cumulative impacts to the regional economy.

In summary, based on the above economic statistics, the overall incremental benefits of the park to the regional economy are major and beneficial.

Conclusion

Alternative A would continue existing minor adverse impacts to the regional economy indefinitely as non-native deer interfere with park ranching and grazing operations. Impacts to agricultural concerns could increase over time to a moderate, adverse level as the density of deer and the damage they cause increases. The impacts are considered minor to moderate because of the potential to impact a large number of businesses. Negligible to minor, adverse socioeconomic impacts are also possible to low-income/minority farm workers should the viability of agricultural operations be threatened under this alternative. As the populations of non-native deer expands outside the park, impacts to agricultural operations would become more widespread and could become major in intensity. When compared to all other alternatives, the No Action alternative would likely result in the highest degree of adverse effects to the regional economy.

The long-term cumulative impact of Alternative A and the projects considered in the cumulative analysis on the regional economy is major and beneficial. Although Alternative A has an adverse minor to moderate impact with the potential to become major, the scale of this economic impact when compared to the overall regional economic benefit of the park (both in dollars and number of businesses) is small.

Type of Impact:	Adverse
Duration of Impact:	Long-term
Intensity of Impact:	Moderate inside the park; major outside the park
Cumulative Impact:	Major and beneficial

Environmental Consequences of Alternative B – Control of Non-Native Deer at Pre-Determined Levels by Agency Removal

This alternative would control levels of fallow and axis deer to below estimated carrying capacity, at numbers that would be both logistically sustainable with NPS staff and funding, would keep deer from leaving the park, and would not likely lead to extinction of either species. In the 1970s and 1980s park staff controlled deer to 350 of each species. For purposes of analyzing impacts of this action alternative, the same levels (700 total non-native deer) would be assumed. Total numbers of non-native deer would be slightly less than current estimated numbers (approximately 250 axis deer and 860 fallow deer estimated in 2003) but high densities of deer in certain areas would still be expected because of the tendencies of both species to congregate in large herds. Initially, only fallow deer numbers would be curtailed by yearly shooting. In the future, when axis deer numbers surpassed the pre-established limit (for purposes of this analysis, 350), this species would also be culled. The age, sex and numbers of deer culled would be determined by resource managers to ensure that populations were maintained at desired levels and to reduce risks of range expansion beyond Seashore boundaries. The impacts to natural resources would differ little between Alternatives B and C.

Impacts on Water Resources and Water Quality

Analysis

The types of impacts to water resources associated with the presence of non-native deer are described in Alternative A, and include:

- loss of riparian vegetation through trampling, girdling and consumption, with resulting increases in runoff and erosion;
- streambank destabilization and loss, which also adds to sedimentation in streams;
- changes in stream morphology including decreases in stream depth and increases in stream width; and
- increases in bacteria and nutrients associated with waste products.

Because fallow deer tend to congregate in large herds and remain in an area for a long period of time, these effects are likely to be noticeable over time.

In addition to these types of impacts, fallow deer rip and tear riparian vegetation, dig holes, and create wide straight trails during the rut when bucks aggressively rub and thrash their antlers (Fellers and Osbourn 2006). Impacts of fallow deer grazing and thrashing to riparian vegetation, hydrology and water quality are most acute within the pastoral zone in Olema Valley, where many riparian areas have been deliberately excluded (with fencing) from livestock grazing on order to restore canopy and natural hydrologic processes. In these areas, heavy grazing, trampling, girdling and antler rubbing by non-native deer have severely retarded revegetation efforts and natural regrowth (B. Ketcham, NPS, personal communication). Continual grazing of new shoots and seasonal thrashing by fallow deer prevents native riparian plants from growing beyond shrub height. As noted above, without vegetation, soils are much more likely to erode in streamside forests and shrublands and would degrade water quality.

Because it leads to decreased non-native deer numbers in the Seashore in the short-term, Alternative B would result in localized improvements to water resources and water quality compared to the No Action alternative. These improvements include increased streambank stabilization, regrowth of riparian vegetation and improved capacity for runoff absorption and sediments stabilization, lowered suspended solids and lowered sedimentation of streams as soils stabilize, and less likelihood that water would be contaminated with bacteria or nutrients associated with animal feces. However, although impacts to water resources and water quality would be less than those in Alternative A, they would remain minor to moderate in intensity, depending on the area, as the remaining fallow and axis deer would continue to congregate in areas adjacent to streams and have continued impacts as described above.

Use of vehicles off-road to cull deer or remove carcasses could result in localized, minor soil erosion and potential for increased sedimentation of waterways. Alternative B specifies that NPS staff would attempt to remain on roads and trails whenever possible in order to avoid degrading soils, waterways and vegetation. Because cross-country use of vehicles would rarely be used, particularly in wilderness and sensitive areas, adverse impacts to water resources from sedimentation resulting from this alternative are considered insignificant (See Appendix A, minimum tool analysis).

Past practice indicates that maintaining population sizes to 350 of axis and fallow deer is likely to keep them inside the Seashore boundaries. This is a potential substantial benefit of this alternative, compared to Alternative A, to regional water quality and water resources, since the expansion of the herds has the potential to exert the same types of impacts as described above on a regional scale if the No Action Alternative is adopted.

Unlike with livestock impacts, where fencing and grazing limits may be enforced through permit authority, there are no means of mitigating for impacts of non-native deer to water resources and water quality.

Cumulative Impacts

Cumulative impacts of this alternative would be similar to those in Alternative A; that is, agricultural operations, removal of vegetation, burning and past logging practices have adversely affected many of the watersheds that are partially or completely inside the park, with the result that all watersheds inside the park exceed the recommended Total Suspended Solids standard. Restoration efforts, both inside the park and in partnership with other agencies are beneficial impacts to park water quality.

Maintaining populations of non-native deer long term would perpetuate concentration-associated impacts to hydrologic process in the lands no longer managed for agriculture. This alternative may also reduce the success and effectiveness of riparian restoration projects due to grazing, trampling and thrashing pressure by non-native deer on recovering native riparian vegetation. None of the projects described in the cumulative assessment of impacts to water quality would impede the continued impacts of non-native deer in the park. Though the cumulative impact scenario describes several restoration, rehabilitation and facility improvement projects that incrementally represent a substantial improvement to park and vicinity water resources, only the marsh restoration project would provide some treatment of water quality degraded by concentrations of non-native deer in Olema Valley. Non-native deer would continue to pass through the fences protecting sensitive resources from cattle. Cumulative impacts of Alternative B, when viewed incrementally with the above projects, would result in adverse long-term, moderate to major impacts to water resources inside and outside of the park.

Conclusion

Based on current and past data on fallow and axis deer, healthy non-native deer populations would remain, albeit at lower numbers, within the Seashore. No impairment to water resources would occur from implementing Alternative B. While benefits from slight population reductions would occur, continued presence of the two deer species would result in minor to moderate adverse impacts to hydrologic processes, aquatic habitat and water quality. Substantial benefits to water resources in the region relative to Alternative A are possible from reducing the risk of the expansion of non-native deer outside the Seashore. Overall, cumulative impacts of Alternative B are adverse and moderate to major in intensity.

Type of Impact:	Beneficial and adverse
Duration of Impact:	Short-term and long-term
Intensity of Impact:	Minor to moderate residual impacts
Cumulative Impact:	Adverse, long-term moderate to major

Impacts on Soils

Analysis

Alternative B would result in decreases in the number of fallow deer, and an increase to no more than 350 axis deer. Currently, fallow deer congregating in large herds and lekking fallow bucks are responsible for at least 120 acres of impacts to soils, and a reduction from nearly 900 animals to 350 would reduce impacts from current levels.

The types of impacts non-native deer have on soils in the Seashore are described in the impacts of Alternative A. These include the compaction and disturbance of soils, particularly in moist, riparian bottomlands of the Seashore, which leads to increased runoff and erosion. Axis and fallow deer also use riparian areas for feeding and shelter, and can consume large quantities of vegetation, or damage and destroy vegetation by girdling, trampling or breaking trails. Fallow deer trails are wider than native deer trails, cross streams and can erode substantially in the rainy season. Fallow bucks also destroy vegetation through behaviors during the rut, including polishing their antlers and scraping and pawing the ground. These areas of affected shrubland or forest can be quite obvious in the Seashore, (totaling 4 acres in the Bear Valley area alone) and the bared ground becomes erodable during the fall and winter. Each of these areas, where loss of vegetation and root destabilization has occurred, are subject to erosion and soil loss. If the impact is severe, it can be perpetuated indefinitely since vegetation does not grow back as readily where soils are compacted or where top layers are lost.

Unlike with livestock, where fencing and grazing limits are effective, there are no means of mitigating for impacts of non-native deer to soil resources. However, the reduction in the number of animals in the park could mean at least some of these areas where deer congregate would not be occupied, or would be occupied with fewer deer. It is possible that a negligible or minor improvement in soils in known fallow deer habitat would occur, although historic data suggest the difference would not be highly noticeable. During the first few years, before axis herds increase and as fallow herds are thinned, a minor short-term benefit may occur.

Use of vehicles off-road to cull deer or remove carcasses could result in localized, minor soil compaction. Alternative B specifies that NPS staff would attempt to remain on roads and trails whenever possible in order to avoid degrading soils, waterways and vegetation. Because cross-country use of vehicles would rarely be used, particularly in wilderness and sensitive areas, adverse impacts to soils from compaction resulting from this alternative are considered negligible or minor.

The greatest benefit of implementing this alternative to soils may be the much reduced risk of non-native deer expanding beyond park boundaries. If Alternative A were implemented, damage to soils could become regional in nature and major in its intensity. Relative to that alternative, maintaining the herds at 350 each could have substantial benefits to landowners outside the park.

Cumulative Impacts

Cumulative impacts to soils within the Seashore would be similar to those described for Alternative A. These include compaction, changed nutrient levels and denudation associated with livestock operations inside the park.

Soil compaction from cattle at the Seashore is restricted to the pastoral zone and by fencing. Non-native deer may feed in that zone as well, and compaction by deer would add to the impacts caused by cattle. Outside of the pastoral zone, non-native deer are adding to compaction in riparian areas and areas outside the pastoral zone.

Alternative B will add to impacts of erosion from past practices like logging, and from the Vision Fire and development.

Although adverse cumulative impacts would be less relative to No Action, there would remain cumulative adverse effects on soils. Based on the number of acres with soil impacts in Alternative B, the adverse impacts on soil resources would not be significantly offset by the beneficial impacts of some of the projects reviewed in the cumulative analysis and, along with continued cattle ranching, would continue to present a long-term, adverse major impact on the soil resources within the park. The total cumulative number of acres with adverse soil impacts would exceed 500 acres, characterizing the total impact as major.

Conclusion

Based on current and past data on fallow and axis deer, congregating non-native deer would continue to adversely affect soils through trampling, compaction and denuding sites even at the lower population sizes that would exist if Alternative B were selected. No impairment to soils would occur from implementing Alternative B. A negligible to minor short-term improvement to soils in some localized areas currently used by non-native deer could occur in the first few years, although the continued presence of large herds of axis and fallow deer would result in long-term minor to moderate, adverse impacts. Substantial benefits relative to Alternative A, from lower risk of non-native deer expanding outside the park and affecting soils regionally, are likely.

Based on the number of acres with soil impacts in Alternative B, the adverse impacts on soil resources would not be significantly offset by the beneficial impacts of the projects described in the cumulative analysis and, along with continued cattle ranching, would continue to present a long-term, adverse major impact on the soil resources within the park.

Type of Impact:	Beneficial in the short-term, adverse in the long-term
Duration of Impact:	Short-term and long-term
Intensity of Impact:	Minor to moderate
Cumulative Impact:	Adverse, long-term major

Impacts on Vegetation

Analysis

The types of impacts non-native deer can have on vegetation are described above under the Impacts of Alternative A. To summarize, they include consumption, girdling, trampling and loss from behaviors such as creating trails and antler thrashing during the rut. These, in turn, have indirect effects on vegetation, through increased compaction and erosion of soils, which make revegetation difficult; and through changes in nutrients and responses by plants to grazing. Deer also have impacts on the physical structure of vegetation, species richness and species composition across landscapes, as well as distribution of seeds and nutrients.

Heavy browsing by deer can remove the middle and lower levels of vegetation, and create a browse line that reaches from the ground to as high as the deer can reach. It can also keep trees and shrubs from reaching their full height, and can eliminate palatable species entirely from an area. In some cases, theses species are rare or protected, or the vegetative community affected by deer grazing is unique. In the extreme, ungulate grazing can change woodlands into grasslands, can prevent succession from open grasslands to shrublands or forests and can create vegetative communities composed of only a few species. In the park, one unique community that is heavily affected by fallow deer is riparian. Fallow deer congregate in streamside shrublands and forests, particularly during the rut, and may remain there for long periods of time. In addition to removing vegetation by grazing, deer trampling and compaction of soil, rutting behaviors and trail breaks can result in severe loss of riparian vegetation locally. In some cases, the park has deliberately attempted to restore riparian areas by fencing out cattle, only to have the fences breached by fallow deer and the riparian areas degraded. Densities of fallow deer can reach 80 per square kilometer, several times higher than that of white-tailed deer in areas of Pennsylvania where major changes in species richness and vegetative cover were noted (NPS 2002a; deCalesta 1997).

Because it would quickly reduce total numbers of fallow deer in the Seashore, Alternative B would result in some short-term reduction of current moderate to major impacts to vegetative processes (associated with plant establishment and regrowth), habitat (associated soil erosion and plant growth rates), and plant diversity (associated with preferential grazing and browsing). However, as axis deer populations grow and the total number remains at 700, the difference in impacts to vegetation over the long term between this alternative and Alternative A are more likely to decrease, and adverse moderate impacts would persist indefinitely.

The major benefit of implementing this alternative to vegetation may be the reduced risk of non-native deer expanding beyond park boundaries. If Alternative A were implemented, damage to vegetation could become regional in nature and therefore, by the definitions described in Chapter 4, Methodology, would become major in intensity. Relative to that alternative, maintaining the herds at 350 each could have substantial benefits to landowners outside the park.

Use of vehicles off-road to cull deer or remove carcasses could result in localized, minor direct destruction of vegetation. Alternative B specifies that NPS staff would attempt to remain on roads and trails whenever possible in order to avoid degrading soils, waterways and vegetation. Indirect impacts from capture or culling operations would also include increased potential for the dispersal of non-native plant seed and vegetative propagules. In addition, operation of vehicles could compact soils and trample vegetation, making regrowth more difficult. Because cross-country use of vehicles would rarely be used, particularly in wilderness and sensitive areas, adverse impacts to vegetation from destruction resulting from this alternative are considered negligible or minor.

Cumulative Impacts

Cumulative impacts would be similar to those identified for Alternative A. These include ranching operations, as well as restoration operations conducted by the park. These restoration efforts include working with the agricultural community to modify operations within the lease areas to reduce adverse impacts associated with livestock concentration. Ranching operations have been reduced from their historic extent (on the entire Point Reyes Peninsula) to only 25% of the overall land area. Nearly all of the remaining 75% of Seashore lands is managed as natural or wilderness areas. Some of these areas are returning to shrub and forest communities without the "clearing" effects of livestock grazing. In areas that are managed for agriculture, tools have been implemented to exclude livestock from sensitive areas, such as riparian zones and creeks.

Based the effects in Alternative B on vegetation and the adverse cumulative effects of the projects in the cumulative analysis, the adverse impacts on vegetation resources would be moderate to major. Cumulative impacts from ranching activities could be irreversible and substantial. Beneficial impacts of some of the above projects would not significantly offset the adverse impacts of ranching and non-native deer.

Conclusion

This alternative would maintain non-native deer at slightly reduced numbers within the Seashore and throughout Marin County. No impairment to vegetation would occur from implementing Alternative B. Based on current reports of damage to riparian and understory vegetation within the Seashore, the magnitude of current impacts to vegetation within NPS boundaries are currently considered moderate to major in intensity, depending on the area. Under this alternative, the impact intensity is expected to decrease slightly initially, but remain moderate because of localized high deer densities and geographic scope over the long term. Substantial benefits are likely relative to Alternative A from lowering the risk of non-native deer expansion outside the park and reducing impacts to vegetation regionally.

Based the effects in Alternative B on vegetation and the adverse cumulative effects of the projects in the cumulative analysis, the adverse impacts on vegetation resources would be moderate to major. Cumulative impacts from ranching activities could be irreversible and substantial. Beneficial impacts of some of the above projects would not significantly offset the adverse impacts of ranching and non-native deer.

Type of Impact:	Beneficial in the short-term, adverse in the long-term
Duration of Impact:	Mixed—both short-term and long-term
Intensity of Impact:	Moderate
Cumulative Impact:	Adverse, long-term moderate to major

Impacts on Wildlife

Analysis

In the following analysis, the best professional judgment of wildlife biologists, as well as research completed at the Seashore and elsewhere, have been used to provide guidance for evaluating impacts of increasing fallow and axis deer populations and range on other wildlife species.

Non-native Cervids

The increased population size for axis deer, which would result from this alternative, would clearly benefit that species. Range would likely increase within the Seashore.

Because fallow deer populations would initially be reduced to 350, this alternative has adverse impacts for fallow deer in PRNS. Current fallow deer range maps suggest that fallow deer have spread recently towards the south and eastward borders of the Seashore. Any deer control program involving lethal removal of animals with firearms has the potential to scatter deer herds and push deer out of the Seashore into adjacent lands. Provisions in Alternative B that specify removing animals from the edges of the Seashore before culling animals deeper within the park would mitigate such scattering. However, large numbers of fallow deer on the Vedanta Society property would remain outside NPS management authority.

Impacts to non-native deer from Alternative B would be beneficial to axis deer and adverse to fallow deer. Because change in total deer numbers and range are expected to be small and Alternative B calls for maintenance of non-native deer in PRNS indefinitely, impact intensity is considered minor and long-term.

Alternative B, because it results in shooting of non-native deer, would cause a measure of pain and suffering to culled animals. The degree of pain and suffering would be mitigated by use of trained agency sharpshooters for all control operations. Culling would be conducted by NPS staff or contractors specifically trained in wildlife sharpshooting. (In addition to other federal contracting requirements, for the purposes of this plan, a contractor is a fully insured business entity; non-profit group or government agency engaged in wildlife management activities that include trapping, immobilization and the lethal removal through sharpshooting and chemical euthanasia. The contractor must possess all necessary permits and be able to pass any needed security clearances.) Efforts would be made to deliver immediately lethal shots to target animals and sharpshooters would be required to complete NPS range qualifications specifically designed for ensuring humane and effective wildlife removal.

Native Cervids

In their study of axis and fallow deer introductions nationwide, Feldhammer et al. (1993) stated:

> "We may expect competition between exotic and native artiodactyls both intuitively, and on the basis of previous field experiments with a variety of animal groups from various trophic levels and habitats…"

Native black-tailed deer are primarily browsers while both axis and fallow deer have been shown to be grazers. However, studies at PRNS have demonstrated that, during times of low forage availability, non-native deer adapt their feeding habits and consume larger amounts of forbs and browse (Elliott 1983; Elliott and Barrett 1985; Fallon-McKnight 2006). Elliott could not detect statistically substantial effects of non-native deer on black-tailed deer fawn production or survival. He suggested that densities of exotic deer present in 1973 ($\leq$17 deer / sq. km. or 350 of each species) would not negatively affect the density of black-tailed deer. A review of Elliott's 1982 dietary overlap study by Gary Fellers, a U.S. Geological Survey scientist, suggested that exotic deer at levels of 350 for each species could reduce the native black-tailed deer population size by up to 30%. If black-tailed deer numbers are strongly influenced by the energy content of their diet, the reduction in their population, when fallow deer number 350, could be as much as 40% below carrying capacity (Fellers 1983 and 2006).

700 non-native deer would result in competition with native black-tailed deer for forbs and browse during droughts, at the end of summer, and year-round on poor quality ranges (Connolly 1981; Elliott 1983; Fellers 1983). Competition for limited forage would result in decreased condition in black-tailed deer (Brunetti 1976; Fellers 1983). It has been repeatedly shown in the scientific literature that poor condition in adult female cervids results in decreased reproductive capacity (Verme 1962, 1967; Thorne et al. 1976; Keech et al. 2000). Competition for forage would likely result in reduced black-tailed doe fertility, decreased long-term fawn production and lower fawn survival, although, in the short-term, all these parameters would be improved over current levels. The magnitude of the impacts to black-tailed deer populations would depend on range conditions, precipitation patterns and non-native deer numbers but would likely range from minor to moderate and could be expected to last longer than two breeding cycles. It is important to note that adverse impacts to black-tailed deer from increased competition would occur

throughout larger portions of the Seashore's pastoral zone and some natural areas if axis deer range expands in the future as a result of this alternative.

Continued presence of non-native deer in areas of the Seashore where free-ranging tule elk inhabit would likely inhibit expansion of the elk herd and may suppress elk numbers where the new free-ranging subpopulations are not well established. These areas include the southwestern wilderness areas of the park south of Drake's Estero and west of Inverness ridge.

Tule elk, like fallow and axis deer, are primarily grazers. Grasses constitute a large proportion of the diets of all three species year-round (Elliott and Barrett 1985; Gogan and Barrett 1985; Fallon-McKnight 2006). Fallow deer, present at Limantour but not Tomales Point (the two locations of tule elk populations in the Seashore), may impact sympatric elk in the Limantour area in their foraging for forbs, grasses and especially, *Plantago* spp. (a high energy and high protein forage). (Fallon-McKnight 2006). Competition between elk and fallow deer for forbs likely continues throughout spring and summer, which is a time that both species are nursing young. Increased grazing pressure on this and other important forage items by fallow deer could potentially deprive Limantour elk of the nutritional benefits of these food resources at a critical time (Fallon-McKnight 2006). In addition to inhibiting further expansion of tule elk herds, 700 non-native deer in the Seashore would likely continue to adversely impact current elk populations in the Seashore through competition for forage (Brunetti 1976). Such impacts would be reflected in lower elk calving rates, delayed onset of reproduction in tule elk cows and reduced elk calf survival.

Direct behavioral competition between fallow deer and tule elk currently exists at PRNS and would likely continue, albeit at lower levels, with Alternative B. Researchers in the Zehusice Deer Park in the Czech Republic have documented behavioral exclusion of red deer (a subspecies of elk similar in size to tule elk) by fallow deer at high-density feeding sites (Bartos et al. 1996). Fallow deer at Zehusice were observed to: (1) be consistently more aggressive than red deer, (2) preferentially seek out feeding sites where red deer congregated, and (3) attack red deer from the rear as a strategy to overcome their larger opponents (Bartos 1996). In the Tomales Point Elk Reserve at PRNS, fallow bucks have been observed sparring with tule elk bulls (PRNS unpublished data (m)). In all observed instances, fallow bucks were successful in chasing away elk bulls in spite of a major size disadvantage. The consequences of a decrease in behavioral competition are difficult to predict with certainty but could include decreased exclusion of elk from higher quality forage or habitat, improved condition of reproducing adults and ultimately, increased population growth.

Paratuberculosis, or Johne's disease, is an infectious and incurable diarrheal wasting disease of wild and domestic ungulates. In a study conducted at PRNS in 1979, paratuberculosis was documented in 9.6% and 8.1% of axis and fallow deer, respectively (Riemann et al. 1979b) and reconfirmed in axis deer in 2000 (NPS unpublished data (g)). The disease has been documented in tule elk at Tomales Point Elk Reserve since 1980 (Jessup et al. 1981). In spite of their known susceptibility to the disease, black-tailed deer have not been documented to carry paratuberculosis in PRNS (Williams et al. 1983; Sansome 1999 unpublished report). Few black-tailed deer at PRNS have been tested for Johne's disease and it is possible that the disease causes rapid death in this species (E. Manning, Johne's Testing Center, personal communication). In 1998-1999, relocation of 45 adult tule elk from Tomales Point to the Limantour wilderness area included a 6-month quarantine and extensive testing for Johne's disease (Manning et al. manuscript in press). Only those animals that consistently tested negative on all blood tests and fecal cultures were released in July 1999 to form a new free-ranging herd. This elk herd is currently made up of 45 animals. The goal of the relocation was to restore the dominant native herbivore to the Seashore's wilderness ecosystems.

Transmission of the organism that causes paratuberculosis (*Mycobacterium avium ss. paratuberculosis*) occurs primarily from infected adults to young animals. The period of greatest susceptibility for this infection is the first 6 months of life. The organism is shed by infected animals into feces that may contaminate feed, water, and pastures. The prevalence of the infection and the incidence of clinical disease may climb when an affected population approaches carrying capacity. At these high densities, affected herds experience the stressors of reduced forage nutritional quality and reduced ability to fight disease. This immunosuppression can result in increased transmission of infection and progression to clinical illness as well as heavier parasite loads (Manning et al. 2003). Animals in the clinical phase of Johne's disease shed the organism more often and in greater numbers. Premise contamination with this hardy and long-lived organism may thus increase, a factor relevant to the health of numerous species. All cervids are believed to be susceptible to this infection (Manning and Collins 2001). In Alternative B, non-native deer populations would be controlled below carrying capacity. The potential for transmission to tule elk and black-tailed deer, which share their habitat, would be minor.

As noted in the analysis of Alternative A, ectoparasites on fallow and axis deer have been newly discovered. These three species of lice pose an unknown but potentially significant risk of disease to native black-tailed deer and tule elk. Pediculosis, resulting from the inter-species transfer of both chewing and sucking lice to cervids has been well documented in the literature (Brunetti et al. 1971; Foreyt et al. 1986; Westrom 1976; Bildfell et al. 2004). USDA researchers and NPS managers are concerned that clinical disease resulting from transfer of any non-native lice to native deer could cause increased morbidity, mortality and reduced recruitment of young. Alternative B would result in lower densities of fallow deer and higher densities of axis deer in PRNS and outside of NPS boundaries. The potential for transmission to the tule elk and black-tailed deer that share their habitat is unknown but is considered minor to moderate.

Genetic variability assists populations in adapting to environmental changes and reduces vulnerability to catastrophic events such as disease, abnormal weather cycles, pollution etc. Fewer than 4,000 of the 500,000 tule elk historically present in California, currently remain. Tule elk at PRNS have passed through four severe population reductions or "bottlenecks". With each bottleneck, the amount of genetic variability in the population has been reduced. It has been estimated that PRNS elk are among the most inbred in California, with a degree of relatedness equivalent to that resulting from three consecutive brother-sister matings (McCullough et al. 1996). Physical signs of inbreeding, such as cleft palate, have been observed in the Tomales Point herd (Gogan and Jessup 1985).

Management techniques to increase genetic diversity within and among wildlife populations include: (1) translocating animals between subpopulations, and (2) increasing the number of reproducing animals within each subpopulation (McCullough et al. 1996). For the past 5 years, NPS has cooperated with California Department of Fish and Game to transfer adult elk cows to Tomales Point, in order to increase genetic variability. One of the primary goals of the PRNS General Management Plan is to maintain viable populations of tule elk in the Seashore and to restore free-ranging elk to wilderness ecosystems. Alternative B would likely slow the growth of tule elk numbers required to increase genetic variability in the Limantour elk herd. Competition for resources with fallow deer and minor potential for transmission of paratuberculosis could adversely impact herd growth. Smaller numbers of breeding animals would result in lower genetic variability and increased risk of catastrophic population downswings.

Alternative B would result in:

- decreased tule elk and black-tailed deer food availability;
- slowed growth or reduction of tule elk and black-tailed deer numbers;
- decreased expansion of tule elk range; and
- reduced potential for increased genetic variability within a the PRNS tule elk population.

Depending on precipitation and range conditions, impacts to native cervids from Alternative B within and outside of NPS boundaries would be beneficial and moderate in the short-term. In the long-term, continued presence of non-native deer in the Seashore would constitute moderate adverse impacts.

Small Mammals

The impacts of 700 non-native deer on small mammals would occur in two ways: (1) by beneficial or adverse habitat alteration, influencing food supply and cover, and (2) by direct, adverse competition for resources, mainly, food (Flowerdew and Ellwood 2001). In order to definitively demonstrate impacts of deer populations on small mammals at PRNS, large-scale deer exclosure experiments would have to be used to investigate responses at varied deer densities. Such experiments have not been carried out at PRNS. Evaluation of impacts to small mammals is guided by research completed in the U.S. and in the U.K. on fallow deer and white-tailed deer in lowland woodlands (Putman 1986; McShea 2000; Flowerdew and Ellwood 2001; Fuller 2001). Inventories of small terrestrial vertebrates, conducted at PRNS from 1998-2001 in the agricultural and ungrazed areas of the Seashore, were also considered in this analysis (Fellers and Pratt 2001).

In the Britain, heavy grazing pressure (100 deer/ sq. km. by fallow deer in lowland forests caused reductions and even local extirpations of wood mice, bank voles and common shrews (Putman et al. 1989). The loss of palatable ground-level vegetation removes food sources for small herbivores and at the same time, changes microclimates and reduces protection from predators (Flowerdew and Ellwood 2001). Increased browsing of shrubs in forested habitat or on forest-grassland interfaces, as has been demonstrated in both axis and fallow deer at the end of summer and during droughts (Elliott 1982), could alter suitability of those areas for some species. High densities of fallow deer year-round as well as fallow bucks during the breeding season have been observed to alter woodland and riparian cover and vegetation at PRNS through browsing and antler thrashing (Fellers and Osbourn 2006; B. Ketcham, NPS, personal communication). Such high-density impacts could decrease cover and habitat for the dusky-footed woodrat (*Neotoma fuscipes*).

Inventories of small mammals in non-wooded areas of the Seashore revealed fewer western harvest mice (*Reithrodontomys megalotis*) and California meadow voles (*Microtus californicus*) captured in those pastures heavily grazed by cattle than in moderately grazed pastures or similar non-wooded areas (Fellers and Pratt 2002). Densities of fallow deer in the Olema Valley areas of PRNS currently approach 80 deer/ sq. km. (NPS 2002a) and could be expected to decrease in some of these areas with Alternative B. However, the Vedanta Society property, which supports the highest densities of fallow deer, is outside NPS management authority and no deer would be removed there. It is likely that deer densities would remain unchanged or might increase with Alternative B if deer from neighboring NPS lands are pushed on to Vedanta lands with park removal operations. Grazing pressure from non-native deer in many Olema Valley sites is currently considered heavy. Should this grazing pressure continue or increase with Alternative B, species that could be adversely affected are the: Pacific jumping mouse (*Zapus trinotatus*), dusky-footed woodrat (*Neotoma fuscipes*), western harvest mouse (*Reithrodontomys megalotis*), California vole (*Microtus californicus*), black-tailed jack rabbit (*Lepus californicus*), and brush rabbit (*Sylvilagus bachmani*). High, localized non-native deer densities resulting from Alternative B would likely reduce habitat for these species in limited areas of the Seashore. Higher axis deer densities resulting from Alternative B could impact small mammal habitat in other areas of the Seashore if axis deer range increases. The adverse impacts are considered minor and long-term.

Not all species decline with increasing deer grazing pressure. Grazing at intermediate and low deer densities has been shown to increase or have no effect on some plant and animal species in Britain (Fuller and Gill 2001). At PRNS, deer mice (*Peromyscus maniculatus*) were found more often in pastures grazed by cattle than in pastures where cattle were excluded (Fellers and Pratt 2002). It is possible that with the continued localized grazing pressure resulting from Alternative B, deer mouse abundance would increase in PRNS and countywide. The Valley pocket gopher (*Thomomys bottae*), another small mammal species that thrives in open grassland environments, could also remain unaffected or increase.

Direct competition for food between non-native deer and small mammals is a potentially adverse impact resulting from Alternative B. As stated before, definitive documentation of competition would require exclosure experiments. In the absence of such experimentation, evidence of dietary overlap between species has been evaluated. In California and elsewhere, fallow deer are known to feed on acorns, an important food source for many small mammals (Poli 1996; Jurek 1977). In addition, analyses of fallow and axis rumen and fecal samples have shown heavy use of many of the same species used by small mammals (Elliott 1982; Fallon-McKnight 2006). Small mammals likely to be adversely affected by increasing competition for food are the: Pacific jumping mouse (*Zapus trinotatus*), California vole (*Microtus californicus*), deer mouse (*Peromyscus maniculatus)*, western harvest mouse (*Reithrodontomys megalotis*), black-tailed jack rabbit (*Lepus californicus*), and brush rabbit (*Sylvilagus bachmani*).

Depending on local deer densities, weather patterns and the yearly mast crop, overall impacts to small mammals from Alternative B are considered to be adverse and range from minor to moderate in the Seashore. Because impacts would persist for longer than 2 breeding cycles, they are considered long-term.

Mammalian and Avian Predators

This category includes wildlife species, such as mountain lions (*Felis concolor*), coyotes (*Canis latrans*), grey foxes (*Urocyon cinereoargenteus*), bobcats (*Felis rufus*), badgers (*Taxidea taxus*), weasels (*Mustela spp.*) and the raptors that prey on small mammals.

Although no research at PRNS has been conducted to document the extent to which non-native deer are preyed upon by carnivores, anecdotal and historical evidence suggest low-level predation, especially on fawns. Since their introduction in the 1940s, there has been a decrease in the proportion of observed white fallow deer, from 75% to 21%, suggesting that white individuals may be preferentially selected by predators (Wehausen 1973; NPS 2002a). An anecdotal report exists of an axis doe defending her fawn from a bobcat (NPS unpublished data (n)). Ranchers have reported coyotes preying on axis fawns in the pastoral zone (N. Gates, NPS, personal communication). However, because non-native deer congregate in large groups and prefer open habitat, it is unlikely that they serve as a primary prey base for native mega- and meso-carnivores, which specialize on stalking black-tailed deer and small mammals. Alternative B would likely leave the prey base for mountain lions, coyotes and bobcats essentially unchanged over current conditions. The expected long-term decrease in both the black-tailed deer and small mammal prey base for these carnivores, foxes, weasels and badgers resulting from Alternative B would cause minor adverse impacts to these predators.

In the New Forest in Britain, heavy grazing, mainly from fallow deer, was shown to result in lowered reproduction in tawny owls (*Strix aluco*) and kestrels (*Falco tinnunculus*), especially during severe weather cycles and poor mast crop years (Putman 1986). Because of the likely adverse long-term impact on their rodent prey base, especially in areas of high deer densities, Alternative B would have an adverse impact on birds of prey such as great-horned owls (*Bubo virginianus*), short-eared owls (*Asio otus*), western screech owls (*Otus kennicottii*), long-eared owls (*Asio otus*), barn owls (*Tyto alba*), American kestrels (*Falco sparverius*), red-shouldered hawks (*Buteo lineatus*), red-tailed hawks (*Buteo jamaicensis*), Northern harriers (*Circus cyaneus*), black-shouldered kites (*Elanus caeruleus*), sharp-shinned hawks (*Accipiter striatus*), and Cooper’s hawks (*Accipiter cooperii*).

Overall, the adverse impacts of Alternative B to predators in the Seashore and in Marin County would be minor to moderate and long-term.

Other Birds

Little is known about the impacts of grazing wildlife on birds in the Seashore. In 1997-1998, researchers at the Point Reyes Bird Observatory compared avian abundance and species richness in areas grazed by cattle and in ungrazed areas (Holmes et al. 1999). Results showed that in all habitat types except coastal scrub, cattle-grazed areas had lower diversity, lower species richness and lower relative abundance of passerines and near-passerines (hummingbirds, woodpeckers and doves). Only one species, the savannah sparrow (*Passerculus sandwichensis*), was found in higher numbers in grazed grasslands.

Deer exclosure studies in Pennsylvania hardwood forests indicate that high densities of white-tailed deer (*Odocoileus virginianus*) cause declines in intermediate canopy-nesting songbirds. This study showed complete absence of certain songbird species, including American robins (*Turdus migratorius*), at deer densities over 25 deer/ sq. km. (deCalesta 1994). These declines are thought to occur because high deer numbers alter the structure of woody and herbaceous vegetation 0.5 - 7.5 meters above the ground (deCalesta 1994). Studies of fallow deer, roe deer (*Capreolus capreolus*) and muntjac deer (*Muntiacus reevesi*) in British lowland forests suggested that some bird species, namely understory nesters, declined with high deer grazing pressure while other species, namely bark foragers, benefited from reductions in understory vegetation. Researchers in British lowland forests determined that “losers” substantially outnumbered “winners” and that breeding populations of migrant birds were especially vulnerable to adverse impacts from heavy deer grazing pressure (Fuller 2001).

Table 10 lists the ground or low nesting bird species (nesting at approximately 0.3–3 meters) found in the Seashore. These species are found in habitats where the greatest impacts from large herds of non-native deer would occur (T. Gardali, Point Reyes Bird Observatory, personal communication, Shuford and Gardali, in review). Impacts to the species listed would likely occur in a manner similar to the Pennsylvania study (deCalesta 1994). That is, there would be a decrease in abundance of low nesting species that depend on understory vegetation to place their nests. Impacts on reproductive success and survival are unknown. It should be noted that Table 10 primarily contains species breeding at PRNS and GGNRA and is not exhaustive. Two species that would likely be impacted, the San Francisco common yellowthroat (*Geothlypis trichas sinuosa*), and the California Swainson’s thrush (*Catharus ustulatus oedicus*) are not listed in this table because they are either California Bird Species of Special Concern (CDFG) or Birds of Conservation Concern (USFWS) and are discussed in the Impacts on Species and Habitats of Management Concern section.

TABLE 10: BIRD SPECIES LIKELY TO BE ADVERSELY IMPACTED BY ALTERNATIVE B. (T. GARDALI, POINT REYES BIRD OBSERVATORY, PERSONAL COMMUNICATION, SHUFORD AND GARDALI, IN REVIEW)

Common Name	Scientific Name
Allen’s hummingbird	*Selasphorus sasin*
American goldfinch	*Carduelis tristis*
Bewick’s wren	*Thryomanes bewickii*
Brewer’s blackbird	*Euphagus cyanocephalus*
California towhee	*Pipilo crissalis*
California quail	*Callipepla californica*
Hermit thrush	*Catharus guttatus*
Horned lark	*Eremophila alpestris*

Lark sparrow	*Chondestes grammacus*
Lazuli bunting	*Passerina amoena*
Marsh wren	*Cistothorus palustris*
MacGillivray's warbler	*Oporornis tolmiei*
Orange-crowned warbler	*Vermivora celata*
Oregon junco	*Junco hyemalis thurberi*
Red-winged blackbird	*Agelaius phoeniceus*
Spotted towhee	*Pipilo maculatus*
Western meadowlark	*Sturnella neglecta*
Wilson's warbler	*Wilsonia pusilla*
Winter wren	*Troglodytes troglodytes*
Wrentit	*Chamaea fasciata*

In areas of PRNS and GGNRA, it is expected that overall avian species richness, abundance and diversity would decrease measurably in areas of continued heavy grazing pressure resulting from Alternative B. Beneficial impacts to a few grassland species would be offset by larger adverse impacts to relatively more species that depend on understory shrub layers for nesting, especially in impacted riparian and woody-grassland interfaces. The adverse impacts to various species would range from minor to moderate in intensity, depending on precipitation and range conditions, and would be long-term within NPS boundaries.

Reptiles and Amphibian

Some information is available on the impacts of large herds of grazing herbivores on reptiles and amphibians in the Seashore. During inventories of small vertebrates conducted at PRNS in 2001, northern alligator lizards (*Gerrhonotus coeruleus*) were not found in pastures grazed by cattle but were found in similar ungrazed sites (Fellers and Pratt 2002). Changes to woodland understory vegetation, especially in riparian areas, as has been documented with fallow deer at PRNS, would alter microclimates and habitats for frogs, lizards and salamanders. Adverse impacts could be expected for: alligator lizards, California slender salamanders (*Batrachoseps attenuatus*), rubber boas (*Charina bottae*), western skinks (*Eumeces skiltonianus*), racers (*Coluber constrictor*), garter snakes (*Thamnophis elegans)*, and Ensatina salamanders (*Ensatina eschscholtzii*).

Because of expected mild to moderate adverse impacts of Alternative B on small mammal abundance (see above), concomitant decreases can be expected in reptiles that prey on shrews and rodents. Species in this category are the: western terrestrial garter snake, rubber boa, and gopher snake (*Pituophis melanoleucus*).

Studies of British lowland forests heavily grazed by fallow deer have shown that as a result of decreasing rodent numbers, kestrels relied preyed more heavily on lizards (Putman 1986). Inside the Seashore, similar increases in predation by raptors and owls on lizards, frogs and snakes is likely to occur in areas of high non-native deer density.

Impacts to amphibians and reptiles in PRNS with Alternative B are expected to be adverse to a number of species. The impacts range from minor to moderate and are long-term.

Because Alternative B is likely to control the expansion of non-native deer outside Seashore boundaries, substantial benefits to wildlife resources affected by non-native deer are likely to occur relative to No Action.

Cumulative Impacts

Cumulative impacts to wildlife under this alternative would be similar to those described for Alternative A. These include adverse impacts to biodiversity of agricultural practices and statewide declines in the number of black-tailed deer related to losses and degradation of habitat. The actions that caused this decline include urbanization, fire suppression and changes in logging (CDFG 1998). As noted above, non-native deer compete with native black-tailed deer, and losses and degradation of native deer habitat in the region have additive adverse impacts on this species.

Losses of acorns as a source of food from sudden oak death, a fungal-type disease that kills tanoaks (*Lithocarpus densiflorus*), coast live oaks (*Quercus agrifolia*) and black oaks (*Quercus kelloggii*) are also aggravated by fallow deer, which feed on them. As noted in the description of cumulative impacts to wildlife for Alternative A, non-native wild turkeys also use acorns as a food source. Turkey numbers are also increasing across Marin County. Adverse cumulative impacts to many species of small mammals, for which acorns are an important food source, are likely under this alternative.

Overall, Alternative B, combined with the projects and issues described in the cumulative analysis (see Alternative A), will have a long-term moderate cumulative adverse impact on wildlife. The effects would not be significantly offset by the beneficial impacts of any of the projects described in the analysis.

Conclusion

Data on current and past population growth of axis deer at PRNS indicate that this alternative would result in a decrease in total non-native deer numbers over current levels (to 700) within the Seashore (beneficial impacts compared to the No Action alternative). Axis deer range is expected to increase in pastoral and natural areas of the Seashore. No impairment to native wildlife would occur from implementing Alternative B. Based on research on impacts of non-native deer to wildlife in other countries as well as known impacts of grazing by cattle and white-tailed deer in the U.S., the impacts of Alternative B are expected to be beneficial to a few native species and adverse to a larger number of native species. Pockets of extremely high non-native deer density, such as those currently seen in Olema Valley, are likely to be found in the Vedanta property and limited areas within the Seashore. Native species richness and diversity would likely decrease in those high-density areas. Overall, the magnitude of impacts to native wildlife within and outside of NPS boundaries are considered moderate in intensity, adverse and long-term.

Overall, Alternative B, combined with the projects and issues described in the cumulative analysis, will have a long-term moderate cumulative adverse impact on wildlife.

Type of Impact:	Beneficial in the short-term, adverse in the long-term
Duration of Impact:	Mixed—both short-term and long-term
Intensity of Impact:	Moderate
Cumulative Impact:	Long-term moderate adverse

Impacts on Species and Habitats of Management Concern

This category includes federally listed wildlife species, other species of concern recognized by the state of California, and bird and plant species of concern. Birds of Conservation Concern (USFWS) include several species of nesting land birds and raptors.

Although no research at PRNS has been conducted to document the extent to which non-native deer affect listed species, anecdotal, historical evidence and expert opinion can provide insights and guidance. The federally listed species that are likely to be affected by non-native deer include northern spotted owls (*Strix occidentalis caurina*), western snowy plover (*Charadrius alexandrinus nivosus*), California red-legged frog (*Rana aurora draytonii*), Coho and Chinook salmon (*Oncorhynchus kisutch and Oncorhynchus tshawytscha*), steelhead trout (*Oncorynchus mykiss*), and Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*).

Analysis

Special Status Species

Northern Spotted Owl

The northern spotted owl is a federally threatened species that reaches the southern limit of its range within GGNRA, PRNS and Muir Woods National Monument in Marin County, California. Data collected by the NPS indicates that these parks may support the highest density of spotted owls known. However, the population is geographically isolated and subject to unique threats including urban development, intense recreational pressure, habituation of owls to humans, potential for catastrophic wildfires, and changes in hazardous fuel management practices. Owls occur throughout the forested lands in the Seashore and the population is likely stable; however, owls have been monitored for only 7 years in the Seashore (NPS and Point Reyes Bird Observatory unpublished data). Owls prey almost exclusively on small mammals, particularly dusky-footed wood rats (*Neotoma fuscipes*) in the Seashore (Chow 1998). Woodrats, in turn, are dependent on roots, stems, leaves, seeds and mast (Linsdale and Tevis 1951; Willy 1992).

Fallow deer have been recorded in areas where spotted owls nest and roost. To date, no direct effects have been noted on the productivity or survival of owls. However, deer compete with the prey species of owls, and therefore, likely have an indirect negative impact on food resources. By biting off buds and flowers they reduce the amount of seed and fruit available in autumn and winter. In California and elsewhere, fallow deer are known to feed on acorns, an important food source for many small mammals (Poli 1996; Jurek 1977). In the New Forest in Britain, heavy grazing, mainly from fallow deer, was shown to result in lowered reproduction in tawny owls and kestrels, especially during severe weather cycles and poor mast crop years (Putman 1986). Because of the likely minor adverse impact on rodent prey base due to competition for forage, Alternative B would have an indirect adverse impact on northern spotted owls. Overall, the adverse impacts of Alternative B to owls in the Seashore and in Marin County would be minor and long-term.

Western Snowy Plover

Western snowy plovers, federally listed as threatened by the U.S. Fish and Wildlife Service (USFWS), nest along the sandy beaches of the Seashore, primarily on Point Reyes Beach between North Beach and Kehoe Beach. Historically, plovers also nested at South Beach, Drakes Beach and Limantour. Plover nesting success has increased slightly over the past few years due to intensive management by the Seashore; however, the species is vulnerable to numerous activities in the park including predation by ravens and disturbance by recreationists. Fewer than 20 chicks fledged in 2002 (Peterlein 2002). Cattle roaming on the beaches in the past were a potential source for disturbance; however, the Seashore now intensively restricts cattle from beaches. A large herd of 60 axis deer has been seen on South Beach within the last five years, and where the herd occurred, the ground was heavily impacted (S. Allen, NPS personal communication). The frequency of this activity by axis deer is unknown but likely does not occur with regularly. Because Alternative B results in higher populations of axis deer within the Seashore, such impacts may increase slightly in frequency. Consequently, the overall adverse impact of Alternative B to plovers in the Seashore is likely minor, depending upon whether plovers nest again at South Beach or whether axis deer expand onto the North Beach to Kehoe Beach area.

California Red-legged Frog

The California red-legged frog was federally listed as a Threatened species on June 24, 1996. Red-legged frogs breed in ponds or pools during the wet season (December through March), and use ponds and/or riparian habitats during the rest of the year. Fallow deer regularly frequent riparian areas and vigorously rub and thrash their antlers during the rut, resulting in maiming and destruction of riparian vegetation (Fellers and Osbourn 2006). While engaged in this activity, fallow deer cause extensive trailing and may trample frogs. Damage to the vegetation could lead to degradation of non-breeding habitat. Overall, the adverse impacts of Alternative B to frogs in the Seashore and in Marin County would be minor and long-term.

Coho Salmon, Steelhead Trout, and Chinook Salmon

Anadromous fish, listed as endangered or threatened by National Marine Fisheries Service (NOAA Fisheries), occur in many of the streams of the Seashore, particularly in Olema Creek and Lagunitas Creek. In 2004, the California Department of Fish and Game (CDFG) approved listing coho salmon in this Evolutionary Significant Unit as Endangered under the California Endangered Species Act. In their 2001 Status Review, NOAA-Fisheries acknowledged that within the evolutionary significant unit, the decision to list coho salmon as threatened may have been overly optimistic, concluding that the evolutionary significant unit population was presently endanger of extinction (NMFS 2001). As a result of these and further findings, NOAA-Fisheries completed a rulemaking process in June 28, 2005, which downgraded the coho status (upgraded listing protection) in the evolutionary significant unit to Endangered (Federal Register 2005a).

The Seashore contains 10% of the last remaining wild population of coho salmon within the Central California Coast Evolutionarily Significant Unit, and consequently, any loss of this population would have an impact on the evolutionary significant unit. The NPS, along with the NOAA Fisheries and the CDFG, have conducted intensive fish surveys and have funded and implemented numerous restoration projects along the streams that flow through the park and adjacent lands. Numerous culverts have been removed along with other blockages to fish passage. In addition, the agencies have installed fencing to restrict cattle from riparian areas. These fences, however, do not impede the movement of fallow deer.

Fallow deer regularly frequent riparian areas and damage the riparian vegetation, particularly during the rut when bucks thrash branches and leaves with their antlers and girdle small trees and saplings (Fellers and Osbourn 2006). While engaged in this activity, fallow deer indirectly affect the fish by damaging riparian plants, resulting in: increased erosion and sediment delivery to the stream, reduced cover, and potentially warmer water in streams due to exposure to sunlight. Persistence of fallow deer would prolong this impact to riparian vegetation. In addition, continued presence of non-native deer would reduce the success and effectiveness of riparian restoration projects for salmon due to grazing and thrashing pressure on recovering native riparian vegetation. In restoration areas, revegetation efforts and natural regrowth would be severely retarded due to heavy grazing and antler rubbing. Different from browsing where leaves are plucked from a stem, this constant grazing and thrashing prevents native riparian plants from growing beyond shrub height. In riparian areas where large numbers of fallow deer congregate or travel, fish redds can be trampled, adversely impacting reproduction in all 3 species. Overall, the adverse impacts of Alternative B to anadromous fish in the Seashore and in Marin County would be minor and long-term.

California Freshwater Shrimp

The California freshwater shrimp (*Syncaris pacifica*) is listed by the USFWS as Endangered. The shrimp inhabits lower Lagunitas Creek and lower Olema Creek, within the current fallow deer range at PRNS. Shrimp are highly dependent on overhanging riparian vegetation, under which they live year-round. Fallow deer have not been observed within known shrimp habitat. However, in other areas of both Lagunitas and Olema Creeks, high densities of fallow deer have been observed to browse and trample riparian vegetation (Fellers and Osbourn 2006). A decrease in fallow deer range resulting from Alternative B is likely to result in no detectable change, e.g. a negligible impact to this species.

Myrtle's Silverspot Butterfly

Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*) is one of three coastal subspecies of *S. zerene* in the Western United States. The USFWS listed the subspecies as endangered in 1992, citing habitat loss and degradation as the primary threats (USFWS 1992).

As of 1998, three populations are known to remain. The USFWS Myrtle's Silverspot Butterfly Recovery Plan (1998) estimated the three populations combined comprise 10,000 individuals. Two populations of Myrtle's silverspot butterfly occur within the Seashore and the third is on private land in northern Marin County. The Center for Conservation Biology at Stanford monitored distribution and abundance of the Myrtle's silverspot butterfly at Point Reyes National Seashore almost yearly from 1992 to 1998. The Stanford survey work shows a decline in Myrtle's silverspot butterfly population levels during the six-year period and the central population to be "barely existing" (Launer et al.1998). Grazing is believed to deplete the Myrtle's silverspot butterfly larval host plants. The Seashore is currently supporting an intensive survey of the habitat of the Myrtle's silverspot butterfly and research on the current abundance and distribution of the larval host plant and adult nectar sources.

The PRNS coastal dune system and coastal prairie provide critical habitat for the federally endangered Myrtle's silverspot butterfly. Many different plants are used by the Myrtle's silverspot butterfly's as nectar sources; native plants (*Grindelia rubicaulis, Abronia latifolia, Monardella undulata, Erigeron glaucus,* and *Wyethia sp*.) as well as non-native bull thistle (*Cirsium vulgare*) and Italian thistle (*Carduus pycnocephalu*s). The only known larval host plant is the western dog violet (*Viola adunca*).

Axis and fallow deer frequent coastal prairie habitat. To date, it is not known whether they browse on the preferred nectar or larval host plants of the Myrtle's silverspot butterfly. Research in which deer-proof exclosures were monitored in the New Forest in England showed that fallow deer preferentially consumed a *Viola* species in a 1969 but not in a repeat survey in 1978 (Putman 1986). In Hawaii, the introduction of axis deer and mouflon sheep to Lana`i have likely played a major role in the disappearance of *Viola lanaiensis* (USFWS 1995a). Another Hawaiian species, *Viola kauaensis* var. *wahiawahensis,* is also listed as endangered by USFWS because of perceived threats of habitat degradation by feral animals and axis deer (USFWS 1995b). It therefore seems likely that non-native deer, given the opportunity, would graze on the Myrtle's silverspot butterfly's larval host plant.

Intensive localized grazing would further threaten the availability of these plants for the butterfly. If fallow and axis deer populations persist in the Seashore and axis deer range increases, potential adverse impacts to larval host plants and nectar sources persist. Overall, the adverse impacts of Alternative B to Myrtle's silverspot butterfly in the Seashore and in Marin County are considered moderate and long-term.

Bird Species of Concern

The Seashore has collaborated with the Point Reyes Bird Observatory over the past two decades to protect and restore habitat of nesting land birds within the boundaries of the Seashore. Many species of land birds are species of concern both under the California Bird Species of Special Concern (CDFG) and the Birds of Conservation Concern (USFWS). Examples of species include common yellowthroat *(Geothlypis trichas sinuosa*), California Swainson's thrush *(Catharus ustulatus oedicus),* and tricolored blackbird *(Agelaius tricolor).*

Numerous restoration projects and fire management actions have strived to improve nesting success in land birds, particularly in riparian areas. In addition, the park is an active member of the Partner-in-Flight program, collaborating with other agencies and organizations to protect and restore populations of neotropical migratory songbirds. The Point Reyes Bird Observatory has monitored the reproductive success and species composition of birds for more than 30 years. Monitoring has taken place in areas of the park (Palo Marin) where fallow deer occur only rarely.

In areas where fallow deer are abundant, there often is a well-defined browse line on trees and shrubs between 1.5 and 2 meters above the ground. Studies of fallow deer, roe deer (*Capreolus capreolus*) and muntjac deer (*Muntiacus reevesi*) in British lowland forests have suggested that some bird species, namely understory nesters, declined with high deer grazing pressure (Fuller 2001). Similarly, ground or low nesting (approximately 0.0–3 meters) bird species found in the Seashore are vulnerable to heavy grazing by non-native deer. These species are found in habitats where the greatest impacts from large herds of non-native deer would occur (T. Gardali, Point Reyes Bird Observatory, personal communication, Shuford and Gardali, in review). There may be a decrease in abundance of low nesting species that depend on understory vegetation to place their nests. The potential impacts on reproductive success and survival are unknown. Overall, the adverse impacts of Alternative B to understory nesting songbirds of concern in the Seashore and in Marin County would be minor to moderate and long-term.

Plant Species of Special Concern

This category includes federal, state, and California Native Plant Society listed plant species.

Although no research at PRNS has been conducted to document the extent to which non-native deer affect plant species of special concern, anecdotal and historical evidence and expert opinion can provide insights and guidance. Rare plants have been inventoried at Point Reyes National Seashore over the past twenty years. The preponderance of this information is presence/absence data for species of concern, with some additional data describing distribution of select species. Given the substantial amount of plant distribution data, it is important to note that this information only describes known rare plant occurrences. Obviously there are many acres within the seashore that have not yet been surveyed for rare plants. Impacts related to rare plants, therefore, can only be estimated in terms of limited best available information.

Rare plants known to occur within current axis deer range include:

- *Arabis blepharophylla*, coast rock cress
- *Campanula californica*, swamp harebell*
- *Ceanothus gloriosus* var. *porrectus*, Mt. Vision ceanothus
- *Cordylanthus maritimus ssp. palustris*, Point Reyes bird's beak *
- *Fritillaria liliaceae*, fragrant fritillary**
- *Grindelia hirsutula* var. *maritima* San Francisco Bay gumplant
- *Limnanthes douglasii* var. *sulphurea*, Point Reyes meadow foam*
- *Linanthus grandiflorus*, large-flowered linanthus
- *Triphysaria floribundus,* San Francisco owl's clover

Rare plants known to occur within current fallow deer range include:

- *Abronia umbellata ssp. breviflora*, pink sand-verbena
- *Agrostis blasdalei*, Blasdale's bent grass
- *Arabis blepharophylla*, coast rock cress
- *Arctostaphylos virgata*, Marin manzanita
- *Astragalus pycnostachyus var. pycnostachyus*, coastal marsh milk-vetch*
- *Calystegia purpurata* ssp. *saxicola*, coastal bluff morning-glory
- *Campanula californica*, swamp harebell*
- *Ceanothus gloriosus var. gloriosus*, Point Reyes ceanothus
- *Ceanothus gloriosus var. porrectus*, Mt. Vision ceanothus
- *Chorizanthe cuspidata* var. *cuspidata*, San Francisco bay spineflower
- *Cordylanthus maritimus ssp. palustris*, Point Reyes bird's beak *
- *Elymus californicus*, California bottlebrush grass
- *Fritillaria affinis var. tristulis*, Marin checkerlily**
- *Fritillaria liliaceae*, fragrant fritillary
- *Gilia capitata ssp. chamissonis*, dune gilia
- *Grindelia hirsutula* var. *maritima* San Francisco Bay gumplant
- *Lilium maritimum*, coast lily**
- *Linanthus grandiflorus* large-flowered linanthus
- *Microseris paludosa*, marsh microseris*
- *Perideridia gairdneri ssp. gairdneri*, Gairdner's yampah
- *Polygonum marinense*, Marin knotweed
- *Ranunculus lobbii*, Lobb's aquatic buttercup*
- *Sidalcea calycosa ssp. rhizomata*, Point Reyes checkerbloom*
- *Triphysaria floribundus*, San Francisco owl's clover

* These species occur in wetlands or saltmarsh habitats. It is highly unlikely that these species are affected by non-native deer activities.

** Denotes bulb species.

Non-native deer can impact rare plant species directly by consuming and trampling them. PRNS staff observed fallow deer digging up and eating *Fritillaria* bulbs within the burned area after the 1995 Vision Fire (Sarah Allen, NPS, personal communication). It should be noted that damage to *Fritillaria sp.* and other lily species has been observed outside exotic deer range, presumably caused by black-tailed deer or other herbivores (Michelle Coppoletta, NPS, personal communication). Based on analyses of deer diets conducted in Point Reyes, it can be inferred that after a major vegetation-changing event such as a wildfire, both axis and fallow deer would seek other food sources to supplement a depleted diet (Elliott 1983). This might include heavier foraging on bulb species.

Other species that may be impacted would be those occurring in areas of high-density herd congregations, where damage to plants through trampling would occur. Fallow deer herds have been observed most often in grassland, evergreen scrub, and Douglas fir/redwood plant communities (NPS 2001b). These communities provide habitat for the plant species listed above. Adverse impacts to rare plants in the Seashore are currently considered to be moderate and short-term. Long-term, Alternative B would result in little overall change in densities for both species and would likely lead to adverse impacts which were minor and long-term.

There are no means of mitigating for impacts of non-native deer to the species of special concern of the Seashore.

Cumulative Impacts

Cumulative impacts would be the same as those described for Alternative A.

Depending on the species of concern, adverse, long-term cumulative impacts might range from moderate to major.

Conclusion

No impairment to special status species would occur from implementing Alternative B. All of the impacts on special status species, associated with the continued presence and/or expansion of non-native deer populations, are characterized as adverse. While short-term impacts of reduced fallow deer numbers may be beneficial to wildlife and plant species that currently suffer adverse impacts, long-term persistence of axis and fallow deer in the Seashore would result in adverse impacts of minor to moderate intensity.

Depending on the species of concern, adverse, long-term cumulative impacts might range from moderate to major.

Type of Impact:	Beneficial in the short-term, adverse in the long-term
Duration of Impact:	Mixed—both short-term and long-term
Intensity of Impact:	Minor to moderate
Cumulative Impact:	Adverse, long-term and moderate to major (depending on the species of concern)

Impacts on Human Health and Safety

Analysis

Under Alternative B, the use of firearms by NPS staff and contractors as the sole method of control and maintenance of non-native deer numbers may increase related risk of injuries to staff and visitors. As this activity would continue indefinitely under Alternative B, minor, short-term (transitory, individual culling efforts) to long-term (indefinite duration of activity), adverse impacts to staff and visitor safety resulting from risk of firearms injuries are expected.

Under Alternative B, the numbers and range of both species of non-native deer are expected to decrease through lethal removal to a number totaling 700. A concomitant decrease in deer-vehicle collisions over current levels is expected, a minor, long-term benefit to human safety similar to effects expected under Alternative C.

Cumulative Impacts

Cumulative impacts would be the same as those described for Alternative A.

The projects and issues described in the cumulative analysis will have a long-term beneficial and adverse major cumulative impact on public health and safety. This effect of Alternative B is negligible when viewed incrementally with the effects detailed in the cumulative analysis and does not change the overall cumulative effect.

Conclusion

Alternative B would result in minor adverse impacts to human health and safety for Seashore visitors and staff over an indefinite period of time due to risk of firearms-related accidents. In addition, minor benefits to public safety can be expected through the likely reduction in deer-vehicle collisions under Alternative B. When compared to the No Action alternative, the use of firearms under this alternative would result in increased risks to human health and safety of indefinite duration. Conversely, decreasing numbers of non-native deer numbers under Alternative B would result in a slight reduction of human safety risks compared to Alternative A.

The projects and issues described in the cumulative analysis will have a long-term beneficial and adverse major cumulative impact on public health and safety.

Type of Impact:	Adverse and beneficial
Duration of Impact:	Short-term and long-term
Intensity of Impact:	Minor
Cumulative Impact:	Long-term adverse and beneficial, minor to moderate

Impacts on Visitor Experience

Analysis

This alternative would eventual result in the reduction of non-native deer to fewer than are in the Seashore today. As a result, it is possible that those visitors with humanistic or aesthetic social values and who are aware of the non-native deer at the Seashore would notice the decrease in numbers of fallow deer, in particular, the white color variants of fallow deer. If populations of native black-tailed deer were to increase in number in the areas where fallow deer currently reside, opportunities for viewing deer would not change significantly and visitors with naturalistic or ecologistic social values may experience a slight positive impact. Opportunities to view axis deer would likely increase slightly because of increasing numbers and range, although the vast majority of visitors would not notice any change. Overall, because of changes in deer behavior resulting from the lethal control program, non-native deer viewing opportunities would be fewer and might require more time and effort on the part of the visitor, a long-term, minor adverse impact to the visitor particularly interested in non-native deer viewing. However, the reduction of non-native deer would provide additional habitat for native black-tailed deer, a negligible to minor, long-term benefit to those interested in viewing native ungulates.

Decreased numbers and density of non-native deer grazing in pastoral, wooded and riparian areas could change scenic viewsheds by allowing regrowth of undergrowth vegetation, shrubs and brush. The areas where such changes are most likely to be apparent to visitors are in Olema Valley (from fallow deer). In this area, agricultural grazing is the primary determinant of scenic viewsheds. The contribution which non-native deer make to altering viewsheds is likely to decrease over time with the reduction of non-native deer numbers under this alternative, and would ultimately have a negligible effect on the visitor experience related to viewshed enjoyment.

Under Alternative B, social values of visitors related to lethal removal or use of firearms would also be affected. Visitors with humanistic or moralistic values could experience short-term, adverse effects ranging from negligible to moderate depending on the visitor and the level of his/her objection to the use of the proposed management method. As mitigation for these potential adverse impacts, Alternative B mandates adherence to rigorous training for all NPS staff or contractors and regular completion of NPS range qualifications specifically designed for ensuring humane and effective wildlife removal. (In addition to other federal contracting requirements, for the purposes of this plan, a contractor is a fully insured business entity; non-profit group or government agency engaged in wildlife management activities that include trapping, immobilization and the lethal removal through sharpshooting and chemical euthanasia. The contractor must possess all necessary permits and be able to pass any needed security clearances.) Consequently, wounding of animals would be minimized, and quick and selective death would be the goal for all targets. In addition, all deer management actions would be conducted in a manner that minimizes stress, pain and suffering to every extent possible.

Under this alternative, the management of non-native deer populations through lethal removal techniques (firearms) is proposed for an indefinite time period. The loss of peace and quiet during shooting operations is another possible adverse impact to the visitor experience. Although this Alternative calls for shooting to take place outside of peak visitation hours, visitors who come to the Seashore for solitude and quiet during non-peak times could be uncomfortable with the noise generated. Temporary area closures for large-scale deer management activities are a possibility with this alternative and may inconvenience some visitors. In addition, management by air could take place, as would monitoring. The noise of overflights would contribute negligibly to a loss of peace and quiet.

A small number of visitors may discover carcasses in the wilderness areas where retrieval by NPS sharpshooters is not possible. Moving any carcass near a heavily used trail to a more remote location to reduce odor problems or conflicts between humans and scavengers would mitigate this impact. Collectively, the impact of firearms use related to soundscape, the potential temporary closures of deer management areas, and the possibility of encountering visual intrusions (carcasses) would likely result in negligible to moderate adverse impacts to the visitor experience. Impacts would be both short-term (individual management actions) and long-term (indefinite duration). The perceived intensity of the impact would depend on the numbers of visitor affected and the duration of each incident's effect.

Wilderness Character

The current unnatural conditions in the wilderness would improve if this alternative is selected. During the life of this plan, and in perpetuity, patches of the wilderness landscape impacted by non-native deer would appear unnatural. Visitors to the wilderness would occasionally encounter NPS staff or contractors, and occasional area closures would impact a few visitors. Also on occasion, noise of firearms and possibly helicopters would mar the natural quiet backcountry users often seek. Based on what is known of visitor use patterns in Seashore wilderness areas, these adverse impacts are estimated to affect fewer than 50 visitors per year.

Wilderness Values

The discussion of wilderness values described above for Alternative A would also apply for Alternative B, as it focuses on the debate between whether humans should manage resources in the wilderness to return a more natural character (biocentric, conservationist values) or limit their intervention either because nature is a better manager (intrinsic, symbolic or spiritual value). In the long term, reducing impacts of non-native deer to natural ecological processes in the Seashore wilderness, albeit only partially, would have minor beneficial impacts to those people with biocentric values. For those who hold ecological views about wilderness, eliminating the impacts of human-introduced species would have minor beneficial effects. For those who hold intrinsic, symbolic or spiritual wilderness values, the intrusion of NPS staff or contractors into wilderness for management would have minor adverse impacts.

Since management would continue in perpetuity, all impacts to wilderness values and character are long-term.

Cumulative Impacts

Cumulative impacts would be the same as those described for Alternative A.

The projects and issues described in the cumulative analysis will have a long-term and beneficial major cumulative impact on visitor experience. This effect of Alternative B is negligible when viewed incrementally with the effects detailed in the cumulative analysis and does not change the overall cumulative effect. However, because Alternative B could also result in some temporary area closures, it would have some additional adverse impacts relative to Alternative A, but these are considered negligible because they would not be detectable by the vast majority of visitors.

Conclusion

This alternative would result in a permanent decrease in fallow deer and an increase in axis deer numbers within the Seashore. Adverse effects from this alternative to the visitor experience related to wildlife viewing; social values including wilderness values; and soundscape/access/visual intrusions are expected to range from negligible to moderate (depending on visitor goals and expectations) and would be both short- and long-term in duration. Negligible to minor, long-term benefits to visitor experiences with naturalistic or ecologistic social values related to wildlife viewing of native deer, as well as to the long term wilderness character in the Seashore, would also be realized under this alternative. When compared to the No Action alternative, Alternative B would result in decreased adverse impacts to viewshed enjoyment and increased opportunities for viewing native deer. At the same time, adverse impacts regarding viewing of non-native deer, visitors with moralistic or humanistic social values, and soundscape preservation/access/visual intrusions are greater under this alternative than that expected under the No Action alternative.

The projects and issues described in the cumulative analysis will have a long-term and beneficial major cumulative impact on visitor experience.

Type of Impact:	Adverse and beneficial
Duration of Impact:	Long-term and short-term
Intensity of Impact:	Negligible to moderate
Cumulative Impact:	Long-term beneficial and major

Impacts on Park Operations

Analysis

The control of a continued but reduced presence of non-native deer would constitute an increase in the scope and extent of current financial and personnel resources necessary to address environmental, social and health and safety concerns. This alternative results in the maintenance of a reduced number of non-native deer in the Seashore in perpetuity, the costs of which would be incurred indefinitely. Operational costs and commitments would be expected to increase from both internal deer control operations and from increased coordination and cooperation outside the park. If continued monitoring by resource management staff warranted a change in deer level goals, the following impacts would increase or decrease accordingly.

Costs related to the monitoring of large populations of non-native deer inhabiting the park are those associated with impacts to natural and cultural resources. In FY 2005, personnel costs for 1.5 FTE (full time equivalents) and the costs of equipment, vehicles, supplies and staff for non-native deer monitoring (including one census yearly) totaled \$126,000. Administrative and interpretive costs, excluding the costs of completing this document, likely comprise another \$28,000 These costs, currently 2.9 % of the total PRNS annual budget, can be expected to continue at this current level under Alternative B.

Continuing costs to the park of mitigating impacts of non-native deer under Alternative B are unknown and would continue indefinitely as a result of maintaining non-native deer species at the Seashore. These include:

- Costs of disease monitoring and testing in areas of high deer density and where non-native deer are in close contact with livestock.
- Costs of erecting exclosures or deer-proof fencing in areas where high deer densities are adversely impacting sensitive resources, i.e. riparian areas or populations of rare plants.
- Costs of monitoring native species, such as native cervids, songbirds and special status species, adversely impacted by growing non-native deer numbers and range.

The description of Alternative B outlines the likely deer removal numbers based on population modeling by Barrett (2001) and Hobbs (2003). It is estimated that, initially, Alternative B would require culling of up to 200 fallow deer per year to reduce the population to 350, with up to 75 animals per year removed thereafter. Axis deer, which currently number approximately 250, would not require culling until their numbers surpassed 350. Subsequent removals of up to 40 animals each year would be required to maintain total axis numbers at 350. It should be noted that these numbers are subject to change depending on weather, range conditions and herd growth parameters. Cited figures should be considered approximate guidelines for cost analysis purposes.

The costs of culling 250 deer yearly for the first 3-5 years of the program are estimated to be \$187,000/year and include staff expenses (including one full-time biotechnician), training, vehicles, transport, supplies and carcass disposal. Thereafter, costs (before inflation) of removing up to 65 animals per year would be approximately \$52,000 per year, in perpetuity.

During the first 3-5 years of the program, costs of controlling non-native deer constitute a 132% increase in funds allocated to non-native deer. After this time, costs of maintaining each species at 350 animals would remain a 36% increase over current levels. See Figure 17 for a comparison of the costs of the alternatives considered.

Estimates for minimum costs for the implementation of Alternative B total approximately \$3.5 million by the year 2021. Thereafter, annual costs of \$190,000 could be expected indefinitely. The overall costs of implementing Alternative B would constitute 3% – 6% of the total PRNS annual budget, with higher costs occurring within the first 3-5 years of implementation.

Under Alternative B, non-native deer monitoring, mitigation of damage to natural resources caused by non-native deer, and the operation of the culling program would result in adverse impacts to park operations through increased budget expenditures for an indefinite period of time. Because culling operations would continue indefinitely, a permanent increase in operating costs and/or energy use for the park would be long-term in duration. As these increased costs would be greater than 5% of total park budget for the first 3-5 years of implementation, and less than 5% thereafter, adverse impacts are considered moderate in the short-term and minor in the long-term.

Cumulative Impacts

Cumulative impacts would be similar to those described for Alternative A.

Cumulative impacts of Alternative B with the above actions are characterized as adverse, long-term and moderate. Based on potential operating costs for the all projects considered, the staff of the Seashore estimated the cumulative cost of the projects, when viewed incrementally with Alternative B, would be less than $840,000 or 15% or the current operating budget of $5.6 million. Some future operating costs would be offset by fee increases, non-profit assistance, or special grants.

Conclusion

Park operations under Alternative B would be affected as a result of demand on park staff to monitor and mitigate continued impacts to natural resources and to control deer numbers for an indefinite period of time. All of the impacts to park operations associated with the presence of non-native deer are characterized as adverse. Because controlling non-native deer populations indefinitely would represent a permanent increase in operating costs and/ or energy usage for the park, the impacts of Alternative B are considered long-term. Because additions in cost and/ or energy usage would be more than 5% of total park budget for the first 3-5 years of the control program and less than 5% thereafter, the impacts are considered to be moderate in the short-term and minor in the long-term. When compared to the No Action alternative, Alternative B would require a notably smaller (3–6% versus 5–15%) increase in budgetary commitments. However, as under No Action, these expenses would continue in perpetuity, a detriment to park operations.

Cumulative impacts of Alternative B with the above actions are characterized as adverse, long-term and moderate.

Type of Impact:	Adverse
Duration of Impact:	Short-term and long-term
Intensity of Impact:	Moderate (short-term) and minor (long-term)
Cumulative Impact:	Adverse, long-term and moderate

Impacts on Regional Economy

Analysis

Non-native deer have no documented beneficial impacts to the regional economy. Currently there are an estimated 250 axis deer and 860 fallow deer in the Seashore. Alternative B would result in an increase in axis deer and a decrease in fallow deer. Range size would likely increase for axis deer within the Seashore and could decrease for fallow deer. The spread of fallow deer outside of Seashore boundaries would be curtailed.

Impacts of fallow deer to agricultural operations inside and outside of NPS boundaries could be expected to decrease with this alternative. Conversely, expansion of axis deer in the Seashore, as has been reported historically when total axis deer numbers were higher, is expected to lead to increased competition for pasture forage with livestock, damage to fences and depredation of agricultural products (hay and silage).

Currently, these ranchers report that damage to their operations from axis deer includes:
Fence repair costs ($500-$1000/yr per ranch [4 reports])—damage by deer crossings.

Costs of lost pasture forage (unknown costs [4 reports])—pasture forage consumption by non-native deer (refer to detail in the Regional Economy section of Chapter 3, Affected Environment).

These impacts would likely increase in magnitude with growing numbers of axis deer and would be long-term unless target deer levels were lowered in the future. In addition, other ranches, which now are only sporadically inhabited by few axis deer, could be expected to experience increasing impacts of similar types. Under Alternative B, the increase in axis deer could result in minor, long-term adverse impacts to the regional economy related to agricultural endeavors.

Under Alternative B, a smaller fallow deer population size and range would result in an amelioration of current impacts to Seashore ranches where fallow deer are seen year-round in substantial numbers (M, L, and Stewart Ranches), including those related to:

- Costs of lost supplemental feed (unknown costs [1 report])—supplemental food put out for livestock eaten by non-native deer.
- Costs of reseeding pastures ($9000/yr per rancher [1 report])—overgrazing of fallow fields by non-native deer.
- Veterinary costs ($1200 in 2001 [1 report])—leptospirosis (refer to detail in the Regional Economy section of Chapter 3, Affected Environment).

This improvement would last as long as the deer control continued (in perpetuity). Costs of fence repair and lost pasture forage would decrease, as would the monetary impacts of lost supplemental feed, pasture reseeding and veterinary costs. Such effects would represent a minor, long-term benefit for agricultural concerns in and around the park.

Because this alternative might require occasional area closures but no park closures, there would be no effects to local tourist businesses. This alternative would not have significant and disproportionate effects on minority and low-income populations.

Cumulative Impacts

Cumulative impacts would be similar to those described for Alternative A.

Based on the economic statistics discussed in the cumulative analysis, the overall cumulative benefits of the park to the regional economy, when viewed incrementally with Alternative B, are major and beneficial.

Conclusion

This alternative would result in a decrease in fallow deer and an increase in axis deer numbers within the Seashore. The magnitude of impacts to agriculture within and outside of NPS boundaries created from an increased axis deer population is expected to increase over time, resulting in minor, long-term, adverse impacts to the regional economy. At the same time, the reduction of fallow deer numbers under this alternative would reduce agricultural impacts attributed to these deer below the current level—a minor, long-term benefit to the regional economy. Comparatively, the No Action alternative would likely result in a greater number of adverse effects to the regional economy by way of agricultural impacts and potential impacts to low-income farm workers than would Alternative B.

Based on the economic statistics discussed in the cumulative analysis, cumulative impacts are long-term, major and beneficial.

Type of Impact:	Mixed—both adverse and beneficial
Duration of Impact:	Long-term
Intensity of Impact:	Minor
Cumulative Impact:	Long-term, major and beneficial

Environmental Consequences of Alternative C – Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control

This alternative would control levels of fallow and axis deer to below carrying capacity, at numbers that would be both logistically sustainable with NPS staff and funding, and would not likely lead to extinction of either species. Techniques used to control deer would include both lethal removal (shooting by NPS staff) and treatment of does with the most effective contraceptive technology available. In the 1970s and 1980s park staff controlled deer to desired levels of 350 of each species. For purposes of analyzing impacts of this action alternative, the same levels (700 total non-native deer) would be assumed. Total numbers of non-native deer would be less than current estimated numbers (approximately 250 axis deer and 1,100 fallow deer) but high densities of deer in certain areas would still be expected because of the tendencies of both species to congregate in large herds. Initially, fallow deer numbers would be controlled by yearly shooting and contraception. In the future, when axis deer numbers surpassed the pre-established limit (for purposes of this analysis, 350), this species would also be culled and individuals would be treated with the most efficient contraceptive technology available. The age, sex, and numbers of deer culled would be determined by resource managers to ensure that populations are maintained at desired levels and to reduce risks of range expansion beyond Seashore boundaries.

The impacts to natural resources and the regional economy do not differ between Alternative B and C. Impacts of Alternative C to park operations, health and human safety and visitor experience differ slightly from those of Alternative B.

Impacts on Water Resources and Water Quality

Analysis and Cumulative Impacts

Impacts, including cumulative impacts, are not different from Alternative B. No impairment to water resources would occur from implementing Alternative C.

Type of Impact:	Beneficial in the short-term, adverse in the long-term
Duration of Impact:	Mixed—both short-term and long-term
Intensity of Impact:	Minor to moderate
Cumulative Impact:	Adverse, long-term moderate to major

Impacts on Soils

Analysis and Cumulative Impacts

Impacts, including cumulative impacts, are not different from Alternative B. No impairment to soils would occur from implementing Alternative C.

Type of Impact:	Beneficial in the short-term, adverse in the long-term
Duration of Impact:	Mixed—both short-term and long-term
Intensity of Impact:	Minor to moderate
Cumulative Impact:	Adverse, long-term major

Impacts on Vegetation

Analysis and Cumulative Impacts

Impacts, including cumulative impacts, are not different from Alternative B. No impairment to vegetation would occur from implementing Alternative C.

Type of Impact:	Adverse
Duration of Impact:	Long-term
Intensity of Impact:	Moderate
Cumulative Impact:	Adverse, long-term moderate to major

Impacts on Wildlife

Analysis and Cumulative Impacts

Impacts, including cumulative impacts, to native species are not different from Alternative B. No impairment to native wildlife would occur from implementing Alternative C.

Although fewer non-native deer would be lethally removed in Alternative C than in Alternative B, pain and suffering would result from lethal removals as well as from fertility control. Some of this pain would be mitigated by use of trained sharpshooters in culling deer. Efforts would be made to deliver immediately lethal shots to target animals. Animals treated with contraceptive agents would undergo the stress of capture, restraint, injection and permanent marking (i.e., radio-collaring and ear-tagging) at least once during their lifetimes. Capture of wild deer would result in unavoidable injuries and some deaths.

Type of Impact:	Adverse
Duration of Impact:	Long-term
Intensity of Impact:	Moderate
Cumulative Impact:	Long-term moderate adverse

Impacts on Species and Habitats of Management Concern

Analysis and Cumulative Impacts

Impacts, including cumulative impacts, are not different from Alternative B. No impairment to special status species would occur from implementing Alternative C.

Type of Impact:	Beneficial in the short-term, adverse in the long-term
Duration of Impact:	Mixed—both short-term and long-term
Intensity of Impact:	Minor to moderate
Cumulative Impact:	Adverse, long-term and moderate to major (depending on the species of concern)

Impacts on Human Health and Safety

Analysis

Under Alternative C, it is assumed that 75% of the non-native deer actively managed would be culled rather than given contraception and, therefore, the risk of firearm-related injuries to staff and visitors would be noticeably increased over current levels. As culling would continue indefinitely under Alternative C, minor, short-term (transitory, individual culling periods) to long-term (indefinite duration of activity), adverse impacts to staff and visitor safety could result.

Depending on the agent used, Alternative C calls for treatment of up to 25% of fallow does with a long-acting contraceptive or sterilant. Treatment would require capture and immobilization of animals for permanent marking (ear-tagging and radio-collaring). Permanent marking of treated animals would be needed to ensure accurate monitoring of contraceptive effectiveness and to prevent inadvertent culling of treated does. Capture would be accomplished with a corral trap, a drop net, or with a net gun fired from a helicopter. Regardless of the technique used, wildlife capture and immobilization can result in injury to participating staff, either from the animals themselves or from equipment and aircraft. The number of people at risk from capture-related and treatment-related injury under Alternative C depends on the technique used, and is unknown at this time. Because this alternative requires fertility control activities to continue indefinitely, the total number of people at risk of injury during deer capture/treatment is also unknown. Adverse impacts to human safety of minor intensity are expected as a result of capture/treatment actions. Effects are expected to be short-term (transitory, individual capture/treatment incidents) and long-term (indefinite management period) in duration. The reduction of non-native deer numbers and the concomitant effects this may have on deer-vehicle collisions are similar to that described for Alternative B (long-term, minor benefit).

Cumulative Impacts

There are no known cumulative impacts associated with Alternative C when viewed incrementally with the projects and issues listed under Alternative A.

Conclusion

Minor, long- and short-term, adverse impacts to human health and safety for Seashore staff could result from the use of firearms and contraceptive treatments proposed under Alternative C. Minor benefits to public health and safety resulting from reduced risk of deer-vehicle collisions are expected. Compared to the No Action alternative, the implementation of lethal controls and contraceptive operations under Alternative C would result in notably increased risks to human health and safety for an indefinite period of time. At the same time, the No Action alternative would likely represent a slight increase in risk to human safety as a result of potentially increased deer-vehicle collisions when compared to Alternative C.

Type of Impact:	Adverse and beneficial
Duration of Impact:	Short-term and long-term
Intensity of Impact:	Minor
Cumulative Impact:	Long-term adverse and beneficial, minor to moderate

Impacts on Visitor Experience

Analysis

Effects on wildlife viewing of all deer under this alternative are similar to that described under Alternative B (minor, long-term, adverse for non-native deer; negligible to minor, long-term, beneficial for native deer).

Effects on the visitor experience related to viewshed enjoyment under this alternative are similar to those described under Alternative B (negligible).

Under this alternative, the visitor experience is also related to social values, particularly those of attitudes toward animals. Effects of the management techniques proposed (lethal removal/firearms and contraception) under Alternative C could result in adverse effects to the visitor experience to varying degrees and for varying periods of time. These effects are similar to those described under Alternative B (negligible to moderate, short-term, adverse – depending on the visitor and his/her level of objection to the use of proposed methods). As proposed under Alternative C, if contraception proves effective in controlling and maintaining deer populations at specified levels (700), this alternative would represent a less lethal management approach than that proposed under Alternative B (lethal removal only). This less lethal approach has the potential to benefit or adversely affect visitor experience, depending on individual social values. Notably, while only 35% of polled Bay area residents supported lethal control of non-native deer, 65% supported contraception, suggesting fewer visitors would be adversely affected by this alternative than Alternative B. Mitigation measures proposed for this alternative are similar to that described under Alternative B.

Alternative C proposes the management of non-native deer through a combination of lethal controls and contraceptive methods; Alternative B proposes only the use of lethal methods (firearms). While the degree of effect differs slightly, impacts of firearms use related to soundscape, the potential temporary closures of deer management areas, and the possibility of encountering visual intrusions (carcasses) would likely result in effects similar to that described under Alternative B (short- and long-term, negligible to moderate, adverse impacts, depending on the numbers of visitors affected and the duration of each incident's effect). Mitigation measures for such impacts are also similar to those described for Alternative B. In addition, the use of aircraft for monitoring, and for management of deer (shooting, herding into corrals, etc.) would adversely affect the soundscape.

In most ways, impacts to the wilderness character and values for Alternative C would be the same as for Alternative B (mixed, minor and long-term). In addition, some visitors, especially those searching for a "wilderness experience" in the Seashore, might object to seeing permanent marks such as radio collars and eartags on fallow does treated with contraceptives. Because the population control techniques in Alternative C would be used in perpetuity to maintain a target number of non-native deer populations, resulting visitor experience impacts would be long-term, minor, and adverse for those who find them offensive.

Cumulative Impacts

Cumulative impacts under Alternative C are similar to those described for Alternative B.

Conclusion

This alternative would result in a permanent decrease in fallow deer and an increase in axis deer numbers within the Seashore. Adverse effects from this alternative to the visitor experience related to wildlife viewing; social values; soundscape/access/visual intrusions; and wilderness experience are expected to range from negligible to moderate (depending on visitor goals and perceptions) and would be both short- and long-term in duration. Negligible to minor, long-term benefits to the visitor experience related to viewing of native deer are also possible under Alternative C. Compared to No Action, adverse impacts to social values, soundscape preservation/access/visual intrusions, and wilderness experience would be increased under Alternative C. Conversely, opportunities for viewing of native deer are increased under this alternative when compared to No Action.

Type of Impact:	Adverse and beneficial
Duration of Impact:	Long-term and short-term
Intensity of Impact:	Negligible to moderate
Cumulative Impact:	Long-term beneficial and major

Impacts on Park Operations

Analysis

As in Alternative B, the impacts of continued presence of non-native deer would constitute an increase in the scope and extent of current financial and personnel resources necessary to address environmental, social and health and safety concerns. This alternative results in the maintenance of a reduced number of non-native deer in the Seashore in perpetuity, the costs of which would be incurred indefinitely. Operational costs and commitments would be expected to increase from both internal deer control operations and from increased coordination and cooperation outside the park. If continued monitoring by resource management staff warranted a change in deer level goals, the following impacts would increase or decrease accordingly.

Actions associated with monitoring of non-native deer and mitigation of deer impacts to natural resources under Alternative C are similar to those described under Alternative B.

Chapter 2 outlines the likely deer removal numbers under Alternative C, based on population modeling by Barrett (2001) and Hobbs (2003). It is estimated that, initially, Alternative C would require culling of up to 50% of fertile fallow females per year along with treatment of up to 25% of does per year with a long-lasting contraception to reduce the population to 350. Thereafter, up to 20 animals per year would be removed and treated. Axis deer, which currently number approximately 250, would not require culling or treatment until their numbers surpassed 350. Subsequent removals of 25-40 animals per year would be required to maintain total axis numbers at 350. Should a long-lasting contraceptive be developed for axis deer, numbers culled could decrease as axis does were treated. It should be noted that all of these numbers are subject to change depending on weather patterns, range conditions and herd growth parameters. Cited figures should be considered approximate guidelines for cost analysis purposes.

During the reduction phase of the control program, costs of culling up to 180 deer yearly include staff (including one full-time biotechnician), training, vehicles, transport, supplies and carcass disposal, and are estimated to be $135,000 per year. Thereafter, during the maintenance phase of the control program, costs (before inflation) of removing up to 45-60 animals per year could reach $45,000 per year in perpetuity.

Because there is currently no long-duration contraceptive registered for management of deer with the EPA, any drug used by NPS would likely require experimental research. Costs of such research are difficult to predict but would likely exceed usual management costs. Research requires collection of data on survival and fawning rates of treated and control deer through radio telemetry, fawn counts and necropsies. Additional studies on health effects and safety of the experimental drug may be required by EPA. The costs of giving contraception to deer also depends on the duration and effectiveness of the chosen agent and can only be approximated. An NPS proposal for a one-time administration of up to 70 fallow does was estimated to cost $148,000 or $2,100 per treated deer (NPS unpublished proposal, PMIS# 97426). Should GonaCon® prove effective in preventing reproduction for the life of fallow does, Hobbs' estimate of 176 does requiring treatment to control the population at 350 by 2021 would cost a minimum of $400,000. Thereafter, treatment of up to 25-50 does periodically (every 4-8 years, indefinitely) would cost at least $105,000 per treatment period.

During the first 3-5 years of the program, costs of controlling non-native deer with culling and long-lasting contraception constitute a 300% increase in funds currently allocated to non-native deer and between 3% and 12% of the total Seashore budget. After this time, costs would remain a 25-100% increase over current levels, and up to 5% of the total Seashore budget, depending on the extent to which contraception is used to maintain each species at 350 animals. See Figure 17 for a comparison of the costs of the alternatives considered.

Estimates of minimum costs for the implementation of Alternative C total approximately $3.6 million by the year 2021. Thereafter, annual costs of greater than $200,000 could be expected indefinitely. The costs of implementation of Alternative C would constitute an increase of 3-12% of the total PRNS budget.
Under Alternative C, non-native deer monitoring, natural resource damage mitigation, and deer culling and contraception operations could result in long-term, moderate, adverse impacts to park operations at PRNS resulting from increased financial commitments over an indefinite period of time.

Cumulative Impacts

Cumulative impacts of Alternative C are similar to those described under the No Action alternative.

Conclusion

Alternative C proposes the maintenance (lethal removal and contraception) of axis and fallow deer at specified levels indefinitely. In addition to cumulative Impacts, park operations under Alternative C would be adversely affected as a result of demand on park staff to monitor and mitigate continued impacts and to control deer numbers for an indefinite period of time. Because additions in cost and/or energy usage for non-native deer management would likely be more than more than 5% of total park budget indefinitely, the impacts are considered to be moderate and long-term. When compared to the No Action alternative (5–15% budget increase), Alternative C would require a relatively similar increase (3–12%) in budgetary commitments for an indefinite period of time.

Type of Impact:	Adverse
Duration of Impact:	Long-term
Intensity of Impact:	Moderate
Cumulative Impact:	Adverse, long-term and moderate

Impacts on Regional Economy

Analysis and Cumulative Impacts

Impacts, including cumulative impacts, are not different from Alternative B.

Type of Impact:	Mixed—both adverse and beneficial
Duration of Impact:	Long-term
Intensity of Impact:	Minor
Cumulative Impact:	Long-term, major and beneficial

Environmental Consequences of Alternative D: Removal of All Non-Native Deer by Agency Personnel

This alternative would remove all fallow and axis deer from PRNS and PRNS–administered lands in 15 years. It is expected that large numbers of deer would be removed during the first 5 years of the program and that, because of increased wariness on the part of the deer and lower deer densities, a more gradual decrease over the next 10 years would follow. An effort would be made to remove deer in a manner that did not lead to increased migration outside of NPS boundaries, and it is expected that this alternative would not result in increased numbers of non-native deer on state park or private adjacent lands. However the Vedanta property, which currently contains the highest fallow deer densities in Olema Valley (up to 80 deer/sq. km.), is outside of NPS management jurisdiction and surrounded entirely by NPS lands. It is likely that during the removal program in the Seashore, deer densities on this inholding would increase.

Impacts on Water Resources and Water Quality

Analysis

Potential consequences of non-native deer eradication are reduced concentrations of animals adjacent to and within streams, ponds, and lakes. Fallow deer, typically found in large herds, tend to remain in areas for long periods of time. This behavior results in major denudation of the area around the herds. In addition, fallow deer tend to return to the same locations annually, resulting in long-term degradation of areas. Alternative D would reduce and eventually eliminate this degradation, allowing regrowth of riparian vegetation.

As noted in other sections (see Impacts of Alternative A to water resources and water quality, for example), fallow deer also impact water quality by eliminating riparian vegetation during the rut, when the bucks tend to aggressively rub and thrash their antlers. Impacts of fallow deer grazing and thrashing are most acute within the pastoral zone in Olema Valley, where many riparian areas have been deliberately excluded from livestock grazing to restore canopy and natural hydrologic processes. In these areas, revegetation efforts and natural regrowth have been severely retarded due to heavy grazing and antler rubbing by the non-native deer (B. Ketcham, NPS, personal communication). Continual grazing of new shoots and seasonal thrashing by fallow deer prevents native riparian plants from growing beyond shrub height.

Within NPS boundaries, Alternative D would quickly result in localized beneficial impacts to hydrologic processes (associated with streambank breakdown and erosion), aquatic habitat (associated with excess delivery of sediment to the aquatic resources and impact to riparian vegetation and growth rates), and water quality (both sediment and nutrient related). In the long-term, non-native deer eradication could result in moderate or readily apparent beneficial impacts on hydrologic process, aquatic habitat, and water quality in the Seashore compared to Alternative A.

Because it would be a safe zone, deer populations could expand into private inholdings within Seashore boundaries, such as the Vedanta property in Olema Valley when agency shooting begins. Increased fallow deer densities around riparian areas in this vicinity could cause short-term, minor to moderate adverse impacts to hydrologic processes, aquatic habitat and water quality. In the long-term, eventual eradication of fallow deer in the Olema Valley would reverse these impacts and allow natural restoration of these areas.

Use of vehicles off-road to cull deer or remove carcasses could result in localized, minor soil erosion and potential for increased sedimentation of waterways. Alternative D specifies that NPS staff would attempt to remain on roads and trails whenever possible in order to avoid degrading soils, waterways and vegetation. Because cross-country use of vehicles would rarely be used, particularly in wilderness and sensitive areas, adverse impacts to water resources from sedimentation resulting from this alternative are considered short-term and insignificant.

Cumulative Impacts

Cumulative impacts are the addition of those impacts of the alternative to those already existing or predicted to exist in the near future. Because all adverse impacts to water resources associated with non-native deer would be eliminated in this alternative by 2021, beneficial cumulative impacts of non-native deer eradication would occur by the end of the planning period. However, up until that point, cumulative impacts to water would be similar to those described for Alternatives A-C, and would result from the non-native deer (adverse) along with ongoing ranching (adverse), prescribed burning and thinning under the Fire Management Plan (beneficial), sewage treatment system additions and upgrades (beneficial), and water quality, wetlands and fish restoration projects (beneficial). As non-native deer numbers decrease with time, the beneficial impacts of some the above described projects would increasingly offset the diminishing adverse impacts of fallow and axis deer to water resources. Cumulative impacts of Alternative D, when viewed incrementally with the various restoration projects above, would result in long-term beneficial impacts except with regards to continued ranching, which would result in continued adverse moderate to major impacts to water resources.

Conclusion

No impairment to water resources would occur from implementing Alternative D. Both short-term and long-term impacts to water resources within the Seashore are characterized as beneficial and moderate. Impacts to the water resources in the Vedanta inholding are characterized as adverse and minor in the short-term because of the likely temporary increase in deer densities on the property during the initial stages of the removal program. In the long term, water resources in the Vedanta property, like those within the Seashore, would benefit to a moderate extent from non-native deer eradication since current impacts to hydrologic processes, aquatic habitat and water quality would be removed. Cumulative impacts of Alternative D, because they are considered incrementally with projects that have both adverse and beneficial long-term impacts to water resources, are considered mixed.

Type of Impact:	Mixed—both adverse and beneficial
Duration of Impact:	Short-term (adverse) and long-term (beneficial)
Intensity of Impact:	Minor adverse in the short term, moderate beneficial in the long-term
Cumulative Impacts:	Minor to moderate adverse in the short term; beneficial and adverse cumulative impacts in the long term (after non-native deer are eradicated)

Impacts on Soils

Analysis

As noted in other sections of this document, non-native deer have the potential to increase erosion and soil compaction, particularly where they are congregated in large herds for long periods of times. Fallow and axis deer consume vegetation, trample and destroy it, and increase compaction of soils. Compaction in turn results in increased runoff and reduced infiltration. In combination with soils unanchored by root structures, increased erosion results under these conditions. Fallow and axis deer also increase bare ground in areas they occupy by rutting behaviors and by creating trails. Each of these behaviors has resulted in denuded areas, which are eroded during the fall and winter rainy season at the Seashore. Alternative D would reduce and eventually eliminate this degradation allowing regrowth of riparian vegetation.

Short-term movement of deer populations into private inholdings within Seashore boundaries, such as the Vedanta property in Olema Valley, could result from NPS shooting operations. Increased fallow deer densities in the Vedanta Society property, causing increased trailing, compaction and erosion are possible short-term impacts from deer removals in the Seashore. In the long-term, eventual eradication of fallow deer in the Olema Valley would reverse these impacts and allow natural restoration of soils in Vedanta.

Use of vehicles off-road to cull deer or remove carcasses could result in localized, minor soil compaction. Alternative D specifies that NPS staff would attempt to remain on roads and trails whenever possible in order to avoid degrading soils, waterways and vegetation. Because cross-country vehicles would rarely be used, particularly in wilderness and sensitive areas, adverse impacts to soils from compaction resulting from this alternative are considered short-term and insignificant.

Substantial benefits would occur to park soils, as well as to regional soils compared to Alternative A if non-native deer were eradicated. Alternative A would almost certainly result in expanded herds outside of the Seashore, with regional, major impacts to soils similar to those experienced currently on a localized basis inside the park. Although localized minor impacts to soils at the Seashore would continue for a period of time until eradication is complete or near complete, in the long-term soils would no longer experience impact from non-native deer. Because impacts to soils are not yet severe, over time it is likely that vegetation would regrow in bare or compacted soils.

Cumulative Impacts

Because all adverse impacts to soil associated with non-native deer would eventually be eliminated in this alternative, incremental additive impacts to soils would also eventually be gone. However, up until that point, cumulative impacts would be similar to those described for Alternative A. These include denuding and resulting erosion from continued livestock operations, past development inside and outside of the park and historic logging. Current or future planned changes to buildings inside the Seashore would not likely result in disturbance of soils, although the restoration of the Giacomini property to re-create coastal marsh would involve the movement and disposal of agricultural related soils and manure. As non-native deer numbers decrease with time, the beneficial impacts of some the above described projects would increasingly offset the diminishing adverse impacts of fallow and axis deer to soils. Cumulative impacts of Alternative D, when viewed with the various restoration projects above, would result in long-term beneficial impacts except with regards to continued ranching, which would result in continued adverse moderate impacts to soils.

Conclusion

No impairment to soils would occur from implementing Alternative D. Both short-term and long-term impacts to soil within the Seashore are characterized as beneficial and moderate. Impacts to soil resources in the Vedanta inholding are characterized as adverse and minor in the short-term because of the likely temporary increase in deer densities on the property during the initial stages of the removal program. In the long term, soil in the Vedanta property, like those within the Seashore, would benefit to a major extent from non-native deer eradication since current compaction and erosion would be alleviated. Cumulative impacts of Alternative D, because they are considered incrementally with projects that have both adverse and beneficial long-term impacts to soils, are considered mixed.

Type of Impact:	Mixed—both adverse and beneficial
Duration of Impact:	Short-term (adverse) and long-term (beneficial)
Intensity of Impact:	Minor adverse; moderate beneficial
Cumulative Impacts:	Minor to moderate adverse in the short term; beneficial and adverse cumulative impacts in the long term (after non-native deer are eradicated)

Impacts on Vegetation

Analysis

As noted in the impact analysis of Alternative A, non-native deer can have a multitude of impacts on vegetation inside the park. These include consumption, compaction of soils, and loss of vegetation from trampling, rutting behavior, and breaking trails. Deer can affect the physical structure of vegetative communities, species composition, species richness and the level of nutrients through browsing and the addition of nutrients in the form of feces and urine. Deer can also adversely affect unique vegetative communities or consume species that are unique or protected. In the Seashore, fallow deer have had severe localized effects on riparian vegetation. Axis and fallow deer also eat some of the same foods as native deer and elk in the park, and so may have a cumulative adverse effect on plant species. Because these impacts occur on over 120 acres of the park, they are currently considered major in intensity. The continuation of current management practices (e.g., adoption of Alternative A) would result in expansion of the herd and the spread of these impacts to vegetation across the region, with more widespread and major impacts.

Alternative D would remove fallow and axis deer and over time and would eliminate the ongoing impact they have had on park vegetation. The impacts occur in a large area, but it is likely that most would be restored over time. For example, fencing that has been successful in keeping cattle out of areas where no fallow deer graze has resulted in the restoration of riparian vegetation. If current impacts from non-native deer are similar to those caused by cattle, restoration within a few years of their eradication is likely, even in highly disturbed riparian areas. It is possible that populations of native deer would increase following the eradication on non-native deer. If so, impacts across the park from their browsing may continue at a negligible or minor level, although the concentrated occupation of riparian habitat is not likely to occur.

Alternative D would result in both short and long-term moderate to major localized beneficial impacts to vegetative processes (associated with plant establishment and regrowth), habitat (associated soil erosion and plant growth rates), and plant diversity (associated with preferential grazing and browsing). It would also offer substantial benefits relative to Alternative A by eliminating the risk of non-native species expanding their range to areas outside the Seashore.

A short-term influx of non-native deer populations into the Vedanta Society property from NPS lands, as a result of the lethal removal program, could cause minor adverse impacts to riparian vegetation there. With ultimate eradication of fallow deer in Olema Valley, these impacts would be reversed and restoration of affected areas would eventually occur.

Use of vehicles off-road to cull deer or remove carcasses could result in localized, minor direct destruction of vegetation. Alternative D specifies that NPS staff would attempt to remain on roads and trails whenever possible in order to avoid degrading soils, waterways and vegetation. Because vehicles would rarely be used off-trail, particularly in wilderness and sensitive areas, adverse impacts to vegetation resulting from this alternative are considered insignificant.

Cumulative Impacts

Over the long term, managed populations of non-native deer would reduce concentration-associated impacts to vegetation at the Seashore. This alternative may also improve the success and effectiveness of plant conservation and restoration projects due to the elimination of grazing and thrashing pressure by non-native deer on individual rare species and recovering native vegetation. Until the beneficial effects on vegetation of eliminating non-native deer are fully realized, adverse effects of their presence would continue as described for the cumulative effects section in Alternative A. These effects include trampling, loss and denudation both from the deer themselves and efforts to eradicate them. Other activities such as grazing by native deer and cattle (adverse impacts), continued cattle operations (adverse impacts), and the beneficial effects of fire management activities and fencing to exclude livestock from sensitive riparian areas would have short term incremental effects. As non-native deer numbers decrease with time, the beneficial impacts of some the above described projects would increasingly offset the diminishing adverse impacts of fallow and axis deer to vegetation. Cumulative impacts of Alternative D, when viewed incrementally with various restoration projects, would result in long-term beneficial impacts except with regards to continued ranching, which would result in continued adverse moderate impacts to vegetation.
When non-native deer have been eradicated, beneficial cumulative effects on vegetation would occur although continued adverse impacts, ranging from moderate to major in intensity, would persist from ranching.

Conclusion

No impairment to vegetation would occur from implementing Alternative D. Based on current and past data on fallow and axis deer, eliminating non-native deer from the Seashore would positively affect vegetation communities within over 52,191 acres of current fallow deer range and over 1,500 acres of current axis deer range. Based on current reports of damage to riparian and understory vegetation within the Seashore, the magnitude of current impacts to vegetation within NPS boundaries are currently moderate to major in intensity. Consequences of alleviating these impacts with the actions described in Alternative D would be beneficial, moderate and long-term to Seashore vegetation. Impacts to vegetation on the Vedanta Property would be adverse and minor in the short-term and beneficial and major in the long-term. Substantial benefits to vegetation outside the park relative to Alternative A are likely from eliminating the risk of non-native species expanding their ranges. Cumulative impacts of Alternative D, because they are considered incrementally with projects that have both adverse and beneficial long-term impacts to vegetation, are considered mixed.

Type of Impact:	Mixed—both adverse and beneficial
Duration of Impact:	Short-term (adverse) and long-term (beneficial)
Intensity of Impact:	Minor adverse and moderate beneficial
Cumulative Impacts:	Minor to moderate adverse in the short term; long-term, moderate to major, beneficial and moderate adverse cumulative impacts (after non-native deer are eradicated)

Impacts on Wildlife

Analysis

For this analysis, the best professional judgment of wildlife biologists, as well as research completed at the Seashore and elsewhere, have been used to determine impacts of eradicating fallow and axis deer populations on other wildlife species. In general, eventual disappearance of non-native deer would have beneficial impacts to other wildlife species in the Seashore.

Non-native Cervids

Agency culling of non-native deer would adversely impact axis and fallow deer by removing reproducing animals from the population. In looking at the fallow population model developed by Gogan et al. (2001), culling a total 1,500 fallow deer and 700 axis deer would eradicate both species in 15 years (see Appendix B for an explanation of the model). Total numbers culled depends on the sex and age of removed animals as well as the carrying capacity of their habitat and density dependent pressures on the herds.

Alternative D, because it results in shooting of non-native deer, would cause a measure of pain and suffering to culled animals. The degree of pain and suffering would be mitigated by use of trained agency sharpshooters for all control operations. Efforts would be made to deliver immediately lethal shots to target animals and sharpshooters would be required to complete NPS range qualifications at levels of intensity and frequency required for law enforcement rangers.

Native Cervids

In their study of axis and fallow deer introductions nationwide, Feldhammer et al. (1993) stated:

> "We may expect competition between exotic and native artiodactyls both intuitively, and on the basis of previous field experiments with a variety of animal groups from various trophic levels and habitats…."

Native black-tailed deer are primarily browsers while both axis and fallow deer have been shown to be grazers. Studies at PRNS have demonstrated however that, during times of low forage availability, non-native deer adapt their feeding habits and consume larger amounts of forbs and browse (Elliott 1983; Elliott and Barrett 1985). One researcher estimated that at current levels of non-native deer, there is a 46% reduction in black-tailed deer, a major adverse impact (Fellers 2006). Decreasing numbers of non-native deer would result in decreased competition with native black-tailed deer for forbs and browse during droughts, at the end of summer, and year-round on poor quality ranges (Connolly 1981; Elliott 1983; Fellers 1983). Decreased competition for limited forage would result in improved condition in black-tailed deer (Brunetti 1976; Fellers 1983). Decreased competition for forage would likely result in improved black-tailed doe fertility, increased fawn production and higher fawn survival over current levels. The magnitude of the beneficial impacts to black-tailed deer populations would depend on range conditions and precipitation patterns but would likely be major and could be expected to last longer than two breeding cycles.

Biologists in New Zealand documented that established, high-density populations of fallow deer competitively excluded red deer (*Cervus elaphus scotticus*), an elk species native to Europe (Challies 1985). Red deer are considered the most widespread and successful of all deer species introduced to New Zealand except where their range overlaps with previously established fallow deer populations (Challies 1985). Decreased densities of fallow deer in areas of the Seashore where free-ranging tule elk inhabit would likely allow expansion of the elk herd.

Tule elk, like fallow and axis deer, are primarily grazers. Grasses constitute a large proportion of the diets of all three species year-round (Elliott and Barrett 1985; Gogan and Barrett 1985; Fallon-McKnight unpublished data). In addition to allowing further expansion of tule elk herds, lower numbers of non-native deer could beneficially impact current elk populations in the Seashore through decreased competition for forage (Brunetti 1976). Such impacts would be reflected in higher elk calving rates, earlier onset of reproduction in tule elk cows and improved elk calf survival.

Direct behavioral competition between fallow deer and tule elk currently exists at PRNS and would likely decrease with Alternative D. Researchers in the Zehusice Deer Park in the Czech Republic have documented behavioral exclusion of red deer by fallow deer at high-density feeding sites (Bartos et al. 1996). Fallow deer at Zehusice were observed to: (1) be consistently more aggressive than red deer, (2) preferentially seek out feeding sites where red deer congregated, and (3) attack red deer from the rear as a strategy to overcome their larger opponents (Bartos 1996). In the Tomales Point Elk Reserve at PRNS, fallow bucks have been observed sparring with tule elk bulls (PRNS unpublished data (m)). In all observed instances, fallow bucks were successful in chasing away elk bulls in spite of a substantial size disadvantage. The consequences of decreased behavioral competition are difficult to predict with certainty but could include expansion of elk into higher quality forage or habitats, improved condition of reproducing adults and ultimately, increased population growth, or population stabilization.

Paratuberculosis, or Johne's disease, is an infectious and incurable diarrheal wasting disease of wild and domestic ungulates. In a study conducted at PRNS in 1979, paratuberculosis was documented in 9.6% and 8.1% of axis and fallow deer, respectively (Riemann et al. 1979b). The disease has been documented in tule elk at Tomales Point Elk Reserve since 1980 but has never been found in PRNS black-tailed deer (Jessup et al. 1981; Sansome 1999 unpublished report). In 1998-1999, relocation of 45 adult tule elk from Tomales Point to the Limantour wilderness area included a 6-month quarantine and extensive testing for Johne's disease (Manning et al. 2003). Only those animals that consistently tested negative on all blood tests and fecal cultures were released in July 1999 to form a new free-ranging herd. This elk herd is currently made up of 34 animals. The goal of the relocation was to restore the dominant native herbivore to the Seashore's wilderness ecosystems.

Transmission of the organism that causes paratuberculosis (*Mycobacterium avium ss. paratuberculosis*) occurs primarily from infected adults to young animals. The period of greatest susceptibility for this infection appears to be the first 6 months of life. The organism is shed by infected animals into feces that may contaminate feed, water, and pastures. The prevalence of the infection and the incidence of clinical disease may climb when an affected population approaches carrying capacity. At these high densities, affected herds experience the stressors of reduced forage nutritional quality and reduced ability to fight disease. This immunosuppression can result in increased transmission of infections, heavier parasite loads and progression to clinical illness. (Manning et al. 2003). Animals in the clinical phase of Johne's disease shed the organism more often and in greater numbers. Premise contamination with this hardy and long-lived organism may thus increase, a factor relevant to the health of numerous species. All cervids are believed to be susceptible to this infection (Manning and Collins 2001).

As noted in the analysis of other action alternatives, newly discovered ectoparasites on fallow and axis deer pose an unknown but potentially significant risk of disease to native black-tailed deer and tule elk. Of most concern is *Bovicola tibialis*, a chewing louse typical of fallow deer, but not native to either black-tailed deer or tule elk. USDA researchers are concerned that this parasite may transfer from fallow deer to native cervids and cause disease, pediculosis. Serious pediculosis outbreaks are associated with the exposure of a previously unexposed population to a new or exotic parasite and are a concern for PRNS native deer and elk, as are the associated possible increases in morbidity, mortality and reduced recruitment of young.

Alternative D would result in lower densities, and the eventual elimination of non-native deer in PRNS and outside of NPS boundaries. Because non-native deer could scatter into smaller herds as a result of the culling program, the prevalence of paratuberculosis and pediculosis (louse infestation) would decrease in these herds and the potential for transmission to tule elk and black-tailed deer that share their habitat with these smaller herds would decrease.

Genetic variability assists populations in adapting to environmental changes and reduces vulnerability to catastrophic events such as disease, abnormal weather cycles, pollution etc. Fewer than 4,000 of the 500,000 tule elk historically present in California currently remain. Tule elk at PRNS have passed through four severe population reductions or "bottlenecks." With each bottleneck, the amount of genetic variability in the population has been reduced. It has been estimated that PRNS elk are among the most inbred in California, with a degree of relatedness equivalent to that resulting from three consecutive brother-sister matings (McCullough et al. 1996). Physical signs of inbreeding, such as cleft palate, have been observed in the Tomales Point herd (Gogan and Jessup 1985).

Management techniques to increase genetic diversity within and among wildlife populations include: (1) translocating animals between subpopulations, and (2) increasing the number of reproducing animals within each subpopulation (McCullough et al. 1996). For the past 5 years, NPS has cooperated with California Department of Fish and Game to transfer adult elk cows to Tomales Point, in order to increase genetic variability. One of the primary goals of the PRNS General Management Plan is to maintain viable populations of tule elk in the Seashore and to restore free-ranging elk to wilderness ecosystems. Alternative D would likely accelerate the growth of the free-ranging tule elk herd. Greater numbers of breeding animals would result in higher genetic variability and decreased risk of catastrophic population downswings.

Alternative D would result in:

- increased tule elk and black-tailed deer food availability;
- increase in tule elk and black-tailed deer numbers;
- increased tule elk range; and
- increased genetic variability within a the PRNS tule elk population.

Impacts to native cervids from Alternative D inside and outside of NPS boundaries would be beneficial, moderate to major, depending on the species, and long-term.

Small Mammals

The impacts of decreased non-native deer populations on small mammals would occur in two ways: (1) by habitat alteration, influencing food supply and cover, and (2) by direct, beneficial, competition for resources, mainly, food (Flowerdew and Ellwood 2001). In order to definitively demonstrate impacts of diminishing deer populations on small mammals at PRNS, large-scale deer exclosure experiments would have to be used to investigate responses at varied deer densities. Such experiments have not been carried out at PRNS and are discussed in Chapter 2 (in the Alternatives and Actions Considered but Rejected section). Impacts to small mammals are extrapolated from research completed in the U.S. and in the U.K. on fallow deer and white-tailed deer in lowland woodlands (Putman 1986; McShea 2000; Flowerdew and Ellwood 2001; Fuller 2001). Inventories of small terrestrial vertebrates, conducted at PRNS from 1998-2001 in the agricultural and ungrazed areas of the Seashore, were also considered in this analysis (Fellers and Pratt 2001).

In the Britain, heavy grazing pressure (100 deer/sq. km.) by fallow deer in lowland forests caused reductions and even local extirpations of wood mice, bank voles and common shrews (Putman et al. 1989). The loss of palatable ground-level vegetation removes food sources for small herbivores and at the same time, changes microclimates and reduces protection from predators (Flowerdew and Ellwood 2001). Increased browsing of shrubs in forested habitat or on forest-grassland interfaces, as has been demonstrated in both axis and fallow deer at the end of summer and during droughts (Elliott 1982), has likely altered suitability of those areas for some species. High densities of fallow deer have been observed to alter riparian cover and vegetation at PRNS through browsing and antler thrashing (B. Ketcham, NPS, personal communication). Reducing such impacts with Alternative D could increase cover and habitat for dusky-footed woodrat (*Neotoma fuscipes*).

Inventories of small mammals in non-wooded areas of the Seashore revealed fewer western harvest mice (*Reithrodontomys megalotis*) and California meadow voles (*Microtus californicus*) captured in those pastures heavily grazed by cattle than in moderately grazed pastures or similar non-wooded areas (Fellers and Pratt 2002). Densities of fallow deer in the Olema Valley areas of PRNS currently approach 80 deer/ sq. km. (NPS 2002a) and could be expected to decrease in Alternative D. Grazing pressure from deer in many Olema Valley sites is currently considered heavy. Should this grazing pressure decrease with Alternative D, species that could benefit are the: Pacific jumping mouse (*Zapus trinotatus*), dusky-footed woodrat (*Neotoma fuscipes*), western harvest mouse (*Reithrodontomys megalotis*), California vole (*Microtus californicus*), black-tailed jack rabbit (*Lepus californicus*), and brush rabbit (*Sylvilagus bachmani*). Decreased fallow deer densities and range resulting from Alternative D would likely increase habitat for these species in limited areas of the Seashore, for longer than 2 breeding cycles. The beneficial impacts could therefore be considered moderate and long-term.

Not all species decline with increasing deer grazing pressure. Grazing at intermediate and low deer densities has been shown to increase or have no effect on some plant and animal species in Britain (Fuller and Gill 2001). At PRNS, deer mice (*Peromyscus maniculatus*) were found more often in pastures grazed by cattle than in pastures where cattle were excluded (Fellers and Pratt 2002). It is possible that with decreased deer grazing pressure in PRNS, deer mouse abundance would decrease. Other small mammal species that thrive in open grassland environments, such as the Valley pocket gopher (*Thomomys bottae*), could also remain unaffected or decrease.

Direct competition for food between non-native deer and small mammals is a potential adverse short-term impact resulting from Alternative D. In the absence of definitive data from park exclosure experiments, evidence of dietary overlap between species has been evaluated. In California and elsewhere, fallow deer are known to feed on acorns, an important food source for many small mammals (Poli 1996; Jurek 1977). In addition, analyses of fallow and axis rumen and fecal samples have shown heavy use of many of the same species used by small mammals (Elliott 1982; Fallon-McKnight 2006). Small mammals likely to benefit from decreasing competition for food are the: Pacific jumping mouse (*Zapus trinotatus*), California vole (*Microtus californicus*), deer mouse (*Peromyscus maniculatus)*, western harvest mouse (*Reithrodontomys megalotis*), black-tailed jack rabbit (*Lepus californicus*), and brush rabbit (*Sylvilagus bachmani*).

Depending on local deer densities, weather patterns and the yearly mast crop, relative beneficial impacts to small mammals from Alternative D range from minor to moderate throughout the Seashore. Because they persist for longer than 2 breeding cycles, impacts are considered long-term.

Mammalian and Avian Predators

This category includes wildlife species, such as mountain lions (*Felis concolor*), coyotes (*Canis latrans*), grey foxes (*Urocyon cinereoargenteus*), bobcats (*Felis rufus*), badgers (*Taxidea taxus*), weasels (*Mustela spp.*) and the raptors that prey on small mammals.

Although no research at PRNS has been conducted to document the extent to which non-native deer are preyed upon by carnivores, anecdotal and historical evidence suggest low-level predation, especially on fawns. Since their introduction in the 1940s, there has been a decrease in the proportion of observed white fallow deer, from 75% to 21%, suggesting that white individuals may be preferentially selected by predators (Wehausen 1973; NPS 2002a). An anecdotal report exists of an axis doe defending her fawn from a bobcat (NPS unpublished data (n)). Ranchers have reported coyotes preying on axis fawns in the pastoral zone (N. Gates, NPS, personal communication). However, because non-native deer congregate in large groups and prefer open habitat, it is unlikely that they serve as a primary prey base for native mega- and meso-carnivores that specialize on stalking black-tailed deer and small mammals. Alternative D would decrease the non-native deer prey base for mountain lions, coyotes and bobcats. This beneficial impact would likely be offset by an increase in both the black-tailed deer and small mammal prey base for these carnivores, foxes, weasels and badgers.

In the New Forest in Britain, heavy grazing, mainly from fallow deer, was shown to result in lowered reproduction in tawny owls (*Strix aluco*) and kestrels (*Falco tinnunculus*), especially during severe weather cycles and poor mast crop years (Putman 1986). Because of the likely beneficial impact on their rodent prey base, Alternative D would benefit birds of prey such as great-horned owls (*Bubo virginianus*), short-eared owls (*Asio otus*), western screech owls (*Otus kennicottii*), long-eared owls (*Asio otus*), barn owls (*Tyto alba*), American kestrels (*Falco sparverius*), red-shouldered hawks (*Buteo lineatus*), red-tailed hawks (*Buteo jamaicensis*), Northern harriers (*Circus cyaneus*), black-shouldered kites (*Elanus caeruleus*), sharp-shinned hawks (*Accipiter striatus*) and Cooper's hawks (*Accipiter cooperii*).

Overall, the beneficial impacts of Alternative D to predators in the Seashore and in Marin County would be moderate and long-term.

Other Birds

Little is known about the impacts of grazing wildlife on birds in the Seashore. In 1997-1998, researchers at the Point Reyes Bird Observatory compared avian abundance and species richness in areas grazed by cattle to ungrazed areas (Holmes et al. 1999). Results showed that in all habitat types except coastal scrub, cattle-grazed areas had lower diversity, lower species richness and lower relative abundance of passerines and near-passerines (hummingbirds, woodpeckers and doves). Only one species, the savannah sparrow (*Passerculus sandwichensis*), was found in higher numbers in grazed grasslands.

Deer exclosure studies in Pennsylvania hardwood forests indicate that high densities of white-tailed deer (*Odocoileus virginianus*) cause declines in intermediate canopy-nesting songbirds. This study showed complete absence of certain songbird species, including American robins (*Turdus migratorius*), at deer densities over 25 deer/ sq. km.(deCalesta 1994). These declines are thought to occur because high deer numbers alter the structure of woody and herbaceous vegetation 0.5–7.5 meters above the ground (deCalesta 1994). Studies of fallow deer, roe deer (*Capreolus capreolus*) and muntjac deer (*Muntiacus reevesi*) in British lowland forests suggested that some bird species, namely understory nesters, declined with high deer grazing pressure while other species, namely bark foragers, benefited from reductions in understory vegetation. Researchers in British lowland forests determined that "losers" substantially outnumbered "winners" and that breeding populations of migrant birds were especially vulnerable to adverse impacts from heavy deer grazing pressure (Fuller 2001).

Table 11 lists the ground or low nesting bird species (nesting at approximately 0.3–3 meters) found in the Seashore. These species are found in habitats where the greatest impacts from large herds of non-native deer currently would occur (T. Gardali, Point Reyes Bird Observatory, personal communication, Shuford and Gardali, in review). It is likely that Alternative D would cause an increase in abundance of low nesting species that depend on understory vegetation to place their nests. Impacts on reproductive success and survival are unknown. It should be noted that Table 11 primarily contains species breeding at PRNS and GGNRA and is not exhaustive. Two species that would likely be impacted, the San Francisco common yellowthroat (*Geothlypis trichas sinuosa*) and the California Swainson's thrush (*Catharus* *ustulatus oedicus*) are not listed in this table because they are either California Bird Species of Special Concern (CDFG) or Birds of Conservation Concern (USFWS) and are discussed in the Impacts on Species and Habitats of Management Concern section.

TABLE 11: BIRD SPECIES LIKELY TO BENEFIT FROM ALTERNATIVE D. (T. GARDALI, POINT REYES BIRD OBSERVATORY, PERSONAL COMMUNICATION, SHUFORD AND GARDALI, IN REVIEW)

Common Name	**Scientific Name**
Allen's hummingbird	*Selasphorus sasin*
American goldfinch	*Carduelis tristis*
Bewick's wren	*Thryomanes bewickii*
Brewer's blackbird	*Euphagus cyanocephalus*
California towhee	*Pipilo crissalis*
California quail	*Callipepla californica*
Hermit thrush	*Catharus guttatus*
Horned lark	*Eremophila alpestris*
Lark sparrow	*Chondestes grammacus*
Lazuli bunting	*Passerina amoena*
Marsh wren	*Cistothorus palustris*
MacGillivray's warbler	*Oporornis tolmiei*
Orange-crowned warbler	*Vermivora celata*
Oregon junco	*Junco hyemalis thurberi*
Red-winged blackbird	*Agelaius phoeniceus*
Spotted towhee	*Pipilo maculatus*
Western meadowlark	*Sturnella neglecta*
Wilson's warbler	*Wilsonia pusilla*
Winter wren	*Troglodytes troglodytes*
Wrentit	*Chamaea fasciata*

It is expected that overall avian species richness, abundance and diversity would increase measurably with reduction of the heavy grazing pressure resulting from Alternative D. Adverse impacts to a few grassland species would be offset by larger benefits to relatively more species that depend on understory shrub layers for nesting, especially in the riparian and woody-grassland interfaces currently impacted by high densities of non-native deer. The beneficial impacts to various species would be moderate and long-term within the Seashore.

Reptiles and Amphibians

PRNS has some information on the impacts of large herds of grazing herbivores on reptiles and amphibians in the Seashore. During inventories of small vertebrates conducted at PRNS in 2001, northern alligator lizards (*Gerrhonotus coeruleus*) were not found in pastures grazed by cattle but were found in similar ungrazed sites (Fellers and Pratt 2002). Changes to woodland understory vegetation, especially in riparian areas, as has been documented with high densities of fallow deer at PRNS, would alter microclimates and habitats for frogs, lizards and salamanders. Adverse impacts under current non-native deer densities could be expected for alligator lizards, California slender salamanders (*Batrachoseps attenuatus*), rubber boas (*Charina bottae*), western skinks (*Eumeces skiltonianus*), racers (*Coluber constrictor*), garter snakes (*Thamnophis elegans)*, and Ensatina salamanders (*Ensatina eschscholtzii*). By allowing regrowth of understory vegetation with reduced deer densities, Alternative D would benefit these species.

Because of expected mild to moderate beneficial impacts of Alternative D on small mammal abundance (see above), concomitant increases can be expected in reptiles that prey on shrews and rodents. Species in this category are the: western terrestrial garter snake, rubber boa, and gopher snake (*Pituophis melanoleucus*).

Studies of British lowland forests heavily grazed by fallow deer have shown that as a result of decreasing rodent numbers, kestrels relied preyed more heavily on lizards (Putman 1986). Inside the Seashore, decreases in predation by raptors and owls on lizards, frogs and snakes is likely to occur in areas of decreased non-native deer density.

Impacts to amphibians and reptiles in PRNS with Alternative D are expected to be beneficial to a moderate number of species. The impacts are moderate and long-term.

Cumulative Impacts

During the period when non-native deer are still present at PRNS, their cumulative impacts along with those from other factors affecting wildlife would be similar to those described for Alternative A. These include agricultural impacts to biodiversity, development and loss of habitat, loss of acorns as a food supply from a combination of increases in other non-native wildlife (turkeys) and sudden oak death. When non-native deer are eradicated, the beneficial cumulative (e.g., combined or additive) impacts of their disappearance to native wildlife will result, although continued adverse impacts would persist from continued ranching.

Conclusion

This alternative would result in a marked decrease in total non-native deer numbers and range over current levels over the next 15 years in the Seashore. No impairment to native wildlife would occur from implementing Alternative D. Based on research on impacts of non-native deer to wildlife in other countries as well as known impacts of grazing by cattle and white-tailed deer in the U.S., the impacts of Alternative D are expected to be beneficial, within NPS boundaries, to a large number of native species and adverse to a much smaller number of native species. Because the Vedanta property is surrounded by NPS lands but outside of NPS management authority, it is likely that deer densities there would increase initially, as a result of lethal removals in the Seashore. Short-term, native species richness and diversity would likely decrease in those high-density areas. Overall and in the long-term, the magnitude of impacts to native wildlife within and outside of NPS boundaries are considered moderate to major in intensity, depending on the species, and beneficial. Cumulative impacts of Alternative D, because they are considered incrementally with projects that have both adverse and beneficial long-term impacts to wildlife, are considered mixed.

Type of Impact:	Beneficial
Duration of Impact:	Long-term
Intensity of Impact:	Moderate to major
Cumulative Impacts:	Minor to moderate adverse in the short term; beneficial and adverse cumulative impacts in the long term (after non-native deer are eradicated)

Impacts on Species and Habitats of Management Concern

This category includes federally listed wildlife species, as well as other species of concern. Those recognized by the state of California or Birds of Conservation Concern (USFWS) include several species of nesting land birds and raptors.

Although no research at PRNS has been conducted to document the extent to which non-native deer affect federally and state listed species, anecdotal and historical evidence and expert opinion can provide insights and guidance. The federally listed species that are likely to be affected by non-native deer include northern spotted owls (*Strix occidentalis caurina*), western snowy plover (*Charadrius alexandrinus nivosus*), California red-legged frog (*Rana aurora draytonii*), Coho and Chinook salmon (*Oncorhynchus kisutch and tshawytscha*), steelhead trout (*Oncorynchus mykiss*), and Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*).

Analysis

Special Status Species

Northern Spotted Owl

The northern spotted owl is a federally threatened species that reaches the southern limit of its range within GGNRA, PRNS and Muir Woods National Monument in Marin County, California. Data collected by the NPS indicates that these parks may support the highest density of spotted owls known. However, the population is geographically isolated and subject to unique threats including urban development, intense recreational pressure, habituation of owls to humans, potential for catastrophic wildfires, and changes in hazardous fuel management practices. Owls occur throughout the forested lands in the Seashore and the population is likely stable; however, owls have been monitored for only 7 years in the Seashore (NPS and PRBO unpublished data). Owls prey almost exclusively on small mammals, particularly dusky-footed wood rats (*Neotoma fuscipes*) in the Seashore (Chow 1998). Woodrats, in turn, are dependent on roots, stems, leaves, seeds and mast (Linsdale and Tevis 1951; Willy 1992).

Fallow deer have been recorded in areas where spotted owls nest and roost. To date, no direct effects have been noted on the productivity or survival of owls. However, deer compete with the prey species of owls, and therefore, likely have an indirect negative impact on food resources. By biting off buds and flowers they reduce the amount of seed and fruit available in autumn and winter. In California and elsewhere, fallow deer are known to feed on acorns, an important food source for many small mammals (Poli 1996; Jurek 1977). In the New Forest in Britain, heavy grazing, mainly from fallow deer, was shown to result in lowered reproduction in tawny owls and kestrels, especially during severe weather cycles and poor mast crop years (Putman 1986). Because of the likely beneficial impact on rodent prey base due to reduced competition for food and cover, Alternative D would have a beneficial impact on northern spotted owls. Overall, the beneficial impacts of Alternative D to owls in the Seashore and in Marin County would be minor and long-term.

Western Snowy Plover

Western snowy plovers, federally listed as threatened by the U.S. Fish and Wildlife Service (USFWS), nest along the sandy beaches of the Seashore, primarily on Point Reyes Beach between North Beach and Kehoe Beach. Historically, plovers also nested at South Beach, Drakes Beach and Limantour. Plover nesting success has increased slightly over the past few years due to intensive management by the Seashore; however, the species is vulnerable to numerous activities in the park including predation by ravens and disturbance by recreationists. Fewer than 20 chicks fledged in 2002 (Peterlein 2002). Cattle roaming on the beaches in the past were a potential source for disturbance; however, the Seashore now intensively restricts cattle from beaches. A large herd of 60 axis deer has been seen on South Beach within the last five years, and where the herd occurred, the ground was heavily impacted (S. Allen, NPS personal communication). The frequency of this activity by axis deer is unknown but likely does not occur with regularly. Consequently, the overall beneficial impact of Alternative D to plovers in the Seashore is likely minor.

California Red-legged Frog

The California red-legged frog was federally listed as a Threatened species on June 24, 1996. Red-legged frogs breed in ponds or pools during the wet season (December through March), and use ponds and/or riparian habitats during the rest of the year. Currently, fallow deer regularly frequent riparian areas, girdle small trees and vigorously rub and thrash their antlers during the rut, resulting in maiming and destruction of riparian vegetation. While engaged in this activity, fallow deer cause extensive trailing and may trample frogs. Damage to the vegetation may be degrading non-breeding frog habitat. Overall, the beneficial impacts of Alternative D to frogs in the Seashore would be minor and long-term.

Coho Salmon, Steelhead Trout, and Chinook Salmon

As noted elsewhere in this EIS, these three species of threatened or endangered anadromous fish occur in many of the streams of the Seashore, particularly in Olema Creek and Lagunitas Creek. The Seashore contains 10% of the last remaining wild population of Coho salmon within the Central California Coast Evolutionarily Significant Unit, and consequently, any loss of this population would have an impact on the evolutionary significant unit. The NPS, along with the NOAA Fisheries and the CDFG, have conducted intensive fish surveys and have funded and implemented numerous restoration projects along the streams that flow through the park and adjacent lands. Numerous culverts have been removed along with other blockages to fish passage. In addition, the agencies have installed fencing to restrict cattle from riparian areas. These fences, though, do not impede the movement of fallow deer.

Currently, fallow deer regularly frequent riparian areas and damage riparian vegetation, particularly during the rut when deer girdle trees, thrash branches and leaves with their antlers. While engaged in this activity, fallow deer may indirectly affect the fish by damaging riparian plants, resulting in: increased erosion and sediment delivery to the stream, reduced cover, and potentially warmer water in streams due to exposure to sunlight. Eradicating fallow deer would remove this impact to riparian vegetation. In addition, removing non-native deer would improve the success and effectiveness of riparian restoration projects for salmon. In restoration areas, revegetation efforts and natural regrowth would no longer be retarded due to heavy grazing and antler rubbing. This alternative reduces the risk of fish redds being trampled in riparian areas where large numbers of fallow deer currently congregate or travel. Overall, the beneficial impacts of Alternative D to anadromous fish in the Seashore would be minor and long-term.

California Freshwater Shrimp

The California freshwater shrimp (*Syncaris pacifica*) is listed by the USFWS as endangered. The shrimp inhabits lower Lagunitas Creek and lower Olema Creek, within the current fallow deer range at PRNS. Shrimp are highly dependent on overhanging riparian vegetation, under which they live year-round. Fallow deer have not been observed within known shrimp habitat. However, in other areas of both Lagunitas and Olema Creeks, high densities of fallow deer have been observed to cause wide, straight trails, girdle trees, browse and trample riparian vegetation (Fellers and Osbourn 2006; Brannon Ketcham, NPS, personal communication). A decrease in fallow deer range resulting from Alternative D is not likely to cause either adverse or beneficial impacts to shrimp habitat or shrimp survival.

Myrtle's Silverspot Butterfly

Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*) is one of three coastal subspecies of *S. zerene* in the Western United States. The USFWS listed the subspecies as endangered in 1992, citing habitat loss and degradation as the primary threats (USFWS 1992).

As of 1998, three populations are known to remain. The USFWS Myrtle's Silverspot Butterfly Recovery Plan (1998) estimated the three populations combined comprise 10,000 individuals. Two populations of Myrtle's silverspot butterfly occur within the Seashore and the third is on private land in northern Marin County. The Center for Conservation Biology at Stanford monitored distribution and abundance of the Myrtle's silverspot butterfly at Point Reyes National Seashore almost yearly from 1992 to 1998. The Stanford survey work shows a decline in Myrtle's silverspot butterfly population levels during the six-year period and the central population to be "barely existing" (Launer et al. 1998). Grazing is believed to deplete the Myrtle's silverspot butterfly larval host plants. The Seashore is currently supporting an intensive survey of the habitat of the Myrtle's silverspot butterfly and research on the current abundance and distribution of the larval host plant and adult nectar sources.

The PRNS coastal dune system and coastal prairie provide critical habitat for the Myrtle's silverspot butterfly. Many different plants are used by the Myrtle's silverspot butterfly's as nectar sources; native plants (*Grindelia rubicaulis, Abronia latifolia, Monardella undulata, Erigeron glaucus,* and *Wyethia sp.*) as well as non-native bull thistle (*Cirsium vulgare*) and Italian thistle (*Carduus pycnocephalu*s). The only known larval host plant is the western dog violet (*Viola adunca*).

Axis and fallow deer frequent coastal prairie habitat. To date, it is not known whether they browse on the preferred nectar or larval host plants of the Myrtle's silverspot butterfly. Research in which deer-proof exclosures were monitored in the New Forest in England showed that fallow deer preferentially consumed a *Viola* species in a 1969 but not in a repeat survey in 1978 (Putman 1986). In Hawaii, the introduction of axis deer and mouflon sheep to Lana`i have likely played a major role in the disappearance of *Viola lanaiensis* (USFWS 1995a). Another Hawaiian species, *Viola kauaensis* var. *wahiawahensis,* is also listed as endangered by USFWS because of perceived threats of habitat degradation by feral animals and axis deer (USFWS 1995b). It therefore is likely that non-native deer, given the opportunity, currently graze on the Myrtle's silverspot butterfly's larval host plant.

Decreased grazing would increase availability of these plants for the butterfly. If the fallow and axis deer populations were eradicated, adverse impacts to the vegetation used by this butterfly would likely decrease. Overall, the impacts of Alternative D to Myrtle's silverspot butterfly in the Seashore would be beneficial, moderate to major and long-term.

Bird Species of Concern

The Seashore has collaborated with the Point Reyes Bird Observatory over the past two decades to protect and restore habitat of nesting land birds within the boundaries of the Seashore. Many species of land birds are species of concern both under the California Bird Species of Special Concern (CDFG) and the Birds of Conservation Concern (USFWS). Examples of species include common yellowthroat *(Geothlypis trichas sinuosa*), California Swainson's thrush *(Catharus ustulatus oedicus),* and tricolored blackbird *(Agelaius tricolor).*

Numerous restoration projects and fire management actions have strived to improve nesting success in land birds, particularly in riparian areas. In addition, the park is an active member of the Partner-in-Flight program, collaborating with other agencies and organizations to protect and restore populations of neotropical migratory songbirds. The Point Reyes Bird Observatory has monitored the reproductive success and species composition of birds for more than 30 years. Monitoring has taken place in areas of the park (Palo Marin) where fallow deer occur only rarely.

In areas where fallow deer are currently abundant, there often is a well-defined browse line on trees and shrubs between 1.5 and 2 meters above the ground. Studies of fallow deer, roe deer (*Capreolus capreolus*) and muntjac deer (*Muntiacus reevesi*) in British lowland forests have suggested that some bird species, namely understory nesters, declined with high deer grazing pressure (Fuller 2001). Similarly, ground or low nesting (approximately 0.0–3 meters) bird species found in the Seashore are presently vulnerable to heavy grazing by non-native deer. These species are found in habitats where the greatest impacts from large herds of non-native deer are occurring (T. Gardali, Point Reyes Bird Observatory, personal communication; Shuford and Gardali, in review). Current non-native deer numbers may be limiting nesting species that depend on understory vegetation to place their nests. Current impacts on reproductive success and survival are unknown. Overall, the adverse impacts of Alternative D to understory nesting songbirds of concern in the Seashore and in Marin County are likely to be beneficial, moderate to major and long-term.

Plant Species of Special Concern

This category includes federal, state, and California Native Plant Society listed plant species.

Although no research at PRNS has been conducted to document the extent to which non-native deer affect plant species of special concern, anecdotal and historical evidence and expert opinion can provide insights and guidance. Rare plants have been inventoried at Point Reyes National Seashore over the past twenty years. The preponderance of this information is presence/absence data for species of concern, with some additional data describing distribution of select species. Given the substantial amount of plant distribution data, it is important to note that this information only describes known rare plant occurrences. Obviously there are many acres within the Seashore that have not yet been surveyed for rare plants. Impacts related to rare plants, therefore, can only be estimated in terms of limited best available information.
Rare plants known to occur within current axis deer range include:

- *Arabis blepharophylla*, coast rock cress
- *Campanula californica*, swamp harebell*
- *Ceanothus gloriosus* var. *porrectus*, Mt. Vision ceanothus
- *Cordylanthus maritimus ssp. palustris*, Point Reyes bird's beak *
- *Fritillaria liliaceae*, fragrant fritillary**
- *Grindelia hirsutula* var. *maritima* San Francisco Bay gumplant
- *Limnanthes douglasii* var. *sulphurea*, Point Reyes meadow foam*
- *Linanthus grandiflorus*, large-flowered linanthus
- *Triphysaria floribundus,* San Francisco owl's clover

Rare plants known to occur within current fallow deer range include:

- *Abronia umbellata ssp. breviflora*, pink sand-verbena
- *Agrostis blasdalei*, Blasdale's bent grass
- *Arabis blepharophylla*, coast rock cress
- *Arctostaphylos virgata*, Marin manzanita

- *Astragalus pycnostachyus var. pycnostachyus*, coastal marsh milk-vetch*
- *Calystegia purpurata* ssp. *saxicola*, coastal bluff morning-glory
- *Campanula californica*, swamp harebell*
- *Ceanothus gloriosus var. gloriosus*, Point Reyes ceanothus
- *Ceanothus gloriosus var. porrectus*, Mt. Vision ceanothus
- *Chorizanthe cuspidata* var. *cuspidata*, San Francisco bay spineflower
- *Cordylanthus maritimus ssp. palustris*, Point Reyes bird's beak *
- *Elymus californicus*, California bottlebrush grass
- *Fritillaria affinis var. tristulis*, Marin checkerlily**
- *Fritillaria liliaceae*, fragrant fritillary
- *Gilia capitata ssp. chamissonis*, dune gilia
- *Grindelia hirsutula* var. *maritima* San Francisco Bay gumplant
- *Lilium maritimum*, coast lily**
- *Linanthus grandiflorus* large-flowered linanthus
- *Microseris paludosa*, marsh microseris*
- *Perideridia gairdneri ssp. gairdneri*, Gairdner's yampah
- *Polygonum marinense*, Marin knotweed
- *Ranunculus lobbii*, Lobb's aquatic buttercup*
- *Sidalcea calycosa ssp. rhizomata*, Point Reyes checkerbloom*
- *Triphysaria floribundus*, San Francisco owl's clover

* These species occur in wetlands or saltmarsh habitats. It is highly unlikely that these species are affected by non-native deer activities.

** Denotes bulb species.

Non-native deer can impact rare plant species directly by consuming and trampling them. PRNS staff observed fallow deer digging up and eating *Fritillaria* bulbs within the burned area after the 1995 Vision Fire (Sarah Allen, NPS, personal communication). It should be noted that damage to *Fritillaria sp.* and other lily species has been observed outside exotic deer range, presumably caused by black-tailed deer or other herbivores (Michelle Coppoletta, NPS, personal communication). Based on analyses of deer diets conducted in Point Reyes, it can be inferred that after a major vegetation-changing event such as a wildfire, both axis and fallow deer would seek other food sources to supplement a depleted diet (Elliott 1983). This might include heavier foraging on bulb species.

Other plant species that may be currently impacted by non-native deer are those occurring in areas of high deer densities, where damage to plants is through trampling. Fallow deer herds have been observed most often in grassland, evergreen scrub, and Douglas fir/redwood plant communities (NPS 2001b). These communities provide habitat for the plant species listed above. Adverse impacts to rare plants in the Seashore are currently considered to be minor and short-term. Alternative D would result in beneficial impacts to rare plants, which are minor and long-term.

There are no means of mitigating the impacts of non-native grazing herbivores to the species of special concern of the Seashore.

Cumulative Impacts

In the long term following removal of non-native deer, beneficial cumulative impacts to species of management concern would occur from above described restoration projects. However, during the removal process, adverse cumulative impacts of Alternative D would be similar to those described for Alternative A. These result from incremental adverse effects of Alternative D and development, visitor use, habitat change and wildfires for most species analyzed. In addition, spotted owls are affected by a reduced availability of the prey species, dusky footed woodrats, which feed on acorns. Red-legged frogs may be additionally adversely affected by the restoration of the Giacomini wetlands to coastal, rather than freshwater, habitat. Restoration of riparian habitat inside the park would offer beneficial cumulative impacts to red legged frogs, as well as to listed anadromous fish species. The Giacomini restoration would have beneficial cumulative effects on these fish species as well. Ongoing ranching operations can increase sedimentation and change nutrient concentrations in water and soil, with potential adverse cumulative effects on riparian or water-dependent species of special concern (red-legged frogs, freshwater shrimp, anadromous fish) and on the host plant for Myrtle's Silverspot Butterfly.

Conclusion

No impairment to special status species would occur from implementing Alternative D. All of the impacts associated with the eradication of non-native deer are characterized as beneficial to plant and animal species of concern. Depending on the special status species in question, the impacts of Alternative D range from minor to moderate and are long-term. Cumulative impacts of Alternative D, because they are considered incrementally with projects that have both adverse and beneficial long-term impacts to special status species, are considered mixed.

Type of Impact:	Beneficial
Duration of Impact:	Long-term
Intensity of Impact:	Mixed—minor to moderate
Cumulative Impacts:	Minor to moderate adverse in the short term; moderate to major beneficial and adverse cumulative impacts in the long term (after non-native deer are eradicated)

Impacts on Human Health and Safety

Analysis

Under this alternative, all non-native deer would be removed from the Seashore within a 15-year period through the use of firearms by NPS staff. With adherence to applicable regulations and policies the potential risk to human health and safety would be kept to minor, adverse impacts. Because impacts of individual treatment efforts are transitory, they are characterized as short-term, while additional long-term impacts are expected as a result of the 15-year period of eradication efforts.

Under this alternative, the numbers and range of both species of non-native deer are expected to decrease to zero in 15 years. A concomitant decrease in deer-vehicle collisions over current levels is expected, a minor to moderate, long-term benefit to human safety related to the reduction risk of deer-vehicle collisions, an effect similar to that expected under Alternative E.

Cumulative Impacts

Alternative D does not measurably add to the impacts on health and safety of the projects or issues listed in Alternative A.

Conclusion

The risk of firearms-related injury is increased under this alternative when compared to existing conditions, a minor, adverse impact to human safety, of short- and long-term duration. Minor to moderate benefits to public health and safety resulting from reduced risk of deer-vehicle collisions are expected. When compared to No Action, this alternative poses a higher potential level of risk to human safety related to the use of firearms. At the same time, when compared to No Action, risks to human safety are slightly reduced under this alternative related to the potential decrease in deer-vehicle collisions.

Type of Impact:	Adverse and beneficial
Duration of Impact:	Short-term and long-term
Intensity of Impact:	Minor to moderate
Cumulative Impact:	Long-term beneficial and adverse minor to moderate

Impacts on Visitor Experience

Analysis

The 15-year goal of this alternative is the eradication of all non-native deer within the Seashore, resulting in minor, long-term, adverse effects to wildlife viewing opportunities, particularly for those interested in fallow deer. However, under this alternative the native black-tailed deer may increase in numbers as they move into areas previously occupied by non-native deer. This would represent a minor to moderate, long-term benefit to the related visitor experience. If this should occur, the effects on overall wildlife (deer) viewing opportunities would be negligible.

Effects on the visitor experiences related to viewshed enjoyment under this alternative are similar to those described under Alternative B (negligible).

Visitor experience also relates to social values, particularly those of attitudes towards animals. Effects of the management technique proposed under this alternative (lethal removal/firearms) could result in adverse effects to visitors, particularly those with humanistic and moralistic values, to varying degrees and for varying periods of time. These effects are similar to those described under Alternative B (negligible to moderate, short-term, adverse—depending on the visitor and his/her level of objection to the use of the proposed method). Mitigation measures for this alternative are similar to that described under Alternative B.

Wilderness Character

The current degraded conditions in the wilderness would improve most quickly in this alternative and in Alternative E. As non-native deer were removed, during a 15-year time period, the wilderness character would appear unnatural. Visitors to the wilderness would occasionally encounter NPS staff or contractors. During times of deer management, noise of firearms would mar the natural quiet backcountry users often seek. Few users would be directly affected by noise, as all alternatives call for shooting to take place outside of peak visitation hours. Temporary area closures for large-scale deer management activities are a possibility with this alternative and could inconvenience some visitors. In addition, a small number of visitors could discover carcasses in the wilderness areas where retrieval by NPS staff or contractors is not possible. Moving any carcass near a heavily used trail to a more remote location to reduce odor problems or conflicts between humans and scavengers would mitigate this impact. The impacts of firearms and helicopter use related to the soundscape and wilderness values, the potential temporary closures of deer management areas, and the possibility of encountering visual intrusions (carcasses) would likely result in short-term, negligible to moderate, adverse impacts – depending on the numbers of visitors affected and their particular experience (e.g., distance from impact, level of recreational disruption, duration of each management incident, etc.). Based on what is known of visitor use patterns in Seashore wilderness areas, these adverse impacts are estimated to affect fewer than 50 visitors per year. Such impacts would be totally eliminated within 15 years.

The direct temporary adverse impacts to the wilderness experience would be outweighed by the beneficial long-term effects of increased protection of wilderness habitat. With the riparian and woodland impacts of non-native deer eliminated and native deer restored to natural numbers, the landscape would return to a more natural state, both ecologically and in the eyes of some visitors. This would preserve integral components of wilderness character including the restoration of natural processes and the eventual reduction in signs of external human influence.

Wilderness Values

In the long term, restoring natural ecological processes Seashore wilderness would have long-term beneficial impacts to those people with biocentric values and short-term adverse impacts for those with symbolic or aesthetic values. The former group is characterized by people who most appreciate natural or ecological conditions in wilderness and so restoring these conditions would have permanent and positive effects on their social values regarding wilderness. Intrinsic or symbolic values include aesthetic and spiritual values, and this group might describe wilderness as similar to a church, e.g. as offering a transcendental experience or a part of the earth where humans should be humbled by forces larger than themselves and restrain any effort to manipulate.

Cumulative Impacts

Cumulative impacts under Alternative D are similar to those described for Alternative B.

Conclusion

This alternative results in complete removal of non-native deer from the Seashore by 2021. Adverse impacts to the visitor experience are related to wildlife viewing (minor, long-term); social values (negligible to moderate, short-term); symbolic or aesthetic wilderness values (minor, short-term) and soundscape/access/visual intrusions (negligible to moderate, short-term). Long-term minor to moderate benefits to visitor experience related to viewing of native deer and to those with biocentric wilderness values are also expected under this alternative. Compared to the No Action alternative, Alternative D would result in increased benefits to wilderness character and to viewing of native deer, with increased adverse impacts related to viewing of non-native deer, social values, and soundscape/access/visual intrusions. Short-term cumulative impacts under Alternative D, as in Alternative B, would be minor and adverse while long-term cumulative impacts would be major and beneficial.

Type of Impact:	Adverse and beneficial
Duration of Impact:	Short-term and long-term
Intensity of Impact:	Negligible to moderate
Cumulative Impacts:	Minor adverse in the short term; major beneficial in the long term

Impacts on Park Operations

Analysis

Removal of all non-native deer within the Seashore under this alternative would result in the elimination of associated resource and operational impacts by 2021. Operational costs would increase substantially from 2005 to 2018 due to personnel, material, services and administrative costs of the removal program. Over time, as population numbers decline, per-unit costs could be expected to increase based upon an increasing level of effort to find remaining animals, but overall costs for the program would diminish. Similarly, other costs of mitigating adverse impacts of non-native deer to natural resources would decline as axis and fallow population sizes diminish.

The types of actions associated with the monitoring of non-native deer and the mitigation of damage to natural resources by deer under Alternative D are initially similar to those described under Alternative B. However, impacts (and associated expenses) under Alternative D would be completely eliminated with the removal of all non-native deer populations by 2021, while impacts under Alternative B would continue indefinitely.

Chapter 2 outlines the likely deer removal numbers required in Alternative D, based on population modeling by Barrett (2001) and Hobbs (2003). It is estimated that, initially, this alternative would require culling of up to 200 non-native deer per year (approximately 150 fallow deer and approximately 50 axis deer) to remove all non-native deer by the year 2021. It should be noted that these numbers are subject to change depending on precipitation, range conditions and herd growth parameters. Cited figures should be considered approximate guidelines for cost analysis purposes.

The costs of culling of approximately 200 deer yearly includes staff (including one full-time biotechnician), training, vehicles, transport, supplies and carcass disposal and are estimated to be $115,000 per year. During the eradication program, estimated to last from 2006 to 2021, costs of controlling non-native deer constitute a 132% increase in funds allocated to non-native deer. See Figure 17 for a comparison of the costs of the alternatives considered.

Estimates of minimum cost of implementation of Alternative D total approximately $3.8 million by the year 2021. Thereafter, as a result of non-native deer eradication, no costs are expected. The costs of implementing Alternative D, an increase of 4.5% in the total PRNS annual budget, can be expected to decrease to zero in the future.

Under Alternative D, non-native deer monitoring, natural resource mitigation and elimination (lethal removal) of all deer by 2021 could result in minor, short-term, adverse impacts to park operations. Such impacts result from the increased budgetary expenditures required for implementation. Conversely, moderate, long-term benefits to park operations are expected as all non-native deer management costs decrease and are eventually eliminated within PRNS.

Cumulative Impacts

Cumulative impacts for Alternative D are similar to those described for the No Action Alternative (adverse and moderate) but are short-term rather than long-term because they do not persist indefinitely.

Conclusion

Adverse impacts to park operations under Alternative D associated with eradication of non-native deer populations would be minor and short-term. This is because additions in cost and/or energy usage would represent an approximately budgetary increase of 4.6% of the total park budget and would last only until all actions are completed (by 2021). Beneficial, long-term impacts to park operations under this alternative are characterized as moderate as costs associated with non-native deer management would eventually decrease to zero permanently. When compared to the No Action alternative and its projected budgetary increase (5–15%, in perpetuity), Alternative D offers a notably reduced budgetary commitment (4.5% increase), a benefit to park operations. Alternative D is the least expensive of any of the alternatives. Cumulative impacts for Alternative D are adverse, short term and moderate.

Type of Impact:	Mixed—adverse in the short-term, beneficial in the long-term
Duration of Impact:	Short-term (adverse) and long-term (beneficial)
Intensity of Impact:	Minor
Cumulative Impacts:	Moderate short term adverse

Impacts on the Regional Economy

Analysis

Non-native deer have no documented measurable beneficial impacts to the regional economy. Currently there are an estimated 250 axis deer and approximately 860 fallow deer in the Seashore. This alternative would decrease, and eventually eliminate all non-native deer and their associated impacts to the local economy. Current impacts to those permittees who see non-native deer year-round include (refer to the Regional Economy section of Chapter 3, Affected Environment):

- Fence repair costs ($500-$1000/yr per ranch [4 reports])—damage by deer crossing.
- Costs of lost pasture forage (unknown costs [4 reports])—pasture forage consumption by non-native deer.
- Costs of lost supplemental feed (unknown costs [1 report])—supplemental food put out for livestock eaten by non-native deer.
- Costs of reseeding pastures ($9000/yr rancher [1 report])—overgrazing of fallow fields by non-native deer.
- Veterinary costs ($1200 in 2001 [1 report])—leptospirosis.

Although it is likely that native black-tailed deer numbers would increase as a result of decreased competition for forage, black-tailed deer are primarily browsers and not likely to significantly impact livestock pastures, reseeded fields or supplemented hay. In addition, black-tailed deer do not congregate and travel in large herds as do axis and fallow deer, and rarely cause fence damage. Although black-tailed deer do carry diseases of concern to ranchers, the risks of transmission from small, dispersed groups of native deer are less than those from the large groups of non-native deer which can be found close to stock ponds, ranch horses and cows. Even with an increase in black-tailed deer numbers as a result of non-native deer removal, costs of fence damage and other deer depredation to ranchers would decrease significantly over current levels. Impacts of fallow deer to agricultural operations outside of NPS boundaries but within Olema Valley are also expected to decrease with this alternative. The eventual elimination of the non-native deer populations within the park and their associated adverse impacts to agricultural concerns would result in a minor, long-term benefit to the regional economy.

This alternative would not have significant and disproportionate effects on minority and low-income populations.

Because this alternative might require occasional area closures but no park closures, there are no expected effects on local tourist businesses.

Cumulative Impacts

Alternative D does not measurably add to the impacts on the regional economy of the projects or issues listed in Alternative A.

Conclusion

This alternative would result in removal of all fallow deer and axis deer within the Seashore and a prevention of their spread throughout Marin County. The action would result in minor benefits to agriculture and the regional economy within and outside of NPS boundaries. Because this alternative results in permanent removal of all non-native deer, the beneficial impacts to the local economy are long-term. Comparatively, the No Action alternative would likely result in the greatest number of adverse effects to the regional economy by way of agricultural impacts and potential impacts to low-income farm workers.

Type of Impact:	Beneficial
Duration of Impact:	Long-term
Intensity of Impact:	Minor
Cumulative Impact:	Long-term, major and beneficial

Environmental Consequences of Alternative E (Preferred Alternative): Removal of all Non-Native Deer by a Combination of Agency Removal and Fertility Control

This alternative would remove all fallow and axis deer from PRNS and PRNS–administered lands in 15 years, through a combination of lethal and non-lethal techniques. Until contraceptive technology advanced, only fallow does would be treated with contraceptives while both fallow and axis deer would be lethally removed. If a promising long-duration agent for axis deer were developed, it would be used experimentally. It is expected that large numbers of deer would be lethally removed in the first 5 years of the program and that because of increased wariness on the part of the deer and lower deer densities, a more gradual decrease over the next 10 years would follow. Similarly, most of the treatment of does with contraceptives would occur in the first 5 years of the program, in order to decrease recruitment of fawns and thereby reduce the total number of animals culled. Because contracepted animals would not be removed from the park, it is expected that deer numbers would not decrease as rapidly with this alternative as with Alternative D (Removal of All Non-Native Deer by Agency Shooting), thus prolonging adverse impacts to natural resources. However, the most serious impacts, that is, in areas of high deer density, would be carefully monitored (See monitoring and management plan, Appendix C) and using an adaptive management approach, mitigated with lethal removal. An effort would be made to remove or treat deer in a manner that did not lead to increased migration outside of NPS boundaries and it is expected that this alternative would not result in increased numbers of non-native deer on adjacent state park or private lands. However the Vedanta property, which currently contains the highest fallow deer densities in Olema Valley (up to 80 deer/ sq. km.), is outside of NPS management jurisdiction and surrounded entirely by NPS lands. It is likely that during the lethal removal program in the Seashore, deer densities on this inholding would increase temporarily.

The impacts to natural resources and the regional economy do not differ between Alternative D and E. Impacts of Alternative E to park operations, health and human safety and visitor experience differ slightly from those of Alternative D.

Impacts on Water Resources and Water Quality

Analysis and Cumulative Impacts

Impacts, including cumulative impacts, are not different from Alternative D. The impacts of non-native deer elimination in 15 years would constitute an alleviation of current impacts to water resources and water quality.

Type of Impact:	Mixed—both adverse and beneficial
Duration of Impact:	Mixed—both short-term (adverse) and long-term (beneficial)
Intensity of Impact:	Moderate
Cumulative Impacts:	Minor to moderate adverse in the short term; beneficial and adverse cumulative impacts in the long term (after non-native deer are eradicated)

Impacts on Soils

Analysis and Cumulative Impacts

Impacts, including cumulative impacts, are not different from Alternative D. Non-native deer elimination in 15 years would constitute an alleviation of current impacts to soil.

Type of Impact: Mixed—both adverse and beneficial
Duration of Impact: Short-term (adverse) and long-term (beneficial)
Intensity of Impact: Minor adverse and moderate beneficial
Cumulative Impacts: Minor to moderate adverse in the short term; beneficial and adverse cumulative impacts in the long term (after non-native deer are eradicated)

Impacts on Vegetation

Analysis and Cumulative Impacts

Impacts, including cumulative impacts, are not different from Alternative D. Potential consequences of non-native deer eradication are lower concentrations of animals within a variety of plant communities. Alternative E would alleviate current impacts to vegetation including direct effects of deer foraging, trailing, congregating, thrashing and girdling.

Type of Impact: Mixed—both adverse and beneficial
Duration of Impact: Short-term (adverse) and long-term (beneficial)
Intensity of Impact: Minor adverse and moderate to major beneficial
Cumulative Impacts: Minor to moderate adverse in the short term; long-term, moderate to major, beneficial and moderate adverse cumulative impacts (after non-native deer are eradicated)

Impacts on Wildlife

Analysis and Cumulative Impacts

Impacts, including cumulative impacts, to native species are not different from Alternative D. In general, eventual disappearance of non-native deer would have beneficial impacts to other native wildlife species in the Seashore.

Although fewer non-native deer would be lethally removed in Alternative E than in Alternative D, pain and suffering would result from lethal removals as well as from fertility control. Some of this pain would be mitigated by use of trained sharpshooters in culling deer. Efforts would be made to deliver immediately lethal shots to target animals and sharpshooters would be required to complete NPS range qualifications specifically designed for ensuring humane and effective wildlife removal. Animals treated with contraceptive agents would undergo the stress of capture, restraint, injection and permanent marking (i.e., radio-collaring and ear-tagging) at least once during their lifetimes. Capture of deer would result in unavoidable injuries and some deaths.

Type of Impact: Beneficial
Duration of Impact: Long-term
Intensity of Impact: Moderate to major
Cumulative Impacts: Minor to moderate adverse in the short term; beneficial and adverse cumulative impacts in the long term (after non-native deer are eradicated)

Impacts on Species and Habitats of Management Concern

Analysis and Cumulative Impacts

Impacts, including cumulative impacts, are not different from Alternative D. All of the impacts associated with the elimination of non-native deer are characterized as beneficial to plant and animal species of concern.

Type of Impact:	Beneficial
Duration of Impact:	Long-term
Intensity of Impact:	Mixed—minor to moderate
Cumulative Impacts:	Minor to moderate adverse in the short term; moderate to major beneficial and adverse cumulative impacts in the long term (after non-native deer are eradicated)

Impacts on Human Health and Safety

Analysis

Under this alternative, it is assumed that approximately 75% of fallow and 100% of axis deer would be removed over a 15-year period through the use of firearms by NPS staff or contractors, posing risks of firearms-related injury to staff and visitors. With adherence to appropriate regulations and policies, these risks would be minimized and would keep impacts to human safety at minor levels.

Depending on the agent used, Alternative E calls for treatment of up to 25% of fallow does with a long-acting contraceptive or sterilant. In order to evaluate the effectiveness of any experimental treatment and to avoid inadvertently culling treated animals, NPS would have to capture and immobilize animals for permanent marking (ear-tagging and radio-collaring). Permanent marking of treated animals would be needed to ensure accurate monitoring of contraceptive effectiveness and to prevent inadvertent culling of treated does. Capture would be accomplished with a corral trap, Clover trap, a drop net, or with a net gun fired from a helicopter. Regardless of the technique used, wildlife capture, and immobilization could result in injury to participating staff, either from the animals themselves or from equipment and aircraft. The number of people at risk of treatment-related injury under Alternative E could range from 20-50 per effort, depending on the capture/treatment techniques used over a period of 15 years. Adverse impacts to human safety of minor intensity would be likely. Impacts could be expected to be both short-term (transitory, individual capture/treatment incidences) and long-term (15-year period) in duration.

The effect on human health and safety related to non-native deer population reduction efforts and deer-vehicle collisions under this alternative are similar to that expected under Alternative D (long-term, minor to moderate benefits).

Cumulative Impacts

Alternative E would not change the potential intensity or duration of the impacts to human health and safety resulting from the cumulative impacts of all the projects listed in Appendix F. There are no known incremental cumulative impacts associated with Alternative E.

Conclusion

The risk of injury related to firearms and contraceptive treatments is increased under Alternative E when compared to existing conditions; a minor, adverse impact to human health and safety of short- and long-term duration. Minor benefits to human safety could be realized as a result of likely reductions in numbers of deer-vehicle collisions under this alternative. When compared to No Action, Alternative E would result in increased risks to human safety as a result contraceptive treatments and the use of firearms. Conversely, when compared to No Action, Alternative E offers slight benefits related to potentially decreased deer-vehicle collisions.

Type of Impact:	Adverse and beneficial
Duration of Impact:	Short-term and long-term
Intensity of Impact:	Minor
Cumulative Impact:	Long-term beneficial and adverse minor to moderate

Impacts on Visitor Experience

Analysis

Under this alterative, effects on wildlife viewing, particularly non-native and native deer species, are similar to those described under Alternative D (viewing of non-native deer—minor, long-term, adverse; viewing of native deer—minor to moderate, long term benefits).

Effects on the viewshed related to the visitor experience under this alternative are similar to those described under Alternative B (negligible).

Under this alternative, visitor experience is also related to social values, particularly those of attitudes towards animals. Effects of the management techniques proposed under this alternative (lethal removal and contraceptive methods) could result in adverse effects to the visitor experience to varying degrees and for varying periods of time. These effects are similar to those described under Alternative B (negligible to moderate, short-term, adverse—depending on the visitor and his/her level of objection to proposed methods). As proposed under Alternative E, if contraception proves effective in aiding the elimination of deer populations, this alternative would represent a less lethal management approach than that proposed under Alternative D (lethal removal only). This less lethal approach has the potential to benefit or adversely affect visitor experience, depending on individual social values. Mitigation measures under this alternative are also similar to that described under Alternative B.

Wilderness Character and Values

Impacts of Alternative E to wilderness character and values would not be substantially different from Alternative D. Alternative E proposes the management of non-native deer through a combination of lethal controls and contraceptive methods to eliminate non-native deer populations over a 15-year period (Alternative D proposes only the use of lethal methods, that is, firearms, to accomplish the same goal). While the degree and type of effect differs slightly, impacts of firearms and helicopter use related to the soundscape and wilderness values, the potential temporary closures of deer management areas, and the possibility of encountering visual intrusions (carcasses) would likely result in effects similar to that described under Alternative D (short-term, negligible to moderate, adverse impacts—depending on the numbers of visitor affected and the duration of each incident’s effect). Based on what is known of visitor use patterns in Seashore wilderness areas, these adverse impacts are estimated to affect fewer than 50 visitors per year. Such impacts would be totally eliminated within 15 years. The direct temporary adverse impacts to the wilderness experience would be outweighed by the beneficial long-term effects of increased protection of wilderness habitat necessary for the preservation of integral values of wilderness

Some visitors, especially those searching for a "wilderness experience" in the Seashore, might object to seeing permanent marks such as radio collars and eartags on experimentally treated does. Because the population control techniques in Alternative E would be used for a maximum of 15 years and are therefore transitory, impacts to visitor experience are characterized as short-term, minor, and adverse.

Cumulative Impacts

Cumulative impacts associated with Alternative E are similar to those described for Alternative B.

Conclusion

This alternative would result in the permanent removal of all fallow and axis deer within the Seashore within a 15-year period. Adverse impacts to the visitor experience are related to wildlife viewing (minor, long-term); social values (negligible to moderate, short-term); symbolic or aesthetic wilderness values (minor, short-term) and soundscape/access/visual intrusions (negligible to moderate, short-term). Long-term minor to moderate benefits to visitor experience related to viewing of native deer and to those with biocentric wilderness values are also expected under this alternative. Compared to the No Action alternative, Alternative D would result in increased benefits to wilderness character and to viewing of native deer, with increased adverse impacts related to viewing of non-native deer, social values, and soundscape/access/visual intrusions.

Type of Impact:	Adverse and beneficial
Duration of Impact:	Short-term and long-term
Intensity of Impact:	Negligible to moderate
Cumulative Impact:	Long-term beneficial and major

Impacts on Park Operations

Analysis

Removal of all non-native deer within the Seashore under this alternative would result in the elimination of associated resource and operational impacts of continued non-native deer management by 2021. Operational costs would increase substantially from 2006 to 2021 due to the personnel, material, services and administrative costs of the lethal removal and contraception programs. Over time, as population numbers decline, per-unit costs of lethal removal could be expected to increase based upon an increasing level of effort to find remaining animals, but overall costs for the program would diminish. Similarly, other costs of mitigating adverse impacts of non-native deer to natural resources would decline as axis and fallow population sizes diminish.

The types of actions associated with the monitoring of non-native deer and the mitigation of damage by non-native deer to natural resources under Alternative E are similar to those described under Alternative D.

Chapter 2 outlines the likely deer removal and treatment numbers required in Alternative E, based on population modeling by Barrett (2001) and Hobbs (2003). It is estimated that, initially, this alternative would require culling of up to 200 non-native deer per year (up to 150 fallow deer the first year with decreasing numbers thereafter, and approximately 50 axis deer) to aid in the eradication of the population by the year 2021. It should be noted that these numbers are subject to change depending on precipitation, range conditions and herd growth parameters. If target cull numbers are a percentage of total doe numbers, they would decrease rapidly with time. Cited figures should be considered approximate guidelines for cost analysis purposes.

The costs of culling of approximately 200 deer in the first year includes staff (including one to two full-time biotechnicians), training, vehicles, transport, supplies and carcass disposal and are estimated to be $115,000 per year (similar to costs projected under Alternative D). Costs of removing fewer animals in later years would decrease, but cost of removal per animals would increase because of increased effort required to locate animals.

Because there is currently no long-duration contraceptive registered with the EPA for management of deer, any drug used by NPS would likely require experimental research. Costs of such research are difficult to predict but would exceed usual management costs. Research requires collection of data on survival and fawning rates of treated and control deer through radio telemetry, population counts and necropsies. Additional studies on health effects and safety of the experimental drug may be required by the EPA. The minimum costs of treating 100 does with a lifetime-effect contraceptive (if available) in year 1 of the program are estimated to be $210,000. Minimum costs of monitoring treated animals in future years would be approximately $45,000 per year for the next 6-12 years (the lifetime of treated animals). Should available contraceptives remain effective for less than the reproductive life of the does (less than 8–10 years), the cost of treating animals would be much higher.

During the culling and contraceptive programs, estimated to last from 2006 to 2021, costs constitute a 132% increase in funds allocated to non-native deer. See Figure 17 for a comparison of the costs of the alternatives considered.

Estimates of minimum cost for implementation of Alternative E total approximately $4.5 million by the year 2021; thereafter, as a result of the elimination of all non-native deer, no costs are expected. The costs of implementing Alternative E constitute an increase of 5% – 9% of the total PRNS annual budget, and can be expected to decrease to zero in the future.

Under Alternative E, non-native deer monitoring, natural resource mitigation, and lethal removal and contraception operations would result in short-term, moderate, adverse impacts to park operations as a result of increased (5–9%) budgetary expenditures. In addition, moderate, long-term benefits to park operations would be realized resulting from the eventual elimination of all non-native deer management activities.

Cumulative Impacts

Cumulative impacts for Alternative E are similar to those described for the No Action alternative (adverse and moderate), but would be short-term rather than in perpetuity.

Conclusion

In addition to cumulative impacts, adverse impacts to park operations associated with elimination of non-native deer populations under Alternative E are characterized as moderate and short-term due to a projected 5-9% increase in cost and/or energy usage of the existing park budget. These costs would be incurred until all actions are completed (2021). Beneficial impacts to park operations from this alternative are characterized as moderate and long-term due to the elimination of non-native deer management costs that would eventually decrease to zero. When compared to the No Action alternative and its projected increase in budget commitments (5–15%, in perpetuity), smaller budgetary commitments under Alternative E (5–9%) would eventually be eliminated by the year 2021, constituting an overall positive effect on park operations. Cumulative impacts of Alternative E, with the actions listed in Alternative A, are characterized as short-term, adverse and moderate.

Type of Impact:	Adverse and beneficial
Duration of Impact:	Short-term (adverse) and long-term (beneficial)
Intensity of Impact:	Moderate
Cumulative Impact:	Short-term, adverse and moderate

Impacts on Regional Economy

Analysis and Cumulative Impacts

Impacts, including cumulative impacts, are not different from Alternative D. Impacts associated with the removal of all non-native deer within the park are characterized as beneficial to the regional economy

Type of Impact:	Beneficial
Duration of Impact:	Long-term
Intensity of Impact:	Minor
Cumulative Impact:	Long-term, major and beneficial

Unavoidable Adverse Impacts

The impacts identified below for each alternative are those that cannot be fully mitigated or fully avoided.

Alternative A: No Action

The No Action alternative, by definition, contains no measures to mitigate impacts to resources. Continued population growth and range expansion of non-native deer would result in unmitigated, severe, adverse impacts to soils, water resources, vegetation, wildlife, and special status species, both within and outside of NPS boundaries.

Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal

Within the Seashore and on the Vedanta Society property, there would be a continuation, albeit at lower levels, of current adverse effects of non-native deer on soils, water resources, vegetation, wildlife, and special status species.

Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control

Within the Seashore and on the Vedanta Society property, there would be a continuation, albeit at lower levels, of current adverse effects of non-native deer on soils, water resources, vegetation, wildlife, and special status species.

Alternative D: Removal of All Non-Native Deer by Agency Personnel

There would be a continuation of current adverse effects of non-native deer on soils, water resources, vegetation, wildlife, and special status species for the 15-year removal period. The intensity of these adverse impacts would decrease as the number of non-native deer in PRNS decreased.

Alternative E (Preferred Alternative): Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility control

There would be a continuation of current adverse effects of non-native deer on soils, water resources, vegetation, wildlife, and special status species for the 15-year removal period. The intensity of these adverse impacts would decrease as the number of non-native deer in PRNS decreased.

Relationship Between Local Short-Term Uses and Long-Term Productivity

Alternative A: No Action

Under the No Action alternative, increasing non-native deer numbers would degrade long-term natural productivity.

Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal

Reduction of total non-native deer numbers would enhance, to some degree, the long-term productivity of the PRNS and GGNRA environments. The actions called for in this alternative would allow restoration, albeit incomplete, of overgrazed areas and, trampled riparian environments, and would reduce competition with native ungulates.

Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control

Reduction of total non-native deer numbers would enhance, to some degree, the long-term productivity of the PRNS and GGNRA environments. The actions called for in this alternative would allow restoration, albeit incomplete, of overgrazed areas and trampled riparian environments, and would reduce competition with native ungulates.

Alternative D: Removal of All Non-Native Deer by Agency Personnel

Elimination of non-native deer would enhance the long-term productivity of the PRNS and GGNRA environments. The actions called for in this alternative would allow restoration of overgrazed areas and trampled riparian environments, would reduce competition with native ungulates and eliminate impacts to other native species.

Alternative E (Preferred Alternative): Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility control

Elimination of non-native deer would enhance the long-term productivity of the PRNS and GGNRA environments. The actions called for in this alternative would allow restoration of overgrazed areas and trampled riparian environments, would reduce competition with native ungulates and eliminate impacts to other native species.

Irreversible or Irretrievable Commitments of Resources

Irreversible commitments are those that cannot be reversed. Extinction of a species is an example of an irreversible loss. *Irretrievable* commitments are those that are lost and cannot be replaced. Deterioration past repair of a culturally significant building is an example of an irretrievable loss. The following section identifies irreversible or irretrievable commitments of resources resulting from the various alternatives.

Alternative A: No Action

Under the No Action alternative, loss of soil to erosion and potential extirpation of rare or special status species represent irreversible and irretrievable loss of resources.

Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal

Under this alternative, loss of soil to erosion and potential extirpation of rare or special status species represent irreversible and irretrievable loss of resources.

Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility Control

Under this alternative, loss of soil to erosion and potential extirpation of rare or special status species represent irreversible and irretrievable loss of resources.

Alternative D: Removal of All Non-Native Deer by Agency Personnel

Under this alternative, there would be no irreversible or irretrievable loss of resources due to identified actions.

Alternative E (Preferred Alternative): Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility control

Under this alternative, there would be no irreversible or irretrievable loss of resources due to identified actions.

Chapter 5: Consultation and Coordination

This chapter includes a summary of efforts to involve agencies and the public in this planning process, beginning with public scoping in 2002. It also includes a response to all "substantive" public comments made on the draft EIS. The draft EIS was available for public review from February 4, 2005 through April 19, 2005.

Public Scoping

On April 10, 2002, a Notice of Scoping was published in the *Federal Register* (Volume 67, No. 69). It announced the initiation of public scoping for the environmental impact analysis process for preparation of a non-native deer management plan.

Public comments were heard at a public information meeting at the Point Reyes Dance Palace on May 4, 2002. The public meeting featured a short presentation by the Seashore wildlife biologist on the environmental planning process, background on non-native deer, and issues of importance to park management. Background informational handouts were provided. Members of the Citizen's Advisory Committee for Point Reyes National Seashore and Golden Gate National Recreation Area were given the opportunity to ask questions of park staff. Five individuals spoke at the public meeting. A sign-up sheet at the public meeting provided an opportunity for members of the public to be included on a mailing list for upcoming information on the management plan in development. Two of the speakers at the meeting asked that the EIS examine impacts to vegetation, soils and water. Two other speakers asked that the park not consider lethal removal of deer. A representative of several animal's rights organizations requested that the Seashore investigate the impact of livestock on natural ecosystems and asked that non-lethal control methods be fully investigated.

Public comments were accepted in letter or email form from May 4, 2002 until July 5, 2002. All those who sent written comments during the scoping period and included a return mailing address were also put on the mailing list. The following matrix summarizes the issues raised and alternatives suggested in letters and emails sent to the Seashore during the public scoping period. The issues raised are those that the public wished to see considered in the Environmental Consequences portion of this document (Chapter 4). The alternatives are management actions recommended to address one or more issues of concern.

Issues Raised	**Topic**
	Soil impacts
	Water quality impacts
	Impacts of non-native deer on native deer
	Success, impacts and costs of the previous NPS non-native deer control program
	Impacts of cattle ranching
	Public attitudes towards non-native deer
	Options for carcass management
	Economic impacts of deer to local community

Importance of native versus non-native species in the National Park Service

Recreational value of non-native deer

Humane treatment of deer

Vegetation impacts, including wildflowers and private gardens

Impacts of No Action alternative

Alternatives Recommended

Public hunting of non-native deer

Contraception of non-native deer

Sterilization of non-native deer

Lethal removal of non-native deer

Donation of non-native deer meat to charities

Rancher shooting of non-native deer

Trapping, shipping and slaughter of non-native deer

Herd reduction, not eradication, of non-native deer

Eradication, not herd reduction, of non-native deer

Adoption or relocation of non-native deer

Fencing to control movement of non-native deer

From February to July 2002, park staff gave presentations to local and state public groups on the Seashore's planning process and provided background information on non-native deer. Audiences ranged from local homeowners' and ranchers' associations to local branches of national environmental and animal rights groups. The following groups were addressed:

- Animal Protection Institute
- Environmental Action Committee of West Marin
- Inverness Association
- Marin Audubon
- Marin Conservation League
- Marin Humane Society
- Point Reyes Seashore Ranchers' Association
- Point Reyes Station Village Association
- Sierra Club, Marin Chapter

In addition, the following groups were contacted and given the opportunity to attend an informational presentation but were either unavailable or felt they were sufficiently informed on the topic:

- Defenders of Wildlife
- Federated Indians of Graton Rancheria
- In Defense of Animals

- Inverness Ridge Association
- Marin Agricultural Land Trust
- National Parks and Conservation Association
- Natural Resource Defense Council
- Wilderness Society

Agency Scoping

On December 5, 2001, representatives of public agencies were invited to attend an informational meeting at the Seashore, with the objective of updating those agencies on the development of a non-native deer management plan. Attending the meeting, in addition to NPS staff, were representatives from:
Marin County Parks and Open Space
Marin Municipal Water District
U.S. Geological Survey- Biological Resources Division
California Department of Fish and Game
California State Parks
U.S. Department of Agriculture (Animal Plant Health Inspection Service)

Also invited but not attending was the U.S. Fish and Wildlife Service. NPS biologists informed attendees of the schedule for development of a management plan and EIS, and gave an update on known numbers and range of non-native deer within and outside of the Seashore.

Public Review of the Draft EIS

The DEIS was made available for public review and comment for 63 days, from February 4, 2005 through April 8, 2005. Comments received through April 19, 2005 were considered and responses to the comments prepared. Midway through the public comment period, on March 3, 2005, an informational workshop was held in the Red Barn Classroom at Seashore Headquarters. Approximately 60 people attended the 3-hour meeting and posed questions to a panel of scientists and staff or expressed preference for project alternatives. Audience members were informed of a number of ways of submitting comments on the plan either that night at the meeting, or by mail/email before April 8, 2005. A summary of the meeting is attached (Appendix G).

During the comment period, the NPS received a total of 1,980 pieces of correspondence (including letters, emails, facsimiles, and hand-delivered comment forms), containing 4450 individual comments. Form letters constituted 57% of the emails comment letters received. Ninety-four percent of the comments were sent in by individual members of the public. Seventy-four percent of all correspondence originated from the U.S. with 35% of this originating in California.

All comments were reviewed and considered. Where warranted, the draft plan was revised to reflect edits recommended by commenters or to clarify text questioned by commenters. Responses were prepared for all substantive comments submitted by the public and agencies and are included at the end of this chapter. A Record of Decision will be published no sooner than 30 days following publication by the EPA of the notice of the availability of the Final Environmental Impact Statement in the Federal Register. The Record of Decision is signed by the NPS Regional Director and, once published, signals that the plan may begin implementation.

Compliance Status

Documentation of NPS compliance with federal and state laws and regulations is incorporated into the text of the EIS. Compliance with relevant federal environmental and cultural resource protection laws, regulations and executive orders, is summarized here.

National Environmental Policy Act (NEPA) of 1970. PL 91-190, 83 Stat. 852, 42 U.S.C. §4341 et seq. The EIS provides disclosure of the planning and potential environmental consequences of the Preferred Alternative and alternatives, as required by NEPA. The EIS process for this planning effort has been conducted in accordance with the guidance provided in NPS Director's Order 12 and its accompanying handbook.

Endangered Species Act of 1973, as amended, PL 93-205, 87 Stat. 884, 16 U.S.C. §1531 et seq. The Endangered Species Act protects threatened and endangered species, as listed by the USFWS, from unauthorized take, and directs federal agencies to ensure that their actions do not jeopardize the continued existence of such species. Section 7 of the act defines federal agency responsibilities for consultation with the USFWS and NMFS (for fish and marine mammals) and requires concurrence from these two agencies with any NPS determination that intended management actions would not adversely affect listed species. The National Park Service initiated the consultation process with USFWS and NMFS on March 26, 2003. Concurrence from both USFWS and NMFS that the plan would not adversely affect listed species was requested in letters sent to both agencies.

On March 10, 2005, in a letter to the USFWS, the NPS requested concurrence with its finding that the proposed plan would not be likely to adversely affect the proposed critical habitat for the California red-legged frog or adversely affect nine plant and animal species found in the planning area. In a memo dated April 7, 2005, the USFWS explained that their assessment of potential effect was based on the project constraints described in the consultation letter including: (1) no actions would take place in creeks, waterways or riparian areas, (2) culling would be conducted by specifically trained staff, (3) carcasses would be removed when possible, and where not possible, left to decay naturally, and (4) that if project work descriptions or time frames change from those provided in the consultation letter, those changes would be submitted to the USFWS for review. In the April 7, 2005 memo, the USFWS concurred with the NPS findings that measures in the proposed plan are sufficient to reduce any direct, indirect and cumulative effects to the nine listed species and proposed critical habitat to an insignificant or discountable level. With the issuance of the memo, the USFWS concluded its consultation process for the Non-native Deer Management Plan EIS.

On March 28, 2005, NPS transmitted a letter to NMFS regarding potential project effects on listed fish species and fish habitat during implementation of the plan. The NPS clarified that management actions would not take place in creeks, waterways, or riparian areas and therefore the proposed project is not likely to adversely effect Central California Coast Evolutionary Significant Unit coho salmon, Central California Coast Evolutionary Significant Unit steelhead, Central California Coast Evolutionary Significant Unit Chinook salmon, Designated Critical Habitat for Central California Coast Evolutionary Significant Unit coho salmon, and Essential Fish Habitat for coho salmon and Chinook salmon. NMFS concurred with NPS findings in a letter to the NPS on May 3, 2005, ending the informal consultation process.

Archeological Resources Protection Act of 1979, PL 96-95, 93 Stat. 712, 16 U.S.C. §470aa et seq. and 43 CFR 7, subparts A and B, 36 CFR. This act secures the protection of archeological resources on public or Indian lands and fosters increased cooperation and exchange of information between private, government, and the professional community in order to facilitate the enforcement and education of present and future generations. It regulates excavation and collection on public and Indian lands. It requires notification of

Indian tribes who may consider a site of religious or cultural importance prior to issuing a permit. The NPS would meet its obligations under this Act in all activities conducted in the Non-Native Deer Management Plan through the adoption of standard mitigation measures addressing standard procedures to follow in the event that cultural resources are unexpectedly encountered.

National Historic Preservation Act of 1966, as amended, PL 89-665, 80 Stat. 915, 16 U.S.C. §470 et seq. and 36 CFR 18, 60, 61, 63, 68, 79, 800. The National Historic Preservation Act requires agencies to take into account the effects of their actions on properties listed in or eligible for listing in the National Register of Historic Places. The Advisory Council on Historic Preservation has developed implementing regulations (36 CFR 800), which allow agencies to develop agreements for consideration of these historic properties. The NPS, in consultation with the Advisory Council, the California State Historic Preservation Officer, American Indian tribes and the public, has developed a Programmatic Agreement for operations and maintenance activities on historic structures. This Programmatic Agreement provides a process for compliance with National Historic Preservation Act, and includes stipulations for identification, evaluation, treatment, and mitigation of adverse effects for actions affecting historic properties. The NPS sent a scoping notice to the state historic preservation officer and the Advisory Council for Historic Preservation. The Draft EIS was sent to the state historic preservation officer (through the State Department of Parks and Recreation) and the State Native American Heritage Commission These agencies did not submit comments on the management plan during the scoping or the public comment periods. The Chief of Cultural Resources of PRNS concluded that as non-native deer are not part of the traditions or history of the Native American people of the region or the local ranching culture and as implementation of the management plan would not affect historic structures or districts, no further compliance with Section 106 is warranted (Gordon White, 10/6/03).

American Indian Religious Freedom Act, PL 95-341, 92 Stat. 469, 42 U.S.C. §1996. This act declares policy to protect and preserve the inherent and constitutional right of the American Indian, Eskimo, Aleut, and Native Hawaiian people to believe, express, and exercise their traditional religions. It provides that religious concerns should be accommodated or addressed under NEPA or other appropriate statutes. The National Park Service, as a matter of policy, is as nonrestrictive in permitting Native American access to and use of identified traditional sacred resources for traditional ceremonies.

Executive Order 11988: Floodplain Management. This Executive Order requires federal agencies to avoid, to the extent possible, adverse impacts associated with the occupancy and modification of floodplains, and to avoid development in floodplains whenever there is a practical alternative. If a proposed action is found to be in the applicable regulatory floodplain, the agency shall prepare a floodplain assessment, known as a Statement of Findings. All of the actions proposed in the Non-Native Deer Management Plan are consistent with this executive order.

Executive Order 11990: Protection of Wetlands. This Executive Order established the protection of wetlands and riparian systems as the official policy of the federal government. It requires all federal agencies to consider wetland protection as an important part of their policies and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. All of the actions proposed in the Non-Native Deer Management Plan are consistent with this executive order.

Executive Order No. 13112: Invasive Species. This Executive Order prevents the introduction of invasive species and directs federal agencies to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species. Actions proposed in the EIS include measures to prevent the introduction and spread of invasive species.

Coastal Zone Management Act, 16 U.S.C. § 1451-1464. This act protects coastal environments. While this act transferred regulatory authority to the States and excluded federal installations from the definition of the “coastal zone,” it requires that federal actions be consistent with state coastal management plans. Activities taking place within the coastal zone under the definition established by the California Coastal Management Plan require a federal consistency determination. The NPS submitted a letter to the Coastal Commission requesting concurrence with the conclusion reached by the NPS that the proposed management plan would not adversely affect coastal resources. The Coastal Commission staff issued a letter in reply on August 5, 2005, concurring with the NPS conclusion that the project warranted a negative determination, i.e., a finding of no adverse effect. The Coastal Commission letter explained that although the management plan could result in short-term adverse effects such as increased intermittent noise from aircraft and firearms and temporary area closures where culling or contraception are being conducted, the long-term effects of the plan would result in enhancement of the visitor experience. This enhancement would result from the restoration of native habitats, increased opportunities for viewing native fauna and prevention of migration of non-native deer species into the adjacent coastal zone.

40 C.F.R. 1506 NPS must file the FEIS with EPA’s Office of Federal Activities. Each week, EPA publishes a notice in the *Federal Register* that lists the FEIS’s received during the preceding week. The 30-day time period for public review of a FEIS is measured from the date of publication in the *Federal Register*. The EPAP ensures that agencies, such as NPS, comply with several federal environmental laws such as the Clean Air Act, the Clean Water Act, and the Federal Insecticide, Fungicide and Rodenticide Act, among others.

Clean Air Act 16 U.S.C. § 1451-1464. This law prevents pollution of air, and in Section 309 authorizes the Environmental Protection Agency (EPA) to review certain proposed actions of other federal agencies in accordance with the National Environmental Policy Act (NEPA) and to make those reviews public. If the proposing agency (the "lead" agency) does not make sufficient revisions and the project remains environmentally unsatisfactory, EPA may refer the matter to the President's Council on Environmental Quality for mediation

List of Preparers

Between August 2001 and September 2003, an interdisciplinary team of Seashore biologists, administrators, and specialists met nine times and supervised the preparation of the DEIS. In addition, personnel from Golden Gate National Recreation Area and the NPS Pacific West Regional office were instrumental in providing guidance. Following the close of the public comment period on April 8, 2005, the interdisciplinary team met to consider the comments submitted by the public, organization and agencies and develop responses. Staff at the NPS Denver Service Center provided support to the team in collating comments into issue areas. NPS personnel who assisted in the preparation of the EIS documents for the management plan were:

Dawn Adams, Inventory and Monitoring Coordinator, PRNS; BS, General Biology, University of Illinois.

Sarah Allen, Ecologist, PRNS; PhD, University of California, Berkeley, MS, University of California, Berkeley; BS, Conservation of Natural Resources, University of California, Berkeley.

Ben Becker, Marine Ecologist, PRNS; PhD, University of California, Berkeley; MS, Yale University; BA, University of California, Los Angeles.

John Dell’Osso, Chief of Interpretation, PRNS; B.S. Environmental Planning and Management, University of California, Davis.

Gary Fellers, PhD, Research Biologist, Western Ecological Research Center, US Geological Survey; PhD, University of Maryland; M.S, University of Maryland; BA, University of California, Berkeley.

Natalie Gates, Wildlife Biologist, PRNS; MS, Environmental Science and Policy, University of California; DVM, New York State College of Veterinary Medicine (Cornell); BA, Biology, Harvard University.

Daphne Hatch, Chief of Natural Resource Management and Science, GGNRA; M.S. Range Management and PhD Candidate Wildland Resource Science, University of California, Berkeley, CA.

Brannon Ketcham, Hydrologist, PRNS; MEM, Water Resources Management, Duke University; BA, Geology, Pomona College.

Bill Merkle, Wildlife Ecologist, GGNRA; PhD, Department of Environmental, Population, and Organismic Biology, University of Colorado, Boulder; BA, Stanford University.

Barbara Moritsch, Plant Ecologist, PRNS; MS, Environmental Science, Oregon State University; BS, Resource Planning and Interpretation, Humboldt State University.

Don Neubacher, Superintendent, PRNS; MS Resource Management, Humboldt State University; BS, Environmental Planning, University of California, Davis.

Lorraine Parsons, Wetland Ecologist, PRNS, M.S. San Diego State University, BA University of Southern California, BS University of Southern California.

Suzanne Pettit, Exotic Deer Biotechnician, PRNS: BS, Biology, University of Michigan.

Wendy Poinsot, Environmental Planner PRNS and GGNRA, BA, Park History, Colorado State University.

Jane Rodgers, Plant Ecologist, PRNS; BS, Forestry, University of California, Berkeley.

William Shook, PRNS; BS, Secondary Education, Pennsylvania State University.

Gordon White, Chief of Cultural Resources, PRNS; MA, Architecture, University of California, Berkeley; BA, Environmental Design, University of California, Berkeley.

List of Agencies and Organizations to Whom Notices of the Environmental Impact Statement are Being Sent

Federal Agencies

U. S. Army Corps of Engineers
U. S. Coast Guard
U. S. Department of Commerce National Oceanic and Atmospheric Administration
U.S. Environmental Protection Agency
U. S. Geological Service
U. S. Fish and Wildlife Service
U. S. Natural Resources Conservation Service
U. S. National Marine Fisheries

Federal Advisory Groups
Advisory Council for Historic Preservation

Elected Officials
California State Assemblyperson Joe Nation
California State Senator John Burton
Marin County Supervisor Steve Kinsey
U. S. Representative Lynn Woolsey
U. S. Senator Barbara Boxer
U. S. Senator Dianne Feinstein

State Agencies
Bodega Marine Lab
California Coastal Commission
State of California Department of Environmental Science
State of California Department of Fish and Game
State of California Department of Parks and Recreation
State of California Department of Transportation
State of California Office of Planning and Resources State Clearinghouse
State Historic Preservation Office
State Native American Heritage Commission
University of California, Berkeley
University of California Cooperative Extension
Wildlife Health Center, University of California, Davis, School of Veterinary Medicine

Regional, County, and Municipal Agencies
Bolinas Fire Department
Bolinas Community Public Utility District
Inverness Fire Department
Marin Humane Society
Marin County Fire Department
Marin County Open Space
Marin County Planning and Acquisition
Marin County Sheriff's Department
Marin County Resource Conservation District
Marin Municipal Water District
Nicasio Fire Department
San Francisco Regional Water Quality Control Board
Sonoma County Agriculture Preservation and Open Space District
Sonoma County Water Agency

Non-Governmental Organizations, Non-Profit Organizations, etc.
Animal Protection Institute
Audubon Canyon Ranch & Cypress Grove Preserve
Audubon Society, Marin Chapter
Bay Area Ridge Trail Council
Bay Institute
Bicycle Trails Council
Bolinas Community Parks Planning
California Native Plant Society
Coastwalk

Committee for the Preservation of Tule Elk
Defenders of Wildlife
East Shore Planning Group
Environmental Action Committee of West Marin
Environmental Forum of Marin
Federated Indians of Graton Rancheria
Friends of the Estero
Gardener's Guild
In Defense of Animals
Inverness Association
Inverness Ridge Association
Marin Agricultural Land Trust
Marin Audubon Society
Marin Conservation League
Marin County Farm Bureau
Marin Horse Council
National Parks and Conservation Association
North American Trail Ride Conference
Planning and Conservation League
Point Reyes Bird Observatory
Point Reyes Light
Point Reyes Seashore Rancher's Association
Point Reyes Village Association
Preserve Historic Olema Valley
Sierra Club, Marin Group
Sonoma Horse Council
Sonoma County Farm Bureau
Sustainable Conservation
Tomales Bay Advisory Committee
Tomales Bay Watershed Council
Trout Unlimited
Trust for Public Lands
Vedanta Society
West Marin Chamber of Commerce
West Marin Community Radio
West Marin Paths
Wilderness Society

Libraries
Bolinas Library
Inverness Library
Marin County Library
Point Reyes Library
Stinson Beach Library
San Rafael Library

The plan will be placed on the Point Reyes National Seashore website at www.nps.gov/pore/planning. A notice will be mailed to all individuals that have indicated interest in PRNS planning and management activities.

Responses to Comments

Introduction

The purpose of this section is to analyze the substantive comments given to the Seashore by the public (see below). The Final EIS is meant to be an accurate analysis of impacts of each alternative. Public and agency review of the draft helps to ensure quality. Analysis of comments allows NPS to identify the public's opinion on the adequacy of the document, collect new information on resources, alternatives and environmental issues. The Seashore used public comments to review the alternatives, supplement/improve/modify impact analysis, correct factual errors and clarify information presented in the draft version.

This section is divided into four subsections: Introduction, Commenter Index, Agency and Sample Comments, and NPS Response to Comments. As described above, during the comment period, the NPS received a total of 1,980 pieces of correspondence, containing 4450 individual comments. Form letters constituted 57% of the emails comment letters received. Ninety-four percent of the comments were sent in by individual members of the public. Many of these comments were highly similar or exact duplicates of others. Each comment was read and assigned a Topic Code number. Similar comments received the same code number. This allowed NPS staff to respond once to a comment or concern that several people shared. The commenter index, posted on the Seashore website, allows each person to locate responses to their particular comments.

All comments, as well as attachments and included materials, were reviewed and considered. Where warranted, the draft EIS was revised to reflect edits recommended by commenters or to clarify text questioned by commenters. Responses were prepared for all substantive comments raised by the public and agencies. Substantive comments are defined for the purposes of an EIS as those that raise, debate, or question a point of fact or policy. Substantive comments do one or more of the following:

- question, with reasonable basis, the accuracy of information in the EIS.
- question, with reasonable basis, the adequacy of environmental analysis.
- present reasonable alternatives other than those presented in the EIS.
- cause changes or revisions in the preferred alternative.

Comments in favor or against an alternative, or comments that only agree or disagree with NPS policy are not considered substantive. Comments were either responded to individually or with a response that addressed the concerns of several commenters made on a closely related topic. Such concerns, each one summarizing a substantive comment found in one or more letters, are identified by a unique Topic Code number.

Commenter and Correspondence Indices

An index matching each commenter with a Correspondence ID number, a unique identifier for the letter, email or fax submitted by each individual or organization, has been posted on the Seashore website (http://www.nps.gov/pore/pphtml/documents.html). This Commenter Index is arranged alphabetically. A second index matching the Correspondence ID to one or more Topic Codes is also posted at the website (Correspondence Index). Several Topic Codes are listed after a Correspondence ID if the commenter included more than one substantive comment in his/her letter. Topic Codes, each with its corresponding NPS response, follow in the NPS Response to Comments section.

Agency and Sample Comments

The following is an index of all organizations that submitted comments on the plan, along with the Topic Code(s) which represent the substantive comments within those letters. Again, a larger index which includes all individual commenters, is posted on the Seashore website. All responses are found in the Response to Comments section, at the end of this chapter. All submitted comments, as well as attachments and included materials, are available for public perusal in the administrative record.

Organization Name	Topic Code
Audubon Canyon Ranch, Cypress Grove Research Center	AL1400
	AL1500
	WH2000
	WH4000
California Cattlemen's Association	AL1500
California Department of Fish and Game	AL1500
	WH2000
California Native Plant Society, Marin Chapter	AL1400
	AL1500
	AL1110
California State Parks	AL1500
	WH2000
California State Parks, Natural Resources Division	AL1500
Friends of the Folsom Zoo, Inc.	AL5000
House of Representatives, US Congress	AL4300
	PN8000
	PN8000
In Defense of Animals	AL1410
	AL2000
	AL4000
	AL4400
	AL5000
	GA3000
	PN8000
	TE4000
	WH1000
	WH2000
	WH4000
	WV 1000
Marin Audubon Society	AL1400
Marin Conservation League	AL1500
Marin Humane Society	AL4400
Marin Municipal Water District	WH1100
	WH2000
Marin Peace and Justice Coalition	AL1100
National Humane Education Society	AL5000
	AL2000
	AL5000

	GA3000
National Parks Conservation Association	AL1110
	AL1210
	AL1310
	AL1400
	WH4000
Natural Resources Defense Council	AL1400
People for Golden Gate National Recreation Area	AL1110
	AL1210
	AL1310
	AL1500
	PO4000
Planned Feralhood	AL2000
	AL4300
	WH1100
Point Reyes Light	AL1510
	GA3000
Point Reyes Seashore Ranchers Association	AL1200
	AL1300
	WH1000
	WH4000
Point Reyes Bird Observatory Conservation Science	AL1500
San Francisco League of Conservation Voters	AL1210
	AL1310
	AL1500
Sierra Club	AL1500
	WH2000
	WH4000
Sierra Club Marin Group	AL1110
	AL1500
	AL4500
	PO4000
	WH4000
Sonoma-Marin Cattlemen's Association	AL1110
The Environmental Action Committee of West Marin	AL1500
The Humane Society of the United States	AL1100
	AL1101
	AL4000
	AL4100
	AL4300
The Jane Goodall Institute	AL4000
	AL4300
	AL4400
	AL5000
The Science and Conservation Center	AL4000
Voices for Animals	AL4400
Wildlife Fawn Rescue	AL4500

Because of the volume of correspondence received during the public comment period, this document cannot include all comment letters. All substantive comments found within all correspondence were responded to as described above. NEPA requires NPS to reprint any federal, state or local agency, or tribal letters of comment. They are reprinted in the following pages, with a sample of non-agency letters - an example of the two most commonly received form letters and some letters containing multiple substantive comments representative of various viewpoints.

LYNN WOOLSEY
6TH DISTRICT, CALIFORNIA

COMMITTEES:
EDUCATION AND THE WORKFORCE
RANKING MEMBER, SUBCOMMITTEE ON EDUCATION REFORM
SUBCOMMITTEE ON WORKFORCE PROTECTIONS
SCIENCE
SUBCOMMITTEE ON ENERGY

WEB PAGE AND E-MAIL:
http://www.woolsey.house.gov

Congress of the United States
House of Representatives
Washington, DC 20515–0506

WASHINGTON OFFICE:
2263 RAYBURN BUILDING
WASHINGTON, DC 20515–0506
TELEPHONE:

DISTRICT OFFICES:
101 COLLEGE AVENUE, SUITE 200
SANTA ROSA, CA 95404
TELEPHONE: (707) 542–7182

NORTHGATE BUILDING
SAN RAFAEL, CA 94903

RECEIVED
Point Reyes National Seashore
APR 12 '05

SUPT.
ASST. SUPT.
SPEC. PK. USES
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RES./SCIENCE
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PERSONNEL
BUDGET
CENTRAL FILES

April 8, 2005

Don Neubacher, Superintendent
Point Reyes National Seashore
Point Reyes, CA 94965

Dear Superintendent Neubacher:

I am writing you concerning the draft Environmental Impact Statement/ Non-native Deer Management Plan that has been prepared by the Park Service to address the problems posed by the growing populations of non-native axis and fallow deer at the Pt. Reyes National Seashore.

Over the past few weeks my office has received numerous letter from constituents deeply concerned about this issue. I'm sure that you know the arguments. On one side there is a wish to protect the native species, biodiversity, and historical uses of the park (and nearby private property), which are threatened by a rapidly expanding population of non-native deer. On the other side, there is strong and heartfelt support for the preservation of these very beautiful creatures.

Unfortunately, I've been told that many of these deer carry a contagious disease, which is both difficult to screen and incurable, and would preclude relocating them to the wild or other less sensitive preserve areas, which would be my first choice.

I believe, however, that the most positive action would be fertility control as a significant component of a non-native deer control program and urge the Park Service to engage in the research that will be necessary to develop and deliver long-acting contraception to the non-native deer population. While fertility control may not be the entire answer, however, research into these areas would have the beneficial effect of helping to develop the technologies to humanely deal with similar problems in the future.

Please know that I appreciate the difficult and very complex work that the Park Service does to protect our national treasures.

Sincerely,

Lynn Woolsey

Lynn Woolsey
Member of Congress

PRINTED ON RECYCLED PAPER

STATE OF CALIFORNIA—THE RESOURCES AGENCY

ARNOLD SCHWARZENEGGER, *GOVERNOR*

CALIFORNIA COASTAL COMMISSION
45 FREMONT, SUITE 2000
SAN FRANCISCO, CA 94105-2219
VOICE AND TDD (415) 904-5200
FAX (415) 904-5400

RECEIVED
Point Reyes
National Seashore
AUG 10 '05

August 5, 2005

cc: WILDLIFE MGT.

Don L. Neubacher
Superintendent,
Point Reyes National Seashore
ATTN: Natalie Gates
Point Reyes, CA 94956

Subject: Negative Determination ND-078-05, Non-Native Deer Management Plan, Point Reyes National Seashore, Marin County

Dear Mr. Neubacher:

The Coastal Commission staff has reviewed the above-referenced negative determination. The National Park Service (NPS) proposes to implement a management plan for the eradication of non-native axis and fallow deer from within Point Reyes National Seashore by the year 2020 through a combination of long-lasting contraceptives and lethal removal. Individuals of both species were purchased from the San Francisco Zoo in the 1940s and 1950s and released on the Point Reyes peninsula by a private landowner before the establishment of the Seashore. The NPS estimates that currently there are approximately 250 axis and 860 fallow deer within the Seashore. Populations of both species of deer have increased in recent years and the range of fallow deer appears to be expanding eastward, towards and beyond the seashore boundary.

Point Reyes National Seashore is comprised of land and water owned and controlled by the NPS. Section 304(1) of the Coastal Zone Management Act excludes from the coastal zone all lands held in trust by or whose uses are subject solely to the discretion of the federal government. Notwithstanding this exclusion, if proposed activities on excluded lands could affect land or water uses or natural resources of the coastal zone, those activities must be reviewed for consistency with the California Coastal Management Program. It is in this context that the proposed management plan for the removal of non-native deer within the Seashore is reviewed.

The Point Reyes National Seashore 1999 Resource Management Plan (RMP) states that:

> *Regardless of potential competition and disease issues, the presence of these non-native deer compromises the ecological integrity of the Seashore and the attempts to reestablish the native cervid fauna comprising tule elk and black-tailed deer.*

The proposed management plan states that removal of non-native deer would assist the NPS in the restoration of soils, water quality, aquatic habitat, riparian vegetation, forest understories, and threatened and endangered species habitat for salmonids and red-legged frogs within the Seashore that have been and continue to be damaged by the presence of non-native deer. In

ND-078-05 (National Park Service)
Page 2

addition, the proposed activity would prevent the spread of non-native deer into surrounding private and public lands (including lands within the coastal zone) and the consequent spread of natural resource impacts, and would address adverse impacts to agricultural permittees by non-native deer within the Seashore.

The NPS proposes to eradicate all axis and fallow deer within the Seashore by 2020. A percentage of fallow deer would be treated with a long-acting contraceptive, and both axis and fallow deer would be removed by NPS staff trained in wildlife sharpshooting. The NPS reports that population modeling for fallow deer at the Seashore suggests that total numbers of both species of non-native deer removed by 2020 are projected to be at least 1,350 (800 axis and 550 fallow deer), while total numbers of fallow does treated by 2020 with a contraceptive could range from 100 to 150. The population and distribution of non-native deer within the Seashore would continue to be monitored throughout the 2005-2020 time period.

Temporary area closures (excluding beaches) may be required for the safe capture and culling of non-native deer and may temporarily inconvenience visitors to the Seashore. Increased noise from aircraft use or firearms may temporarily result in the loss of peace and quiet in the Seashore during periods of non-native deer management activities. Over the long term, however, removal of two invasive animal species will enhance the quality of the visitor experience by contributing to the restoration of damaged habitats within the Seashore and providing increased opportunities for viewing native deer and elk in the Seashore. In addition, the proposed action would keep non-native deer from migrating into the coastal zone and adversely affecting environmentally sensitive habitats.

In conclusion, the Commission staff **agrees** that implementing the non-native deer management plan within Point Reyes National Seashore will not adversely affect coastal zone resources. We therefore **concur** with your negative determination made pursuant to 15 CFR 930.35 of the NOAA implementing regulations. Please contact Larry Simon at (415) 904-5288 should you have any questions regarding this matter.

Sincerely,

Peter Douglas

PETER M. DOUGLAS
Executive Director

cc: North Central Coast District Office
California Department of Water Resources
Governor's Washington, D.C., Office

State of California – The Resources Agency ARNOLD SCHWARZENEGGER, Governor
DEPARTMENT OF FISH AND GAME
http://www.dfg.ca.gov
1416 Ninth Street
Sacramento, California 95814
(916) 653-4673

March 24, 2005

Mr. Don L. Neubacher, Superintendent
Point Reyes National Seashore
Point Reyes, California 94956

Dear Mr. Neubacher:

The California Department of Fish and Game (Department) has reviewed the draft Environmental Impact Statement regarding the Non-Native Deer Management Plan. The National Park Service is proposing to remove axis and fallow deer within the Point Reyes National Seashore's boundary through a combination of long-duration contraception and lethal control. The Department has the following comments regarding the proposal:

1. The Department supports control of non-native species in natural areas where management goals are the protection of native ecosystems and species;

2. The Department supports all management actions that will prevent the movement of these non-native deer species outside the Point Reyes National Seashore's boundary;

3. Due primarily to disease concerns, the Department does not support the movement of any live, non-native deer within the State for any purposes.

Thank you for the opportunity to provide these comments. If you have any questions, please contact John Carlson, Jr., Chief, Wildlife Programs Branch, at (916) 445-3555.

Sincerely,

Sonke Mastrup
Deputy Director

cc: John Carlson, Jr., Chief
Wildlife Programs Branch

Conserving California's Wildlife Since 1870

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

RECEIVED
Point Reyes
National Seashore
MAR 8 - '05
SUPT.
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SPEC. PK. USES
LAW ENFORC.
RES./SCIENCE
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BUDGET
CENTRAL FILES

March 2, 2005

Don Neubacher, Superintendent
Point Reyes National Seashore
Point Reyes, CA 94956

Subject: Non-Native Deer Management Plan Draft Environmental Impact Statement (DEIS)
[CEQ # 050030]

Dear Mr. Neubacher:

The U.S. Environmental Protection Agency (EPA) has reviewed the above referenced document. Our review and comments are provided pursuant to the National Environmental Policy Act (NEPA), the Council on Environmental Quality's NEPA Implementation Regulations at 40 CFR 1500-1508, and Section 309 of the Clean Air Act.

The DEIS analyzes alternatives for management of Axis Deer and Fallow Deer in Point Reyes National Seashore (PRNS) and Golden Gate National Recreation Area lands administered by PRNS. The intent of the plan is to assist the National Park Service in restoring native ecosystems within park lands and preventing the spread of non-native deer into surrounding private and public lands, and to address impacts to agricultural permittees within PRNS. We have rated this DEIS as LO -- Lack of Objections (see enclosed "Summary of Rating Definitions").

We appreciate the opportunity to review this DEIS and request a copy of the Final Environmental Impact Statement when it is filed with our Washington, D.C. office. If you have any questions, please call me at (415) 972-3854, or have your staff call Jeanne Geselbracht at (415) 972-3853.

Sincerely,

Lisa B. Hanf

Lisa B. Hanf, Manager
Federal Activities Office

003944
Enclosure: "Summary of Rating Definitions"

Printed on Recycled Paper

SUMMARY OF EPA RATING DEFINITIONS

This rating system was developed as a means to summarize EPA's level of concern with a proposed action. The ratings are a combination of alphabetical categories for evaluation of the environmental impacts of the proposal and numerical categories for evaluation of the adequacy of the EIS.

ENVIRONMENTAL IMPACT OF THE ACTION

"LO" (Lack of Objections)

The EPA review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

"EC" (Environmental Concerns)

The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

"EO" (Environmental Objections)

The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

"EU" (Environmentally Unsatisfactory)

The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potentially unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the CEQ.

ADEQUACY OF THE IMPACT STATEMENT

Category 1" (Adequate)

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

"Category 2" (Insufficient Information)

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analysed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

"Category 3" (Inadequate)

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analysed in the draft EIS, which should be analysed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

*From EPA Manual 1640, "Policy and Procedures for the Review of Federal Actions Impacting the Environment."

MARIN MUNICIPAL WATER DISTRICT

220 Nellen Avenue Corte Madera CA 94925-1169
www.marinwater.org

April 11, 2005

Mr. Don Neubacher
Superintendent
Point Reyes National Seashore
Point Reyes, CA 94956

Attention: Non-Native Deer Management Plan

Dear Mr. Neubacher:

On behalf of the Board of Directors of The Marin Municipal Water District (District) I am writing in support of Point Reyes National Seashore's Non-Native Deer Management Plan Draft Environmental Impact Statement (Plan) and specifically for the preferred Alternative E. As a neighboring landowner to the Seashore we share common interests in managing invasive species such as axis and fallow deer. You will recall that our agencies collaborated on successful feral pig control in the 1980s. Our watershed management polices promote the protection of native flora and fauna and specifically call for the control of exotic species. Your plan suggests male fallow deer are already leaving National Park Service lands and that without effective control, fallow deer may become resident on our lands. We are very concerned about this prospect.

We support Alternative E because it calls for the eradication of both non-native deer from the park because it is consistent with natural area management policies that protect native diversity. We also believe that it is a more humane alternative in the long run than maintenance of herds at pre-determined low levels (Alternatives B and C), because herd maintenance calls for culling herds in perpetuity. Alternative E calls for the application of long-acting contraceptives in combination with shooting by trained NPS staff. We applaud the park service for emphasizing non-lethal means even though they are experimental and unproven.

A successful deer management program is required to protect the ecological integrity of our wildlands. A no action alternative would lead to widespread ecological degradation beyond park boundaries and is therefore unacceptable. We commend you and your staff for the careful science-based evaluation and effective proposal for a difficult and controversial issue.

Sincerely,

Paul Helliker

Paul E. Helliker
General Manager

F:\DIVISION\BOARD\LETTERS\2005\NPS DEER MGMT LETTER.DOC

recycled
recyclable

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802- 4213

RECEIVED
Point Reyes
National Seashore
MAY 3 - '05

SUPT.
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LAW ENFORC.
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RANGE CONS.
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PERSONNEL
BUDGET
CENTRAL FILES

May 3, 2005

In Response Refer to:
151422SRW05SR00250:DL

Don L. Neubacher, Superintendent
National Park Service
Point Reyes National Seashore
Point Reyes, California 94956

Dear Mr. Neubacher:

This letter is in response to your request for written concurrence from the NOAA's National Marine Fisheries Service (NMFS) regarding the National Park Service's (NPS) three determinations related to its Non-native Deer Management Plan for the Point Reyes National Seashore: 1) the project is not likely to adversely affect threatened California Coastal (CC) Chinook salmon (*Oncorhynchus tshawytscha*), Central California Coast (CCC) coho salmon (*O. kisutch*), or CCC steelhead (O. mykiss); 2) the project is not likely to result in adverse effects to designated critical habitat for CCC coho salmon or the proposed critical habitat of CC Chinook salmon and CCC steelhead; and 3) the project is not likely to result in adverse modification of Essential Fish Habitat. NPS proposes to eradicate nonnative axis deer (*Cervus axis*) and fallow deer (*Cervus dama*) on its holdings throughout the Lagunitas Creek watershed in Marin County California. The proposed eradication efforts will occur in grassland or scrub areas where deer can be handled or culled safely. No management actions will occur in streams or riparian areas. Therefore, I concur with NPS's three determinations stated earlier in this paragraph.

This concludes informal section 7 consultation for this proposed project in accordance with 50 CFR section 402.14(b)(1). Consultation must be reinitiated if new information becomes available revealing the effects of the action on listed species in a manner or to an extent not previously considered, the project plans change, if the action is subsequently modified in a manner that causes an effect to listed species that was not considered, or if a new species or critical habitat is designated that may be affected by this action.

If you have questions concerning this consultation, please contact Daniel Logan at (707) 575-6053.

Sincerely,

for Rodney R. McInnis
Regional Administrator

cc: ARA-PRD, NMFS

State of California • The Resources Agency
Arnold Schwarzenegger, *Governor*
DEPARTMENT OF PARKS AND RECREATION • P.O. Box 942896 • Sacramento, CA 94296-0001
Ruth Coleman, *Director*
(916) 653-6725

April 7, 2005

Don L. Neubacher
Superintendent
Point Reyes National Seashore
Point Reyes, California 94956

Dear Superintendent Neubacher:

Thank you for the opportunity to comment on the Draft Non-Native Deer Management Plan Environmental Statement (EIS).

California State Parks manages property in close proximity to both Point Reyes National Seashore (Tomales Bay State Park) and to Golden Gate National Recreation Area (Mount Tamalpais SP, Marconi State Historic Park, and Samuel P. Taylor SP). These State and Federal parks make up a landscape level reserve of statewide significance that protects the natural resource values representative of the Coastal Steppe Mixed Forest Province. Given this proximity, and the population models presented in the Draft Plan, it seems highly likely that California State Parks will become populated by non-native deer if prompt corrective actions are not taken. Non-native deer have already been reported to occur in Tomales Bay State Park according to a Natural Resources Condition Assessment our Department conducted in 2001-02.

Similar to the National Park Service, California State Parks is mandated to protect and preserve native ecosystems. The presence of non-native animals is generally inconsistent with the Department's mission of maintaining native species and natural systems. It is the general policy of California State Parks that non-native animals not be maintained in the State Park System except to fulfill unit-specific State Park management goals.

The non-native deer population clearly competes with native deer populations and with other species for food, water, and cover. The non-native deer populations also have deleterious impacts on soils, water quality, and vegetation. Diseases known to be present in the non-native deer population must be prevented from spreading to native wildlife to the extent feasible.

California State Parks supports the preferred alternative, Alternative E, in the Draft Non-Native Deer Management Plan. To not undertake, or to delay, action to control the population of axis and fallow deer would perpetuate and exacerbate the problem so that an even more extensive and expensive control effort involving the eradication of more animals would be required.

Superintendent Neubacher
Page Two
April 7, 2005

Thank you for the opportunity to comment on this document. If you have any questions, please call Cynthia Roye, Associate State Park Resource Ecologist, at (916) 653- 9083.

Sincerely,

Richard G. Rayburn, Chief
Natural Resources Division

cc: Diablo Vista District
North Bay District

STATE OF CALIFORNIA
Governor's Office of Planning and Research
State Clearinghouse and Planning Unit

Arnold Schwarzenegger
Governor

Sean Walsh
Director

April 11, 2005

Don Neubacher
National Park Service
Point Reyes National Seashore
Point Reyes, CA 94956

Subject: Non-Native Deer Management Plan
SCH#: 2005022060

Dear Don Neubacher:

The State Clearinghouse submitted the above named Draft EIS to selected state agencies for review. The review period closed on April 8, 2005, and no state agencies submitted comments by that date. This letter acknowledges that you have complied with the State Clearinghouse review requirements for draft environmental documents, pursuant to the California Environmental Quality Act.

Please call the State Clearinghouse at (916) 445-0613 if you have any questions regarding the environmental review process. If you have a question about the above-named project, please refer to the ten-digit State Clearinghouse number when contacting this office.

Sincerely,

Terry Roberts

Terry Roberts
Director, State Clearinghouse

RECEIVED
Point Reyes
National Seashore
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1400 TENTH STREET P.O. BOX 3044 SACRAMENTO, CALIFORNIA 95812-3044
TEL (916) 445-0613 FAX (916) 323-3018 www.opr.ca.gov

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In Reply Refer to:
1-1-05-I-0035

April 7, 2005

Memorandum

To: Park Superintendent, Point Reyes National Seashore, National Park Service, Point Reyes, California (Attn: Ranger Natalie Gates)

From: Deputy Assistant Field Supervisor, Endangered Species Program, Sacramento Fish and Wildlife Office, Sacramento, California Cliff Nagano

Subject: Concurrence with Not Likely to Adversely Affect Determination for Nine Listed Species and Proposed Critical habitat for the California Red-legged Frog as a result of the Non-Native Deer Management Plan at the Point Reyes National Seashore and Golden Gate National Recreation Area in Marin County, California

This memorandum is in response to the U. S. National Park Service's March 10, 2005, request for the concurrence of the U.S. Fish and Wildlife Service (Service) for the proposed Non-Native Deer Management project at the Point Reyes National Seashore and Golden Gate National Recreation Area in Marin County County, California. Your request was received by this Field Office on March 14, 2005. Additional information was received from the National Park Service in a letter to the Service dated March 30, 2005, that was received by us on April 6, 2005. At issue are the potential effects of the proposed project on the threatened California red-legged frog (*Rana aurora draytonii*), threatened western snowy plover (*Charadrius alexandrinus nivosus*), threatened northern spotted owl (*Strix occidentalis caurina*), endangered California freshwater shrimp (*Syncaris pacifica*), endangered Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*), endangered Sonoma alopecurus (*Alopecurus aequalis* var. *sonomensis*), endangered beach layia (*Layia carnosa*), endangered clover lupine (*Lupinus tidestromii*), endangered Sonoma spineflower (*Chorizanthe valida*), and proposed critical habitat for the threatened California red-legged frog. This response is provided pursuant to section 7(a) of the Endangered Species Act, as amended (16 U.S.C. 1531 *et seq.*)(Act), and in accordance with the regulations governing interagency consultations (50 CFR § 402).

This document is based on your March 10, 2005, letter and associated information; your March 30, 2005, letter; *Point Reyes National Seashore Threatened and Endangered Species Locations as of 2001*, undated, that was prepared by the National Park Service; and other information available to the Service.

TAKE PRIDE IN AMERICA

Park Superintendent 2

It is our understanding the proposed project consists of the lethal removal and fertility control of all axis deer (*Axis axis*) and fallow deer (*Dama dama dama*) by the year 2020. A percentage of the fallow deer would be treated with an existing long-acting contraceptive, and both species of deer would be removed via shooting. The proposed management activities will take place in open flat grassland or scrub areas where deer can be safely handled for contraceptive administration or safely culled. No management activities will take place in creeks, waterways, or riparian areas. The culling would be conducted by National Park Service staff specifically trained in wildlife sharpshooting. Deer carcasses will be removed when possible; in cases where carcasses could not be accessed, they will be left in place to recycle nutrients into the ecosystem. Monitoring would continued until all non-native deer area eradicated by the year 2020.

The measures in the proposed project are sufficient to reduce any direct, indirect, and cumulative effects on the California red-legged frog, western snowy plover, northern spotted owl, California freshwater shrimp, Myrtle's silverspot butterfly, endangered Sonoma alopecurus, endangered beach layia, endangered clover lupine, endangered Sonoma spineflower to an insignificant or discountable level, or result in adverse modification or destruction of the proposed critical habitat of the California red-legged frog. Critical habitat for the other eight species has not been proposed, designed, or is located in the action area. Therefore, the Service concurs that the project, as described within your March 10, 2005, and March 30, 2005, letters and accompanying material, is not likely to adversely affect these nine listed species and proposed critical habitat for the California red-legged frog. If project work descriptions or time frames change, or were not evaluated, it is our recommendation that the changes be submitted for our review. This concludes our review of the actions outlined in the March 10, 2005, and March 30, 2005, letters and accompanying material, and no further coordination with the Service under the Act is necessary at this time. Please note that this memorandum does not authorize the take of listed species.

As provided in 50 CFR § 402.14, initiation of formal consultation is required where there is discretionary Federal agency involvement or control over the action (or is authorized by law) and if: (1) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this review; (2) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (3) a new species is listed or critical habitat designated that may be affected by the action.

We appreciate your proactive efforts to conserve and recover endangered species. Please contact Chris Nagano, Deputy Assistant Field Supervisor (Endangered Species Program), at the letterhead address or at 916/414-6600 if you have questions regarding this response.

cc:
Ranger D. Hatch, GGNRA, NPS, San Francisco, California
Ranger N. Hornor, GGNRA, NPS, San Francisco, California
Ranger D. Fong, GGNRA, NPS, San Francisco, California
Ranger S. Allen, PRNS, NPS, Point Reyes Station, California
Gary Fellers, USGS, Point Reyes Station, California

4/6/2005 7:41 PM FROM: visualpoint.com-usr TO: 84,,14156638132 PAGE: 001 OF 001

Wednesday, April 6, 2005

Ann Nelson
Point Reyes National Seashore
National Park Service
Point Reyes National Seashore
Point Reyes, CA 94956

Dear Point Reyes National Seashore Nelson,

Thank you for the opportunity to contribute to the planning process at Point Reyes National Seashore. I applaud the excellent work you've done in the past, and as you finalize your management plan I encourage you to choose Alternative D - a proactive approach to the problem of axis and fallow deer.

The park is at a critical juncture in its relationship with non-native deer. Because of the deer's expansive nature, the disruption they cause to Point Reyes' native ecosystem could become irreparable. With the Park Service mandate to protect and restore native ecosystems, I believe the park must adopt a plan that can address these issues based on its human and financial resources. If action is not taken soon, proactive solutions will pass us by. Point Reyes must have a roadmap to deal with these ever-expanding species before it's too late.

As you well know, the invasive axis and fallow deer are disruptive in a number of ways. In addition to disturbing native flora and out-competing native fauna, they pose threats to endangered species like the red-legged frog and coho salmon that you've worked so hard to protect. As they grow in population and gain more ground, the deer might become more aggressive toward park visitors. In addition, the financial drain is significant for nearby ranchers, the community at large, and a Park Service already struggling with inadequate budgets. I understand that you have limited staff and resources to deal with monitoring the spread of disease through these invasive animals, which is why an aggressive program that begins now will make all the difference in the future.

Thanks again for this opportunity to voice my support for Alternative D for Point Reyes National Seashore.

Sincerely,

Frank Holmes
6965 Holt Drive
Colorado Springs, CO 80922 - 1608
fsholmes2@msn.com

APR-06-2005 16:47 92% P.01

joslynb@sbcglobal.net
03/01/2005 06:26 PM
GMT

To: ann_nelson@nps.gov
cc:
Subject: Possibly Spam: Spare the Exotic Deer of Point Reyes National Seashore

Ms. Ann Nelson

Dear Ms. Nelson,

Please cancel plans to kill deer in the Reyes Point National Seashore. The exotic deer are in the park because of human action. They were placed on a private ranch for hunting purposes in the 1940's. We now have an ethical responsibility to devise a humane and non-lethal approach to managing them. The culling plan is inhumane and further, the Draft Environmental Impact Statement (DEIS) lacks evidence to indicate that the fallow and axis deer are negatively impacting the environment or other species in the park. The DEIS lacks full and objective information about the feasibility of wildlife contraception methods. The Statement should include an analysis of the feasibility of wildlife contraception, written by experts in the field. Further, the DEIS lacks an alternative that just considers management of the axis and fallow deer through contraception alone. The axis and fallow deer are a special and important part of the visitor experience to the National Seashore and this unique wildlife viewing opportunity should not be destroyed. Please let me know that you will cancel this plan. Thank you for your time and attention.

Sincerely,

Joslyn Baxter
3907 26th Street
San Francisco, California 94131

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Point Reyes
National Seashore

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THE HUMANE SOCIETY OF THE UNITED STATES

8 April 2005

Don L. Neubacher,
Superintendent
Point Reyes National Seashore
Point Reyes, CA 94956
Transmitted via Mail and Email: ann_nelson@nps.gov

Re: Draft Environmental Impact Statement: Non-Native Deer Management Plan

Dear Mr. Neubacher:

On behalf of The Humane Society of the United States (HSUS) and our more than 8.5 million members and constituents, I appreciate this opportunity to provide input on the Draft Environmental Impact Statement (DEIS) on Non-Native Deer Management in Point Reyes National Park (PORE).

While we are sympathetic with the National Park Service's (NPS) concerns for the protection and restoration of native ecosystems on park lands, the DEIS demonstrates that there is, to date, very little documentation of negative impacts of fallow and axis deer on native wildlife, water resources, vegetation, soils, or other natural resources at PORE. The lack of documentation for such impacts calls into question the need for action.

Executive Order 13112 mandates environmentally sound control of invasive species but, as NPS is aware (see DEIS, p. 28), not all non-native species are invasive. While the Point Reyes National Seashore General Management Plan does not appear to differentiate between non-native and invasive species, and does require exotic plant and animal "reduction," it does not require eradication. The more recent PORE Resource Management Plan addresses the "control" of non-native animals (and plants) "that disrupt natural (ecosystems) or prevent their restoration." It apparently does not (at least according to the sections quoted in the DEIS) require eradication, and does not require control or eradication of non-native animals that do not disrupt natural ecosystems. The 2001 NPS Management Policies also require "management" of non-native species if the species "interferes with natural processes and the perpetuation of natural features, native species or natural habitats," but again do not require eradication.

In other words, none of the policies, executive orders, or management plans cited in the DEIS require eradication, and all or most recognize that there is a distinction between non-native species that are invasive vs. those that are ecologically relatively benign. While research into potential impacts of non-native species could become endless and may be viewed as a delay of necessary

Promoting the protection of all animals
2100 L Street, NW, Washington, DC 20037 ▪ 202-452-1100 ▪ Fax: 202-778-6132 ▪ www.hsus.org

management, it appears that such research on the impacts of fallow and axis deer at PORE (or even at other similar sites) has hardly even begun. Before undertaking such an intensive, long-term, and controversial management action that will impact the welfare of fallow and axis deer, NPS must first demonstrate that fallow and axis deer are, indeed, having the detrimental effects that they are alleged to be having. And NPS must also demonstrate that the proposed action (Preferred Alternative) will measurably contribute to the restoration of native wildlife and natural ecosystems within PORE. This second point is important because, while the Preferred Alternative may effectively reduce non-native deer populations (or eradicate them), it is not clear whether control or eradication would help NPS achieve the desired ecological state of the park (e.g. by allowing native cervid populations to increase and reducing ungulate impacts to soil, vegetation, and water resources). At this point, NPS has neither documented negative impacts due to non-native deer, nor shown whether eradication (or control) of non-native deer has the potential to reverse any such negative impacts.

We acknowledge that NPS has done population modeling to roughly estimate the number of deer that would be killed or handled under different management scenarios, and to gauge the feasibility of different management techniques (sharpshooting and fertility control) in achieving eradication. This is an important component of any management plan and we appreciate that the modeling exercises indicate the possibility of reducing the number of deer killed by combining lethal control with fertility control. However, these careful predictive models should have been preceded by equally careful studies to document impacts of fallow and axis deer, determine whether their impacts go beyond those of native cervids (including whether they actually displace native cervids), and modeling to help predict how eradication versus control or no management would affect native ecosystems.

Furthermore, the dairy and beef cattle operations will apparently remain within PORE at least for the near term; these operations are, themselves, likely to be negatively impacting native ecosystems. Because NPS is not planning to remove the cattle operations from the park at this time, it will be impossible for the park to fully restore natural ecosystems. The presence of, not only non-native wildlife which may or may not be impacting native ecosystems, but also domesticated ungulates in PORE, also suggests that the eradication of non-native deer is, at the very least, not a crisis in need of immediate resolution and could be replaced with a plan to at least begin filling in the research gaps before taking action.

Specifically, the justification for the Preferred Alternative (Alternative E), or in fact for any alternative other than the No Action alternative, appears to be based almost entirely on *potential* impacts of fallow and/or axis deer populations, especially at population sizes larger than those that exist currently in PORE.

With respect to impacts of non-native deer on water resources and water quality, the DEIS acknowledges (p. 137) that "little is known about the specific impacts of non-native deer at the Seashore on water resources" and uses impacts of cattle, and/or ungulates generally, to approximate the impacts of non-native deer at PORE. Behavioral characteristics of fallow deer, such as their tendency to congregate in large numbers and remain in one area for long periods, are described anecdotally and are used to suggest that fallow deer impacts are probably similar to those of cattle or other confined ungulates. However, first, cattle are at PORE (even if fenced

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from some sensitive areas) and will remain there for the near term at least, continuing to have whatever impact they may be having whether or not the non-native deer remain. Second, no evidence is presented in the DEIS to show that fallow or axis deer are having any negative impacts on water quality or that the anecdotally described "thrashing" behavior during the rut causes permanent damage to water resources. Third, the DEIS does not show that any impacts non-native deer may be having on water quality go beyond the impacts of the native cervids that evolved in association with the riparian ecosystems addressed in the DEIS. The behavioral characteristics of fallow deer (but probably not axis deer) might suggest a hypothesis of greater impacts on water resources, but such an hypothesis has not been empirically tested.

Regarding impacts on vegetation and soil, the DEIS again relies upon the literature regarding the impacts—or ecological interactions—of ungulates generally, both native and non-native. Any impacts that the cattle may have on vegetation and soil will, of course, continue indefinitely because the cattle will remain in the park under this management plan. Furthermore, the DEIS fails to acknowledge that native wild cervids in PORE are likely to have effects on vegetation and soils that are very similar to those of fallow and axis deer. The DEIS indicates (p. 147) that at "one riparian restoration area in particular, John West Fork of Olema Creek, NPS staff has observed extensive damage to native willows (*Salix spp.*) in areas excluded from livestock access…." But there is no indication of whether native cervids might have similar impacts in the future (or currently). At Yellowstone National Park, for example, it has been widely reported in both the scientific literature and the media that the return of the gray wolf to Yellowstone has helped reduce elk pressure on willows, which has in turn been a boon to wetland and riparian ecosystems. If the untested assumption that non-native deer compete with native cervids were correct, then non-native cervid removal would likely allow tule elk and/or black-tailed deer populations to increase and to use areas currently used more by non-native deer. This in turn would likely allow elk and/or black-tailed deer to impact vegetation and soil (as well as other wildlife and other park resources) in a way that may be qualitatively and quantitatively equivalent to that of the non-native deer currently.

Regarding impacts of non-native deer on native wildlife, the DEIS again relies on untested assumptions or "potential" impacts, as well as a few studies of ungulate diet and dietary overlap among species. The key finding of concern to the NPS appears to be the overlap between the diet of black-tailed deer and that of both non-native deer species in times of drought and at the end of the summer, as well as the overlap in diet among elk and the two non-native deer species. As the DEIS acknowledges (p. 149), information about diet or dietary overlap is not sufficient to conclude that interspecific competition is occurring and is limiting black-tailed deer or tule elk populations in PORE. The DEIS describes the scientific literature regarding poor condition of female cervids and reduced fertility as a result of food shortage. This is certainly a concern if it is occurring, but the DEIS presents no evidence that it is happening. The observations of behavioral displacement of tule elk by fallow deer suggest that research is needed to quantify this displacement and to determine whether it is associated with decreased foraging, lower body condition, or reduced reproductive output in elk. With respect to the susceptibility of native (and non-native) cervids to livestock diseases, we have found nothing in the DEIS to suggest that the mere presence of non-native deer actually increases the risk of disease transmission to tule elk or black-tailed deer (i.e. above the risk that would exist if all cervids in the park were native).

We appreciate that NPS is not considering public hunting as an option in non-native deer management. The HSUS believes that public hunting is an inappropriate activity for National Parks and National Seashores. We agree that, even if non-native deer eradication (by any method) could be justified, public hunting is unlikely to be effective in achieving such an eradication and would likely result in unnecessary pain, injury, and distress to affected deer.

We also appreciate that NPS has selected a Preferred Alternative that combines non-lethal management with lethal control, rather than selecting a lethal-only alternative. However, as we explain above, there is little evidence of "invasiveness" of the non-native deer at PORE. Again, we understand NPS' concerns that are based on anecdotal evidence and limited research on diet and dietary overlap. But we suggest that, at this point, rather than initiating a long-term and intensive management action that may prove to have little real benefit, the NPS instead withdraw this DEIS and initiate much needed research into the impacts of fallow and axis deer on native ecosystems within PORE, both at current population sizes and at projected future population sizes. Examples of research questions include, but are not limited to: (1) whether displacement of tule elk by fallow deer results in reduced time foraging by elk, reduced body condition of elk, or reduced reproductive output by elk; (2) whether dietary overlap between native and non-native cervids reduces forage or cover available to native wildlife and in turn limits the survival and/or reproduction of native wildlife; (3) whether non-native deer impacts on soil, vegetation, and water resources is qualitatively or quantitatively different from impacts of native cervids; and (4) whether presence of non-native deer measurably increases the risk of transmission of livestock diseases to native cervids. Addressing these and other research questions would provide a solid scientific basis for any future management decisions and would allow the NPS to determine whether management of non-native deer is necessary to restore and protect native ecosystems, whether and how eradication or control will benefit native ecosystems, and whether fertility control alone could be used to achieve eradication (or control) especially if long-lasting (or permanent) or easily delivered contraceptives become available in the near future.

In addition, we suggest that NPS fully explore an alternative that would result in elimination or a gradual phase-out of livestock operations within PORE. The livestock diseases to which native cervids are susceptible will continue to pose a risk to native cervids as long as livestock remain in the park, with or without the presence of non-native cervids. Furthermore, as the DEIS acknowledges, the concentrated livestock operations are almost certainly degrading park resources (e.g. DEIS p. 148). Though the DEIS notes that these ranching operations have been reduced to "only 25%" of the overall land area, we find it incredible that a National Seashore would maintain so much land in agricultural operations that "might adversely affect several threatened and endangered species at the park," according to the U.S. Fish and Wildlife Service's Biological Opinion (referenced on p. 34 of the DEIS). A full quarter of the park's land area is used for concentrated dairy and beef cattle operations, and this will be allowed to continue while fallow and axis deer will be eradicated in an attempt to restore natural ecosystems despite a lack of evidence that these deer are degrading ecological processes in the park. The DEIS notes that changes in policies regarding livestock operations are possible in the near future with the next round of general management planning. We strongly urge the NPS to make such policy changes the management priority for the near future. With respect to non-native deer, the immediate need is research, as suggested above.

However, if NPS undertakes management actions to control or eradicate non-native deer despite the current lack of scientific justification, we believe that a more reasonable approach at this time would be an alternative combining research on non-native deer impacts with fertility control. We suggest that NPS revise this DEIS to evaluate an alternative that would combine research (such as that suggested above) with fertility control. This would allow NPS to shore up scientific understanding of non-native deer impacts at PORE but would also allow for non-native deer management to begin, even in the absence of scientific support for the need for or effectiveness of such management.

Again, we appreciate the opportunity to comment on this important matter.

Sincerely,

Bette Stallman, Ph.D.
Wildlife Scientist
Wildlife and Habitat Protection

5

The
NATIONAL HUMANE
EDUCATION SOCIETY

Fostering a sentiment of kindness to animals

April 8th, 2005

Superintendent John Dell'Osso
Point Reyes National Seashore
Point Reyes, CA 94956

Dear Superintendent Dell'Osso,

I am writing on behalf of The National Humane Education Society (NHES) and its 400,000 supporters nationwide—many of whom are California residents—to strongly urge the Point Reyes National Seashore to implement only humane methods of population control for the growing number of Fallow and Axis deer on the national park land.

As a non-profit organization which promotes the humane treatment of all animals, NHES is opposed to cruelty to animals in any form, and we are therefore, adamantly opposed to the use of mass killing as a form of wildlife population control. Specifically, NHES is strongly opposed to the proposal of exterminating the Fallow and Axis deer population via hunting.

Further issues of consideration:

- *Net Loss of Revenue:* Many wildlife watchers stop going to parks when they feel unsafe and displeased by hunting; this comes as significant loss of revenue as there are far more wildlife watchers then hunters.
- *Unnecessary Strife:* Often wildlife must endure hunting seasons outside of park lands, and must also adjust to increasing human development. National parks may be the last safe haven wild animals have from unnaturally arduous stresses.
- *Not Effective Population Control:* There is currently no solid evidence supporting hunting as an effective management tool for overpopulation, diseases, nuisance animals, or protection of endangered species.
    - Furthermore, at this time there is no solid evidence supporting the suggestion that Fallow and Axis deer are negatively impacting the environment or harming the native Black Tail deer.

NATIONAL OFFICE:
P.O. Box 340
Charles Town, WV 25414-0340
Phone 304/725-0506
Fax 304/725-1523
www.nhes.org

PROGRAM:
SPAY TODAY
P.O. Box 340
Charles Town, WV 25414-0340
Phone 304/728-8332
Fax 304/724-6765
www.nhes.org

AFFILIATE:
PEACE PLANTATION
ANIMAL SANCTUARY
12752 State Hwy. 206
Walton, NY 13856-2327
Phone 607/865-5759
Fax 607/865-6334
www.ppasny.org

PROGRAM:
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P.O. Box 1023
Charles Town, WV 25414-10
Phone 304/724-6558
Fax 304/724-6765
www.baacs.org

With these facts in mind, NHES adamantly requests that Point Reyes National Seashore pursue humane methods of population control for the Fallow and Axis deer. In place of killing these sentient creatures, we highly encourage the park to use humane methods such as relocation of deer to less population areas of land, and the use of contraceptives to deter excessive reproduction.

In closing, NHES feels that the creation and enactment of laws pertaining to the humane treatment of *all* animals is of utmost importance. To allow animals neglect and/or abuse is a definite risk to a community and society as a whole. By utilizing humane wildlife population control within national parks, we can remain one step closer to a more humane society.

Thank you very much for your time and effort regarding this issue. NHES will also continue to work for animal welfare and responsible and humane communities nationwide. I look forward to your positive influence on this situation.

For the animals,

Maria Keith

Maria Keith
Humane Education Assistant

IN DEFENSE OF ANIMALS

April 3, 2005

Mr. Don Neubacher
Superintendent
Point Reyes National Seashore
Point Reyes Station, CA 94956

Via Fax (415/663-8132) and Email: ann_nelson@nps.gov
16 Pages

Dear Mr. Neubacher:

Please accept this letter as comments on the Non-native Deer Management Plan Draft Environmental Impact Statement (DEIS) submitted on behalf of In Defense of Animals.

We are disappointed in this document because we believe it is not an objective assessment of the situation with the non-native deer at the park, nor is it an adequate evaluation of the non-lethal alternatives available to the park for controlling the exotic deer populations.

In reading the DEIS document, we are struck by the lack of scientific documentation indicating that the deer are negatively impacting the natural resources of the Pt. Reyes National Seashore (PRNS). We are also struck by the lack of hard data to support the Berkeley computerized population projections. We recall how far off these projections were regarding the carrying capacity of the tule elk range in the early 1990's.

While we recognize your legitimate concerns about the deer colonizing outside the park, it is also clear that the deer are not having significant negative impacts on the park environment at present. As a result, the park has the luxury of time to undertake non-lethal fertility control programs that could impact population growth of both species over the long run.

We believe that the DEIS is woefully inadequate in its exclusion of a strictly non-lethal, alternative for managing the deer population. The section describing the feasibility of immunocontraception and immuno-sterilization is also woefully inadequate and appears to have been written by biologists philosophically opposed to wildlife contraception.

We believe that no discussion of non-native deer extirpation through lethal means can occur while cattle graze nearly 20,0000 acres. These cattle are far more destructive to the park's natural resources than the non-native deer could ever be. The park should conduct an Environmental Impact Statement (EIS), in accordance with NEPA, thoroughly addressing the significant environmental impacts of agricultural lease renewals on the PRNS before completion of the non-native deer management plan. NEPA requires that the cumulative

IN DEFENSE OF ANIMALS • 131 CAMINO ALTO, SUITE E • MILL VALLEY, CA 94941 • 415/388-9641

process for only non-native species, you have looked at only one side of the equation. More is required under NEPA before lethal extirpation of the non-native deer could be legally or ethically justified.

Clearly public opinion favors non-lethal, humane management of these deer species. The DEIS should be re-written to include a preferred alternative of non-lethal management methodologies and the PRNS should rely on actual experts in the field of wildlife fertility control in its assessment of this alternative.

More detailed comments are attached to this letter.

Sincerely,
Suzanne Roy

Suzanne Roy
Program Director
In Defense of Animals
919/732-8978
Suzanne.e.roy@earthlink.net

Attachment: Specific comments on DEIS
U.S. District Court, District of Columbia Civil No. 98CV2355 (RMU)
Abstract: Zoo Biology, Vol. 22, Issue 3, Pages 261-268

APR-04-2005 17:00 99% P.02

IN DEFENSE OF ANIMALS

April 4, 2005

Mr. Don Neubacher
Superintendent
Point Reyes National Seashore
Point Reyes Station, CA 94956

Via Fax (415/663-8132) and Email: ann_nelson@nps.gov

1 Page: Addendum to IDA's Comments on the PRNS Non-native Deer Management Plan Draft Environmental Impact Statement (DEIS)

Dear Mr. Neubacher:

I have just been in touch with Dr. Jay Kirkpatrick. He reports not only does pZP work fine in fallow deer (as stated in the Zoo Biology article included with my comments), but also that the antibody titers remain very high for a long period of time. This means that after the first two or three years of treatment, the deer do not have to be treated annually. His current estimate is that they would have to be treated once every four to five years after that. He reports that this is different from white-tail deer and seems to be species-specific in fallow deer.

The omission of the latest published research on immunocontraception in fallow deer, and the failure of the DEIS author to contact Dr. Jay Kirkpatrick, the leader in the field of immunocontraception is a major shortcoming of this document. It is disappointing that your staff did not prepare a more objective assessment of this cutting-edge wildlife management technology.

Sincerely,

Suzanne Roy
Program Director
In Defense of Animals
919/732-8978
Suzanne.e.roy@earthlink.net

IN DEFENSE OF ANIMALS • 131 CAMINO ALTO, SUITE E • MILL VALLEY, CA 94941 • 415/388-9641

APR-04-2005 17:15 99% P.01

IDA COMMENTS ON PRNS NON-NATIVE DEER MANAGEMENT PLAN DRAFT ENVIRONMENT IMPACT STATEMENT
April 3, 2005

I. Overview

The 2001 NPS policy regarding non-native species "specifically requires managers to manage all non-native species not maintained for an identified park purpose, up to, and including eradication, if control is prudent and feasible and the species "interferes with natural processes and perpetuation of natural features, native species or natural habitats."

In its preferred alternative, PRNS seeks to eradicate the non-native deer primarily through lethal culling activities, supplemented by small-scale immunosterlization trials. Through the DEIS, however, the park has failed to demonstrate that this extermination of the axis and fallow deer from PRNS is justified.

The DEIS lacks evidence that the non-native deer species are interfering with the natural resources of the park in any significant way. Further, the DEIS failed to adequately explore the impacts of culling on the natural resources of the park, a factor that could render massive sharpshooting and extirpation of the deer imprudent. Finally the DEIS failed to realistically assess the ability of culling to eradicate non-native deer from the park, a factor that would make the PRNS preferred alternative infeasible and not in accord with the 2001 NPS directive.

II. There is no scientific documentation to indicate that the axis and fallow deer are negatively impacting native species in the park.

The NPS has clearly failed to ensure the scientific integrity of the DEIS's analysis of the impacts of culling non-native deer on the Park's resources, as is required by the Council on Environmental Quality (CEQ) regulations. <u>See</u> 40 C.F.R. § 1502.24. This is demonstrated clearly in the summary statement:

> "Some of the more serious effects these non-native deer have at the seashore include possible competition with, and displacement of native tule elk and black-tailed deer... the *potential* for transmitting disease to these native ungulates, and heavy use of and resulting impacts to riparian habitat and *presumably* to the native wildlife dependent on these habitats." (p. 24, Emphasis added)

A. <u>Many of the impacts cited are either minor or speculative:</u>

> "Current impacts to water quality and resources from non-native deer in the park are minor. . ."

> "Soils *could* be affected by non-native deer in several ways. . ."

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"Deer, and other ungulates, *can cause* a variety of impacts on vegetation"

"Damage to riparian and understory vegetation within the seashore is currently considered minor in intensity."

"Non-native deer, *can* affect native wildlife . . ."

"To date, no direct effects have been noted on the productivity or survival of [spotted] owls."

"Western snowy plovers nest along the sandy beaches of the Seashore that *may* also be used sporadically by axis deer."

"Fallow deer regularly frequent riparian areas where California red-legged frog live and/or breed. They *can* destroy vegetation by trampling or eating plants, and by thrashing their antlers during the rut. Overall the adverse impacts . . .. would be minor and long term."

"To date it is not known whether the non-native deer browse on the preferred nectar or larval host plants of the [Myrtle's silverspot] butterfly. However, research elsewhere suggests that they *may* graze on species similar to the one plant that serves as a larval host for Myrtle's silverspot butterfly at PRNS."

B. <u>Future impacts are based on questionable computer models of population growth curves.</u>

These computer models have been demonstrated to be faulty before, as in the case of wrong estimates of the carrying capacity of the tule elk range, which have been revised upwards by hundreds of animals since the original modeling projections – made by the same U.C. Berkeley scientists – were generated in the early 1990's.

The computer models are not based on real field data. Data that PRNS lacks include:

- Studies that look at the reproductive rate for fallow, axis, black tailed deer and tule elk as impacted by amount and distribution over a year of rainfall. This actual data could be collected through fecal samples and weather records.
- Evaluation of whether vegetation in areas where fallow deer live is different in biomass and/or species varieties than in areas where they do not live;
- Examination of the degree of overlap in the diet between the fallow, axis, and black-tailed deer and tule elk.

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This real data could be generated by scientists doing work in the field as opposed to those sitting behind their desks working on computer models that have been proved wrong in the past.

One actual study is apparently underway. Page 123 of the DEIS states that an analysis of ungulate fecal pellets by Humboldt State University has been ongoing since 2000. The DEIS states that this study should be able to identify any overlap between the tule elk diet and the fallow deer diet in the Limantour area of the PRNS. However, the data is not yet in, and the assumptions in the DEIS about fallow deer impact on vegetation and native tule elk species are premature.

C. <u>The DEIS relies on anecdotal information to suggest a negative impact of the non-native deer on native species.</u>

- For example, the DEIS mentions unpublished data of fallow bucks observed sparring with tule elk bulls and chasing them off. No information is given on the number of bulls involved or of the frequency with which this behavior has been observed. IDA is aware that one male fallow buck was seen challenging tule elk males around the time of the rut. This was considered to be an odd an exceptional animal – who has been seen trying to herd female elk around but not being very successful at it.

<u>D. The DEIS makes speculations that do not seem to be grounded in reality.</u>

The DEIS states:

> "resource managers are concerned that [the tule elk] *may* be kept from fully occupying habitat in PRNS [at the Limantour site] by competition from fallow and/or axis deer."

With 38 elk on 22,0000 square acres at that site, this speculation stretches the limit of credibility.

<u>E. The DEIS relies on studies of questionable relevance to the situation at PRNS.</u>

The relevance of studies in New Zealand of high-density populations of fallow deer out-competing native red deer is questionable. Too few variables are described to know whether extrapolation from that situation to the PRNS situation

III. There can be no justification for extirpation of non-native deer through lethal means while non-native, environmentally destructive, cattle continue to graze tk acres of the PRNS.

A. <u>Cattle have far greater environmental impacts on the park than do non-native species</u>.

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PRNS cites a Biological Assessment, conducted under the Endangered Species Act, to analyze the effect of agricultural lease renewals on special status species in the park. PRNS reaches the illogical conclusion that ranching with 6,350 non-native cattle on 18,900 acres of the national seashore is not likely to jeopardize these species, while it uses speculation, anecdote and supposition to conclude that the 860 fallow deer and the 250 axis deer in the park will negatively impact these species.

PRNS should undertake an objective assessment, in accordance with NEPA, of the environmental impacts of ranching lease renewals in the park. The final EIS on the management plan for the non-native deer should include an alternative that considers eliminating ranching and dairy operations from the park. Such a plan would create thousands of acres more habitat for native species and would change the equation with regard to concerns about non-native deer.

NEPA requires that "connected actions, which means they are closely related" should be "discussed in the same document. (CEQ Regulation 1502) The DEIS considers only one side of the equation – the impacts of non-native deer – without considering the impacts of cattle and their interrelatedness with overall impacts to the PRNS ecosystem.

The DEIS also discusses the impacts of the non-native deer on ranching operations. In doing so, it exaggerates these impacts – in reality only 4 of 26 ranches reported problems of minor intensity. IDA does not believe that the objective of the park to eliminate the non-native deer to lessen impacts on ranching within the PRNS is legitimate or legally justified.

The DEIS discusses the potential that non-native deer carry paratuberculosis, but does not state that the deer got the disease from the cattle in the first place. Paratuberculosis is endemic to the West Marin region, due to the predominance of ranching activities there. The DEIS states the prevalence of paratuberculosis was about 10% and 8% in axis and fallow deer, respectively, but does not state the prevalence of the disease in cattle in the region.

Again, this is an issue that has been distorted in the DEIS - suggesting that the non-native deer are vectors for this disease without reporting that the disease, is in fact, endemic to cattle and dairy ranching in West Marin. It is the cattle that are the real reservoir of this disease and pose the most risk to native wildlife.

In addition, the chances that paratuberculosis will become more of a problem will be increased by culling, as a stressed population is more susceptible to this disease. Culling could <u>increase</u> chances of disease transmission to cattle and native wildlife. This impact should have been explored in the DEIS.

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APR-04-2005 17:00 99% P.06

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III. The DEIS failed to include an alternative that involved a strictly non-lethal fertility control program for management of the deer.

A. The DEIS did not objectively evaluate the potential of immuno-contraception and immuno-sterilization for control of the non-native deer species.

NEPA requires that an environmental impact statement should "rigorously explore and objectively evaluate all reasonable alternatives . . . " (CEQ Regulation 1502).

The PRNS officials dismissed the feasibly of non-lethal population management without out consulting leaders in the field of wildlife contraception for their assessment.

The DEIS appears to have been prepared by biologists who are philosophically opposed to wildlife fertility control

- Park biologists met with community groups as long as 2 years ago and stated that contraception was not feasible. This conclusion was reached before any environmental analysis was prepared.

- Park biologists used unscientific statements to support their contention about the infeasibility of fertility control. One example is the claim that immunocontraceptives could get into the food chain if a deer is preyed upon by a mountain lion or hunted by people and used for meat. This is untrue. According to Dr. Jay Kirkpatrick, the pioneer of the immunocontraceptive porcine Zona Pellucida (pZP), "The vaccine is a non-microbial protein molecule, which can't go through the food chain even if you wanted it to." Dr. Kirkpatrick states if that was possible scientists wouldn't have to go out and dart the animals, they could just feed them the contraceptive drug. (email communication 3/14/2005)

B. The DEIS selectively quotes the scientific literature to make a case against the use of fertility control in non-native deer.

The DEIS states:

> " No published reports exist of pZP's effectiveness in preventing fallow deer from reproducing; however Kirkpatrick concludes from unpublished data that a yearly pZP vaccine would be "ineffective in fallow deer" (Kirkpatrick, et. all 1996a and b)." (Pg. 42, Emphasis added.)

The DEIS ignores recent published data indicating that fawn production was "reduced significantly" in two herds of semi-free ranging fallow deer inoculated

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with pZP. ("Immunocontraception of captive exotic species: Contraception and population management of fallow deer," Zoo Biology, Vol 22, Issue 3, p. 261-268, June 2003. (See attached abstract.)

C. The DEIS, without foundation, rejects out of hand the use of SpayVac, a longer-acting immunocontraceptive on axis deer.

It states:

> "No long-acting contraceptive currently exists for axis deer. . . .annual contraception is ineffective in reducing the population of axis deer to 350." (p. 44)

Yet on Page 42, the DEIS states,

> "Immunocontraception with the porcine Zona Pellucida (pZP) vaccine has also been shown to prevent conception for 1 year in a variety of deer species, including axis deer. (Kirkpatrick, et. al. 1996) "

The DEIS fails to state that SpayVac, the immunocontraceptive/sterliant the park proposes to pilot is just a longer-acting version of the pZP vaccine.

D. The latest information about immunocontraception in fallow deer is not included in the DEIS.

No mention is made of the pilot study currently underway on private land in South Carolina with SpayVac on fallow deer. In that project, a South Carolina marsh of 3 square miles and 600 deer, 87 deer were caught, tagged and immunized in a one-month period. (Allen Ruttberg, Tufts University, telephone conversation, 3-22-05)

D. The DEIS states that a fertility control program large enough to manage the non-native deer without lethal control is too labor and cost intensive without considering the volunteer expert assistance and private funding that would be available to PRNS for a progressive, non-lethal fertility control program.

As one example of private funding availability, the Bosack Kruger Foundation awarded PRNS a $40,000 grant to underwrite the tule elk immunocontraception project in the mid- 1990's. In addition, public support for a non-lethal program is strong; contributions from the public to underwrite such a program could be made to the Pt. Reyes National Seashore Association. This aspect of resource availability for the park was completely overlooked in the DEIS.

E. DEIS rejects out of hand the feasibility of fertility control programs, again basing its conclusion on unverified, theoretical computer models and as cited above, selective citing of the scientific literature. This conclusion is reached before the results of the pilot study of SpayVac on fallow deer (Exotic Deer Immunosterilant, PORE *PMIS Number 67856*) are known.

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IV. The DEIS does not adequately explore the effectiveness or the impacts of culling on the park.

A. The DEIS overestimates the ability of park sharpshooters to exterminate the non-native deer from the park.

The DEIS does mention that once shooting begins, deer may move to various inholdings of private land in and around the park. One of these, the Vendanta property, has stated unequivocally that they will not allow park sharpshooters to kill any deer on their property. This means that there will be a refuge for the non-native deer in Olema Valley, making their total elimination highly unlikely.

B. The DEIS failed to explore the likelihood that culling will actually increase the incidence of non-native deer leaving the park.

Sharpshooting activities will create pressure on the non-native deer population to leave park boundaries for private inholdings or areas beyond park boundaries where hunting is rare. The low incidence of hunting in Marin County means that it will be safer for non-native deer outside the park then inside the park. This action could actually create an effect opposite to PRNS's goal of decreasing the number of deer leaving park boundaries.

C. The DEIS failed to examine the impact of culling on paratuberculosis infection of the non-native deer herds.

Published research shows that paratuberculosis affects young, old and weakened animals. A stressed population will be more vulnerable to paratuberculosis. If the incidence of paratuberculosis in the non-native deer populations increases, and the non-native deer leave the park in increasing numbers, then spread of paratuberculosis could become a real issue. Currently, only a small percentage of deer carry the disease and few seem to be affected by it.

D. The DEIS failed to adequately assess the impact of culling on other wildlife species in the park.

- The DEIS did not adequately examine the impacts of culling activities on native deer. These include: increased human intrusion into deer habitat, noise, stress from shooting, and increased predation due to decrease in non-native deer population.
-

IDA COMMENTS ON PRNS NON-NATIVE DEER MANAGEMENT PLAN DRAFT ENVIRONMENT IMPACT STATEMENT
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- The DEIS did not adequately assess the impact of culling activities on endangered and threatened species, such as the spotted owl, in the park, including <u>any</u> site-specific discussion of where sharpshooting is expected to take place, and what ESA-listed species may be affected. These include: increased human intrusion into habitat, including wilderness areas, noise, stress from shooting and possible conflicts with Fish and Wildlife Service Species Recovery Plans.

- The DEIS presents insufficient details on culling activities, such as numbers of sharpshooters, duration of shooting, specific vehicular intrusions on habitat, etc. for the public to make an informed decision about the impacts of culling activities on wildlife in the park.

- The DEIS does not address the fact that culling activities and the resultant increased human intrusion onto habitat are counter to the goals of minimizing human impact on wilderness areas and habitat for special status species.

- The PRNS does not appear to have undertaken a Section 7 consultation with Fish and Wildlife Service with regard to the impact of culling/extirpation activities on protected species, as required under the Endangered Species Act. Particularly with respect to the ESA-listed bird species in the Park, including the Northern spotted owl and the plover, acoustical disturbances from sharpshooting will undoubtedly have an effect on any species that are in the vicinity. Although the EIS failed to identify, much less discuss in any meaningful detail, the impacts that culling in the Park may have on these species, and has nowhere explained exactly where sharpshooting is to occur, all of the impacts discussed above warrant further analysis by the NPS and the FWS through ESA section 7 consultation. Indeed, without such analysis, there is certainly a risk that sharpshooting in the project area could result in a prohibited "take" of these species under ESA section 9, by either "harm[ing]" or "harass[ing]" them within the meaning of the ESA. <u>See</u> 16 U.S.C. § 1538(a)(1)(B); 50 C.F.R. § 17.3.

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April 8, 2005

Mr. Don Neubacher, Superintendent
Point Reyes National Seashore
Point Reyes Station, California 94956

Re: National Park Service Non-Native Management Plan/Draft Environmental Impact Statement – Point Reyes National Seashore

Dear Superintendent Neubacher:

On behalf of the Marin Conservation League's Board of Directors, I am writing to voice MCL's strong support for the National Park Service's Preferred Alternative which would eradicate both species of non-native deer from the Point Reyes National Seashore by 2020 in the December 2004 Non-Native Management Plan/Draft Environmental Impact Statement - Point Reyes National Seashore (hereinafter Draft Plan). The League, whose mission is to preserve, protect and enhance the natural assets of Marin County, is deeply concerned about the significant impacts that exotic species are having on biological diversity and our ecosystems – both locally and worldwide.

The presence of hundreds of Axis deer (*Axis axis*) and Fallow deer (*Dama dama*), both non-native cervids introduced decades ago into what is now the Point Reyes National Seashore, not only are competing directly with native species for food and cover, but are also degrading their habitats by adversely impacting the area's soils, vegetation and water. Failing to address these problems through a scientifically-based deer management plan will only perpetuate and amplify these impacts within the National Park boundaries and eventually throughout Marin County.

MCL has carefully reviewed the Draft Plan alternatives and believes that the Service compellingly demonstrates that Alternatives B and C, which call for controlling non-native deer numbers for both species at a pre-determined level, are biologically and scientifically misguided and uneconomic. If adopted, these actions would result in thousands of animals being killed in perpetuity, millions of dollars in public funds being expended, and valuable staff time being diverted, with only limited benefit to the National Seashore's ecosystems. It is clear that

Mr. Don Neubacher
April 8, 2005
Page Two

the most environmentally responsible alternative must include complete eradication of both Axis and Fallow deer, as proposed in Alternative E.

The Draft Plan reviews the current state of contraceptive technology and argues convincingly that contraception alone will not remove all the non-native deer from the National Seashore. Although lethal removal is clearly the most effective and economical method for management and removal of non-native deer populations, the Service needs to develop contraceptive methodology for potential application to other federal lands and so includes the use of limited contraception in its Preferred Alternative. That said, the Service's overriding management goal must be the timely removal of both Axis and Fallow deer and eliminating the environmental impacts these non-native species are having on the Seashore's ecosystems.

While there are those who oppose the use of lethal means for removing Axis and Fallow deer, these concerns should not override critical management decisions made by park professionals charged with overseeing the protection and restoration of federal lands. The Service's mandate is to protect and restore native wildlife and plant life on its lands. For this reason MCL believes that preserving an introduced invasive species at the expense of the health of an entire ecosystem would be unjustified and a poor use of American taxpayers' money.

Thank you for the opportunity to comment on this important matter and we look forward to reviewing the Final Environmental Impact Statement in the coming weeks.

Sincerely,

Jana Haehl
President

The Marin Humane Society

March 10, 2005

Superintendent Donald Neubacher
Pt. Reyes National Seashore
Pt. Reyes, CA 94956

RE: Non-native deer management

Dear Superintendent Neubacher:

I am writing on behalf of the Marin Humane Society to express our concern about the lethal elements of the proposed Management Plan for the axis and fallow deer at the seashore.

Over the past 50 years the community has hiked the seashore trails and picnicked on its slopes seeing axis, fallow and black-tail deer along with the reintroduced Tule elk. Although labeled "non-native" and scheduled for eradication in the Plan, after a half-century the axis and fallow species are now an integral part of the landscape.

Adding the label "invasive" to "non-native", the deer are blamed for a range of sins that sidesteps our collective responsibility for releasing the animals in West Marin. If there is an environmental imperative to address the number of deer, then there is also a moral imperative to do so humanely. In doing so we must keep in mind that individual animals as well as species have moral standing in our worldview and actions.

The Humane Society sees the deer as easy targets in 2005 for a Park that is totally out of sync from the landscape of 1905. What meaning does non-native have anymore? Are there plans to eliminate the red fox and opossum? What makes these two cervid species dangerous to the continued integrity of the Park?

171 Bel Marin Keys Blvd. Novato, CA 94949
(415) 883-4621 • FAX (415) 382-1349 • www.MarinHumaneSociety.org

If a compelling argument can be made for reducing the number of axis and fallow deer, then the Marin Humane Society urges the Park Service to explore and implement a 100% nonlethal approach. In such an approach you would find the Humane Society and its 10,000 constituents both partners and allies.

I would appreciate the opportunity to speak with you before the April 8 comment deadline. I can be reached directly at (415) 506-6200 or dallevato@marinhumanesociety.org.

Sincerely,

Diane Allevato
Executive Director

cc: Senator Barbara Boxer
Senator Dianne Feinstein
Representative Lynn Woolsey

NPCA NNDMP Final Comments

Point Reyes National Seashore
Non-Native Deer Management Plan Comments

Submitted by
Neal Desai
on behalf of
National Parks Conservation Association
April 8, 2005

The National Parks Conservation Association (NPCA) submits the following comments and suggestions to help guide the process of creating the Non-Native Deer Management Plan (NNDMP) for Point Reyes National Seashore (PORE). NPCA is a non-profit organization with a primary mission to protect and enhance America's National Parks for present and future generations. As the nation's largest membership organization dedicated solely to national parks, we represent a broad array of existing and potential park users. We have more than 300,000 members nationwide, with more than 40,000 members in the state of California.

NPCA would first like to recognize the excellent work of the National Park Service (NPS) in the overall management of this unit to date. Having been established in 1962 to "preserve, for the purposes of public recreation, benefit, and inspiration, a portion of the diminishing seashore of the United States that remains undeveloped," we feel that the management of PORE has generally been successful in serving the various stakeholders and user groups the park's enabling legislation intended it for.

NPCA supports PORE's proactive approach in developing the NNDMP, as past management of the non-native deer (NND) did not involve the breadth and depth of analysis, both scientific and park management, which this plan displays. Because of the NND's expansive nature, the known and anticipated disruption they cause to PORE's native ecosystem, and the NPS mandate to protect and restore native ecosystems (*Management Policies*, Executive Order 13112), NPCA believes that the park must adopt a plan that can address the above issues thru a plan based on its human and financial resources.

Therefore, Alternative A/The No-Action Alternative would be ruled out since it does not contribute to the NPS mandate to remove non-native species. NPCA acknowledges that even though some analysis and modeling of the NND is based on deer data outside PORE, this is not ground to discredit the findings as it applies to PORE and the pursuit of an action alternative. It is only a matter of time, if not acted upon, that the park will be forced to take a reactive stance in managing the NND. PORE must have a roadmap to deal with these ever-expanding species.

Currently, both species of NND are:

- **Disruptive to natural ecosystem, which will increase the risk and probability of a future crisis situation, perhaps irreparable.** These NND eat

NPCA NNDMP Final Comments

more than 1 ton of forage a day (this will mean competition for food with native tule elk and black-tailed deer, especially during the dry season). Unacceptable high levels of congregation in riparian and woodland habitat by NND have the potential to negatively affect endangered species, such as red-legged frog and Coho Salmon. We ask that PORE consider visitor safety in adopting an alternative, as fallow deer are known to be very aggressive to other wildlife and potentially to, as their population and geographic range grows, park visitors.

- **Financial burden for NPS, ranchers, and community at large.** Some ranchers spend up to $4K repairing damage caused by deer. When the geographic range of the NND expands, this financial burden will also carry. Relating to PORE, as long as the NND exist, there are infinite staff time and resource costs for monitoring disease/spread of disease in NND.

NPCA supports the need to take action in Alternatives B and C, however both fall short in adequately addressing control (i.e. deer that will eventually leave the park as time increases), known negative impact of NND to native habitats, and perhaps most important in overall park management: minimizing long-term diversion of staff time and Seashore resources from other resource management projects. By taking into account other projects in resource management, and also other areas in the PORE's operations that fulfill the mission of the park (e.g. interpretation), we recommend PORE adopt an eradication alternative, as too much human and financial resources are consumed by both Alternatives B and C over the long run, given each has no time limit. Because axis deer breed year-round and as early as the age of 4 months, plans to successfully contracept females of this species appear less feasible.

Considering eradication is the end goal over the same time period, NPCA supports Alternative D. Alternative D, compared to the preferred Alternative E, is less painful/and one can argue less cruel to the deer, more manageable than contraception procedure (i.e. capture/immobilize, inject contraceptive, tag deer for monitoring), safer for PORE staff (risk of injury from struggling deer and aerial net gunning), and less expensive (D costs $300/animal, and E costs $3,000/animal).

NPCA would recommend that PORE devise a detailed plan for Alternative D, outlining the logistics for the process, from sharpshooter training to removal of deer, and alternatives within, taking into account any roadblocks, such as the monitoring of the deer.

Thank you in advance for this opportunity to contribute to the planning process at PORE. NPCA looks forward to working further with NPS and other stakeholders to develop a NNDMP that will guide non-native species management for years to come and protect the park for future generations.

UNIVERSITY OF CALIFORNIA, BERKELEY

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COLLEGE OF NATURAL RESOURCES
DEPARTMENT OF ENVIRONMENTAL SCIENCE, POLICY, AND MANAGEMENT
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BERKELEY, CA 94720-3110

28 March 2005

Mr. Don Neubacher, Superintendent
Attention: Non-Native Deer Plan
Point Reyes National Seashore
Point Reyes Station CA 94956

Re: Exotic Deer Control Plan

Dear Mr. Neubacher:

I want to express my support for the Exotic Deer Management Plan currently open for comment, and endorse the preferred alternative.

I had been a professor of wildlife biology and management for 40 year until my retirement last fall, but still remain active in research and management issues. I spent most of my career studying the ecology and behavior of large mammals and, in fact, did much of the basic work supporting the models used in this report. I have had a long involvement with wildlife policies at Point Reyes National Seashore, having visited there before its establishment, and served on a number of formal and informal reviews of issues. Therefore, I feel qualified to make professional judgments concerning the exotic deer report.

First of all, technical matters. I think the report is strongly supported by the science available now, and it is more than adequate to the purpose. Yes, some things will prove to be a bit in error, but the essential facts are well founded on objectively pursued research, both at Point Reyes and elsewhere. It further should be noted that because of its inherent natural values, Point Reyes National Seashore has been blessed with an inordinate amount of large mammal research. On-site documentation is available, and has been for a long time.

The two modelers (Barrett and Hobbs) who submitted analysis of the impacts are well known to me (literally since they were students), and both are excellent at this work. The results are as close to accurate as can be had, firstly because the basic principles underlying the models have withstood the test of time, and secondly because of the rich body of information specifically from Point Reyes peninsula. Although no rational scientist would claim that the results are exact, the predictions are almost certainly within 5-10% of the correct ones, and this degree of accuracy is far more than need to support the management actions being proposed. In general, the report is modest in its claims, and gives a conservative evaluation, given the abundance of data and length of time things have been studied at Point Reyes.

Second, I will address the emotional issues. I am well aware that animal protection groups will find the use of lethal means objectionable on moral grounds, and this is a position with which I sympathize. I too regret that such an approach is necessary, especially in a National Seashore, and wish it was not. Still, these objections must be balanced against countervailing moral issues, and must take into account the practical consequences of what needs to be done.

Thus, the need for lethal control of exotic deer at Point Reyes must be weighed against the imperative that we stop and, to the extent possible, reverse the effects of wholesale transporting of exotic species about the globe by humans. The devastating ecological effects of so-called "invasive species", which label masks that most of them are not "invasive" having been put there against their will by humans, is one of the moral outrages of our time. These deer simply should not have been put at Point Reyes in the first place. What about our moral obligation to native species? Just because it takes more diligence to see the losses due to exotics do we claim ignorance, and give greater weight to exotics and less to native species? That the exotic deer were introduced through ignorance in the past only heightens the moral obligation for us to avoid further ignorance now. Yes, it is easy to sympathize with the exotic deer. But we should not use that as a façade to hide our even greater moral obligation to native species.

In many cases it is impossible to correct the consequences of unwise introductions. That it is possible to do so in the case of exotic deer on Point Reyes, however, places a heavy moral burden on us to act responsibly to protect native species from the impacts of exotics. And, we must do it sooner rather than later. Fallow deer are now spreading eastward rapidly, as I have seen myself, and we will soon loose the containment that, fortunately, we have had up to this time. I do not want to repeat my regret that the eastern fox squirrel, once found solely on the Berkeley campus (and fed by well-meaning people), could have been eradicated easily in the 1960s. Now, it has not spread throughout the East Bay and is moving into the Central Valley, displacing the native gray squirrel along the way. It is too late to eradicate them now. I sincerely hope we do not make the same mistake with fallow deer.

This brings me to means. It would be wonderful if reproductive intervention was magic, but it is not. The methods available to date are far from perfect, which is why so few of them are approved for use. In situations where animals can be captured and handled easily, they work fairly well, but not without trauma. These are wild animals, and all of their stress responses are triggered by capture, predation-like events. They simply can not know that we are subduing them with such noble and caring intentions, and hope to release them without harm. Still, the big problem is that we do not have the means to deliver the contraceptives or surgical alterations to a sufficient proportion of the population to achieve the goal—either control or eradication in most cases in the wild.

I think the preferred alternative in the plan presents a balanced application of contraceptive and lethal methods to the exotic deer problem. In essence, contraception is used to the extent it can be applied successfully, and that, in turn, reduces the need to use lethal means. It is impossible to know in advance the optimum mix of the two approached to minimize the total mortality. This depends on how contraception works out. To the extent contraceptive fails to meet the objective, however, lethal means will have to be employed.

Sincerely,

Dale R. McCullough

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Emeritus Professor of Wildlife Biology

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March 28, 2005

Superintendent, Point Reyes National Seashore:

The Sierra Club, on behalf of its 7,000 Marin County members and its 750,000 members nationally, supports the 12/04 Point Reyes National Seashore (PRNS) Non-Native Deer Management Plan draft Environmental Impact Statement (dEIS) Preferred Alternative E.

The impact of invasive species on biodiversity and native and threatened species is a core issue for the Sierra Club. The National Invasive Species Council, which helps coordinate federal activities, notes that total costs of invasive species in the United States are more than $100 billion each year and that invasive species impact nearly half of the threatened or endangered species. PRNS is rich in biological diversity with over 45% of North American avian species, nearly 18% of California's plant species, and 23 threatened and endangered species. If PRNS were to become a monoculture of invasive plants and animals, that would greatly diminish a biodiverse haven for wild creatures and humans while relegating the remnants of our native species to museums.

Use of ungulate habitat at PRNS is a zero-sum game with winners and losers. Any decision that PRNS makes, including no decision, will result in the death of animals; the only question is which animals. The environmental impacts from the No Action Alternative of letting invasive deer expand at PRNS would reduce habitats for and thus increase deaths of native black-tailed deer, native tule elk, endangered coho and steelhead, and riparian songbirds. These impacts on native, threatened and endangered species far outweigh the impacts from removal of a small portion of the large worldwide population of these deer.

The Sierra Club does not believe that an invasive deer species in PRNS increases biodiversity because of significant later consequences. The first introductions of yellow star thistle, west nile virus, scotch broom, and sudden oak death could have been said to momentarily increase biodiversity in California, but the subsequent impacts from these invasive species have caused huge economic and environmental damage. Goats introduced on San Clemente Island are responsible for the extinction of 8 endemic plant species. Rats introduced to Anacapa Island threatened several native species -- including the Xantus' murrelet.

The Sierra Club does not support the idea that the need to manage the invasive deer implies that all exotic species are inherently bad. In their native habitats these same species are usually well integrated into the local biological diversity.

However, these otherwise harmless species, when removed by human action from their native habitat, sometimes find themselves with no natural limits to their populations and invade, displace and destroy native flora and fauna. It is when the behavior of these displaced species becomes aggressive and threatens their neighbors that the National Park is mandated to take action. A failure to take action on invasive deer threatens not only the native species being displaced but also the entire program to control invasives of all kinds.

National Parks have wide-open spaces and cannot feasibly keep an invasive species separate from the local species it is displacing. Zoos, of course, maintain biodiversity by keeping predator/invasive species in separate cages from the prey/refugee species, but National Parks must reduce or eliminate invasive populations in order to maintain diversity. These invasive deer cannot legally be removed or feasibly contained, and managing these deer at PRNS is not simple. If some females are contracepted and the population reduced below carrying capacity, the remaining females respond by greatly increasing their fertility; if some males are sterilized, the females respond by greatly increasing their estrous cycles for remaining males. Unless 100% of the deer are treated, populations will increase. But treating 100% of deer running wild over 70,000 acres is likely impossible, so some level of lethal removal will likely be required. Although these invasive deer were introduced to this area for the purpose of hunting, the Sierra Club agrees with the dEIS that hunting in PRNS would be inappropriate, although if State Fish and Game removed the limit on legal hunting outside the park, then that action could help control spread of the invasive deer beyond park boundaries.

The Sierra Club understands that lethal removal is controversial. Opposing lethal removal is an agreeable position to take, but the Sierra Club acknowledges that maintaining a diverse ecosystem is a complex task in which all actions, including no-action, have to have both risks and benefits assessed. We believe that the dEIS does a reasonable job in this assessment by using local studies combined with studies elsewhere to draw logical conclusions about the impacts from the invasive deer on PRNS habitat, flora and fauna. We agree that the risks from not managing the deer far outweigh the risks of management. However disagreeable it is to kill any animal, protecting a fertile and complex genetic biodiversity is fundamental to National Parks. Allowing the invasive deer to expand does not account for the pain and suffering of native species that would be displaced and thus indirectly killed.

The Sierra Club supports the prioritization of contraception over lethal removal within the framework of a continued decline in population so that if new methods are discovered for feasible contraception, then the percentage of deer lethally removed would be lowered. However, PRNS should not divert dollars that could go to native and endangered species protection to attempt at any and all cost to avoid any lethal removal of invasive deer. The Sierra Club supports PRNS's proposal to explore all feasible contraception options, but we also encourage PRNS to set up a fund for contributions from individuals that could provide additional funds for research on contraception. The effectiveness of experimental contraceptive techniques must be measured against the standard of a constantly declining population. Invasive deer cannot be allowed to continue to expand in the hope that future contraceptive action may prove effective. Furthermore, for any wild free-ranging animal, trauma, injury and mortality result even from use of contraceptives. The Preferred Alternative's complete removal of invasive deer results in the lowest number of total deaths compared to Alternatives that only reduce populations, because allowing even a few invasive deer to remain and breed would require continued removal actions in the future and greatly increases the number of animals needed to be contracepted or lethally removed.

Therefore, to the extent that contraceptives prove unable to reduce populations, the Sierra Club understands that specially trained park sharpshooters with a mandate for only taking sure, euthanizing shots must be the backstop insuring the success of the invasive deer removal. We ask that special precautions be taken if lethal removal is undertaken to ensure minimum impact to native species, including use of non-lead bullets, and that both the lethal removal program and its participants be monitored to insure effectiveness and humaneness. The Sierra Club supports donation of deer meat, when feasible, to local charity dining facilities.

The Sierra Club does not support the idea that since there are already considerable numbers of non-native species (cattle) living in PRNS, then no action can be taken on any other non-native species (invasive deer) until the last cattle are removed. PRNS was established in part to allow the continuation of "cattle ranching and dairying" (not wild deer raising) for those willing to continue those operations after the ranches were purchased for incorporation into PRNS. The Sierra Club is well aware that cattle impact the environment, but those impacts are declining as PRNS works with cooperative ranchers towards more "sustainable" agriculture. Furthermore, management difficulties for domestic cattle are minimal compared to the great difficulty of managing wild, invasive deer.

The Sierra Club understands that there are no easy solutions to management of non-native deer. A March 20 editorial in the New York Times captured the essence of the dilemma: "*Unfortunately, deer contradict our innate assumption that only ugly creatures can be vermin…But wise conservation means looking at the environment as a whole - from the smallest wildflower on forest floor to the biggest brown-eyed herbivore. The whole system - not just the prettiest mammals - needs protection.*" The Sierra Club supports protecting the whole system and therefore supports the 12/04 PRNS Non-Native Deer Management Plan draft Environmental Impact Statement (dEIS) Preferred Alternative E.

Sincerely, G Bennett

Gordon Bennett, Marin Group Chair

NPS Response to Comments

In reviewing the 1,900 pieces of correspondence received during the comment period, NPS grouped similar substantive comments from one or more commenters and summarized them under subject topics (e.g. Alternative A, Wildlife and Wildlife Habitat etc.), each with a unique Topic Code number (e.g. AL 1000, WH 4000). These Topics were grouped together to reflect related issues where appropriate and to avoid repetition in the responses.

AL 1100 – Alternative A (1)

What is the need for the management plan if none of the adverse impacts of Alternative A (No Action, continuation of the current management) would result in the impairment of park resources?

Response In common parlance, the word "impair" means "to damage or make worse" and as such, the term "impairment" in an EIS is often thought by the public to mean the same thing as "adverse impact". However, the term "impairment" has been given a specific legal meaning through the interpretation of the 1916 NPS Organic Act, which established the National Park Service. The Organic Act established the NPS to preserve and protect designated resources of the country and provide for their enjoyment by the public in so far as the resources are "unimpaired for the enjoyment of future generations" (16 USC 1). Impacts of a proposed action could be adverse, long-term and severe and still not constitute "impairment." Impairment, when used by the NPS, is narrowly defined as an impact that, "would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values" (NPS 2001). Guidance in the NPS Management Policies (2000) defines an impact as constituting impairment if it affected a resource or value that was:

- Necessary to fulfill specific purposes identified in the establishing legislation for a park;
- Key to the natural or cultural integrity of a park or to opportunities for enjoyment of the park; or
- Identified as a goal in the park's general management plan or other relevant NPS planning documents.

The establishing legislation for Point Reyes (Public Law 87-657, 76 Stat. 538, 16 USC) identified "…public recreation, benefit, and inspiration," and ensuring that "a portion of the diminishing Seashore of the United States that remains undeveloped" as the specific purposes of the Seashore. Public Law 94-544 and 94-567 amended the Seashore's enabling legislation by inserting the words: "…without impairment of its natural values, in a manner which provides for such recreational, educational, historic preservation, interpretation, and scientific research opportunities as are consistent with, based upon, and supportive of the maximum protection, restoration, and preservation of the natural environment within the area." Although the continued existence of exotic deer would have adverse and sometimes major adverse effects on park resources and values as described in the EIS, under current conditions, the impacts of their continued existence would not prevent fulfillment of these stated purposes and so would not constitute impairment as defined by NPS. However, should non-native deer populations and range expand, as with Alternative A, NPS believes impairment to wildlife would likely occur.

Data on current and past population growth of fallow and axis deer at PRNS indicate that the No Action Alternative would result in an increase in non-native deer numbers within the Seashore and throughout Marin County. Adverse impacts of No Action to native deer, particularly native black-tailed deer, would be major. Black-tailed deer are considered a "keystone " species in the native California coastal ecosystem because increases and decreases in their population numbers have repercussions throughout the ecosystem. Alternative A therefore affects a resource that is key to the natural integrity of the park or to opportunities for enjoyment of a park and as such, impairment would likely occur. For a detailed description of the impacts of non-native deer to Seashore resources, see FEIS Chapter 4, Environmental Consequences, and in particular, the discussion of the impacts of the No Action Alternative.

In addition and separate from the requirement that park resources and values be left unimpaired for future generations, the Organic Act requires the conservation of park resources and values at all times, even when there is no risk that any park resources or values may be impaired. NPS managers are called upon to always seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values (NPS Management Policies Section 1.4.4). For this reason, even though impacts of the No Action alternative would not rise to the standard of "impairment" for most resources, the Seashore is obliged to evaluate options that would help in rectifying damage caused by fallow and axis deer and select what it believes to be the best among them for implementation. Only by doing so can it minimize or avoid possible impacts of non-native deer on Point Reyes National Seashore resources and values and best meet the NPS conservation mandate.

AL 1101 – Alternative A (2)

NPS must demonstrate that the proposed action (Preferred Alternative) will measurably contribute to the restoration of native wildlife and natural ecosystems within PRNS.

Response The discussion of the beneficial impacts of Alternatives D and E are in two principal areas of the FEIS: Chapter 2, discussion of the *Environmentally Preferred Alternative* and *Park's Preferred Alternative* and Chapter 4, *Environmental Consequences of Alternative E*. The discussion in Chapter 2 Alternative E explains how the NPS concluded that Alternative E best achieves the objectives of the management plan. In particular, objective # 1, "to correct past and ongoing disturbances to Seashore ecosystems from introduced non-native ungulates and thereby to contribute substantially to the restoration of naturally functioning native ecosystems" is clearly accomplished by removal of all fallow and axis deer within NPS boundaries, as called for in the Preferred Alternative. Native ecosystems are, by their very nature, comprised of interdependent native species. Two cornerstones of native ecosystem restoration are reintroduction of extirpated native species and removal of non-natives.

Al 1110 – Alternative A (3)

Commenters believe that the park must adopt a plan that can address the impacts of non-native deer to staffing and financial resources.

Response One of the objectives of the plan is to minimize long-term impacts, in terms of reduced staff time and resources, to resource protection programs at the Seashore, incurred by continued monitoring and management of non-native ungulates. As the EIS indicates (see Park Operations in the Impacts chapters and figure 17 for more information), continuing with current management of non-native deer is likely to cost about \$2.1 million through 2021 and then further maintenance and management costs would be up to \$280,000 per year. Although implementing the Preferred Alternative would cost more initially, about \$4.5 million through 2021, it would eliminate the costs for non-native deer management after this date.

AL 1110 – Alternative A (3)

Commenters state the adverse impacts of the No Action alternative are understated and are major both inside and outside the Seashore.

Response The impact analysis for Alternative A (Chapter 4) indicated that major impacts to water resources, soil, vegetation, wildlife, species of special concern and the regional economy outside the park could occur. The degree of impact to these same resources inside the park under the No Action alternative would be moderate for soil, water, the regional economy and species of special concern, and moderate to major (depending on species and location) for vegetation and wildlife. Moderate impacts to park operations would also occur. The definitions of impact thresholds for each of these resources is provided in the Methodology section of the EIS. Thresholds and impact indicators were developed through consultation with resource experts, literature searches in some cases, and the best professional judgment of NPS managers. Thresholds are defined to delineate differences not only in the intensity of an impact, but include considerations of context, duration and timing. The definitions for moderate and major differ in geographic context and duration for many of the affected resources. Examples for a few resources are provided below to illustrate this difference.

Impacts to Water Resources

Moderate:	would be apparent locally and would have the potential to become larger or regional.
Major:	would be substantial, highly noticeable, and regional (i.e., would occur over a large area, such as the Tomales Bay watershed, or Point Reyes National Seashore).

Impacts to Wildlife

Moderate:	would be sufficient to cause a change in the resource or population (e.g., abundance, distribution, quantity, or quality); however, the impact would remain localized in the Seashore. The change would be measurable, but negative effects could be reversed with active management, and the resource or population could recover within the Seashore.
Major:	would be substantial, highly noticeable, measurable, and potentially irreversible (permanent). The resource or population would be unlikely to recover within the Seashore with or without active management.

Impacts to the Regional Economy

Moderate:	detectable in a moderate to large number of local businesses or could have the potential to expand into an increasing influence on the economic environment.
Major:	a substantial, highly noticeable influence on many local businesses, and could be expected to alter those environments permanently.

AL 1200 – Alternative B (1)

Commenters support control of non-native deer numbers in perpetuity rather than total elimination because they want to have some non-native deer available for viewing.

Response Alternatives B and C, which both result in maintaining non-native deer through perpetual control of their numbers, were not chosen as the Preferred Alternative for a number of reasons. First and foremost, the adverse impacts of these two alternatives on park resources (e.g. vegetation, wildlife, soils, water resources, special status species, human health and safety, park operations) and the regional economy are more severe and of longer duration than in the Preferred Alternative (Alt. E), which calls for removal of all non-native deer by 2021. The impacts of the non-native deer populations on riparian and woodland ecosystems, to other wildlife and to ranchers would continue forever if non-native deer remain, albeit at reduced levels if the number of deer were reduced. The Preferred Alternative (and Alternative D, which would completely remove all non-native deer through lethal means) would best accomplish the objectives of the plan and comply with NPS laws, regulations and policies (see Table 1 in the EIS).

Another consideration in choosing the Preferred Alternative was the cumulative total number of deer that would need to be killed over the lifetime of the plan. If a population of axis or fallow deer were maintained in the park (as in Alternative B or C), it would require perpetual management through lethal removals because control of non-native deer through contraception alone is infeasible. Over many years, the total number of deer removed would be very high. This is illustrated in Table 1 and Figure 1 in the final EIS.

AL 1210 – Alternative B (2)

Commenters oppose maintenance of any non-native deer populations because it would result in excessive ongoing costs and in the removal of thousands of animals, in perpetuity.

Response Comment noted. Further information may be found in FEIS Chapter 4, Environmental Consequences, which discusses the environmental impacts of the two alternatives (B and C) that would maintain non-native deer in the Seashore in perpetuity. Also see the response to AL 1200.

AL 1310 – Alternative C (2)

Commenters oppose Alternatives B and C for a variety of reasons, mostly because contraception appears infeasible and the alternative requires a high expenditure of park operations resources.

Response Your comment is noted and reflects, to a large extent, the assessment of NPS. Please see FEIS Chapter 4, *Environmental Consequences*, for the impacts to park operations from Alternatives B and C. Also, see Chapter 2, Table 3 for a summary of the impacts of each alternative.

AL 1400 – Alternative D (1)

Commenters support Alternative D for a variety of reasons, mostly because it will reduce impacts to Seashore ecosystems, ranchers and park operations quickly.

WH 1100 – Wildlife and Wildlife Habitat: Ethical Issues

Commenters state that rapid removal of all non-native deer is the most humane method in the long-term.

Response Both Alternative D (Removal of All Non-Native Deer by Agency Personnel) and the Preferred Alternative E (Removal of All Non-Native Deer by a Combination of Agency Removal and Fertility Control), are the Environmentally Preferable alternatives, because they cause the least damage to the biological and physical environment. (See Chapter 2, Environmentally Preferable Alternative.) Both alternative D and E also contribute to restoration of natural ecological processes and best protect, preserve, and enhance historic, cultural, and natural resources.

Although both Alternatives D and E fully accomplish all four of the Seashore's stated objectives for non-native deer management, Alternative E is the park's Preferred Alternative. Although Alternative E does have increased safety risks to NPS staff responsible for capturing and treating animals with a contraceptive, and is more expensive, it also may reduce the total number of deer requiring lethal removal. Lower levels of culling would mitigate some, though not all, of the concerns of members of the public who oppose using lethal methods to control the non-native deer populations.

Alternative E will also expand current knowledge about long-term reproductive intervention in wild ungulates. The Preferred Alternative presents an opportunity for long-term study of the use of potential sterilants in controlling overabundant or unwanted deer under free-ranging conditions. Issues of wildlife overabundance often arise in areas where lethal removal is difficult, such as areas with firearms restrictions or public safety concerns. Information gained through Alternative E could benefit other national park units, other land-management agencies and zoological parks nationwide.

We believe these benefits outweigh the additional time Alternative E would take to eradicate non-native deer compared to Alternative D, and the increased cost to NPS and risks to staff.

AL 1410 – Alternative D (2)

The process of culling will increase the rate at which non-native deer disperse beyond the park boundaries and will not meet the plan objectives.

Response See Chapter 4, Impacts on Wildlife of Alternatives B-E. Any deer control program involving lethal removal of animals with firearms has the potential to scatter deer herds and push deer out of the Seashore into adjacent lands. Provisions in those action alternatives that specify removing animals from the edges of the Seashore before culling animals deeper within the park would mitigate such scattering. Experts with experience in wildlife removal programs will be consulted prior to initiation of the culling and a comprehensive implementation plan will be developed. A monitoring plan incorporating the principles of adaptive management has been included in the FEIS as an appendix. This plan includes measurement of population size and range with projections of herd movements. The goals will be to reduce the populations as quickly as possible to minimize impacts on native species, minimize the risk that axis and fallow deer would expand their ranges outside the park, minimize the total number of deer removed, and maximize the overall culling efficiency.

AL 1410 – Alternative D (2)

Commenters are concerned about residues of any contraceptives used and consequent adverse impacts to native predators.

Response For a detailed discussion of current wildlife contraceptive technology, see Chapter 2, Alternatives C and E. In the past, some fertility control agents, namely steroid hormones, have raised concerns about residues in meat that might be consumed by humans or other wildlife. For this reason, steroid contraceptives are not being considered for use at Point Reyes National Seashore.

The most promising long-lasting drugs currently being considered for use in PRNS non-native deer are Spayvac® and GonaCon®. As of the writing of this document, Spayvac® is no longer available for use in wildlife. Both of the products are protein vaccines injected into female deer in order to induce an immune response to the deer's own reproductive proteins. Should a treated deer become preyed upon or scavenged by other animals, any contraceptive remaining in the deer's tissues would be digested by the predator's digestive system. Like other proteins, these vaccines are denatured (broken down) by digestive enzymes and are not expected to cause any effect to the predator or scavenger. Therefore, the adverse impacts to other wildlife prey or scavenger species from these two contraceptive drugs are considered insignificant. However, as described in Chapter 2, before granting registration or an experimental use permit, the Environmental Protection Agency (EPA) would require safety data from the applicant.

AL 1410 – Alternative D (2)

The commenter states that the DEIS failed to examine the impact of culling on disease transmission as non-native deer will leave the park as a result of culling and will be weaker from the stress involved with culling.

Response The commenter states that stress resulting from herd culling may increase the incidence of paratuberculosis in the non-native herd. Stress, as defined in veterinary texts, is the physiological (rather than psychological) condition arising when those mechanisms concerned with adapting an animal's body to its environment are taxed beyond their normal capacities. Psychological factors, although they are acknowledged as playing some part in the process, are considered relatively minor. The physiological responses typical of stress are hormonal, with release of glucocorticoid steroid hormones, and behavioral actions (the "fight or flight" response). Environmental factors that cause stress include poor nutrition, severe climate, physical effort, pain and crowding.

Culling of deer results in increased pain for animals that are shot and in increased physical effort for bystander animals. As described in the EIS (Chapter 2, descriptions of Alternatives B-E), efforts would be made to deliver immediately lethal shots to target animals to reduce the duration of painful stimulus. It should be noted that increased physical effort and pain are also likely results of almost any wildlife management action including relocation, capture (for euthanasia, contraception or relocation), and remote injection (darting). Such stressors clearly could cause increased susceptibility to some diseases.

However, paratuberculosis is an infectious disease transmitted primarily through the fecal-oral route. Important factors for an increased prevalence of paratuberculosis are crowding and increased fecal contamination of forage and water. The prevalence of the infection and the incidence of clinical disease may climb when a population approaches carrying capacity, as in Alternative A (No Action). Animals, including those most susceptible to the infection, i.e. the calves, would be exposed to greater numbers of the organisms more frequently. At these high densities, affected herds would be stressed by reduced forage nutritional quality and reduced ability to fight disease through a weakened immune system. This immunosuppression could result in increased transmission of infections, heavier pathogen loads and progression to clinical illness (Manning et al. 2003). Animals in the clinical phase of Johne's disease shed the organism more often and in greater numbers, increasing the potential for contamination from this hardy and long-lived organism, a factor relevant to the health not only of non-native deer, but of numerous other susceptible native species.

Both crowding and fecal contamination of the environment are alleviated by lethal removals (Alternatives B-E). In addition, culling activities would likely "split" large herds into smaller groups, further reducing deer densities and the potential for fecal contamination. Reducing the overall number of infected animals would have a far greater positive effect on the current and future disease status in the non-native deer population than would shielding them from the stress of culling.

Commenters note that non-native deer are more likely to leave the Seashore as a result of culling activities. Any deer control program involving lethal removal of animals with firearms has the potential to scatter deer herds and push deer out of the Seashore into adjacent lands (see Chapter 4, Alternative E, Impacts to Wildlife). Provisions in all alternatives that include lethal removals specify removing animals from the edges of the Seashore before culling animals deeper within the park to minimize such scattering.

AL 1500 – Alternative E (1)

Commenters state preference for Preferred Alternative and removal of non-native deer from the park.

Response Comment noted.

AL 1510 – Alternative E (2)

Commenters state that the park's Preferred Alternative will fail because the non-native deer population is already on private lands and is beyond NPS control.

Response NPS believes that the Preferred Alternative (E), which includes a combination of lethal removal and non-lethal fertility control, will succeed in eradicating non-native deer from the Seashore. This assessment is based on consultation with experts in the field of wildlife biology and contraception, population models developed by some of these experts, and the past history of non-native deer management in the Seashore. NPS recognizes that the presence of non-native deer on the Vedanta property complicates management because the Vedanta Society has expressed that lethal removal on their lands is unlikely. However, the Society has also expressed support for the use of fertility control on these populations. Records and data from the Seashore's non-native deer culling program from 1976 to 1994 indicate that a focused lethal removal program, when adequately funded and staffed, would be successful in removing large numbers of axis and fallow deer.

AL 2000 – Alternatives: Alternatives Eliminated

Commenters state that the discussion and evaluation of the current state of available contraceptive technology is inadequate. The Seashore should rely on experts with successful immunocontraception projects to assess the feasibility of non-native deer control through contraception alone.

Response Please see Chapter 2, *Alternatives and Actions Considered But Rejected*, and the Response to AL 4300 for a discussion of why NPS considers eradication of non-native deer with fertility control alone to be infeasible. In coming to this conclusion, NPS consulted with a large number of leading experts in the field of wildlife contraception, from universities, government agencies and non-profit institutions. The experts consulted were unanimous in concluding that, because of the size of the non-native deer population in the Seashore and its relative inaccessibility to capture and treatment, it would be infeasible to rely on contraception alone for control or elimination.

The list of experts consulted includes scientists who are currently conducting fertility control research with both captive and free-ranging deer. Seashore biologists themselves have experience with using immunocontraception in free-ranging tule elk from 1996 to 2004. The population models developed by Barrett and Hobbs incorporate peer-reviewed and published modeling techniques to reach the conclusions which informed the document. In the opinion of NPS biologists as well as the experts consulted, the contraceptive literature published since the release of the Draft EIS, including some references listed by commenters, do not alter the choice of Alternative E as the Preferred Alternative. The discussion of the current state of wildlife contraceptive technology has been updated in the final EIS to reflect the most recent developments (see Chapter 2, *Alternative E* and Chapter 2, *Alternatives and Actions Considered But Rejected*).

AL 2000 – Alternatives: Alternatives Eliminated

The EIS rejects contraception- only alternatives because of unverified, theoretical computer models and selective citing of the scientific literature. The document does not include full consideration of Spayvac®.

Response The document includes a discussion of Spayvac®, a long-duration formulation of porcine Zona Pellucida, in Chapter 2, *Alternatives C and E*. All available information on Spayvac® was reviewed during the preparation of the plan and the manufacturing company was consulted directly. The park's Preferred Alternative calls for using the latest contraceptive technologies to safely prevent reproduction for as long as possible with minimal treatments per animal. Spayvac® was one of the contraceptives considered for use. Unfortunately, since the release of the Draft EIS, Spayvac® has become unavailable for use in wildlife research, according to company representatives. Therefore other experimental products, such as GonaCon®, would be considered for use.

The Final EIS contains updated information on wildlife contraceptive technologies, collected since release of the draft (see Chapter 2, Alternatives C and E). As mentioned in the responses above, the preparation of the document involved consultation with many leading experts in the field of wildlife contraception, from universities, government agencies and non-profit institutions. These experts informed NPS of any promising new contraceptive technologies.

AL 2000 – Alternatives: Alternatives Eliminated

Commenters support the NPS Preferred Alternative since using contraception alone would be futile and inexact.

Response Your comment has been noted. The reasons for dismissing alternatives that did not include lethal removal are listed in Chapter 2, *Alternatives and Actions Considered But Rejected*.

AL 2000 - Alternatives: Alternatives Eliminated

Commenters state that NPS should not reject the contraception-only alternatives because of cost or difficulty.

AL 4000 – Alternatives: New Alternatives or Elements

AL 2000 – Alternatives: Alternatives Eliminated

There is a lack of evidence in the EIS that non-native deer are degrading ecological processes in the park.

AL 1101 – Alternative A (2)

NPS must first demonstrate that fallow and axis deer are having the detrimental effects alleged in the document.

Response See the FEIS Chapter 4, *Environmental Consequences of the No Action Alternative* (A) for a lengthy description of the adverse impacts of non-native deer to water resources, soils, vegetation, wildlife and special status species. These impacts have been documented both in the Seashore and elsewhere. Axis and fallow deer were introduced to the Seashore in the 1940s and are not native components of its ecosystems. The resources and habitats they utilize are consequently rendered unavailable to native species.

Because they maintain populations of non-native deer in the Seashore, Alternatives A, B and C would continue ongoing impacts to park natural and physical resources. The presence of non-native axis and fallow deer is disruptive to many elements of the natural ecosystem at PRNS. Some of the more serious effects these non-native deer have at the Seashore include competition with native tule elk and black-tailed deer (particularly in high deer density or low forage conditions), the potential for transmitting disease to these native deer, and heavy use of and resulting impacts to riparian and woodland habitats and the native wildlife dependent on these habitats. Introduced fallow deer in other parts of the world are known to cause reduction or local extinctions of small mammals that rely on the same ground-level grasses and forbs. Both axis and fallow deer at PRNS browse shrubs when grasses are not available, and fallow deer in particular alter riparian cover and vegetation through thrashing, trampling, browsing and creating trails. Loss of riparian habitat would affect a number of species at PRNS, including several special status species, such as California red-legged frog, Coho and Chinook salmon and steelhead trout. In contrast, Alternative D or E would remove all non-native deer from NPS lands and eliminate these impacts on natural and physical resources.

Wildlife monitoring in the Seashore is ongoing and the analysis in the FEIS on impacts of non-native deer has been supplemented by new information since the DEIS was published, including the following:

- A US Geological Survey analysis of the impacts of non-native deer on native black-tailed deer (Fellers, 2006),

- A US Geological Survey report on the impacts of "lekking" fallow deer to woodland and riparian vegetation and soils (Fellers and Osbourn, 2006),

- A Humboldt State University report on dietary overlap between fallow deer and native tule elk (Fallon-McKnight, 2006).

Data on the adverse impacts of fallow and axis deer to natural ecosystems, (both at PRNS and elsewhere in the U.S,) and detailed results of the studies cited above are described in FEIS Chapter 3, *History of Research on Non-Native Fallow and Axis Deer at Point Reyes National Seashore and Golden Gate National Recreation Area* and FEIS Chapter 4, particularly under Alternative A, No Action).

AL 2100 – Alternatives: Hunting

To eliminate the threat that non-native deer will spread far outside the park, NPS should work with California Department of Fish and Game in expanding hunting of non-native deer on private lands.

Response The threat of non-native deer moving outside the park is one of several reasons a management plan is needed. As noted in responses to comments above, NPS laws, policies and regulations and the results of research and monitoring indicate removal of these exotic species is needed inside the park. Therefore, simply coordinating a hunting effort with the California Department of Fish and Game for those deer that would move outside the Seashore would not resolve policy and impact issues inside the boundaries of PRNS.

The NPS has no jurisdiction over hunting on private property, state or county lands and would only be able to make recommendations to CDFG on how alteration of hunting regulations might be used to benefit the Seashore's mission or help conserve its resources. The NPS works with CDFG now to try and minimize adverse impacts of non-native deer and would continue to do so in implementing the Non-Native Deer Management Plan as needed.

AL 2100 – Alternatives: Hunting

The NPS should include an alternative with public hunting.

Response See FEIS Chapter 2, Alternatives and Actions Considered but Dismissed, for an explanation of why public hunting, either alone or in combination with another management technique, was rejected. The reasons can be summarized as follows:

- Public hunting within Golden Gate National Recreation Area is not allowed in its establishing legislation. Eighteen thousand of the 90,000 acres administered by Point Reyes National Seashore are GGNRA lands.
- The limited hunting season and restricted hunting zone, along with the large number of non-native deer (at least 1,100) make it extremely unlikely that reduction of the population to a manageable number or eradication of either species could be accomplished solely by public hunting.
- There are serious public safety concerns for a hunt in a national park with such high visitation and in such proximity to 3 towns.
- Public comments received during the initial scoping process and public comment period for the draft EIS indicate that the public does not favor public hunting in the park. Historically, local communities have responded unfavorably to any PRNS wildlife management plans that included public hunting.

AL 4000 – Alternatives: New Alternatives or Elements

The need for the Non-Native Deer Management Plan is not sufficiently supported by the current level of information. More research is needed for a solid scientific basis for the proposed management decisions such as will removal protect native ecosystems, whether and how eradication versus control would benefit native ecosystems, and whether fertility control alone could eventually achieve eradication in the future if it was more effective and easily delivered.

WH 2000 – Wildlife and Wildlife Habitat: Methodology and Assumptions

Further studies are needed such as impact of annual rainfall on reproductive rates for the deer collected from fecal samples, examination of vegetation type and biomass change in areas used by non-native deer, the degree of overlap in diet between non-native deer and native deer.

Response The need for a management plan arises out of a combination of monitoring and research findings and the requirement to follow stated laws, regulations and policies of the National Park Service. These regulatory requirements are summarized in response to comments above, and in the *Purpose and Need* chapter of the EIS.

We disagree that the plan is not sufficiently supported by the current level of information, and note that the monitoring and research findings at PRNS on the ecology, population biology and diseases of non-native deer has been extensive (see Chapter 3, History of Research on Non-Native Fallow and Axis Deer at Point Reyes National Seashore and Golden Gates National Recreation Area). The impacts of non-native deer to livestock and native deer have been analyzed by a number of respected biologists through dietary analyses, range studies and population projections (Brunetti 1974, Elliott 1983, Fellers 1983, Gogan et al. 2001, Hobbs 2003, Fellers and Osbourn 2006). There is little, if any, argument among professional wildlife biologists that expanding populations of axis and fallow deer would have detrimental effects on native black-tailed deer and tule elk.

In terms of further studies, research into non-native deer impacts is already a stated component of all analyzed alternatives. Please refer to Chapter 2, Actions Common to All Alternatives, for a list of activities the NPS considers indispensable for protection of native species and ecosystems and to assess the success of any management action. These activities include the continued monitoring of native and non-native deer numbers, ranges and impacts. Specific examples include monitoring of disease in non-native deer, surveillance for evidence of overgrazing by non-native deer, and assessment of dietary overlap between native and non-native deer.

Finally, we note that research alone would not accomplish any of the objectives of the management plan, which include following the required laws, regulations and policies of the NPS described above and in the *Purpose and Need* chapter of the EIS.

AL 4000 – Alternatives: New Alternatives or Elements

Non-Native Deer Management Plan Alternatives should include the contraception of native deer because there are too many of them.

Response As set forth in FEIS Chapter 1, *Need for Action* and *Purpose* and *Objectives* sections, management of these two non-native deer species is being proposed in order to protect the park's resources and values, which include the native deer. Some commenters suggested broadening this planning effort to include native deer and elk at Point Reyes National Seashore. However, an existing document, the "Point Reyes National Seashore Tule Elk Management Plan and Environmental Assessment," completed in 1998 (National Park Service 1998), already directs management of native tule elk in the Seashore. The park's population of native black-tailed deer is currently considered to be below carrying capacity and not requiring a management plan. Should such a need arise, a black-tailed deer management will be developed and appropriate compliance completed.

AL 4000 – Alternatives: New Alternatives of Elements

The NPS should use implementation of the Non-Native Management Plan as an educational and research opportunity for complex environmental issues.

Response Research would continue under any of the alternatives, including No Action or the Preferred Alternative. Research activities are described in the section *Actions Common to All Alternatives*, and include: monitoring of native and non-native deer numbers, growth rates, survival and fecundity, deer range, dietary overlap and disease. Educational opportunities would continue to be numerous as well. The Seashore has had and expects to continue to have many successful relationships with individuals and organizations that have provided educational programs, fund-raising campaigns, and a host of other activities. In addition, interpretive and educational programs provided by Seashore staff help park visitors understand, appreciate, and enjoy the park and its resources (NPS Management Policies, 2001). The Seashore Interpretive Program has always stressed the importance of preserving native ecosystems, and in recent years, has designed interpretive materials and presentations on the history and future of non-native deer management. This emphasis will certainly continue.

Some commenters suggested that further research into non-native deer impacts and the use of non-lethal deer management techniques were rejected because of their cost. This is not the case. The Seashore's Preferred Alternative includes non-lethal deer management techniques in the form of experimental use of long-lasting contraceptives (see Chapter 2, Alternative E). Contraception as the sole method of controlling or eliminating non-native deer was rejected because it is infeasible and unlikely to succeed (see Chapter 2, Alternatives and Actions Considered but Rejected).

AL 4000 – Alternatives: New Alternatives or Elements

To protect the deer and other wildlife immediately NPS should reduce the speed limit on West Marin roads.

Response The loss of deer through vehicular accidents within and outside NPS boundaries is regrettable but is outside the scope of this management plan. Prevention of deer-vehicle interactions is accomplished through NPS signage, road maintenance and state highway (Caltrans) programs. NPS has no jurisdiction over wildlife outside of its boundaries.

AL 4000 – Alternatives: New Alternatives or Elements

Commenters state the plan/EIS should consider reintroduction of mountain lions as a management control tool.

Response Mountain lion (*Puma concolor*), as well as other predators such as bobcat (*Felis rufus*) and coyote (*Canis latrans*), are already important to the Seashore ecosystem and are thought to exist at carrying capacity, or maximum sustainable numbers. These species did not evolve with fallow or axis deer and are likely not well adapted to prey effectively upon them. In light of the steady growth of non-native deer populations since the discontinuation of lethal control in 1994, Seashore biologists do not believe that these predators act as efficient controllers of deer numbers.

Historically, two other potential deer predators, grizzly bear (*Ursus arctos*) and black bear (*Ursus americanus*), were also present in the Point Reyes area but were extirpated over the past century. Recent sporadic observations of black bear in Marin County suggest that the range of this species may naturally be expanding southward. It is unlikely that the black bear, whose diet consists predominantly of vegetation and mast, would effectively limit non-native deer populations, even if its numbers were at carrying capacity. Re-introduction of the grizzly bear would also not be likely to have more than a negligible impact on reducing the non-native deer population. Grizzlies have very large home range requirements (100-400 square miles), so very few could live on park lands. In addition, current land use trends in Marin County, and the potential for dangerous interactions with humans and livestock would make any attempt at reintroduction highly controversial. The Seashore has no plans for re-introducing extirpated predators in the near future.

AL 4000 - Alternatives: New Alternatives or Elements

Commenters state that an element of the alternatives should combine contraception or sterilization with predator reintroduction and also suggest an element combining contraception or sterilization with relocation of deer outside of the Seashore.

Response See also the above response addressing increasing natural predation. It was unclear whether the commenters were suggesting that all or only a portion of the 1,100 plus non-native deer in the Seashore should be relocated to new environments. Relocation requires live capture and handling capture of deer in the wild, a task which is difficult, risky for NPS staff and deer and will result in some unavoidable animal deaths. Given their large numbers and the extent (>50,000 acres) and geographical difficulty of their range, it is unlikely that all the non-native deer in the Seashore could be captured. It is also unlikely that any individuals or groups would be interested in taking sufficient deer to make any substantial difference in current populations. Because lethal removal would be required as part of any alternative, including one that involves select relocation, we believe contraception is a more viable non-lethal management element. Contraception does not depend on the continued supply of individuals or groups interested in taking and maintaining live deer, yet it accomplishes the same goals of reducing numbers of deer lethally removed.

Relocation is discussed in the FEIS in the *Alternatives* and *Actions Considered but Rejected* section of Chapter 2. This section of the FEIS explains the regulatory impediments and health concerns which make adoption of more than a token number of deer very difficult. As detailed in the *Alternatives Considered But Rejected*, the relocation alternative was found to be unlikely to accomplish the objectives of the project, would be incompatible with state wildlife policy and would pose risks to wildlife, livestock and farmed deer outside of the Seashore.

AL 4000 – Alternatives: New Alternatives or Elements

The commenter favors non-lethal alternatives and recommends that the NPS discourage the public from feeding deer which further increases the deer population.

Response NPS managers are unaware of any feeding of deer in or around the Seashore and there is no evidence that feeding of deer has contributed to the continued increase in the non-native deer population. The feeding of wildlife, whether native or non-native, is inconsistent with NPS *Management Policies* (NPS 2001). Feeding of fallow, axis and black-tailed deer does not occur within NPS boundaries. The feeding of wildlife by private citizens, outside of NPS boundaries, is illegal under CA Department of Fish and Game (CDFG) regulations and is regulated by that agency.

Please also refer to the above responses in this section for discussion of the NPS determination that non-lethal methods would not be feasible.

AL 4000 – Alternatives: New Alternatives or Elements

Commenters state that NPS should consider an alternative that would relocate deer to fenced "deer viewing areas", whether inside or outside of the park on the lands of willing private owners. Commenters note that this has precedent in other national parks and federal lands and ask why this would not be appropriate for this plan.

Response Please refer to the Alternatives and Actions Considered but Rejected section of Chapter 2 where the alternatives Restricting Deer to a Fenced Area and Relocation are discussed. The primary mission of the NPS is to preserve park resources and values in as natural a state as possible and unimpaired for future generations. Those resources include the native ecosystems of the Seashore.

Although wildlife have been fenced in NPS units (including the Seashore) as a first step towards restoration of native species, maintaining wildlife in enclosed areas for a long period of time or permanently is more in keeping with private game farms, game parks or zoological collections. Fencing non-native deer within the Seashore would also be in conflict with the NPS Management Policies (sec 4.15 and others) which states that parks “will re- establish natural functions and processes in human-disturbed components of natural systems in parks unless otherwise directed by Congress” and identifies removal of exotic species as one of the actions that may be necessary to restore natural conditions.

If non-native deer were restricted to deer viewing areas on private property outside NPS boundaries, relocation and a willing recipient of the animals would be required. FEIS Chapter 2, Alternatives and Actions Considered but Rejected addresses the range of problems that make a relocation alternative infeasible. Title 14 §671.6 of the California Code of Regulations states: “No person shall release into the wild without written permission of the commission any wild animal…which: (1) is not native to California.” In addition, paratuberculosis, or Johne’s disease, has been documented in non-native deer at PRNS (Riemann et al. 1979b). Johne’s disease is a chronic, incurable and transmissible diarrheal disease of domestic and wild ruminants. Carriers can shed the organism sporadically and Johne’s disease can be difficult to diagnose in infected cervids. Because of the difficulty of accurately screening deer for Johne’s disease and the infection risk that carrier animals would pose to livestock, farmed deer, and other wildlife, California Department of Fish and Game has communicated to NPS that movement of non-native deer to other parts of the state is undesirable. Relocating non-native deer would require a permit from the Department.

AL 4000 – Alternatives: New Alternatives or Elements

AL 4300 – Contraception

The alternatives should include continued research on types of contraceptives and other non-lethal techniques.

Response As noted above and in the EIS, two techniques in the Preferred Alternative include the use of contraception in combination with lethal removal to decrease the size of non-native deer populations. The description of all potential contraceptive agents for deer is in Chapter 2, Alternative C and again under Alternative E, the Preferred Alternative. These sections identify a set of criteria any contraceptive would need to meet, including:

- few adverse effects on the target species (non-native deer);
- no adverse effects on non-target species or humans;
- a multi-year or permanent effect;
- logistically and economically feasible delivery;
- either registered for use in wildlife by the EPA or with an EPA-approved experimental use permit.

There are currently no contraceptive drugs registered for use in wild deer. In order to register a chemical, a sponsor is obliged to provide the EPA with substantial evidence of its effectiveness through controlled studies and must demonstrate the safety of the agent on target and non-target species. Environmental and human safety issues must be addressed as well. In order to receive an experimental use permit, NPS and the sponsor would need to submit to EPA safety and effectiveness data on the proposed chemical. Alternatively EPA could grant NPS a permit to use an unregistered but researched contraceptive if it could document that the use of the chemical would avert an emergency, either of an agricultural or an ecological nature. The data submitted would likely be gathered from the company sponsoring the chemical, although the Seashore would also be required to continue monitoring and gathering additional information about its effectiveness in the field. This continued monitoring would require collection of data on survival and fawning rates of treated and control deer through radio telemetry, population counts and/or necropsies. Additional studies on health effects and safety of the experimental drug could be required by the EPA.

AL 4100 – Alternatives: Livestock

Given all the other impacts to resources that are ongoing at the park, such as the impacts of agriculture, why does the issue of non-native deer need immediate resolution rather than a more intermediate step while additional research is conducted?

Response Please see the response to Concern 10376 above. We believe existing research supports the need for action now before the populations expand outside the Seashore.

AL 4400 – Alternatives: Non-Lethal

The commenter states that the EIS should include more non-lethal control alternatives such as: 1. relocation to another area; 2. use of the existing sterilization vaccine; 3. participation in field trials for a new vaccine; 4. funding through a local ballot initiative; 5. funding through a park admission charge.

Response See also Response to AL 4000 and AL 1110 for additional background information on the NPS decision-making process for rejecting contraception-alone alternatives as infeasible and unreasonable alternatives for inclusion the EIS.

The non-lethal alternatives (relocation, sterilization vaccines, research into contraceptives) suggested by commenters were either determined to be infeasible or would not accomplish the objectives of the plan, as stated in Chapter 1, Purpose and Need. The reasons for rejecting these alternatives are discussed in Chapter 2, Alternatives and Actions Considered but Rejected.

The raising of additional funds through local ballot initiatives or park admission fees would not make these rejected alternatives any more feasible and would not accomplish the objectives of the plan. In addition, placement of a bond measure on the local ballot is beyond the jurisdiction of the National Park Service and is beyond the scope of the document. Charging of an admission fee at the Seashore has historically been rejected because of the many entryways into the park, leading to difficulty enforcing any admission program.

Use of fertility control alone to control or eliminate non-native deer is not only expensive and logistically difficult, it is infeasible. All of the programs in which contraceptives have been documented to successfully control or reduce deer populations have occurred in small confined populations (as in zoos or islands). Researchers currently conducting contraceptive studies with wild deer agree with the Seashore's assessment that such non-lethal control techniques would not succeed unless augmented with lethal removals.

The current state of wildlife contraceptive technology and regulations require that the following conditions be met for any expectation of population control in free-ranging, wild deer:

- a small area with good road or trail access to subject animals
- approximately 250 or fewer subject animals
- "approachable" or non-wary subject animals
- a multi-year contraceptive drug which is effective in fallow and axis deer, is specific to them, and is available with a registration number from EPA.

The Seashore encompasses 90,000 acres of pastoral, natural and wilderness areas. Indeed, the predominant appeal of the park is its lack of roads and wild character, juxtaposed with its proximity to a major metropolitan area. Current estimates of non-native deer numbers are 250 axis deer and 860 fallow deer. The minimum number of fertile does is estimated to be 470. In 2003, Hobbs created a stage-based simulation model to examine the effects of culling and fertility control on fallow deer numbers in PRNS (see Appendix B). Using Seashore data on fallow deer numbers, Hobbs found that attempting to eradicate the population in 15 years using only fertility control (even with longer duration agents) would be futile.

Wildlife biologists agree that in order to control a deer population, at least 80% of all fertile does must be treated with a contraceptive. If the contraceptive is not effective in 100% of animals treated, if the population is near carrying capacity or if a reduction in deer numbers is desired, upwards of 95% of all fertile females must be treated. Because of the Seashore's size, lack of roads and rugged topography, it is impractical to expect that such requirements could be met.

Dale R. McCullough, Professor Emeritus of Wildlife Biology at University of California, Berkeley, wrote in a communication to NPS:

"Stated plainly, there is no way that contraception alone will eliminate feral deer populations from Point Reyes National Seashore. Furthermore, even in the most optimistic scenario, the degree of population reduction will be moderate. It will be inadequate to reduce feral deer populations to low enough numbers to achieve the essence of the program goals."

AL 4400 – Alternatives: Non-Lethal

WH 4000 – Wildlife and Wildlife Habitat: Impact of Proposal and Alternatives

AL 4300 – Alternatives: Contraception

Commenters feel that the Plan/EIS should include alternatives and management actions to control non-native deer that rely on non-lethal methods only.

Response Non-lethal options include relocation and contraception, and both were considered in the formulation of alternatives analyzed in this EIS. As noted above, relocation in the numbers required to meet park objectives is not feasible because a steady supply of recipients would be difficult to secure, and the permitting agency who would decide whether translocation is allowable (California Department of Fish and Game) has indicated it is not likely. This leaves contraception, which is included to the maximum extent feasible, as part of the Preferred Alternative. However, contraception by itself would not meet objectives. In analyzing the likelihood of success of a contraception-only alternative, the following sources of information were consulted:

- past data on 5 years of contraception of tule elk at the Seashore
- scientific literature reviews
- the opinions of experts in the field of wildlife contraception
- population models designed by wildlife biologists (See Appendices A and B).

Contraception, by its very nature, prevents reproduction but does not remove adults from the population. In fact, life expectancy of treated females can increase as a result of reduced energetic costs of pregnancy and lactation (Warren 2000b, Hone 1992) and increased resources in populations with strong density-dependent responses (Garrott 1995). Therefore, only if at least 75-95% of females were treated and the contraceptive was 100% effective for each year in the reproductive lifetime of each female (8-10 years), could a population be controlled or fall to zero by attrition (see Barrett model, Appendix A).

The logistical difficulties of treating such large numbers of animals and the uncertainty of effectiveness have led the vast majority of wildlife biologists to conclude that controlling large free-ranging populations of long-lived ungulates solely with annual contraception is impractical and unlikely to succeed (McCullough 1996, Garrott 1991and 1995, Curtis et al. 1998, Warren et al 1992 and 2000, Rudoph et al. 2000, Fagerstone et al. 2002). Without exception, all of the experts in the field of wildlife contraception that reviewed the document agreed with NPS's rejection of this alternative as infeasible.

Treating a minimum of 400 deer per year with even the most effective, remotely delivered yearly contraceptive, during the 2-3 months before the reproductive season when it must be delivered is beyond the logistic capabilities of most commercial deer ranching facilities or zoos. The capture, treatment, marking and re-treatment of deer at the Seashore is significantly more difficult than this, and well beyond the financial, logistic and operational abilities of the Seashore.

There is currently no EPA-registered multi-year duration wildlife contraceptive drug. It is unknown at this time whether any of the drugs currently in development would cause lifetime sterility in fallow or axis deer. Because these drugs are experimental, and treatment animals are free-ranging, each treated animal would require capture and permanent marking, as well as monitoring over its reproductive life. Capture and handling of wild deer is difficult, risky for NPS staff and deer and will result in some unavoidable animal deaths. Even if a lifelong injectable sterilant for axis and fallow deer were 100% effective, capture, permanent marking and treatment of the minimum numbers required for to remove all non-native deer, using sterilants alone, are impractical for free-ranging deer in a 70,000-acre park.

AL 4500 – Alternatives: Lethal Removal (1)

WH 4000 – Wildlife and Wildlife Habitat: Impact of Proposal and Alternatives

Commenters recommend that deer carcasses be given to charity.

Response As noted in the EIS (see Chapter 2, *Actions Common to All Alternatives* and the descriptions of the individual Alternatives B through E) where fallow and axis deer carcasses are accessible to transport, they would be donated to charitable organizations as food for the needy. In addition, the Seashore is currently developing a cooperative program with the U.S. Fish and Wildlife Service and the California Condor Recovery Program to donate deer carcasses for use as food by reintroduced California Condors (*Gymnogyps californianus*), an endangered species. Funds to enable the donation of meat to the needy or to the condor reintroduction program will be provided by the NPS National Resource Preservation Program (NRPP) and Operating Formulating System (OFS).

AL 4500 – Alternatives: Lethal Removal (1)

The commenter prefers the use of professional sharpshooters rather than hunters, to be more humane to non-native deer.

WH 4000 – Wildlife and Wildlife Habitat: Impact of Proposal and Alternatives

If contraceptive treatment is not feasible, sharpshooters should be used, employing the most humane methods.

Response We agree that the most humane method of lethal control is by way of professional sharpshooters**.** The Seashore's Preferred Alternative (E) calls for the use of professional sharpshooters for removal of deer, along with contraception of fallow does over a 15-year period. As described in Chapter 2, all culling would be conducted by NPS staff or contractors specifically trained in wildlife sharpshooting. Efforts would be made to deliver immediately lethal shots to target animals and sharpshooters would be required to complete range qualifications specifically designed for ensuring humane and effective wildlife removal. Use of hunters to control deer was rejected as being infeasible and unlikely to accomplish plan objectives (see Chapter 2, Alternatives and Actions Considered but Rejected).

The Preferred Alternative is also more humane than those that prolong the removal process because it would remove fewer total deer. This is because taking longer would allow deer to reproduce and repopulate the herd, requiring the removal of the offspring. This is illustrated in the final EIS in Figure 1 and Table 1, which show the total number of deer that would require removal under each of the alternatives.

As specified in Chapter 2, contraception by itself is not feasible. However, the Preferred Alternative (E) includes fertility control (long-lasting contraception of deer) in combination with lethal removal. Both actions would continue until both axis and fallow deer have been extirpated. Because of their current large populations (~250 axis deer and ~860 fallow deer), it is expected that total removal of both species under the Preferred Alternative would require 15 years. Monitoring during program implementation would be done to assess success of the program and to guide adjustments in the management techniques used. The Alternatives chapter describes the necessary criteria a contraceptive must meet, including a multi-year or permanent effect. Although the Preferred Alternative assumes one of chemicals currently in development would be available for use in fallow deer and perhaps for axis deer as well, lethal removal via sharpshooting would be used if fertility control agents could meet the criteria or were not available.

GA 1101 – Impacts Analysis: Livestock (2)

Why is one of the Non-Native Deer Management Plan objectives to reduce non-native deer impacts to ranching when cattle have impacts that are so much greater than the non-native deer?

Response **(**See also Response to PN 8000, which addresses why the issue of ranching and ranching impacts is not within the scope of this resource management plan but rather the park's General Management Plan, currently under development.) Cattle operations in the Seashore are a separate issue from exotic deer management and outside the scope of this plan.

The U.S. Fish and Wildlife Service, which administers the federal Endangered Species Act, recently concurred with the Seashore's Biological Assessment (NPS 2002c) that ranch lease renewals would not be likely to jeopardize any listed threatened or endangered species in the park. Both the Biological Assessment and Biological Opinion are available by request.

In addition, while the park's general management plan dictates removal of the exotic deer, it mirrors the Seashore's enabling legislation in specifically allowing cattle ranching and dairying to continue (see Issues Considered but Rejected section in the EIS for more information). Ranching pre-dates the park and is specifically allowed in the enabling legislation and general management plans of both PRNS and GGNRA. The 1980 PRNS General Management Plan (GMP) designates a "Pastoral Lands" zone of approximately 17,040 acres in the National Seashore "to permit the continued use of existing ranchlands for ranching and dairying purposes." The 1980 GGNRA GMP specifies that the northern Olema Valley be part of a Pastoral Landscape Management Zone in which "where feasible, livestock grazing will continue within limits of carefully managed range capacities." Although changes in these policies are possible in the next cycle of general management planning over the next two years, these laws, policies and plans are currently binding on the actions of the Seashore.

GA 1200 – Impact Analysis: Native Deer

The need for the management plan should be revised because native deer can cause the same adverse effects (to ranchers for example) and have the same diseases.

Response **(**See also response above, which reiterates, based on FEIS Chapter 1, Purpose and Need, why the management plan is directed at non-native deer and is necessary given the fundamental purpose of the national park system to preserve native plants and wildlife.)

The need for managing non-native deer at the Seashore goes beyond disease control and the reduction of impacts to ranchers. As noted above, and in more detail in Chapter 1 of the FEIS, axis and fallow deer cause numerous impacts on native species and the Seashore's natural ecology, and their presence is in contrast with direction provided by the National Park Service laws, regulations and policies. These impacts and regulatory policies indicate the reduction or elimination of these species is warranted.

The primary mission of the National Park Service is the preservation of resources, including natural resources, in an unimpaired condition. In its 2001 *Management Policies*, the NPS provides park units with the specifics of what this mission means to resource managers (NPS 2001). For example, the 2001 Policies direct parks to "re-establish natural functions and processes in human-disturbed components of natural systems (sec 4.1.5)." This same section includes non-native (also called "exotic" or "alien") species as an example of a human-caused disturbance that can have severe impacts on natural biota and ecosystems. Native deer are considered part of the native ecosystem, in which the species have evolved in concert with each other, and as such, are to be protected and restored. Parks are specifically mandated to control exotic species "up to and including eradication" of a population if that species does not meet an identified park purpose and if such control is "prudent and feasible." Only through the removal of exotics and other changes resulting from human disturbance can the NPS return its park units to the most natural condition possible and meet its mandate to preserve them in this condition for future generations.

The presence of non-native axis and fallow deer is the result of human activities and is disruptive to many elements of the natural ecosystem at PRNS. Non-native deer differ in their habitat use and life histories from native black-tailed deer and elk. It is these differences, as well as the apparent explosive growth of the herds in recent years that results in impacts to natural resources. Some of the more serious effects these non-native deer have at the Seashore include competition with, and displacement of, native tule elk and black-tailed deer (particularly in high deer density or low forage conditions), the documented potential for transmitting disease to these native deer, and heavy use of and resulting impacts to riparian and oak woodland habitats, habitats which support a large number of sensitive native wildlife species. Spread of non-native deer to areas outside PRNS boundaries would result in expansion of these impacts to natural areas throughout Marin County.

It is for reasons like these that both the joint PRNS/GGNRA General Management Plan and the Point Reyes Resource Management Plan direct park staff to protect existing ecosystems and reduce or eliminate exotic plants and animals (see *Relationship to Other Federal Laws, Plans, and Polices* section of the FEIS for more information).

GA 3000 – Impact Analysis: General Methodology for Establishing Impacts/Effects

How will culling occur?

Response Information on how lethal control would be implemented is in the FEIS Chapter 2, under the description of Alternative B. Alternatives C through E address culling, but since it is already described in detail, readers are referred back to the more complete description under Alternative B.

Culling would be conducted by NPS staff or contractors specifically trained in wildlife sharpshooting. Efforts would be made to deliver immediately lethal shots to target animals and sharpshooters would be required to complete range qualifications specifically designed for ensuring humane and effective wildlife removal. NPS would follow the recommendations of the American Veterinary Medical Association (AVMA) for humane treatment of animals (see the AVMA website for examples: www.avma.org/resources/euthanasia.pdf.). As such, every attempt would be made, to "reduce pain and distress to the greatest extent possible during the taking of an animal's life" (AVMA 2001).

Beyond culling, all actions which involve direct management of individual animals, ranging from aerial surveillance to live capture and contraception would be conducted in a manner which minimizes stress, pain, and suffering to every extent possible. In addition, every effort would be made to minimize the degree of human contact during all procedures that require handling of wild ungulates.

Specifics of timing and location of the removal activities would be determined by PRNS managers and would vary depending on movement of animals, seasonal grouping patterns and estimates of numbers. Because visitor and staff safety would be paramount, removal activities would not occur during times and locations of high visitation.

PN 8000 – Purpose and Need: Issues Eliminated from Further Consideration

TE 4000 – Threatened and Endangered Species: Impact of Proposal and Alternatives

Al 4000 – Alternatives: New Alternatives of Elements

Commenters indicate that there should be an alternative that eliminates ranching because the impacts are more severe than from non-native deer.

The impacts of ranching should be included as a cumulative impact.

Is the purpose of the Non-Native Deer Management Plan to obtain more land for ranching?

Response In Chapter 1, *Issues Considered and Rejected*, a number of issues that were suggested by the public or members of the NPS interdisciplinary team, like the issue of livestock management at PRNS, were found to be outside the scope of this planning effort and were therefore not carried forward for analysis.

As noted above, ranching pre-dates the park and is specifically allowed in the enabling legislation and general management plans of both PRNS and GGNRA. The 1980 PRNS General Management Plan (GMP) designates a "Pastoral Lands" zone of approximately 17,040 acres in the National Seashore "to permit the continued use of existing ranchlands for ranching and dairying purposes." The 1980 GGNRA GMP specifies that the northern Olema Valley be part of a Pastoral Landscape Management Zone in which "where feasible, livestock grazing will continue within limits of carefully managed range capacities." Any proposed changes to these agricultural policies will be thoroughly discussed and open to public comment over the next two years as the Seashore updates its general management plan. However, these policies are currently binding on the Seashore and an alternative that eliminates ranching is therefore not a reasonable one for this plan to analyze. The response to GA 1101 addresses relative impacts from ranching and non-native deer. The USFWS recently concurred with Seashore biologists that the effect of renewing existing cattle leases on several listed threatened and endangered species would be adverse, but would not be likely to jeopardize any of these species.

The impacts of livestock grazing, along with other park programs are analyzed in the cumulative impact sections of each alternative and each resource. For example, the combined impacts of cattle operations, past, present and future planned park activities, activities outside the Seashore and those of continuing current management of non-native deer on vegetation are analyzed in the cumulative impact section of impacts of Alternative A to Vegetation. The combined impacts of cattle ranching and other activities relevant to soils are analyzed under the Soils impact analysis.

As stated in Chapter 1, Need, Purpose and Objectives, the need for action is a review of the existing problems, regulatory guidance, and concerns related to the presence and management of the non-native deer in PRNS and GGNRA. The need for developing a non-native deer management plan is not related to any foreseeable change in the amount of land to be used for agricultural purposes or other issues to be addressed by the general management plan.

PN 8000 – Purpose and Need: Objectives in Taking Action

Commenters question why the plan focuses on non-native deer when other non-native species, such as feral cats and off-leash dogs, are impacting the park.

Response The issue of feral cats and dogs, as well as off-leash pet dogs, is of concern to Seashore managers but is a separate planning issue from that of the management herds of the two non-native deer species. Though stray and abandoned dogs and cats can have detrimental impacts to native wildlife, it is not as broad as the effect of expanding and migrating herds of non-native deer. In addition, the management and regular control of these animals within PRNS takes place through law enforcement officers and is authorized under the Code of Federal Regulations (36 CFR 2.15). Regulations governing feral and domestic animals in the park are detailed in the Seashore's *Compendium*, updated in 2005. Issues concerning dogs and cats were not addressed in the non-native deer management plan because these issues have no influence on the persistence, management or eradication of the non-native deer herds and are outside the scope of this planning effort.

PO 4000 – Park Operations: Impact of Proposal and Alternatives

The management plan is a waste of scarce federal funding.

Response (Also see Response to WH 1000 and GA 1200, reiterating the need for the management plan.) The primary purpose of the National Park Service (NPS) is to preserve the nation's natural and historic treasures for the continued enjoyment of future generations. The NPS expends significant financial resources toward the preservation and perpetuation of natural processes and native species. Considerable effort is directed toward stabilizing rare, threatened and endangered species by improving habitat conditions for their continued survival. A key component of habitat improvement is the control or removal of factors that negatively impact native species. Scientists around the world recognize that the most important cause of native species decline, second only to habitat loss, is non-native species invasions.

Consequently, one of the best uses of limited financial resources to benefit native ecosystems is to improve habitat conditions through removal of non-native competitors where prudent and feasible. Not doing so guarantees the continuation of harmful impacts these species have and also requires perpetual expenditures of staff and budgetary resources, often at the expense of improving conditions for or management of native species of concern. Beyond the outright acquisition of undisturbed habitat, the most effective means, both financially and logistically, of benefiting numerous native, threatened, and endangered species and of perpetuating natural processes is through a focused removal of competing non-native organisms.

Specifically, the non-native deer management plan was developed to accomplish the following important objectives:

- To correct past and ongoing disturbances to Seashore ecosystems from non-native deer and thereby to contribute substantially to the restoration of naturally functioning native ecosystems.
- To minimize long-term impacts, in terms of reduced staff time and resources, to resource protection programs at the Seashore, incurred by continued monitoring and management of non-native deer.
- To prevent spread of populations of both species of non-native deer beyond Seashore and GGNRA boundaries.

- To reduce impacts of non-native deer through direct consumption of forage, transmission of disease to livestock, and damage to fencing to agricultural permittees within pastoral areas.

The NPS considers the accomplishment of these objectives via implementation of the preferred alternative, to manage and eventually eliminate non-native deer from the Seashore, to be highly beneficial for native species, consistent with the primary purpose of the National Park Service and a worthwhile expenditure of public funds.

ON 1000 – Other NEPA Issues: General Comments

The commenter states that NPS was biased (pre-decisional) in its choice of eradication as a component of the Preferred Alternative.

Response The purpose of an Environmental Impact Statement (EIS), and of the National Environmental Policy Act (NEPA), is to make sure that federal agencies fully consider the environmental costs and benefits of their proposed actions before they make any decision to undertake those actions. The NPS is required to analyze impacts and a reasonable range of alternatives, as well as input from the public, before choosing the alternative that causes the least damage to the biological and physical environment. It must also develop and fully analyze an alternative which best protects, preserves, and enhances historic, cultural and natural resources.

The range of alternatives and the impact analyses were developed with input from NPS subject experts, wildlife and contraception experts from universities and other agencies, and from literature searches. Public input was also considered in developing the range of reasonable alternatives as well as the issues of importance in the impact analysis. Before beginning the EIS, the Seashore accepted public comments at a public information meeting at the Point Reyes Dance Palace on May 4, 2002 as well as in letter or email form from May 4, 2002 until July 5, 2002.

Both the national NEPA Regulations and those that guide the National Park Service state that "the preferred alternative must be identified in the draft EIS" so that agencies and the public can understand the lead agency's "orientation" (40 CFR 1502.14 (e), Q4a). In these regulations, "preferred alternative" is defined as the agency-preferred course of action at the time a draft EIS is released. Having a preferred alternative helps the public focus its comments during review of the NEPA document. Therefore the identification of a preferred option at the draft EIS stage is not predecisional, but required. It is also not the same as the "selected" alternative, as the park will consider all comments on the draft EIS before making any final decision on which alternative to implement.

Though the NPS has expressed preference for this alternative, the assessment in the EIS is developed equally for all alternatives. Only after thorough analysis of all the impacts was it obvious that the alternatives which feature eradication of all non-native deer (D and E) would best reduce damaging impacts to natural and physical resources. The non-eradication alternatives (A, B and C), which feature no action or control of deer numbers as some specified level, would perpetuate ongoing detrimental impacts to park natural and physical resources. Alternative E (Removal of all Non-Native Deer by a Combination of Agency Removal and Fertility Control) was found to be the park's Preferred Alternative and, along with Alternative D (Removal of all Non-Native Deer by Agency Personnel), was also found to be the Environmentally Preferable Alternative.

WH 2000 – Wildlife and Wildlife Habitat: Methodology and Assumptions

The commenters are concerned that spread of non-native deer outside of NPS boundaries endangers the mission of other agencies/organizations to preserve native biodiversity.

Response The commenters' concerns are well founded and addressed in the plan's Purpose and Need stated in Chapter 1, and Chapter 4, Environmental Consequences for Alternative A (No Action).

The document concludes that for wildlife, data on current and past population growth of fallow and axis deer at PRNS indicate that continuing current management (the No Action alternative) will result in an increase in non-native deer numbers within the Seashore and throughout Marin County. Pockets of extremely high non-native deer density, such as those currently seen in Olema Valley, are likely to be found increasingly throughout Marin County. Native species richness and diversity would decrease in those high-density areas. Overall, the magnitude of impacts to native wildlife within NPS boundaries are considered moderate or major in intensity, adverse and long-term, and those outside the boundary have the potential to become major in intensity. Similar moderate to major adverse impacts are expected for vegetation inside and outside NPS boundaries.

The recent expansion of non-native deer towards park boundaries is of concern to NPS managers and is one of the compelling components of the stated Need for Action (Chapter 1). The Preferred Alternative (E) would reduce and eventually eliminate the expansion pressure over 15 years by removing all deer within the Seashore. Outside the Seashore, because NPS has no wildlife management authority over state and private lands, California Department of Fish and Game would be responsible for non-native deer control should it become necessary.

PN 8000 – Purpose and Need: Objectives in Taking Action

If one of the objectives for the plan/EIS is truly to prevent transmission of disease, then wouldn't the park also need to address the reduction of disease transmission from livestock or native deer?

Response It is true that one of the objectives includes preventing the transmission of disease from non-native deer to cattle or to other wildlife. The disease of greatest concern in this regard is paratuberculosis, or Johne's disease, an incurable diarrheal wasting disease of wild and domestic ungulates. Both tule elk and black-tailed deer are susceptible to paratuberculosis, which is also carried by axis and fallow deer at the Seashore. Prevalence of paratuberculosis was about 10% and 8% in axis and fallow deer, respectively, during the most recent survey (Riemann et al. 1979). Although paratuberculosis has been documented in tule elk at the fenced Tomales Point Elk Reserve, it has not been documented in PRNS black-tailed deer (Sansome 1999) or in the newly established free-ranging tule elk in the Limantour Wilderness Area The restoration of tule elk in Limantour in 1998 involved a 6-month quarantine of 45 elk which were transported from Tomales Point. The Limantour animals are considered to be the most extensively paratuberculosis-tested wild elk known (Manning et al 2003). Only those animals that tested negative for a battery of fecal and blood tests were released to start the new herd. In 1999, Sansome collected over 120 samples from PRNS black-tailed deer for paratuberculosis testing. All samples tested negative and Sansome concluded that "black-tailed deer pose a minimal risk of re-infecting *M. paratuberculosis* (the organism which causes paratuberculosis) free elk in free-ranging herds" (Sansome 1999). Transmission of paratuberculosis is facilitated by large numbers of animals in close proximity. Because both species of non-native deer gather in large herds, and both are becoming more numerous at PRNS, managers are concerned that the new disease-free Limantour elk herd and native black-tailed deer are susceptible to infection from axis and fallow deer.

Domestic cattle are also carriers of paratuberculosis and infection of native deer from livestock is considered a possibility, albeit minor. The reverse, transmission of disease from native deer to cattle, is also a possibility, and is again considered minor. Elk and black-tailed deer tend to avoid areas where large numbers of livestock congregate and are therefore less likely to be infected (or to infect) with the organism that causes paratuberculosis. Livestock management at PRNS is outside the scope of this planning effort. The impacts of livestock to wildlife and any proposed changes in the Seashore's agricultural policies will be thoroughly discussed, and open to public comment, over the next two years in the next cycle of general management planning leading to a revised General Management Plan.

TE 4000 – Threatened and Endangered Species: Impact of Proposal and Alternatives

Commenters express concern that an excessive population of non-native deer will have detrimental impacts on threatened and endangered species if not controlled. The damage includes loss of vegetation, erosion and negative impacts upon endangered species.

Response See Chapter 4, the section on impacts to special status species of increasing non-native deer numbers and range (No Action, Alternative A). The federally listed species that are likely to be affected by non-native deer include northern spotted owls (*Strix occidentalis caurina*), western snowy plover (*Charadrius alexandrinus nivosus*), California red-legged frog (*Rana aurora draytonii*), Coho salmon (*Oncorhynchus kisutch*), steelhead trout (*Oncorynchus mykiss*), California freshwater shrimp (*Syncaris pacifica*), and Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*). Based on current and past data on fallow and axis deer, without active control their populations will continue to increase, resulting in expanded range and higher animal concentrations within the Seashore and Marin County. Ongoing impacts to species of special concern range from minor to major. All of the impacts associated with the presence and/or expansion of these populations are characterized as adverse.

TE 4000 – Threatened and Endangered Species: Impact of Proposal and Alternatives

Commenters question the plan's conclusion that non-native deer adversely impact sensitive species when there are many other causes for decline in these species.

Response The EIS makes no claim that non-native deer impacts are currently responsible for decline of listed species outside of PRNS boundaries. However, the discussion, in Chapter 4, of Alternative A (No Action) does detail the impacts of non-native deer spreading outside the Seashore and affecting listed species throughout Marin County. As the commenter states, there are usually multiple, complex and inter-related causes for the decline of any particular species of concern. These causes can usually be found in the recovery plans for the species, prepared by U.S. Fish and Wildlife Service and cooperating agencies or institutions. The presence and expansion of non-native deer populations at the Seashore do contribute to the impacts experienced by some sensitive species, however, as the EIS and the literature and expert opinion document. Other factors outside the Seashore that also adversely impact these same species are briefly described in the cumulative impact sections of the EIS. The non-native deer management plan/EIS is not the appropriate document for a full and detailed discussion of the status and cause of decline of all listed species found in the Seashore. Instead, the primary purpose of the EIS is to define management prescriptions for non-native deer management. The appropriate focus of the impact discussion (Chapter 4) is on the probable environmental consequences related to implementing each of the five deer management alternatives.

TE 4000 - Threatened and Endangered Species: Impact of Proposal and Alternatives

The EIS is non-compliant with the Endangered Species Act and NEPA because it does not consider impacts to listed species from the proposed management actions, such as culling, and the EIS overstates the potential impacts to listed species from non-native deer as opposed to the effects of ranching activities.

Response The EIS is compliant with both the Endangered Species Act (Section 7) and NEPA and has fully analyzed possible impacts of management actions to sensitive and listed species.

For NEPA compliance, see Chapter 4, *Methodology,* for a description of how impacts to threatened and endangered species were assessed and defined. An adverse impact is defined in the document as "likely to result in unnatural changes in the abundance or distribution of a special-status species. This could occur through direct disturbance, mortality, decreased reproduction, or through destruction or alteration of habitat." All impacts of the Preferred Alternative (E) that were not negligible (defined as "imperceptible or not measurable (undetectable)" in the document) were described in Chapter 4, Alternative E*, Impacts on Special Status Species*. There were no impacts of the Preferred Alternative to special status species that were deemed by the NPS to be more than negligible in intensity. Specific limitations to management actions, designed to prevent any possible impacts to these species are described in Chapter 2, description of Alternative E:

- Culling would be conducted by specially trained NPS staff or contractors,
- Culling would take place throughout the Seashore, with the exclusion of northern spotted owl breeding areas during owl nesting season (February 1 – August 1) and a ¼-mile coastal buffer zone, to minimize disturbance to marine mammals and protected shorebirds,
- In remote and sensitive locations where removal of a carcass is difficult, it will be left to recycle nutrients into the ecosystem,
- Culling or capture (for contraception) would not take place in creeks or riparian areas.

It is not the purview of this EIS to compare management of non-native deer and its impacts to those of ranching. These are separate issues which have separate NEPA and planning processes. There may be additive impacts of non-native deer populations and cattle to some Seashore resources, and these are analyzed in the cumulative effects sections of this EIS and will be part of the EIS for the park's revised General Management Plan, which is currently in the early stages of a two-year planning process. During this process, the issue of cattle ranching will be directly addressed and evaluated.

TE 4000 - Threatened and Endangered Species: Impact of Proposal and Alternatives

The NPS failed to comply with requirements to undergo Section 7 consultation for the Non-Native Deer Management Plan.

Response For Endangered Species Act (ESA) compliance, see Chapter 5, Consultation and Coordination. Section 7 of the act defines federal agency responsibilities for consultation with the US Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) and requires concurrence from these two agencies with any NPS determination that intended management actions will not adversely affect listed species. The National Park Service initiated the consultation process with USFWS and NMFS on March 26, 2003 and completed both processes May 3, 2005.

On March 10, 2005, in a letter to the USFWS, the NPS requested concurrence with its finding that the proposed plan would not be likely to adversely affect the proposed critical habitat for the California red-legged frog or adversely affect nine plant and animal species found in the planning area. In a memo dated April 7, 2005, the USFWS explained that their assessment of potential effect was based on the project constraints described in the consultation letter including: 1) no actions would take place in creeks, waterways or riparian areas, 2) culling would be conducted by specifically trained staff, 3) carcasses would be removed when possible, and where not possible, left to decay naturally, and 4) that if project work descriptions or time frames change from those provided in the consultation letter, those changes would be submitted to the USFWS for review. In the April 7, 2005 memo, the USFWS concurred with the NPS findings that measures in the proposed plan would be sufficient to reduce any direct, indirect and cumulative effects to the nine listed species and proposed critical habitat to an insignificant or discountable level. With the issuance of the memo, the USFWS concluded its consultation process for the Non-native Deer Management Plan EIS.

On March 28, 2005, NPS transmitted a letter to NMFS regarding potential project effects on listed fish species and fish habitat during implementation of the plan. The NPS clarified that management actions would not take place in creeks, waterways, or riparian areas and therefore the proposed project would not likely to adversely effect central California coast ESU coho salmon, central California coast ESU steelhead, California coastal ESU Chinook salmon, Designated Critical Habitat for central California coast ESU coho salmon, and Essential Fish Habitat for coho salmon and Chinook salmon. NMFS concurred with NPS findings in a letter to the NPS on May 3, 2005, ending the informal consultation process.

VE 4100 – Visitor Experience: Non-Native Deer

AL 1200 – Alternative B (1)

AL 1300 – Alternative C (1)

The commenter favors an alternative that would maintain some level of non-native deer so the public would be able to view them.

Commenters stated that the plan/EIS should more fully address the viewing of non-native deer as an important and unique part of the visitor experience at Pt. Reyes National Seashore.

Response See Chapter 4, Impacts to Visitor Experience (Alternatives D and E) for details of the impacts of removing all non-native deer to visitor wildlife viewing. The removal of all non-native deer would result in minor, long-term, adverse effects to wildlife viewing opportunities, particularly for those interested in fallow deer. This was determined in accordance with the definitions of minor, moderate and major impacts to visitor experience (see Chapter 3, *Methodology*). Minor impacts are measurable and mild and would be detectable by a few visitors; moderate impacts are clearly detectable by many visitors. There is no indication from public comment or visitor satisfaction surveys completed yearly by the Seashore that the adverse impacts to wildlife viewing would be anything other than minor in intensity.

In addition to this, the laws, regulations and policies that guide management at Point Reyes are those that guide all units of the National Park System, whose mission is to insure the continued unimpaired availability to the public of the natural processes and historic features for which they were established. The Seashore's enabling legislation indicates the primary purpose of the park is to preserve a portion of the California Coast that was rapidly vanishing due to development at the time the legislation was passed. NPS units are considered to be of national significance. The observation of exotic animals is inconsistent with these mandates, and is better accommodated by game or zoological parks.

WH 1000 - Wildlife and Wildlife Habitat: Guiding Policies, Regulations and Laws

How is it determined that fallow and axis deer are non-native?

The DEIS does not consider that after 50 years at the park the ecosystem has long since adjusted itself to non-native deer and that certain species may be dependent on them and could be impacted.

GA 1200 - Impact Analysis: Native Deer

Why is the management plan directed at non-native deer instead of both non-native deer and native deer?

Response The National Park Service (Point Reyes is a unit of the National Park Service) is governed by a set of laws, regulations and policies including its 2001 "Management Policies," and it is this set of rules, as well as standard biological and ecological peer-reviewed literature, that park units use to manage resources. These policies (in section 4.4.1.3) clearly define "native species" as all species that have occurred or now occur as a result of natural processes on lands designated as units of the national park system. "Exotic species" are those species that occupy park lands directly or indirectly as the result of deliberate or accidental human activities.

The mechanisms which allow species to evolve with their surroundings, i.e. natural selection, genetic drift, mutation, and gene flow, require many generations and large stretches of "evolutionary time". The evolutionary timescale is on the order of thousands of years. Fifty years, the length of time during which non-native deer have lived on park lands, is a fraction of the time required by most species (particularly long-lived ones) to co-adapt and co-evolve.

The crucial distinctions between natural evolution of native species and introductions of non-native species is the time scale over which it occurs and lack of human manipulation. A species of plant or animal is generally considered to be "native" if it occupied or migrated to an area over this long period of evolutionary time. The distribution and migration of species is considered to be a natural occurrence if it occurs without the intentional or inadvertent influence of humans. Native species inhabiting the national parks either co-evolved at that location over millennia or migrated there over time.

Under natural conditions, the adaptation of species to their environment and to each other over time results in an ecological accommodation and balance. Human activities have compressed that relationship both spatially and temporally resulting in an upset in the evolutionary balance and a disruption of natural processes. Natural barriers such as oceans, deserts and mountains that allowed the development of unique ecosystems, such as the California coastal ecosystem, have been breached over the past five hundred years by rapidly accelerating human trade and travel. Species entering a new ecosystem as a result of these deliberate or inadvertent human activities often have a competitive advantage over native species in that they have no natural predators to enforce balance in their new environments. Introduced species often consume or prey on native ones, overgrow them, transmit new diseases to them, compete with them, or hybridize with them. Invaders can change entire ecosystems by altering hydrology, nutrient cycling, and other ecosystem processes.

This is the case with axis and fallow deer at Point Reyes National Seashore. Axis deer and fallow deer both evolved, over many thousands of years, in India and Asia Minor, respectively. In their native ranges, the vegetation, wildlife and other living species co-evolved with them, to form a stable ecological balance. None of the species present in the natural California coastal ecosystem evolved with axis and fallow deer or appear to be dependent on them in any way. However, the ways in which non-native deer affect native ecosystems are numerous but subtle. Unlike native black-tailed deer, they congregate in massive herds and cause compaction and erosion of soils, denudation of vegetation and damage to woodland and riparian habitats. The species which depend on these areas, including species of concern and migratory birds, are in turn adversely impacted by a loss of habitat. Non-native deer compete with native deer for food and cause decreased survivability of black-tailed deer in the fall and during droughts. These are the scientific or ecological reasons why the plan addresses non-native deer. Also, because there is no evidence or indication that removal of all non-native deer in the Seashore would result in loss of any species native to the California coastal ecosystem, it was not considered in the impact analysis. Conversely, black-tailed deer and the other species that are indirectly and adversely affected by axis and fallow deer have co-evolved over many centuries and do have a niche in the California coastal ecosystem that is represented in the park. They are part of an intricate web of natural resources including other native species, and their absence would be felt in many different parts of this web.

For a full explanation of the adverse impacts of non-native deer see FEIS Chapter 4, Environmental Consequences, Alternative A.

WH 1100 – Wildlife and Wildlife Habitat: Ethical Issues

The non-native deer are in the park because of human action and the NPS has an ethical responsibility to find a non-lethal solution.

PO 4000 – Park Operations: Impact of Proposal and Alternatives

The proposed management plan is cruel and inhumane.

Response The Preferred Alternative does include non-lethal management in the form of contraception; however fertility control by itself will not accomplish the objectives of the plan and is infeasible as the sole method of non-native deer control (see Chapter 2, *Alternatives* and *Actions Considered but Rejected*). In fact, one of the reasons Alternative E was selected over Alternative D, the only other alternative that would fully meet park objectives, is because it would make the maximum feasible use of this non-lethal method of controlling deer numbers. This is despite the fact that Alternative D offers benefits in the form of less cost, a shorter duration, fewer impacts on park resources, and fewer safety risks for park staff who administer the contraceptive. NPS believes that by selecting Alternative E, we have made the greatest possible use of non-lethal methods, given these constraints.

The issues of the plan being cruel or inhumane were common themes in several comments. Humaneness is a person's perception of harm or pain inflicted on an animal, and although at times it can be quite obvious when an animal is in distress or pain, at other times it is not. For example, the American Veterinary Medical Association (AVMA) considers gunshot to be a preferred means of euthanasia in wildlife when it is delivered by sharpshooters skilled enough to be consistently accurate. Particularly if a shot is delivered using a relatively soundless weapon so to not disturb other deer or wildlife, death is quick and relatively painless.

Whether an animal should be killed at all is a matter of the social values an individual holds (see Chapter 4, Impacts on Visitor Experience). The interpretation of what constitutes harm or suffering to an animal varies from person to person, with different people perceiving the humaneness of any given action differently (USDA 1997). For example, Kellert (1976) identified a number of distinct attitudes toward wildlife including naturalistic, ecological, humanistic, moralistic, scientific, aesthetic, utilitarian, dominionistic, and negativistic (see Table 5 in the document for definitions). While people typically possess more than one view of animals, most people hold a predominant view. For example, farmers tend to have a utilitarian attitude towards animals, while scientists tend to take a scientific view (Kellert 1976).

Animal welfare advocates promote the minimization of pain and suffering to animals and their organizations promote the well–being and quality of life of individual animals, irrespective of the animals' role in an ecosystem. In contrast to the animal welfare movement, the animal rights movement is premised on the equality of humans and animals. There are no specific federal directives for NPS in regards to animal welfare or animal rights. NPS management of wildlife, as described in *Management Policies* (NPS 2001), is based on Aldo Leopold's biocentric land ethic, a holistic approach to environmental ethics that values ecosystems in their own right. NPS wildlife management focuses on the role of animal populations and species within the ecosystem, rather than on individual animals.

Impacts to individual animals within a species are analyzed in the document in the context of pain and suffering caused by proposed actions to wildlife, specifically, non-native deer (see Chapter 4, Alternative

E, Impacts to Wildlife). All proposed alternatives include provisions to prevent unnecessary animal suffering (see Chapter 2, Actions Common to All Alternatives). Recommendations for humane animal treatment developed by the American Veterinary Medical Association (AVMA) are included in all alternatives. As noted above, the AVMA considers, in some circumstances, gunshot to be the only practical and acceptable method of euthanasia in wildlife, when delivered by personnel sufficiently skilled to be accurate and experienced in the proper and safe use of firearms (AVMA 2001). Because pain and suffering are not scientifically measurable in animals, the judgment of professionals like veterinarians and the AVMA, as well as wildlife biologists and wildlife veterinarians, is used to assess the likelihood of suffering in the EIS.

All actions which involve direct management of individual animals, ranging from aerial surveillance to live capture, contraception and lethal removal, will be conducted in a manner which minimizes stress, pain, and suffering to every extent possible (see Chapter 2, *Actions Common to All Alternatives*). Culling would be conducted by NPS staff or contractors specifically trained in wildlife sharpshooting. Efforts would be made to deliver immediately lethal shots to target animals and sharpshooters would be required to complete range qualifications specifically designed for ensuring humane and effective wildlife removal.

Using the recommendations of the AVMA, every effort will be made to minimize the degree of human contact during all procedures that require handling of wild ungulates, including contraception. In addition, managers will attempt to "reduce pain and distress to the greatest extent possible during the taking of an animal's life" (AVMA 2001). As a matter of general policy in all wildlife management activities, Seashore managers always endeavor to minimize animal suffering, eliminate unnecessary pain to every extent possible and comply with the recommendations of the AVMA. A detailed description of AVMA recommendations can be found on the AVMA website: www.avma.org/resources/euthanasia.pdf.

In addition, regardless of whether a non-native species is introduced directly by humans or expands its range into a unit of the National Park Service, NPS is required to preserve unimpaired the natural and cultural resources and values of the national park system for future generations. Legally, through the NEPA process, NPS must choose a Preferred Alternative which will best fulfills the park's statutory mission and responsibilities, considering economic, environmental, and technical factors. NPS must also choose the alternative that best accomplishes the purpose and need for federal action (as stated in the Purpose and Need section). See Chapter 2 (Preferred Alternative) for the reasons why Alternative E was chosen as the Preferred Alternative.

WH 2000 – Wildlife and Wildlife Habitat: Methodology and Assumptions

The model (Barrett) used to predict population trends is not accurate and has been demonstrated to be faulty before, for example when used to estimate carrying capacity of the tule elk range.

Response Two models, independently created by two experts in the field of wildlife population biology, were included in the data used to evaluate the effect of the 5 alternatives on non-native deer populations. Comparing these models to previous models developed for predicting carrying capacity in tule elk (Howell et al 2000, Gogan 1986) is inappropriate because they have very different equations, variables, assumptions and overall objectives.

The two models used in this EIS use different equations but come to very similar conclusions about the expected effect of No Action, fertility control and culling on fallow and axis deer numbers. Dr. Reginald Barrett, of the University of California, Berkeley developed the model described in Appendix A. Dr. N. Thompson Hobbs, of Colorado State University, developed the model described in Appendix B. The commenter questions the assumptions used in the Barrett model.

The strength of any model depends on the suitability of its basic equation and the reliability of its assumptions. For Dr. Barrett's model, the mathematical formulas are based on expert opinion and the published literature concerning fallow and axis deer population dynamics. The assumptions of the model are based on field observations, necropsy data from hundreds of deer, and unpublished and peer-reviewed published data on both species (including reproductive, age and sex-specific mortality rates and sex ratios). The published literature used includes PRNS-specific references (Gogan et al 2001; Wehausen and Elliott 1982). Several experts in the fields of wildlife biology and wildlife contraception reviewed the Barrett and Hobbs modeled and found the assumptions and conclusions to be sound.

The Hobbs and Barrett models are important to the document but did not constitute the sole basis for the comparison of alternatives or choosing the Preferred Alternative. NPS managers relied on current information on impacts of non-native deer, published literature on deer and grazing impacts, and the opinions of wildlife biology experts, as well as the two models, to develop and evaluate action alternatives.

WH 4000 – Wildlife and Wildlife Habitat: Impact of Proposal and Alternatives

Commenters state the EIS underestimates the impact of proposed management actions on native deer, including: increased human intrusion into deer habitat, noise, stress from shooting, and increased predation due to a decrease in non-native deer population. The EIS should more fully describe these impacts.

Response All known or measurable impacts to native species of proposed actions were analyzed in Chapter 4, *Impacts to Wildlife*. Proposed management actions involving culling or use of helicopters to capture and contracept non-native deer would not cause measurable impacts for native species. Measurable or perceptible impacts are those resulting in unnatural changes in survival or reproduction, viability of a population or species, unnatural distribution of available resources or habitat.

Addressing the commenter's specific concerns, native black-tailed deer do not routinely co-mingle with fallow deer, therefore inducement of physiological stress from non-native deer control and contraception activities is insignificant. (See discussion of stress in response to AL 1410). Other native wildlife would also not experience more than negligible impacts (as noted in the description of each action alternative B-E). Culling would take place throughout the Seashore, with the exception of northern spotted owl breeding areas during owl nesting season (February 1 – August 1), and a ¼-mile coastal buffer zone, to minimize disturbance to marine mammals and protected shorebirds. Spreading the effect throughout the 90,000-acre project area means any helicopters used would hover in any given area only a short period of time and only occasionally. While wildlife may be temporarily disturbed, the effect is so short-lived as to be undetectable.

Predator densities should not change appreciably due to reduction in non-native deer populations as there is little indication that non-native deer are a significant prey species for native predators. As noted above, predators are likely at their carrying capacity at the seashore, and even the potential glut of prey offered by non-native deer has not increased their numbers. Clearly the sharp increase in non-native deer numbers in the past decade is a strong indication that native predators are doing little to limit non-native deer populations. Consequently, any compensatory increase in predation of native deer, resulting from reduction of non-native deer, is considered a negligible change.

WH 4000 – Wildlife and Wildlife Habitat: Impact of Proposal and Alternatives

The EIS needs to disclose impacts of non-native deer to riparian and wetland vegetation.

Response Impacts of non-native deer to riparian and wetland vegetation is addressed in a broader context under several impact area topics -- soils, water resources, vegetation, wildlife and special status species -- in Chapter 4, Alternative A (No Action). Since release of the Draft EIS, a study completed in the Seashore in 2005 by U.S. Geological Survey demonstrates clearly the extent and serious magnitude of impacts to riparian areas of rutting (reproductive) behaviors in male fallow deer. (Study results are detailed in Chapter 3, *History of Research on Non-Native Deer*.) Fallow bucks defend specific territories, or leks, during the rut season and the same areas are traditionally used year after year. Bucks scrape craters in the leks, sometimes 0.6 meters deep, and rub against trees and vegetation, breaking branches and girdling young trees. While engaged in breeding behaviors, fallow deer indirectly affect fish and other aquatic life by damaging riparian plants, resulting in: increased erosion and sediment delivery to the stream, reduced cover, and potentially warmer water in streams due to exposure to sunlight. Increased numbers of fallow deer would increase the scope and intensity of this impact to riparian vegetation. Some of these fish (coho and Chinook salmon and steelhead trout) are listed as threatened under the federal Endangered Species Act. An unmanaged and expanding population of non-native deer would reduce the success and potential effectiveness of ongoing and planned riparian restoration projects for salmon because in restoration areas, revegetation efforts and natural regrowth would be severely retarded due to heavy grazing, trailing and antler thrashing. These impacts are unique to fallow deer. Neither native tule elk nor native black-tailed deer form leks.

As described in Chapter 1, *Required Impact Topics*, riparian areas are frequented by fallow deer herds and are analyzed along with other natural resource impacts (i.e. in the *Vegetation* section of Chapter 4) in the document. Because they do not frequent wetland habitat to any measurable degree, non-native deer do not otherwise affect wetlands or floodplains.

WH 4000 – Wildlife and Wildlife Habitat: Impact of Proposal and Alternatives

If lethal removal proceeds, it should be monitored to ensure humane treatment and visitor safety, and shooters should use non-lead bullets.

Response As noted in response to comments above, all actions which involve direct management of individual animals, ranging from aerial surveillance to live capture and lethal removal, would be conducted in a manner which minimizes stress, pain, and suffering to every extent possible. Culling would be conducted by NPS staff or contractors specifically trained in wildlife sharpshooting. Efforts would be made to deliver immediately lethal shots to target animals and sharpshooters would be required to complete range qualifications specifically designed for ensuring humane and effective wildlife removal. NPS will use recommendations of the American Veterinary Medical Association (AVMA) for humane treatment of animals. Also, every effort will be made to minimize the degree of human contact during all procedures that require handling of wild ungulates, including contraception and culling.

Deer management proposals analyzed in the document include the use of firearms, aircraft, and chemical sterilant drugs, all of which can affect health and safety of visitors and staff. Existing regulations including the NPS Management Policies (2001) and several NPS Director's Orders address these activities (see Chapter 1 in the FEIS, Relationship to Other Plans, Laws and Regulations) and will be implemented to ensure human health and safety during project implementation. Among other things, these policies and regulations contain specific language regarding how to ensure public health and safety within areas of NPS jurisdiction and specify when appropriate certifications related to it are required (e.g., use of firearms, aviation).

Because deer carcasses may be used as food for the California Condor Recovery Program, use of non-lead ammunition is likely. Control and monitoring components of the Non-Native Deer Management

Plan will be specified in a detailed implementation plan that will address operational, scientific and resource protection aspects of the program. National Park Service mandates and policies for resource protection and public safety will be incorporated. Mechanisms for monitoring and evaluating efficacy of methodologies employed are described in the monitoring plan attached to the FEIS as an appendix (C).

WH 4000 – Wildlife and Wildlife Habitat: Impact of Proposal and Alternatives

The DEIS makes unrealistic speculations, relies on anecdotal information and studies of questionable relevance to support the contention that non-native deer impact resources.

Response It is unclear whether the commenters are questioning the information used to support the need for reducing or eliminating non-native deer, or that used in the impact analysis. Although both come from a variety of sources including the scientific literature and the best professional judgment of experts both in and out of the National Park Service, the need for action is not based solely on this information. Rather it is a combination of scientific information, results of monitoring inside the Seashore and the requirement to adhere to the laws, policies and regulations of the National Park Service. The relevant laws and policies are described in the EIS (see *Regulatory Background* in chapter 1, for example) and in responses to comments above (ON 1000 for example), but include the requirement to return ecosystems to as natural conditions as possible and to eliminate non-native species if possible.

In terms of the analysis of impacts, NEPA requires agencies to use the best available information, particularly when the potential for major impacts exists. If information, such as locale-specific data, is unavailable, NEPA requires agencies to inform the public if this deficit will result in inability to predict impacts accurately. Fallow and axis deer have been most extensively studied close to their evolutionary point of origin or in areas where they have been introduced for a long period of time. As they are usually considered a non-native, non-game species in the U.S., wildlife conservation agencies here have little incentive to invest in intensive studies and instead focus efforts upon protection and maximization of native game species. Nevertheless, there is a reasonable amount of data on the impacts of fallow and axis deer to ecosystems, both at PRNS and elsewhere in the U.S. These data are summarized in Chapter 3 (History of Research on Non-Native Fallow and Axis Deer at Point Reyes National Seashore and Golden Gates National Recreation Area) as well as in the Impacts sections of each alternative (Chapter 4). Anecdotal data was included for the sake of completeness but was not the sole basis for the impact analysis. Additional data, such as documented impacts to Seashore riparian and woodland habitats, documented dietary overlap with native deer, and documented presence of transmissible diseases, were important in calculating impacts. As described in the Methodology section of Chapter 4, all of these sources of information, including scientific literature about these species in their native lands, anecdotal observations, the best professional judgment of wildlife biologists, as well as research completed at the Seashore and elsewhere have been used to conduct the analysis of impacts of increasing fallow and axis deer populations and range on other wildlife species. In the professional judgment of park scientists, as well as wildlife experts from other agencies and institutions, the data available on non-native deer are sufficient to determine their impacts to Seashore ecosystems.

WH 4000 – Wildlife and Wildlife Habitat: Impact of Proposal and Alternatives

Commenters ask that PRNS consider the range of impacts of the non-native deer on PRNS natural resources including competition for forage w/ native deer and elk, damage to riparian areas and woodlands, potential effects to California red-legged frogs and salmon, and impacts to visitor safety from aggressive fallow deer.

Response The impacts of each alternative to these resources are discussed and analyzed in the *Impacts* chapter of the EIS, in the sections on wildlife, species of special concern, vegetation and human health and safety. In the analysis of impacts to human health and safety of increasing non-native deer numbers and range (see Chapter 4, Alternative A), the document discusses the minor adverse impacts to human safety for staff, Seashore visitors and Marin County inhabitants. These impacts are due to increased risk of deer-vehicle collisions and NPS use of helicopters for monitoring deer. There have been no reports of fallow deer aggression directed towards Seashore staff or visitors and therefore the risk of direct physical harm to visitors by increasing numbers of aggressive deer is considered negligible.

WV 1000 – Wilderness Values: Impact on Wilderness

The DEIS does not address the impacts of the culling activities and the resultant increased human intrusion onto habitat which is counter to the goals of wilderness and special status species management.

Response The FEIS does address the impacts of culling and capture operations on wilderness as part of the resource impact topics such as impacts to water quality, soils, vegetation and visitor experience. Additional text describing wilderness experience and character has been added to the Affected Environment chapter (Visitor Experience) and the Environmental Consequences chapter (Impacts on Visitor Experience of Alternatives A through E). Preservation of wilderness character includes management actions to restore conditions conducive to wildness and naturalness and includes restoration of natural processes. With the Wilderness Act, Congress recognized the concept of Minimum Requirement analysis and use of the administratively determined “Minimum Tool” to achieve objectives for managing wilderness as wilderness. Management activities within wilderness are controlled by these two concepts to limit intrusions upon wilderness character. Actions taken under the Preferred Alternative (E) would be limited in time, place and scope to adhere with to the requirement of Minimum Requirement. See Appendix A, Minimum Requirement Decision Guide, for an analysis of proposed actions to minimize negative impacts to wilderness character and values. As noted in the guide, long-term removal of all non-native deer would result in beneficial impacts to wilderness hydrologic processes, soils, vegetation, native wildlife and special status species. Based on what is known of visitor use patterns in Seashore wilderness areas, these adverse impacts are estimated to affect few visitors per year. As described in the document, the direct temporary adverse impacts of the Preferred Alternative to the wilderness experience would be outweighed by the beneficial long-term effects of increased protection of wilderness habitat necessary for the preservation of integral values of wilderness.

Appendix A: Wilderness Minimum Requirement Guide

ARTHUR CARHART NATIONAL WILDERNESS TRAINING CENTER

MINIMUM REQUIREMENT
DECISION GUIDE

“. . . except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act.”
– Wilderness Act, 1964

Instructions and Worksheets for the Minimum Requirement Analysis
for Actions, Projects, and Activities in Wilderness

The Minimum Requirement Decision Guide is designed for wilderness administrators to effectively analyze proposed actions to minimize negative impacts to wilderness character and values. It assumes a basic knowledge of the Wilderness Act of 1964, agency policies, and specific provisions of the wilderness designation legislation for each unit. This guide is suggested for wilderness administrators for the four federal land management agencies, the Bureau of Land Management, the National Park Service, the U.S. Fish & Wildlife Service and the U.S. Forest Service.

Section 4(c) of the Wilderness Act of 1964 prohibits certain activities in wilderness by the public, and, at the same time allows the agencies to engage in those prohibited activities in some situations. Section 4(c) states:

“… except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area), there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area.”

Therefore, unless a generally prohibited use is allowed by specific unit designation, most of these activities are prohibited. However, in the above language, Congress acknowledged that there are times when exceptions are allowed to meet the minimum required administration of the area as wilderness.
How to Use This Guide
The Minimum Requirement Decision Guide displays a two-step process to assist in making the right decision for wilderness. First, the administrator must decide if a problem or issue in the wilderness unit needs administrative action, and then, and only then, the administrator must decide what tool/action/method, available from a range of identified alternatives, would minimize negative impacts on wilderness character and values. This guide includes templates for documenting both steps of the decision-making process, instructions for completing each step, and a cover sheet for signatures. The Minimum Requirement Decision Guide and future revised editions of the guide can be found on the Arthur Carhart National Wilderness Training Center page at www.wilderness.net.

STEP 1 – DETERMINING THE MINIMUM REQUIREMENT

Is Administrative Action Needed?

What is the problem/issue that may require administrative action? Do not include methods or tools here. This sheet only refers to the issue or problem, not proposed action/project, or tools to be used. Include references from other legislation, policy, or plans, decisions, analyses, and how this issue is addressed in

Briefly describe the issue/problem:

At least 1,000 non-native axis deer (*Axis axis*) and fallow deer (*Dama dama*) inhabit wilderness, natural and pastoral areas of Point Reyes National Seashore. Both species were introduced to the area, before establishment of the Seashore, by a local landowner who purchased individuals from the San Francisco Zoo in the 1940s and 1950s for hunting purposes. The deer now inhabit the entire park and threaten to establish viable populations outside park borders. There is a need to address potential adverse impacts to native species from non-native deer, to maintain native ecosystems, to prevent spread of non-native deer outside NPS boundaries and to eliminate adverse impacts of non-native deer to agricultural lessees.

The following questions assist in analyzing whether the issue needs to be resolved in wilderness. Do not consider what tools are to be used here. Please circle **Yes** or **No**, and explain your reasoning:

1. Is this an emergency? **Yes** **No** If yes, follow established procedures for Search and rescue (SAR), fire or other plans/policies. If no, please continue.

2. Is this problem/issue subject to valid existing rights, such as access to valid mining claim, state lands, etc? **Yes** **No**

If no, continue with **Sheet 1**.

If yes, briefly explain here and then proceed to **Sheet 3**

3. Can the problem/issue be addressed by administrative actions outside a wilderness area? (For example, the administrative actions could be an information program at the visitor center or trailhead instead of a physical action in the wilderness, etc) **Yes** **No**

If yes, conduct actions outside wilderness. If no, continue with **Sheet 2**.

4. Is there a special provision in legislation (the 1964 Wilderness Act or subsequent laws), that allows this project or activity? (For example, maintenance of dams or water storage facilities, access to private inholdings, etc.) **Yes** **No** **If yes, Go to SHEET 3; if no, Go To SHEET 2.**

Is Administrative Action Needed? (Continued)
If the issue/problem is not resolved, or action is not taken, will the natural processes of the wilderness be adversely affected?

$\boxed{\text{Yes}}$ No Why/How?

Current population indices and recent range expansion of non-native deer suggest that at least one species (fallow deer) will continue to increase in number and range throughout wilderness areas of the Seashore. This invasive species will increasingly interfere with natural processes.

If the issue/problem goes unresolved, or action is not taken, will the values of solitude or primitive and unconfined type of recreation be threatened?

Yes $\boxed{\text{No}}$ Why/How?

The presence of non-native deer does not impact the values of solitude or quality of primitive and unconfined recreation.

3. If the issue/problem goes unresolved or action is not taken will evidence of human manipulation, permanent improvements, or human habitation be substantially noticeable ?

$\boxed{\text{Yes}}$ No Why/How?

Exotic deer in the wilderness ecosystem are evidence of human caused non-native species introduction. Because of their numbers and range, non-native deer are substantially noticeable.

4. Does addressing the issue/problem or taking action protect the wilderness as a whole as opposed to a single resource?

$\boxed{\text{Yes}}$ No Why/How?

Non-native deer likely impact the native ecosystem they inhabit on several levels, by consuming native vegetation, competing with native herbivores and causing local impacts to soils and water resources.

5. Does addressing this issue/problem or taking action contribute to protection of an enduring resource of wilderness for future generations?

$\boxed{\text{Yes}}$ No Why/How?

Addressing the problem of non-native deer substantially contributes to the restoration and protection of native wilderness ecosystems for future generations.

6. Is this an issue for reasons other than convenience or cost of administration?

$\boxed{\text{Yes}}$ No Why/How?

If administrative action is warranted, then proceed to Sheet 3 to determine the minimum tool or method for resolving the problem.

Identify and describe a range of alternatives including those that utilize traditional tools and non-motorized and mechanized means as well as other methods.

Alternative A: No Action

This alternative would perpetuate non-native deer management practices since 1995, when ranger culling was discontinued. No non-native deer control actions would be undertaken. Monitoring activities, as outlined in Chapter 2 (Actions Common to All Alternatives) would continue in perpetuity.

Circle yes or no:

Does this alternative involve:

use of temporary road?	Yes	No
use of motor vehicles?	Yes	No
use of motorized equipment?	Yes	No
use of motorboats?	Yes	No
landing of airplanes?	Yes	No
landing of helicopters?	Yes	No
use of mechanical transport?	Yes	No
creating a structure or installation?	Yes	No
Other impacts to wilderness character?	Yes	No

Describe the biophysical effects/benefits of this alternative:

In order to ensure protection of native species and ecosystems, continued monitoring would be an integral part of this action alternative. Helicopter use to monitor non-native deer populations and range may be required.

Describe the social/recreation effects/benefits:
None.

Describe societal/political effects/benefits:
None.

Describe health and safety concerns/benefits:
Use of helicopters to monitor non-native deer populations and range may result in some risk to NPS staff and visitors from aviation accidents.

Describe economic and timing considerations/benefits:
None.

Describe heritage resource considerations/benefits:
None.

Identify and describe a range of alternatives including those that utilize traditional tools and non-motorized and mechanized means as well as other methods.

Alternative B: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal

Non-native deer populations would be controlled initially to a level of 350 for each species (700 total axis and fallow deer). Control of each non-native deer species to 350 animals would be accomplished with lethal removal by NPS staff or contractors specifically trained in wildlife sharpshooting. Efforts would be made to reach target levels in 15 years, to ensure continued presence of both species in the Seashore, and to reduce risks of range expansion beyond Seashore boundaries. Because the goal of this alternative would be to control axis and fallow deer at a specified level and not to eradicate them from PRNS, annual culling would continue indefinitely and total numbers of deer removed is incalculable. Where axis and fallow deer carcasses can be moved, they would be donated to charitable organizations as food for the needy or to assist in endangered species recovery programs. In cases where carcasses cannot be accessed, they would be left in place to recycle nutrients into the ecosystem. Monitoring activities would continue for the life of the Plan.

Circle yes or no:

Does this alternative involve:

use of temporary road?	Yes	$\boxed{\text{No}}$
use of motor vehicles?	$\boxed{\text{Yes}}$	No
use of motorized equipment?	Yes	$\boxed{\text{No}}$
use of motorboats?	Yes	$\boxed{\text{No}}$
landing of airplanes?	Yes	$\boxed{\text{No}}$
landing of helicopters?	$\boxed{\text{Yes}}$	No
use of mechanical transport?	Yes	$\boxed{\text{No}}$
creating a structure or installation?	Yes	$\boxed{\text{No}}$
Other impacts to wilderness character?	Yes	$\boxed{\text{No}}$

Describe the biophysical effects/benefits of this alternative:

Long-term, lower non-native deer numbers would result in beneficial impacts to hydrologic processes, soils, vegetation, native wildlife and special status species.

Describe the social/recreation effects/benefits:

Short-term, public access to some areas could be restricted during lethal removals.

Describe societal/political effects/benefits:

None.

Describe health and safety concerns/benefits:

Use of helicopters and firearms may result in some risk to NPS staff and visitors.

Describe economic and timing considerations/benefits:

Reduction of non-native deer numbers before populations and range increase further will reduce the overall cost of the control program.

Describe heritage resource considerations/benefits:

None

Identify and describe a range of alternatives including those that utilize traditional tools and non-motorized and mechanized means as well as other methods.

Alternative C: Control of Non-Native Deer at Pre-Determined Levels by Agency Removal and Fertility control (Sterilants or Yearly Contraception)

Non-native deer populations would be controlled initially to a level of 350 for each species (700 total axis and fallow deer) using both lethal removal and fertility control. Efforts would be made to reach target levels in 15 years, to ensure continued presence of both species in the Seashore, and to reduce risks of range expansion beyond Seashore boundaries. The contraceptive program would incorporate the latest contraceptive technologies to safely prevent reproduction, for as long as possible, and with minimal treatments per animal. Because the goal of this alternative would be to control axis and fallow deer at a specified level and not to eradicate them from PRNS, annual culling and fertility control would continue indefinitely and total numbers of deer removed and treated with contraceptives is incalculable. Monitoring activities would continue in perpetuity.

Circle yes or no:
Does this alternative involve:

use of temporary road?	Yes	$\boxed{\text{No}}$
use of motor vehicles?	$\boxed{\text{Yes}}$	No
use of motorized equipment?	Yes	$\boxed{\text{No}}$
use of motorboats?	Yes	$\boxed{\text{No}}$
landing of airplanes?	Yes	$\boxed{\text{No}}$
landing of helicopters?	$\boxed{\text{Yes}}$	No
use of mechanical transport?	Yes	$\boxed{\text{No}}$
creating a structure or installation?	Yes	$\boxed{\text{No}}$
Other impacts to wilderness character?	Yes	$\boxed{\text{No}}$

Describe the biophysical effects/benefits of this alternative:

Long-term, lower non-native deer numbers would result in beneficial impacts to hydrologic processes, soils, vegetation, native wildlife and special status species.

Describe the social/recreation effects/benefits:

Short-term, public access to some areas could be restricted during lethal removals and contraception.

Describe societal/political effects/benefits:

None.

Describe health and safety concerns/benefits:

Use of helicopters and firearms may result in some risk to NPS staff and visitors.

Describe economic and timing considerations/benefits:

Reduction of non-native deer numbers before populations and range increase further will reduce the overall cost of the control program.

Describe heritage resource considerations/benefits:

None

Identify and describe a range of alternatives including those that utilize traditional tools and non-motorized and mechanized means as well as other methods.

Alternative D : Removal of All Non-Native Deer from Point Reyes National Seashore (PRNS) and PRNS-Administered Lands of Golden Gate National Recreation Area (GGNRA) by Agency Removal

In Alternative D, all axis and fallow deer inhabiting the Seashore and the GGNRA lands administered by the Seashore would be eradicated by 2021 through lethal removal by NPS staff or contractors specifically trained in wildlife sharpshooting. Where deer carcasses can be moved, they would be donated to charitable organizations as food for the needy or to endangered species recovery programs. In cases where carcasses cannot be accessed, they would be left in place to recycle nutrients into the ecosystem. Monitoring activities would continue until all non-native deer are eradicated, by 2021.

Circle yes or no:
Does this alternative involve:

use of temporary road?	Yes	$\boxed{\text{No}}$
use of motor vehicles?	$\boxed{\text{Yes}}$	No
use of motorized equipment?	Yes	$\boxed{\text{No}}$
use of motorboats?	Yes	$\boxed{\text{No}}$
landing of airplanes?	Yes	$\boxed{\text{No}}$
landing of helicopters?	$\boxed{\text{Yes}}$	No
use of mechanical transport?	Yes	$\boxed{\text{No}}$
creating a structure or installation?	Yes	$\boxed{\text{No}}$
Other impacts to wilderness character?	Yes	$\boxed{\text{No}}$

Describe the biophysical effects/benefits of this alternative:

Long-term, eradication of non-native deer would result in beneficial impacts to hydrologic processes, soils, vegetation, native wildlife and special status species.

Describe the social/recreation effects/benefits:

Short-term, public access to some areas could be restricted during lethal removals.

Describe societal/political effects/benefits:

None.

Describe health and safety concerns/benefits:

Use of helicopters and firearms may result in some risk to NPS staff and visitors.

Describe economic and timing considerations/benefits:

Reduction of non-native deer numbers before populations and range increase further will reduce the overall cost of eradication.

Describe heritage resource considerations/benefits:

None.

What is the method or tool that will allow the issue/problem to be resolved or an action to be implemented with a minimum of impacts to the wilderness?

The Selected alternative is: **Alternative E.**

Identify and describe a range of alternatives including those that utilize traditional tools and non-motorized and mechanized means as well as other methods.

Alternative E (Proposed Action): Removal of All Non-Native Deer from Point Reyes National Seashore (PRNS) and PRNS-Administered Lands of Golden Gate National Recreation Area (GGNRA) by a Combination of Agency Removal and Fertility control (Sterilants or Yearly Contraception)

In Alternative E, all axis and fallow deer inhabiting the Seashore and the GGNRA lands administered by the Seashore would be eradicated by 2021 through lethal removal and fertility control. Culling would be conducted by NPS staff or contractors specifically trained in wildlife sharpshooting. The contraceptive program would incorporate the latest experimental contraceptive technologies to safely prevent reproduction, for as long as possible, and with minimal treatments per animal. Where deer carcasses can be moved, they would be donated to charitable organizations as food for the needy or for endangered species recovery programs. In cases where carcasses cannot be accessed, they would be left in place to recycle nutrients into the ecosystem. Monitoring activities would continue until all non-native deer are eradicated, by 2021.

Circle yes or no:
Does this alternative involve:

use of temporary road?	Yes	$\boxed{\text{No}}$
use of motor vehicles?	$\boxed{\text{Yes}}$	No
use of motorized equipment?	Yes	$\boxed{\text{No}}$
use of motorboats?	Yes	$\boxed{\text{No}}$
landing of airplanes?	Yes	$\boxed{\text{No}}$
landing of helicopters?	$\boxed{\text{Yes}}$	No
use of mechanical transport?	Yes	$\boxed{\text{No}}$
creating a structure or installation?	Yes	$\boxed{\text{No}}$
Other impacts to wilderness character?	Yes	$\boxed{\text{No}}$

Describe the biophysical effects/benefits of this alternative:

Long-term, removal of all non-native deer would result in beneficial impacts to hydrologic processes, soils, vegetation, native wildlife and special status species.

Describe the social/recreation effects/benefits:

Short-term, public access to some areas could be restricted during lethal removals or contraception operations.

Describe societal/political effects/benefits:

None.

Describe health and safety concerns/benefits:

Use of helicopters and firearms may result in some risk to NPS staff and visitors.

Describe economic and timing considerations/benefits:

Reduction of non-native deer numbers before populations and range increase further will reduce the overall cost of eradication.

Describe heritage resource considerations/benefits:
None

STEP 2: DETERMINING THE MINIMUM TOOL

Sheet 4: Selection of the Minimum Tool Alternative

Attach all alternative sheets to this summary page.

Describe the rationale for selecting this alternative

Eradication of non-native deer will be an important step in the restoration of native ecosystems in Seashore wilderness areas and will assist in protection of vegetation, native herbivores, special status species, hydrological and soil resources for the future. Use of long-lasting fertility control, should it prove effective, will reduce the number of deer that need to be culled, consequently reducing the amount of vehicular and helicopter use in the wilderness.

Describe the specific operating requirements for the action. Include information on timing, locations, type of actions, etc. (Use this space or attach a separate sheet)

This alternative requires the use of helicopters for monitoring and deer removal activities. Although it is unlikely that such use would result in helicopter landings in wilderness, emergency landings are always possible. Alternative E also requires the use of vehicles in wilderness to transport NPS sharpshooters and to remove carcasses for donation to charity.

What are the maintenance requirements? This alternative requires maintaining current roads and trails in wilderness.

What standards and designs will apply? **Not applicable.**

Develop and describe any mitigation measures that apply. Aerial operations will not take place during high visitation months or during weekends. Use of vehicles will be restricted to currently permitted roads. Inaccessible carcasses will not be retrieved and will be left to recycle nutrients into the ecosystem.

What will be provided for monitoring and feedback to strengthen future effects and preventative actions to be taken to help in future efforts? **Deer population monitoring will inform mangers on the success of implementation of alternative E. Experts on capture and deer control will be consulted in the first 3 years of the plan to ensure safety and efficacy of the protocols.**

Appendix B: Non-Native Deer Population Model (Barrett)

A. Deer Harvest Models:

POPMODFD (for fallow deer) and POPMODAD (for axis deer), version 12-13-2000, are spreadsheet models developed by Reginald Barrett (Gogan et al. 2001). The models' primary use is to determine the effects of any proposed harvest schemes on axis and fallow deer populations. The mathematical formulas are based on published literature and expert opinion. They assume that survival rates and recruitment of young into the population are all density dependent. In other words, as deer populations increase towards carrying capacity (K), survival of various age groups decreases, as do the birth rate and survival of fawns. The patterns of density dependence were derived from field observations, necropsy data and the published literature on both species. Simulation of future population scenarios requires input from the user of estimates for starting population, carrying capacity and lethal removals (if any).

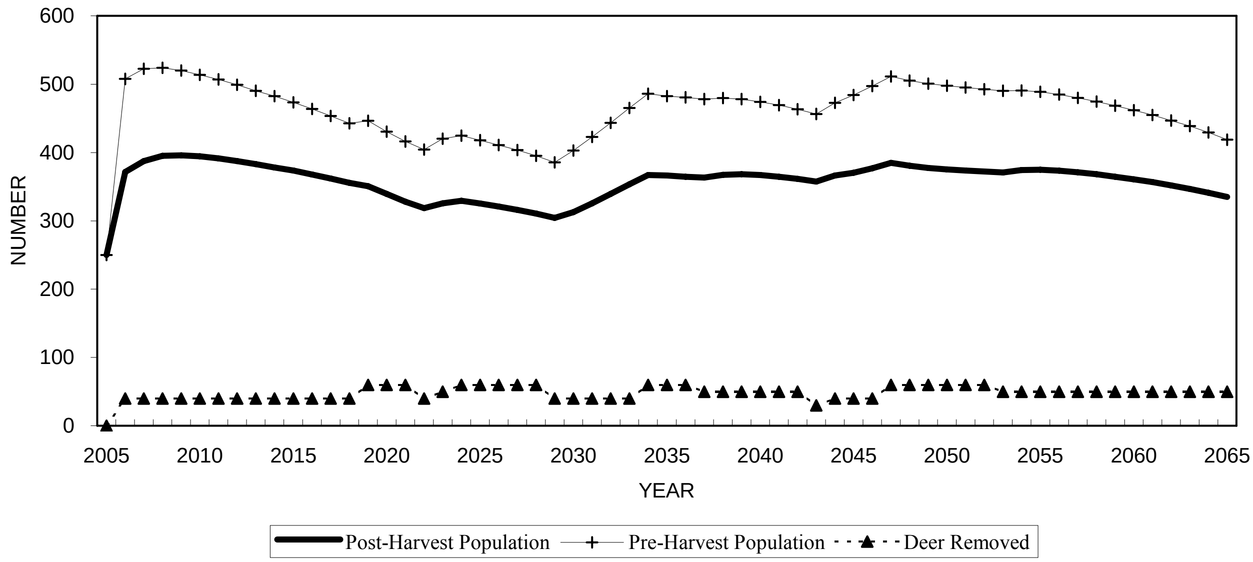
By using past numbers of animals culled as well as populations estimates from the 1970s, Gogan et al. (2001) derived values for carrying capacity of 455 and 775 for axis and fallow deer respectively. These are the population sizes at which population growth essentially stops. It should be noted that in the case of fallow deer, PRNS estimates of the current numbers (N = 859, 90% Confidence Interval = 547 - 1170) slightly exceed the Gogan et al. estimates for carrying capacity (PRNS unpublished data (f)). Wildlife population numbers should always be interpreted as estimates within a confidence interval. As in all empirical models based on such estimates, the Barrett models are best used to detect future trends rather than exact numbers.

Using the Barrett models, we can investigate the effects of culling on either species. If we input current estimates for axis and fallow deer numbers and use the above values for carrying capacity, the following scenarios result.

1. Alternative B - Remove 25-50 axis deer yearly, once the population surpasses 350:

AXIS DEER NUMBERS

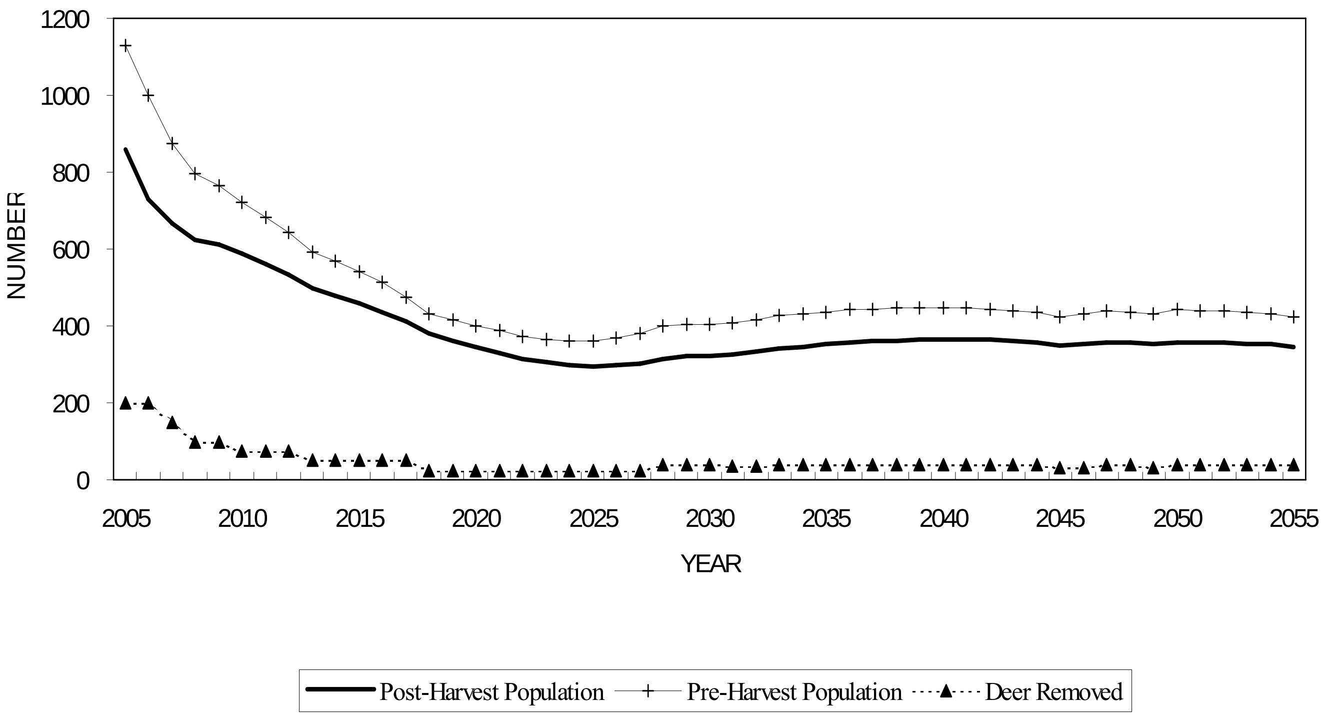
K = 445; Starting Population = 250; NPS removals after population reaches 350 (illustrated here as occurring in 2006)



Approximate number of axis deer removed by 2021 = 650
Approximate number of axis deer removed by 2050 = 2,200

2. Alternative B – Remove 100-200 fallow does yearly until the population reaches 350, and remove 50-75 deer yearly thereafter:

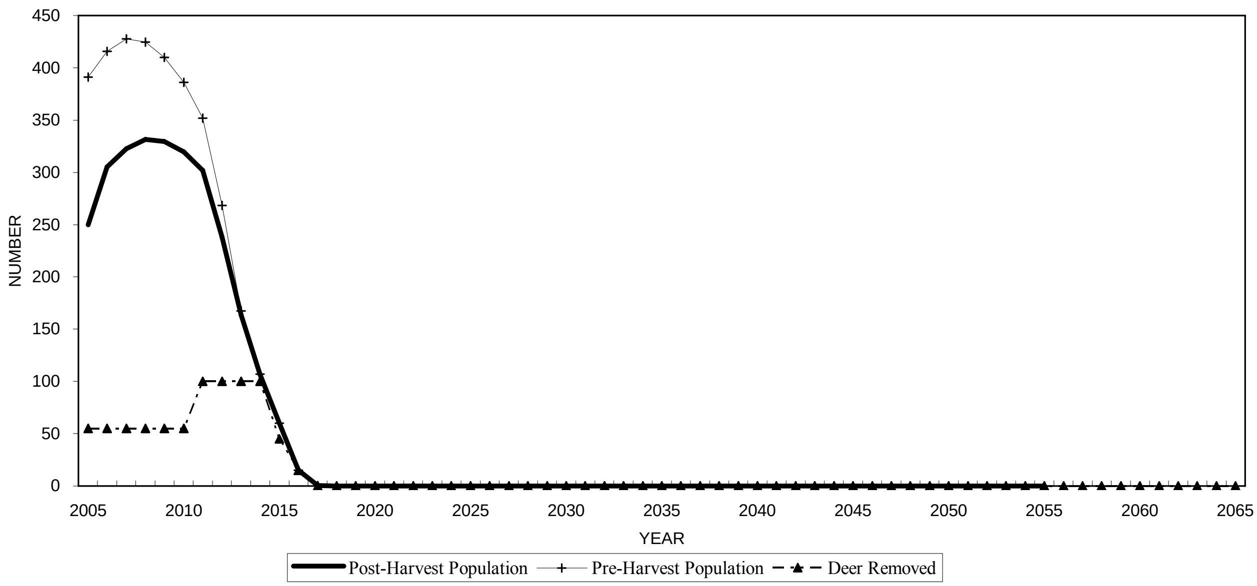
FALLOW DEER NUMBERS
K = 775; Starting Population = 859; NPS removals after 2005



Approximate number of fallow deer removed by 2021 = 2,400
Approximate number of fallow deer removed by 2050 = 5,500

3. Alternative D – Remove 50-100 axis deer yearly until eradication:

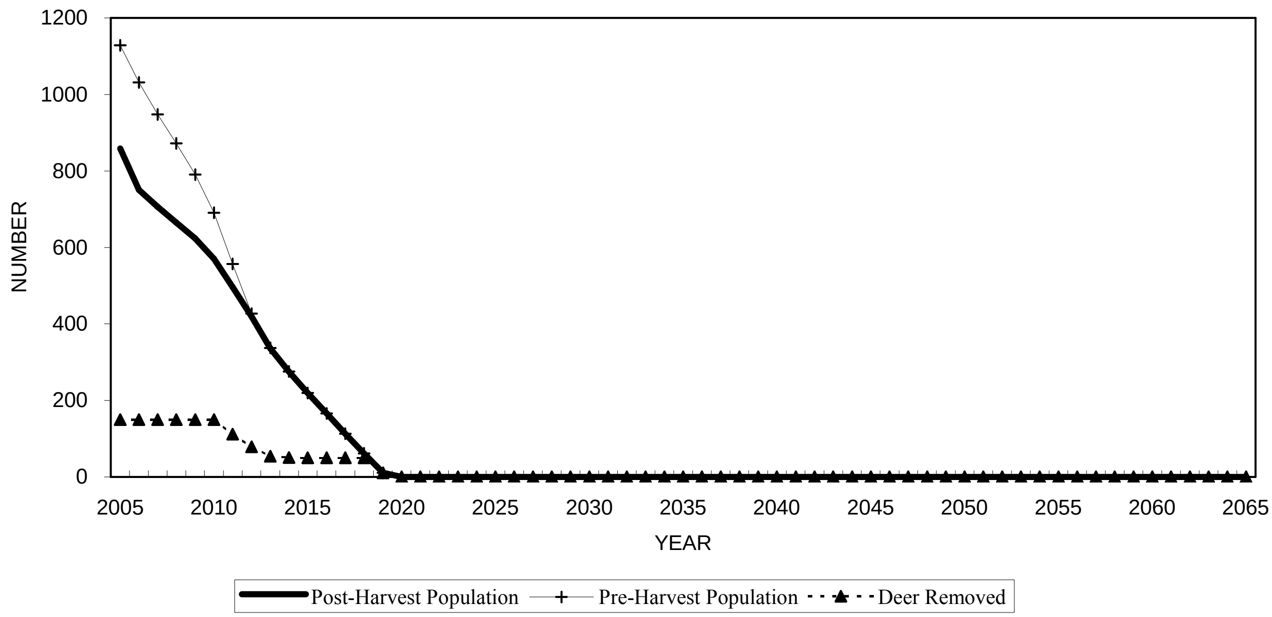
AXIS DEER NUMBERS
K= 445; Starting Population = 250; NPS removals after 2005



Approximate number of axis deer removed until eradication (in approximately 2017) = 800

4. Alternative D – Remove 150-200 fallow deer yearly until eradication:

FALLOW DEER NUMBERS
K=775; Starting Population = 859; NPS removals after 2005



Approximate number of fallow deer removed until eradication (in approximately 2021) = 1,400

Yearly Contraception Model

In 2002, Barrett also incorporated fertility control, without lethal removal, into the above fallow deer model (POPMODFD) to simulate the use of yearly contraception as the sole method of population control for fallow deer (Barrett 2002 unpublished data). The model assumes use of a contraceptive agent that is 100% effective in preventing pregnancy for up to 12 months, and that all treated animals can be marked to avoid double treatment. The model uses the above values for fallow deer carrying capacity (K = 775) and starting population size (N = 859).

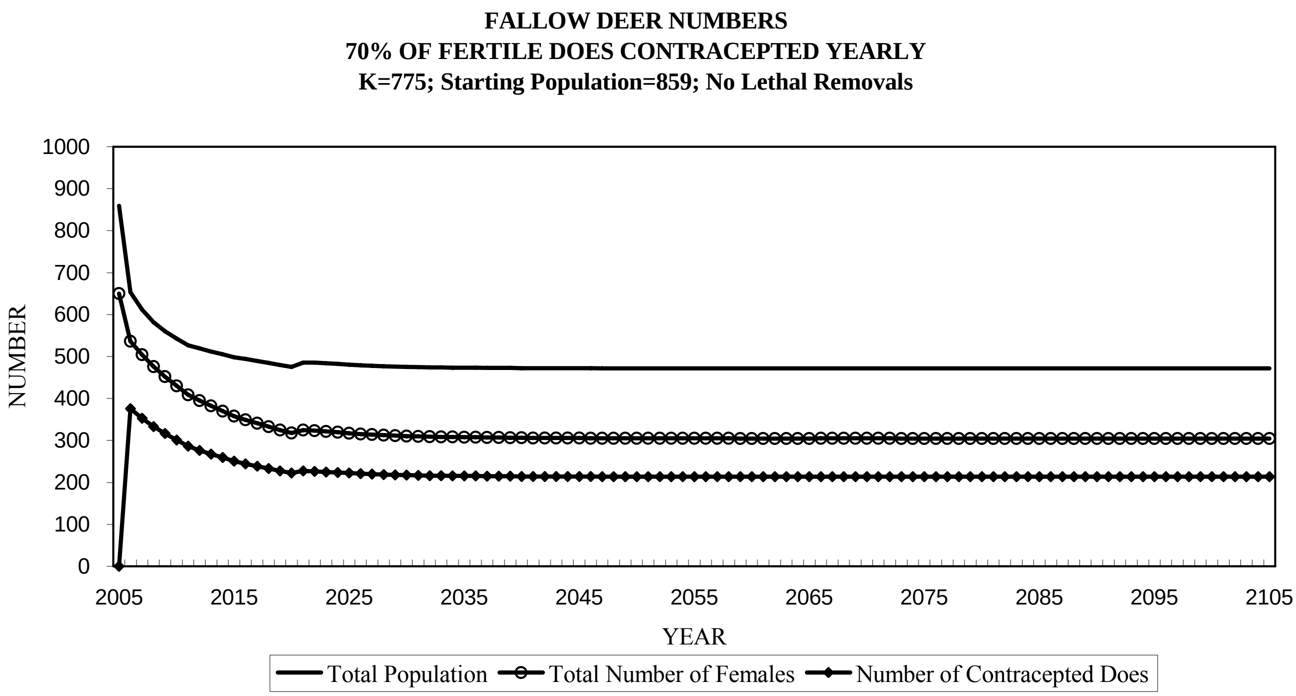
Barrett found that yearly contraception of at least 80% of does was required to reduce the population to 350 within 25 years. This represents a treatment group size of over 300 animals yearly for the first 6 years. Barrett also found that, in the absence of lethal removal, 99% of reproducing females would require treatment with a 100% effective yearly contraceptive in order to eradicate all fallow deer in 20 years. This would constitute a treatment group size of up to 550 animals per year during the first 5 years of the program.

The following projections simulate treatment of various proportions of the fallow doe population with a yearly contraceptive “vaccine” similar to that which has been used in tule elk at Point Reyes National Seashore. For a discussion of current wildlife contraceptive technology, refer to the discussion of contraceptives under Alternative C. It should be noted that the currently available wildlife contraceptive vaccine (porcine Zona Pellucida) requires a second booster injection during the first year of administration to be effective in preventing pregnancy in tule elk and other cervids (Kirkpatrick et al. 1996b; Shideler 2000). A second treatment is not included in the following projections; therefore, projected numbers of treatments should be considered minimum figures.

The action alternatives that include the use of yearly contraceptives to either control the fallow deer population at a pre-determined level or to eradicate the fallow deer from the Seashore are further discussed in the section *Alternatives and Actions Considered but Rejected.* Because of the numbers of animals that would require capture, handling and treatment, these alternatives were dismissed from consideration due to infeasibility.

1. Contraception of 70% of fallow does yearly, beginning in 2006, with no lethal removals:

In this scenario, with 200-400 does treated every year, the total population never drops below 470 animals.

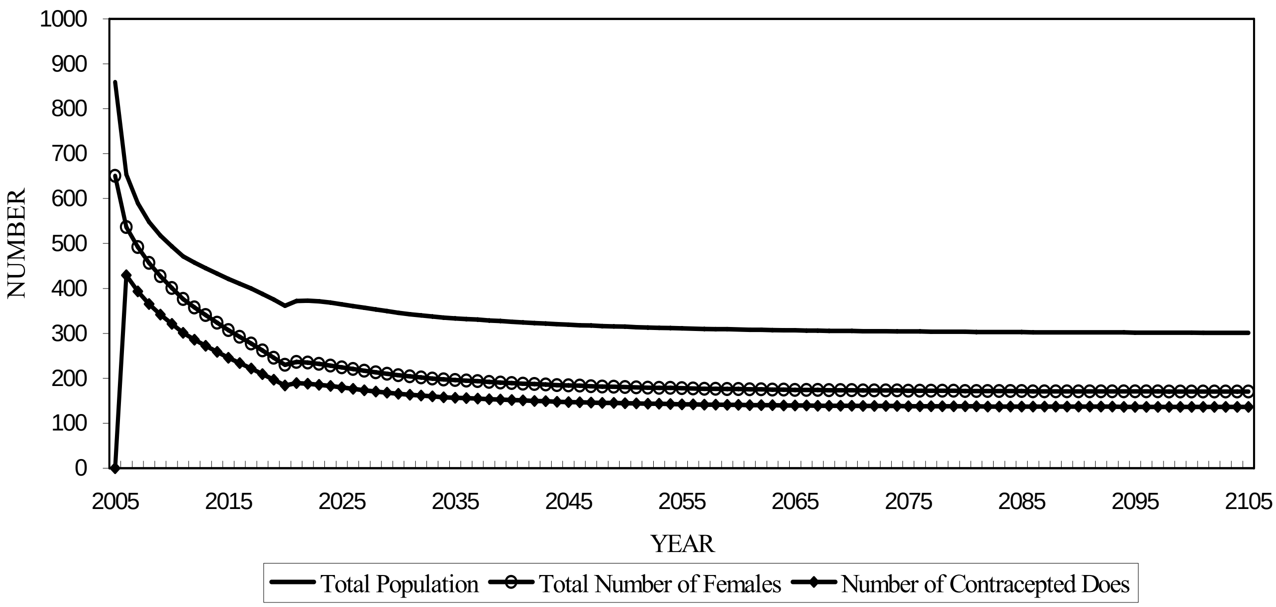


Approximate number of treatments by 2021 = 4,200
Approximate number of treatments by 2050 = 11,000

2. Contraception of 80% of fallow does yearly, beginning in 2006, with no lethal removals (Alternative and Action Considered but Rejected) :

In this scenario, the population reaches 350 in 2030, with up to 450 females treated yearly. Here, total numbers treated are less than in the 70% treatment scenario because the number of fertile females and the total population are both reduced more rapidly.

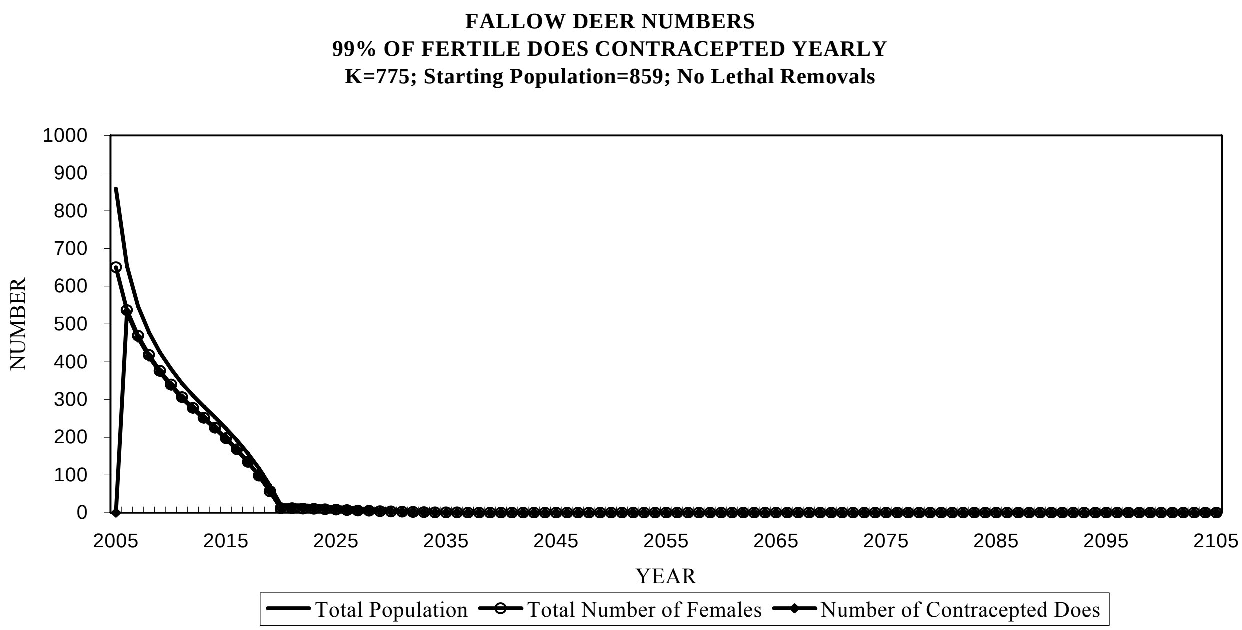
FALLOW DEER NUMBERS
80% OF FERTILE DOES CONTRACEPTED YEARLY
K=775; Starting Population=859; No Lethal Removals



Approximate number of treatments by 2021 = 4,300
Approximate number of treatments by 2050 = 9,100

3. Contraception of 99% of fallow does yearly, beginning in 2006, with no lethal removals (Alternative and Action Considered but Rejected):

In this scenario, up to 500 does are treated yearly during the first 10 years of the program. The population decreases rapidly but is not eradicated until the last doe dies of old age in approximately 2035. Again, total numbers treated are less than in the 70% or 80% treatment scenarios because the number of fertile females and total population are both reduced more rapidly. Most of the population effect of the treatment takes place in the first few years of the program when over 400 does per year are treated.



Approximate number of treatments by 2021 = 3,800
Approximate number of treatments by eradication (approximately 2035) = 3,900

Appendix C: Monitoring and Management Plan for Action Alternatives B, C, D and E

Alternatives B through E contain actions to accomplish the following objectives:

- To correct past and ongoing disturbances to Seashore ecosystems from non-native deer and thereby to contribute substantially to the restoration of naturally functioning native ecosystems.
- To minimize long-term impacts, in terms of reduced staff time and resources, to resource protection programs at the Seashore, incurred by continued monitoring and management of non-native deer.
- To prevent spread of populations of both species of non-native deer beyond Seashore and GGNRA boundaries.
- To reduce impacts of non-native deer through direct consumption of forage, transmission of disease to livestock, and damage to fencing to agricultural permittees within pastoral areas.

The purpose of this monitoring plan is to describe how NPS will collect the information required to design a specific implementation plan for the Preferred Alternative and to modify this plan in future years as a way of ensuring that the above objectives are met.

Successful management of natural systems is a challenging and complicated undertaking. The Department of the Interior requires that its agencies “use adaptive management to fully comply” with the Council on Environmental Quality’s guidance that requires “a monitoring and enforcement program to be adopted . . . where applicable, for any mitigation” (516 DM 1.3 D(7); 40 CFR 1505.2). Adaptive management is based on the assumption that current resources and scientific knowledge are limited. Nevertheless, an adaptive management approach attempts to apply available resources and knowledge and adjusts management techniques as new information is revealed. The principle of adaptive management requires management decisions and policies to be viewed as hypotheses subject to change.

Adaptive management incorporates scientific experimental methods in the management process while remaining flexible to adjust to changes in the natural world, as well as policies that govern it. The goal is to give policy makers a better framework for applying scientific principles to complex environmental decisions.

Through the Environmental Impact Analysis process, NPS has determined that accomplishing the above objectives can only be achieved through reduction of non-native deer numbers to a certain level (Alternatives B and C) or complete removal of all non-native deer from the Seashore (Alternatives D and E). In all four of the Action Alternatives (B, C, D, and E), there are two specific techniques used for control of non-native deer numbers, fertility control (long-duration contraception) and lethal removal. What follows is a description of the parameters that will guide implementation of the Preferred Alternative, how the success of long-lasting contraception or lethal removal will be ascertained and what conditions would indicate a change in these two techniques.

Implementation of the Preferred Action Alternative (E)

In Alternative E, all axis and fallow deer inhabiting the Seashore and the GGNRA lands administered by the Seashore would be removed by 2021. Management techniques would include lethal removal and fertility control (long-lasting contraception or sterilization of deer). Both actions would continue until both axis and fallow deer have been extirpated. Because of their current large populations (approximately 250 axis deer and approximately 860 fallow deer), it is expected that total removal of both species would require a minimum of 13 years, regardless of the technique(s) used. Before initiation of management, experts from the fields of wildlife contraception and deer control would be consulted to refine the important details of implementation. An example of such a detail would be seasonality of fertility control and culling. Another example would be capture sites for experimentally treated deer or focus sites for culling. These implementation details would be subject to review during the plan's duration and alteration based on the data collected on management effectiveness (see Modification of Plan Actions section below). These details do not alter the basic approach of the Preferred Alternative or the environmental impacts as described in this environmental impact statement, but will help the Seashore in maximizing efficiency and achieving the objectives to the greatest possible degree. Monitoring during program implementation would be done to assess success of the program and to guide adjustments in the management techniques used (see Measuring Success section below).

Measuring Success

On a regular basis, the Seashore Resource Management staff and NPS subject matter experts will evaluate the progression of the non-native deer management program towards the four objectives of the management plan. Frequency of reevaluation will depend on the resource being monitored and rates of change (recovery) of this resource. Specifics of this self-evaluation are detailed below:

Objective 1 – Correcting disturbance caused by non-native deer and contributing to ecosystem restoration

As non-native deer numbers decrease, their impacts to native ecosystems are also expected to decrease. This improvement in ecosystem characteristics and processes is expected to manifest itself as any or all of the following:

- In fallow deer lekking areas - reduced bare soil, reduced damage to understory vegetation, reduced trampling and trailing, reduced girdling of trees, reduced incursion of exotic plants
- In fallow and axis deer year-round congregation areas – reduced bare soil, reduced damage to understory vegetation, reduced trampling and trailing, reduced girdling of trees, reduced incursion of exotic plants
- Improved habitat in riparian areas within non-native deer ranges for anadromous fish, amphibians and riparian-dependent birds
- Reduced exposure of native cervids to diseases carried by non-native deer, namely paratuberculosis (Johne's disease) and exotic lice
- Reduced competition between native and non-native deer for limited forage, particularly during times of low forage availability such as during summer and droughts
- Reduced behavioral competition between native and non-native deer

Any or all of the following methods will be used to assess signs of ecosystem restoration mentioned above:

- Monitoring of native and non-native deer numbers through park-wide aerial and/or ground censusing, indirect indices (pellet group or spotlight counts) or area sampling, performed at intervals of 1-3 years. Any use of aircraft to monitor deer would comply with Office of Aircraft Safety regulations and policies for all NPS aerial operations (Director's Order 60).
- Monitoring of native and non-native deer population growth rates through composition counts, with or without multi-year surveillance of marked animals for determination of survival and fecundity rates.
- Monitoring of the diets of native and non-native deer to assess dietary overlap given the new ranges occupied by exotic deer and new deer herd sizes since the previous dietary studies of 1973 and 2000 (Elliott 1983; Fallon-McKnight 2006). Particular attention would be given to assessing the importance of threatened and endangered plant species in the diets of all deer species as well as dietary overlap between non-native deer, native black-tailed deer and native tule elk, re-introduced to Tomales Point in 1978 and the Limantour Wilderness Area in 1999.

- Surveillance for evidence of deer overuse in natural or wilderness areas in which non-native deer are found in high densities. This could include measurements of bare soil and vegetative cover as well as erection of deer-proof exclosures, as experimental controls, in wilderness areas.
- Monitoring of disease in all non-native deer found in high densities within pastoral areas, and in direct contact with livestock within Seashore boundaries. Disease testing could entail collection and complete necropsy of a sample of any deer species for which the two above requirements were satisfied, along with laboratory analysis of appropriate biological samples.

Objective 2 – Minimize long-term impacts, in terms of reduced staff time and resources, to resource protection programs at the Seashore, incurred by continued monitoring and management of non-native deer

Active management of non-native deer, through fertility control and lethal removal, is expected to initially result in increased expenditures of NPS funds and staff time. In the early years of the management program, the capture of large number of deer to administer experimental contraception and the lethal removal of a large number of deer will cause impacts to park operations that should decrease with decreasing non-native deer numbers. However, the wildlife management literature demonstrates that a few, wary deer are often more expensive and time-consuming to control than many, naïve deer. This increased wariness and reduced visibility of the non-native deer in the later years of the 15-year program will result in disproportionate management costs per deer, although since there will be many fewer deer, the overall costs per year are expected to drop. When all non-native deer have been removed (predicted to be in 2021), costs associated with monitoring or managing them will disappear. Progression towards this goal will be measured, during the life of the plan, by monitoring of the costs of the management program including: staff time, training, administrative, legal, and public relations costs and the costs of monitoring as described above.

Objective 3 – To prevent spread of populations of both species of non-native deer beyond Seashore and GGNRA boundaries

NPS believes that the most effective way to accomplish Objective 3 is to reduce non-native deer numbers rapidly. Any deer control program involving lethal removal of animals with firearms has the potential to scatter deer herds and push deer out of the Seashore and into adjacent lands. Provisions described in Alternative B, C, D and E that specify removing animals from the edges of the Seashore before culling animals deeper within the park would mitigate such scattering, as would an initial larger scale removal. Assessing the program's success in achieving Objective 3 will involve monitoring of non-native deer range year-round with special emphasis on identifying changes in non-native deer range beyond Seashore boundaries or within the park as a reaction to management actions. Should exotic deer expand outside the park, the Seashore would provide assistance to California Department of Fish and Game to conduct monitoring programs outside its borders.

Objective 4 – To reduce impacts of non-native deer through direct consumption of forage, transmission of disease to livestock, and damage to fencing to agricultural permittees within pastoral areas.

It is expected that as non-native deer numbers decrease through NPS management, impacts to ranchers within the Seashore will also decrease. Success in achieving Objective 4 will be assessed through communication with ranchers and yearly field assessments by Seashore biologists and range ecologists.

Modification of Plan Actions

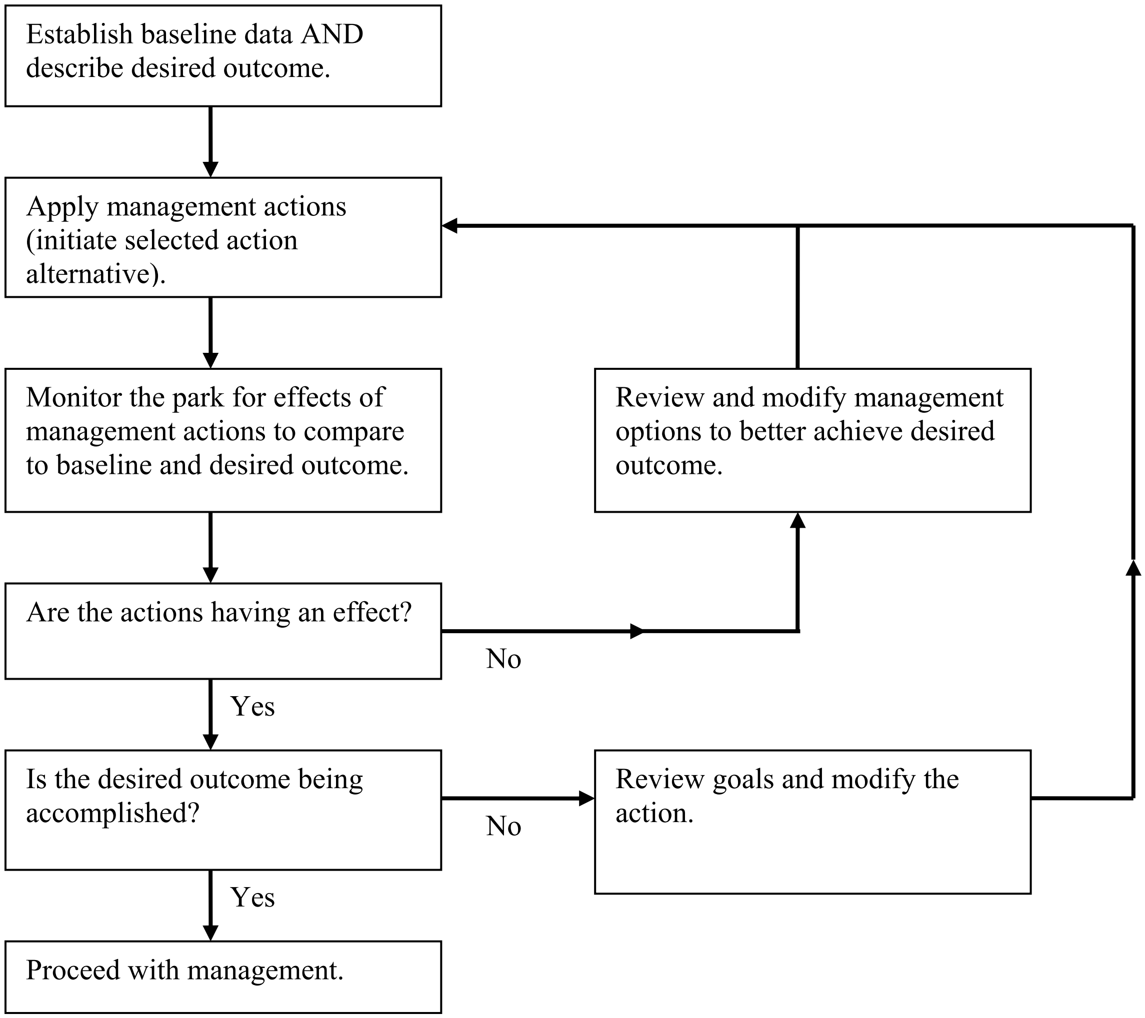
Achievement of the above objectives would warrant continued management as described in the Action Alternatives. However, as illustrated in Figure 1, if desired outcomes are not being achieved, when measured in the monitoring steps described above, a modification of action is warranted.

The two techniques proposed for managing deer numbers in Alternatives B, C, D, and E are experimental fertility control and lethal removal. The following data will be collected on these two techniques during the life of the plan:

- Experimental Fertility Control: In order to assess the efficacy of any experimental contraceptive treatment, treated deer would be permanently marked with radio collars and eartags and monitored for fecundity, mortality and any treatment side effects. In addition, necropsies on opportunistically recovered carcasses would provide data on safety and health effects of the agent.
- Lethal Removal: In order to assess the efficacy of lethal removals on non-native deer populations, data will be collected on numbers culled as well as sex, age class and culling locations. As mentioned above, monitoring of native and non-native deer numbers through park-wide aerial and/or ground censusing, indirect indices (pellet group or spotlight counts) or area sampling, would be performed at intervals of 1-3 years.

Should desired objectives not be met with the level of effort in contraception and lethal removal described in the alternatives, alterations in those levels will be made. Should deer numbers not decrease as predicted by population models (see Hobbs and Barrett models in the appendices), resource managers, along with experts in the field of wildlife contraception and deer management, could decide to increase either fertility control or culling. These decisions would take into account data on the effectiveness of these techniques. For example, should deer numbers fail to decrease along with adverse impacts to soils, vegetation and ranchers, and should 3 years of data on contraception indicate that treatment was only resulting in short-term inhibition of fawning, managers could decide to either try a more promising long-duration contraceptive or cull more animals per year. Conversely, should data indicate that the experimental contraceptive was 100% effective for 4 years or more, a decision could be made to treat more animals. It should be noted that the Preferred Alternative currently call for treating 25% of does. Based on past deer contraceptive programs and deer captures at PRNS, and for reasons of accessibility, Seashore managers believe that this level of treatment approaches the maximum feasible level. It is unlikely, unless deer contraceptive delivery methods change from injected to orally administered, that more than 25% of does could be treated. However, if this is not the case and the agent is both effective and more easily to deliver in the field, it may be used to treat additional deer. As noted in the EIS, the contraceptive program would be adaptively managed to incorporate the latest contraceptive technologies to safely prevent reproduction for as long as possible with minimal treatments per animal. As the technology of wildlife contraception changes, so too could the Seashore program.

<u>Figure 1: An Illustration of the Adaptive Management Approach for the Action Alternatives</u>



Appendix D: Final Report Point Reyes Fallow Deer Modeling

N. Thompson Hobbs
6/15/2003

Modeling Objective

I constructed a stage-based simulation model following Hobbs et al. (2000) to examine the effect of culling and fertility control on the abundance of fallow deer in Point Reyes National Seashore. Specific questions to be addressed by the model included:

a) How many animals must be culled or treated with contraceptives to eradicate the population?
b) Does fertility control offer a feasible alternative to culling as a way to eliminate fallow deer?
c) Can fertility control increase the efficiency of culling in an eradication campaign?
d) How does the duration of effect of contraception influence the number of animals that must be treated or culled to achieve eradication?

Model Structure

Overview

The model represents 2 sexes and 3 age stages, juveniles, yearlings and adults. The number of stages was chosen to represent important differences in survival and fertility and to facilitate comparison with field observations where no more than two ages can be identified. Census occurs in January and most mortality is assumed to occur between census and births (Figure 1). A birth pulse occurs during May, followed by breeding in late October. Thus, juveniles are 8 months old at the time of census. I assume that treatment with contraceptives occurs after births but before breeding. The model consists of linked difference equations and represents annual changes in abundance of animals in each stage (Figure 2) at a one year time step. Simple variations in model structure allow it to represent fertility control agents differing in duration of efficacy.

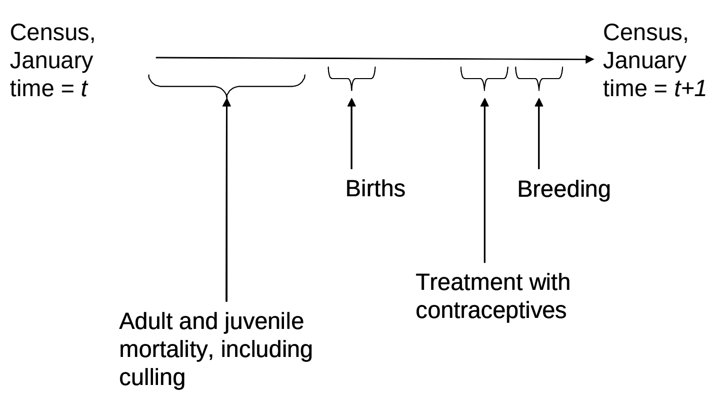
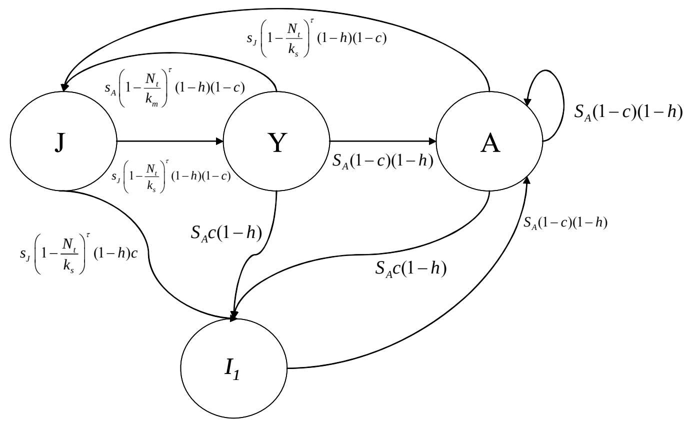
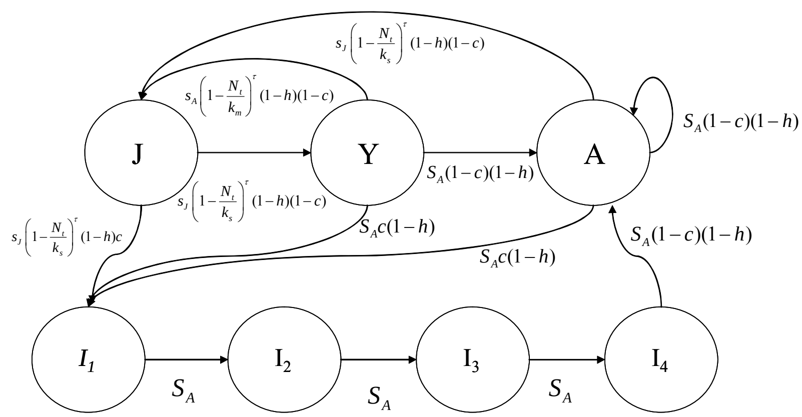


Figure 1. Assumed timing of events in fallow deer model.

1 Year Duration



4 Year Duration



Lifetime Duration

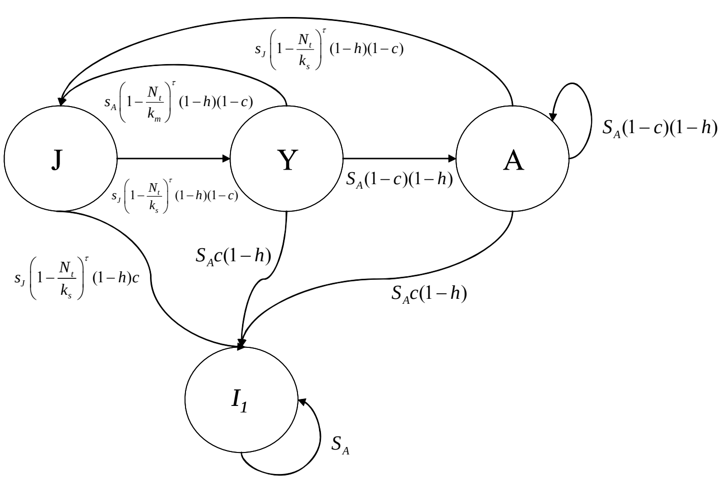


Figure 2. Structure of models used to represent effects of culling and fertility control on fallow deer populations in Point Reyes National Seashore. Duration refers to the length of time fertility control agents remain effective following treatment. See Table 1 for definitions of parameters. See text for definitions of state variables.

Model Parameters

Models include 7 parameters and two decision variables (Table 1). These are tabulated here to facilitate understanding the equations that follow. In a subsequent, section, I describe procedures for estimating parameter values.

Table 1. Values and Definitions for Parameters used in Fallow Deer Model.

Parameter	**Value**	**Definition**
m_A	.9	Maximum per capita rate of recruitment by adult females occurring when population size is close to 0. This recruitment rate specifies the number of offspring that survive to the first census produced per adult female alive at the birth pulse.
m_Y	.5	Maximum per capita rate of recruitment by yearling females occurring when population size is close to 0. This recruitment rate specifies the number of offspring that survive to the first census produced per yearling female alive at the birth pulse.
k_m	1500	The population size at which no offspring survive from birth to census.
r	.5	Sex ratio of offspring
s_J	.9	Maximum survival of juveniles. Juvenile survival is defined as the proportion of juveniles alive at census at time *t* that survive to become yearlings at time *t+1* and, thus, represents survival from age 8 to 20 months. The maximum value occurs when total population size is near 0.
s_A	.9	Adult survival rate, assumed to be constant.
k_s	3600	The population size where juvenile survival rate reaches a minimum value, assumed to be .10.
τ	1	Shape parameter controlling the abruptness of density dependence. As τ approaches 0, effects of density are not seen until large population sizes.
Decision Variables		
h	Specified by user	Culling rate, the number of animals that are culled during time t to t+1 divided by the number of animals that escape natural mortality during time t to t+1
c	Specified by user	Treatment rate, the number of animals treated with contraceptives during time t to t+1 divided by the number of animals that escape culling and natural mortality.

Model Formulation

The equations composing the 4 year duration fertility control model are outlined below in a form that isolates terms for the number of animals culled and treated with contraceptives. Formulating them this way leads to expressions that are not as compact as they could be, but which should be more easily understood than if I wrote equations in their simplest, most reduced form. Equations for the lifetime and single year duration models are variations of the 4 year case and will be described following the development of the 4 year model.

I first define a recruitment function, $f(Y_t, A_t, N_t)$ to estimate the number of fawns that are alive at their first census. This function represents fertility, the number of offspring born per female in the population, as well as survival during the animals first 7 months. I predict recruitment using,

$$f(Y_t, A_t, N_t) = s_A(Y_t m_Y + A_t m_A)\left(1 - \frac{N_t}{k_m}\right)^{\tau} \qquad (1)$$

where t index time, Y_t is the number of yearling females at time t, A_t is the number adults at time t and N_t is total population size at time t. Adult survival is included in the recruitment function because adults must survive from census to births to contribute offspring at the next time step. To achieve a simple formulation, I assume that density affects the number of offspring produced by adults and yearlings in a similar fashion, but that adults produce more offspring than yearlings when density is low. The parameter τ controls the way that recruitment rate responds to density. When τ is 1, then the per capita recruitment rate declines linearly with increasing population size, which is the usual logistic assumption. When τ approaches 0, recruitment remains insensitive to changes in population numbers until high densities are reached (Figure 3) This parameter is included for sensitivity and uncertainty analysis because the shape of the relationship between density and recruitment is not known.

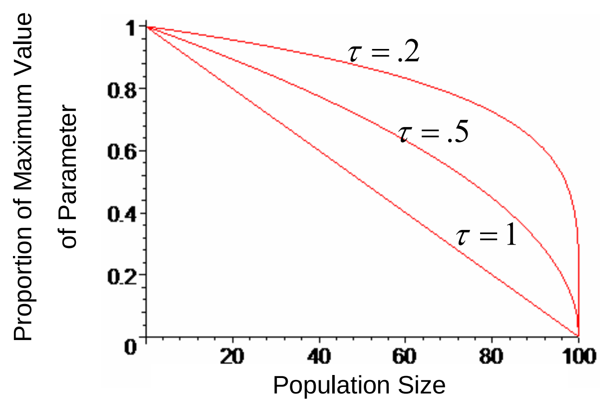


Figure 3. Illustration of model representation of non-linear density dependence for a hypothetical population with carrying capacity = 100 animals.

Dynamics of fertile females are specified by:

$$\begin{aligned} J_{t+1} &= f(Y_t, A_t, N_t)r - H_{Jt} - C_{Jt} \\ H_{Jt} &= f(Y_t, A_t, N_t)rh \\ C_{Jt} &= f(Y_t, A_t, N_t)r(1-h)c \end{aligned}$$

$$Y_{t+1} = J_t s_J \left(1 - \frac{N_t}{k_s}\right)^{\tau} - H_{Yt} - C_{Yt}$$

$$H_{Yt} = J_t s_J \left(1 - \frac{N_t}{k_s}\right)^{\tau} h \qquad (2)$$

$$C_{Yt} = J_t s_J \left(1 - \frac{N_t}{k_s}\right)^{\tau} (1-h)c$$

$$A_{t+1} = (A_t + Y_t)s_A - H_{At} - C_{Yt} + s_A(1-h)(1-c)I_{4t}$$
$$H_{At} = (A_t + Y_t)s_A h$$
$$C_{At} = (A_t + Y_t)s_A(1-h)c.$$

The state variable J_t represents the number of female fawns at time *t*. The state variable I_{4t} gives the number of animals treated with finite duration contraceptives that would have become fertile in the absence of treatment. The decision variable H specifies the number of animals culled from the population during time t to $t+1$,while the decision variable C gives the number of animals treated with contraceptives during that interval. Subscripts on these terms index the stage (juvenile, yearling, adult) and the year. So, for example, C_{At} gives the number of adult females that are treated with contraceptives during time t to $t + 1$.

Dynamics of the male portion of the population resemble those of the females:

$$J'_{t+1} = f(Y_t, A_t, N_t)r - H_{J't}$$
$$H_{J't} = f(Y_t, A_t, N_t)(1-r)h$$
$$Y'_{t+1} = J'_t s_J \left(1 - \frac{N_t}{k_s}\right)^{\tau} - H_{Y't}$$
$$H_{Y't} = J'_t s_J \left(1 - \frac{N_t}{k_s}\right)^{\tau} h \qquad (3)$$
$$A'_{t+1} = (A'_t + Y'_t)s_A - H_{A't}$$
$$H'_{A't} = (A'_t + Y'_t)s_A h.$$

Where each stage is as defined above, with ‘ indexing males.

If animals are treated with contraceptives then infertile females must be represented in the model. When the effect of contraceptives is permanent, the number of infertile animals (I_t) is the population is estimated as

$$I_{t+1} = \left[\left(1 - \frac{C_{Jt}}{I_t}\right)s_A + \frac{C_{Jt}}{I_t}\left(1 - \frac{N_t}{k_s}\right)^{\tau} s_J\right] I_t + C_{Jt} + C_{Yt} + C_{At}\,. \qquad (4)$$

Where I_t is the number of infertile females at time *t* and the *C*'s give the number of animals treated in each age class during time *t* to *t + 1*. Note that this formulation accounts for difference in survival between juveniles and yearlings/adults by weighting the survival rate of juveniles and older animals by their proportions in the infertile stage.

When the effects of contraceptives are temporary, then we must keep track of the time since the animal was treated. This is done as follows:

$$\begin{aligned}
I_{1,\,t+1} &= C_{Jt} + C_{Yt} + C_{At} + C_{I_4 t} \\
I_{2,\,t+1} &= I_{1,\,t}\left[\left(1-\frac{J_t}{N_t}\right)s_a + \frac{J_t}{N_t}s_{Jt}\left(1-\frac{N_t}{k_s}\right)^{\tau}\right] - H_{I_1 t} \\
H_{I_1 t} &= I_{1,\,t}\left[\left(1-\frac{J_t}{N_t}\right)s_a + \frac{J_t}{N_t}s_{Jt}\left(1-\frac{N_t}{k_s}\right)^{\tau}\right]h \\
I_{3,\,t+1} &= I_{2,\,t}s_A - H_{I_2 t} \\
H_{I_2 t} &= I_{2,\,t}s_A h \\
I_{4,\,t+1} &= I_{3,\,t+1}s_A - H_{I_3 t} - C_{I_4 t} \\
H_{I_3 t} &= I_{3,\,t}s_A h \\
C_{I_4 t} &= I_{4t}s_A(1-h)c.
\end{aligned} \tag{5}$$

I assume that animals that are infertile and will not become fertile during time *t* to *t+ 1* (i.e., $I_{1t,}I_{2t},I_{3t}$) are not treated with contraceptives because treatment occurs every 4 years. Again, the *C's* give the number animals that are treated during time *t* to *t+1*. Each *C* is indexed by stage and time, so, for example C_{jt} gives the number of juveniles treated during time *t* to *t+1*. Note that $C_{I_4 t}$ gives the number of animals that were infertile at time *t* and that were prevented from becoming fertile at time *t+1* by treatment.

The total population size is the sum of the stages described above,

$$N_t = J_t + Y_t + A_t + J'_t + Y'_t + A'_t + \sum_{i=}^{4} I_{i,t} \,. \tag{6}$$

The lifetime effect model eliminates 3 infertile stages, replacing them with a single stage that does not return to the fertile adult stage (Figure 2). The single year duration model is identical to the lifetime effects model except that all infertile animals that are not treated return to the fertile adult stage during each time step.

Estimating Model Parameters

Demographic data on the Point Reyes Fallow deer population lack detail and depth, and as a result, we must rely on coarse estimates of parameters to allow simulation of the population's dynamics. Because these estimates are imprecise it will be important to incorporate appropriate uncertainty in model predictions to reflect uncertainty in parameter estimates. Procedures for uncertainty estimation will be discussed in a later section; here I describe procedures for determining best, educated guesses at parameter values.

Parameters controlling density dependent relationships are the most difficult to estimate, but current data allow approximations. Staring with the density dependent relationship controlling recruitment, I estimated m_A and m_Y loosely from allometric relationships for reproductive rates of ungulates. The parameter k_s represents the population size at for which recruitment = 0. (Note that this is not the conventional definition of ecological carrying capacity, which is the population size at which $N_t / N_{t+1} = 1$. Instead, ecological carrying capacity in this model depends on the interplay between k_m and k_s.) We can approximate k_s as follows. We start with the expression for juvenile females, assuming linear density dependence (e.g., $\tau = 1$) and culling and contraception rates = 0:

$$J_{t+1} = s_A(m_A F_t + m_Y Y_t)\left(1 - \frac{N_t}{k_m}\right) r \,. \tag{7}$$

Dividing both sides by $s_a(F_t + Y_t)$ we obtain:

$$\frac{J_{t+1}}{s_A(F_t + Y_t)} = \frac{(m_A F_t + m_Y Y_t)\left(1 - \frac{N_t}{k_m}\right) r}{(F_t + Y_t)}. \tag{8}$$

We don't know F_t or Y_t, but for the problem at hand, we simply need to know $\frac{Y_t}{F_{tt}}$. If we know the ratio of yearling females to adult females, in the population then we can scale the $F_t + Y_t$ term using that ratio by allowing F_t.=1. For example, if there are 25 yearling females per 100 adult females then the scaled sum of $F_t + Y_t$ is 1.25.

The left hand side of this expression is the ratio of juveniles (males and females) to surviving adult females, which is quite analogous to the fawn/doe ratios observed in the fall. Using the average ratios from the last 3 years (=.379), setting N_t = 800 based on the 2002 census, assuming that the sex ratio of offspring is .5, and risking the decidedly heroic assumption that half of the fawns observed in fall counts are female (i.e., J_{t+1} = fawn count/2) we obtain an equation with one unknown, k_m. Solving gives us k_m = 1487.

We can use similar logic to estimate k_s.. Assuming linear density dependence, the expression for juveniles surviving to become yearlings is

$$Y_{t+1} = J_t s_J \left(1 - \frac{N_t}{k_s}\right) \,, \tag{9}$$

which on rearrangement gives us the ratio of yearlings to juveniles at the time of census as a function of N_t and k_s:

$$\frac{Y_{t+1}}{J_t s_J} = \left(1 - \frac{N_t}{k_s}\right) \tag{10}$$

I assumed above s_J = .90, which is a very reasonable guess for populations at low density. (Remember that s_J cannot exceed 1, so it's upper value is constrained.) Equipped with that informed guess and knowing the ratio of yearlings to juveniles at *t* and N_t from data we again arrive at an equation with a single unknown, k_s. Solving provides k_s = 3600. We would expect this value to be higher than k_m because recruitment to age 8 months in ungulates is likely to be much more sensitive to density than their survival thereafter.

Adult survival was assumed to be constant and high, an assumption that has strong support in data for ungulates in general, even if we lack those specific data for fallow deer at Point Reyes.

Management Scenarios

Model runs were designed to represent two management alternatives. The first alternative was to eradicate fallow deer from Point Reyes during the next fifteen years. The second alternative was to reduce the population to 350 animals, including 50 fertile females over the same time interval. For each of these alternatives, I also I evaluated 5 control scenarios: fertility control alone, culling alone, and culling combined with treatment of 25%, 50% and 75% of surviving fertile females with contraceptives. Within each of the fertility control scenarios, I evaluated effects of duration of contraceptives by assuming that a single dose rendered an animal infertile for its lifetime, for 4 years, or for a single year. Current contraceptive technology provides one year of infertility per dose, however, fertility control agents lasting 4 years and agents sterilizing the animal for life are likely to be available for research applications during the next 2 years.

I assumed that fertility control agents were delivered to all ages in the population every 4 years beginning at year 0. Culling was assumed to start in year 1. I evaluated two culling regimes, which I will refer to as Fertiles Only and Females Only. In the Fertiles Only culling regime, I assumed that that only fertile females would be culled during the first ten years of the simulation. This means that animals treated with contraceptives would be marked so that infertile animals and males would be recognizable and would *not* be culled. In the Females Only culling regime, I assumed that only females would be culled during the first 10 years of the simulation. This means that animals treated with contraceptives would not need to be marked and would be culled along with fertile animals. In both regimes, I assumed that culling became indiscriminate after year 10, allowing males as well as fertile and infertile females to be culled.

Simulated control regimes assumed that a fixed *proportion* of animals would be treated or culled annually, rather than a fixed *number* of animals. The primary motivation for this approach was to represent what could be realistically achieved with a fixed annual investment in control efforts. Given a fixed amount of time allocated to finding and treating or culling animals, the number of animals treated or culled will assuredly decline as the population size declines. This is the case because the encounter rate with deer will diminish as the population is reduced, requiring more investment of time per animal treated or culled. Control efforts aimed at a fixed proportion of animals provide a diminishing target number of animals as the population is reduced and in so doing accommodate the increased amount of time that must be invested per deer treated or culled.

I did not evaluate a purely indiscriminate culling regime where all sexes and ages were culled during all years because I assumed that culling males from the outset would diminish the density dependent effects of males on female reproduction and survival and, hence, would increase the number of animals that must be culled. This assumption was verified by preliminary simulations—approximately 30% more animals would need to be culled to eradicate the population if culling was not selective for females in the first 10 years of the eradication effort.

To evaluate efficacy of fertility control alone, I predicted the population size at the end of 15 years assuming that 75% of the females could be treated every 4 years, which was judged to be the maximum possible delivery rate given logistic and financial constraints.

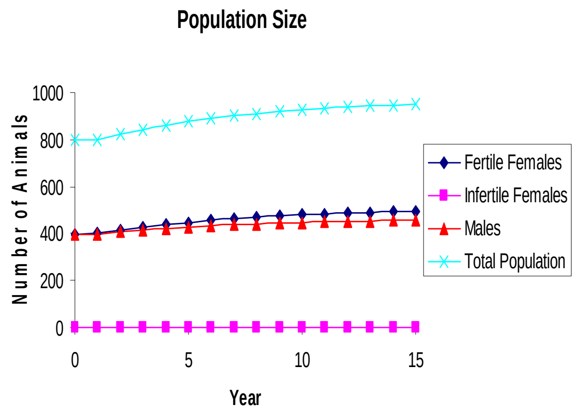


Figure 4. Trajectory of population growth of the Point Reyes fallow deer population in the absence of culling or fertility control.

Model Implementation

Equations outlined above were coded in Visual Basic for Applications running under Microsoft Excel. I used non-linear gradient search techniques to find culling rates that minimized the number of animals culled and treated with contraceptives subject to two constraints: that no more than half of the target population can be culled during any single year and that the population must number fewer than 5 animals 15 years after initiating treatment.

Results: Eradication Alternative

Population Trajectory in Absence of Control Efforts
Deterministic model runs in the absence of any culling or fertility control suggested that the current population is slightly below ecological carrying capacity and will continue to grow to a steady state of approximately 1000 animals (Figure 4). This estimate is reasonably close to the estimate obtained by (Gogan et al. 2001), and although both estimates could be wrong, it is reassuring that two different approaches to estimating carrying capacity yielded similar results.

It is imperative to understand that these results depend on the assumption that the Point Reyes fallow deer population is "closed" , which is to say that there is no emigration from the population to the surrounding area. This simplifying assumption is necessary to because we lack the data needed to model movement out of the park to the adjacent landscape. However, it is virtually certain that such movement would occur.

Effects of Fertiles Only Culling With and Without Fertility Control
Simulations of culling alone and culling in combination with fertility control indicated that the population could be eradicated within 15 years (Figure 5), but the effort required to achieve eradication differed among management scenarios. Culling alone required killing 653 animals over the course of the 15 year campaign (Figure 6). Combining culling with fertility control reduced the numbers of animals that would need to be culled, but increased the total number of animals that would need to be treated or culled (Figure 6). The extent of reduction in culling declined with declining duration of the contraceptives; the greatest reductions were achieved by delivering lifetime effect contraceptives. The smallest reductions occurred in simulations of single year duration contraceptives (Figure 6).

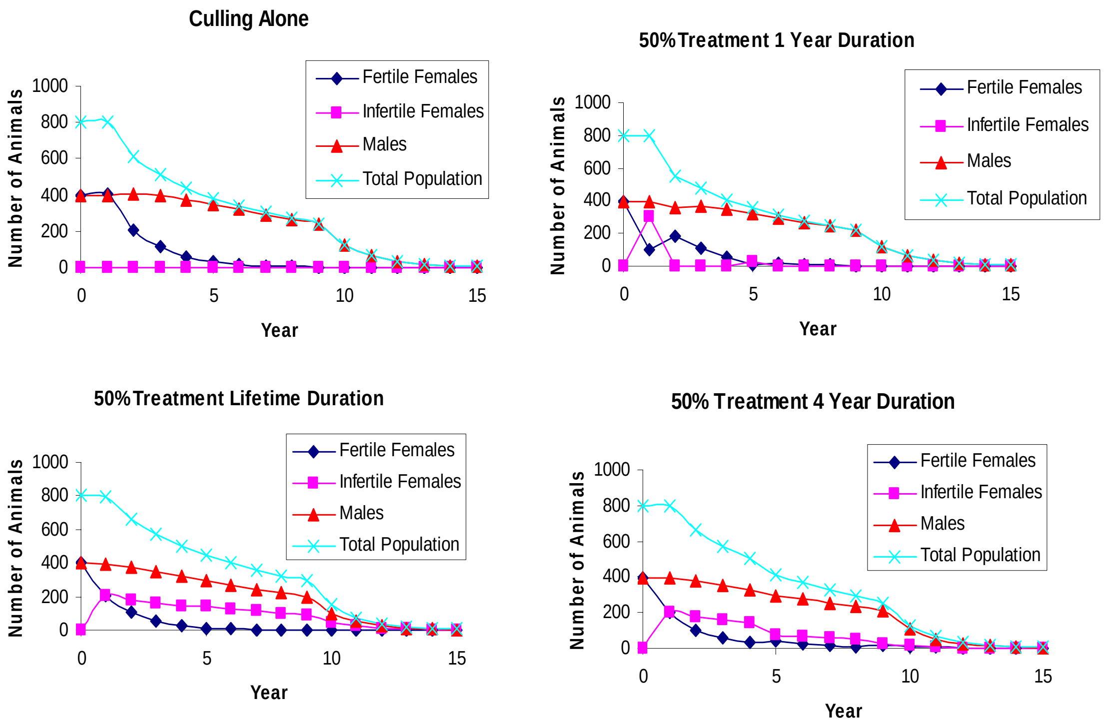


Figure 5. Simulated trajectories of fallow deer populations under four eradication regimes assuming only fertile females were culled before year 10. Shapes of curves for the .25 and .75 treatment levels closely resembled those shown here. Simulations assumed that infertile animals were marked and that only fertile females were culled during years 0-10. Thereafter, culling included males as well as fertile and infertile females.

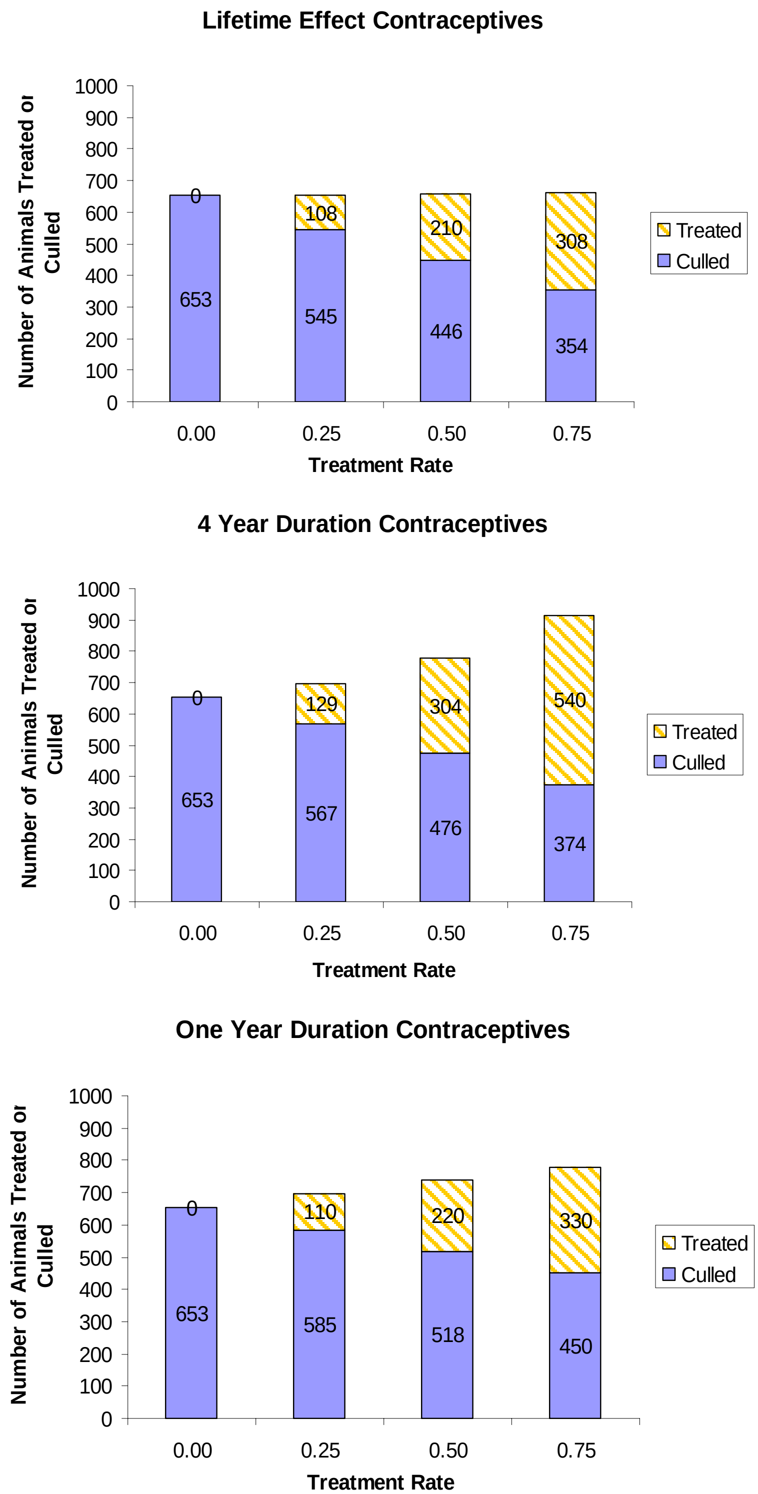


Figure 6. Total number of animals treated and/or culled during simulated 15 year campaign to eradicate fallow deer at Point Reyes National Seashore.

When culling was combined with fertility control, the total number of animals treated + culled was smallest for regimes using lifetime effect contraceptives and largest for regimes using 4 year duration contraceptives (Figure 6). The seeming efficiency of the single year duration contraceptives resulted from effects of culling early in the simulation (Figure 7, Appendix Tables 1-3). High levels of culling were possible in the early years of single year duration simulations because animals became fertile after one year and, hence were vulnerable to culling under the Fertiles Only culling regime. In contrast, animals treated with longer lasting agents would not be culled. The rapid decline in females resulting from culling in the single year duration simulations explains the greater requirement for culling in these simulations and the lower requirement for culling + treatment relative to the 4 year duration simulations (Figure 6, 7).

Virtually all treatment with contraceptives occurred during the first delivery period for the lifetime effect and single year duration contraceptives (Figure 7, Appendix Tables 1-3). This occurred because few fertile females remained the population by year 4 of the simulation, when the next fertility control treatment occurred. In the lifetime duration case, the absence of fertile females in year 4 occurred because the initial treatment and subsequent culling of the untreated portion of the population eliminated fertile females. In the single year duration case, the low numbers of fertile females in year 4 resulted because all females became vulnerable to culling after the first year of the simulation and most were killed before the next scheduled treatment with contraceptives. There were 3 significant treatments with contraceptives for the 4 year duration agents during year 0, 4, and 8. Multiple treatments were required for 4 year duration agents because 1) animals had to be retreated every 4 years to maintain infertility and 2) during the 4 year interval between treatments they were not vulnerable to culling under the Fertiles Only culling regime.

Simulations revealed that attempting to eradicate the population using fertility control alone is futile. Treatment of 75% of the females with single year duration agents every 4 years allowed the population to *increase* slightly. Although longer duration agents reduced the population substantially, they failed to achieve eradication even after 4 treatments applied over 15 years (Table 2). The inability of fertility control alone to reduce the population is easy to understand. Even when 100% of the females are maintained infertile, the maximum rate of decline of the population is no greater than the maximum mortality rate, which, in a long lived species like fallow deer, is quite small, approximately 10% per year.

Table 3. Results of simulation of eradication efforts using fertility control alone. Simulations assumed treatment of 75% of fertile females during years 0, 4, 8, and 12.

	Duration of Contraceptive		
Simulated Response	1 year	4 years	Lifetime
Population during year 15.	884	420	259
Total number of females treated	1318	922	439

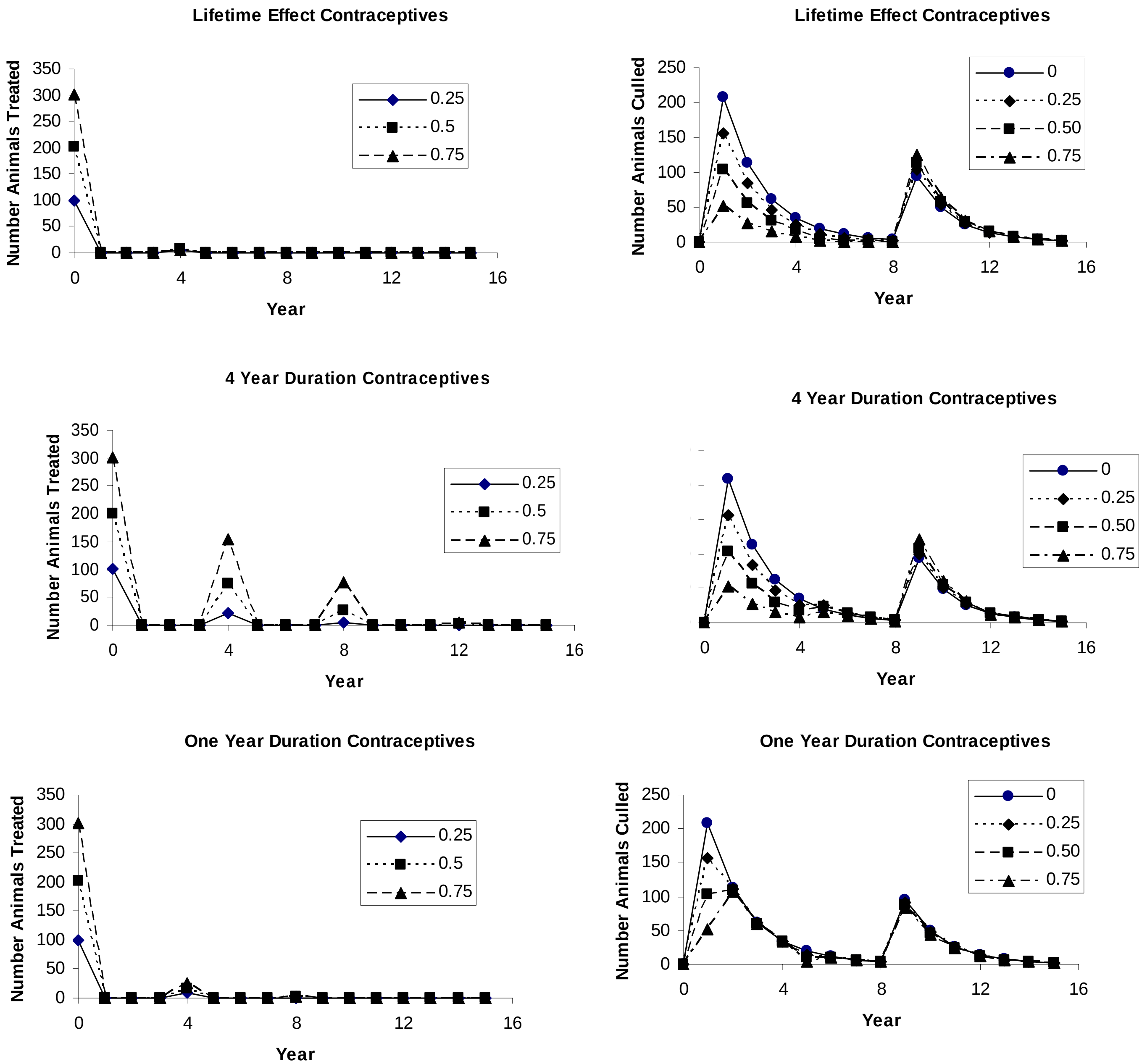


Figure 7. Number of animals annually treated (left column) or culled (right column) during simulated 15 year campaign to eradicate fallow deer at Point Reyes National seashore.

Uncertainty in model predictions was assessed for culling and culling combined with lifetime and 4 year duration contraceptives using Monte Carlo Simulation. This is a technique that uses multiple model runs to estimate the error in model output based on assumptions about the uncertainty in model input. For each model run, input values are chosen randomly for a distribution of potential parameter values. The results of these many runs are accumulated allowing calculation of means and confidence intervals on all model predictions.

Distributions of model parameters were chosen to allow for relatively high levels of uncertainty. (Table 3), thereby providing conservative (broad) confidence intervals on model predictions. Initial conditions for numbers of animals in each age/sex class were estimated by simulating density dependent population growth starting with a population of 20 males and 20 females and allowing the population to grow until it reached a size determined by a random variable drawn from a normal distribution with a mean equal to the current population size and a standard deviation equal to 20% of the mean.

Mean values of model predictions of number of animals treated and culled were calculated as the average of 100 replicate runs. Confidence intervals were estimated from the upper and lower .025 percentiles of the 100 replicates.

Table 4.

Model Parameter	Distribution	Distribution Parameters
Initial N	Normal	Mean = 800, standard deviation = 160
□	Uniform	lower = .5, upper = 1
s_A	Uniform	lower = .85, upper = .95
s_j	Uniform	lower = .85, upper = .95
m_a	Uniform	lower = .85, upper = .95
m_J	Uniform	lower = .45, upper = .55

Monte Carlo simulations provided reasonable confidence in estimates of the number of animals that would need to be treated or culled to eradicate the population within 15 years assuming the treatment regimes described in the results of deterministic simulations above (Table 5). The means shown in Table 5 do not perfectly match the predictions of the deterministic simulations (Figure 6) because the model is non-linear and stochastic results from non-linear models will not match deterministic results. Moreover the deterministic simulations assumed linear density dependence (i.e., $\tau = 1$) while the Monte Carlo simulations allowed for non-linear density dependence (i.e., $\tau < 1$).

Table 5. Means and 95% confidence intervals for model predictions of the number of animals treated with contraceptives and culled in simulations of a 15 year campaign to eradicate fallow deer from Point Reyes National Seashore.

		Number Treated			Number Culled		
Duration of Contraceptive	Proportion Fertile Females Treated	Mean	95% CI		Mean	95% CI	
4 year	0	0	0	0	677	426	924
	0.25	133	85	176	595	366	848
	0.5	327	219	442	530	324	775
	0.75	570	362	731	409	217	619
Lifetime	0	0	0	0	693	453	988
	0.25	134	89	181	604	349	866
	0.5	306	199	398	486	291	709
	0.75	553	361	795	395	221	709

Effects of Females Only Culling With and Without Fertility Control

Culling fertile and infertile females (but not culling males) substantially reduced any benefits of fertility control. Under this scenario, virtually all reductions in animal numbers resulted from culling. Duration of effects of contraceptives did not modify this result.

Results: Reduce Population to 350 Alternative

Effects of Fertiles Only Culling With and Without Fertility Control

Simulations of culling alone and culling in combination with fertility control indicated that the population could be reduced to 350 animals (including 50 fertile females) within 15 years, but the effort required to achieve this reduction differed among management scenarios. Culling alone required killing 452 animals over the course of the 15 year campaign (Figure 8). Combining culling with fertility control reduced the numbers of animals that would need to be culled, but markedly increased the total number of animals that would need to be treated or culled (Figure 8). The extent of reduction in culling declined with declining duration of the contraceptives; the greatest reductions were achieved by delivering lifetime effect contraceptives. The smallest reductions occurred in simulations of single year duration contraceptives (Figure 8).

When culling was combined with fertility control, the total number of animals treated + culled was smallest for regimes using lifetime effect contraceptives and largest for regimes using 4 year duration contraceptives (Figure 8). The seeming efficiency of the single year duration contraceptives resulted from effects of culling early in the simulation (Figure 9).

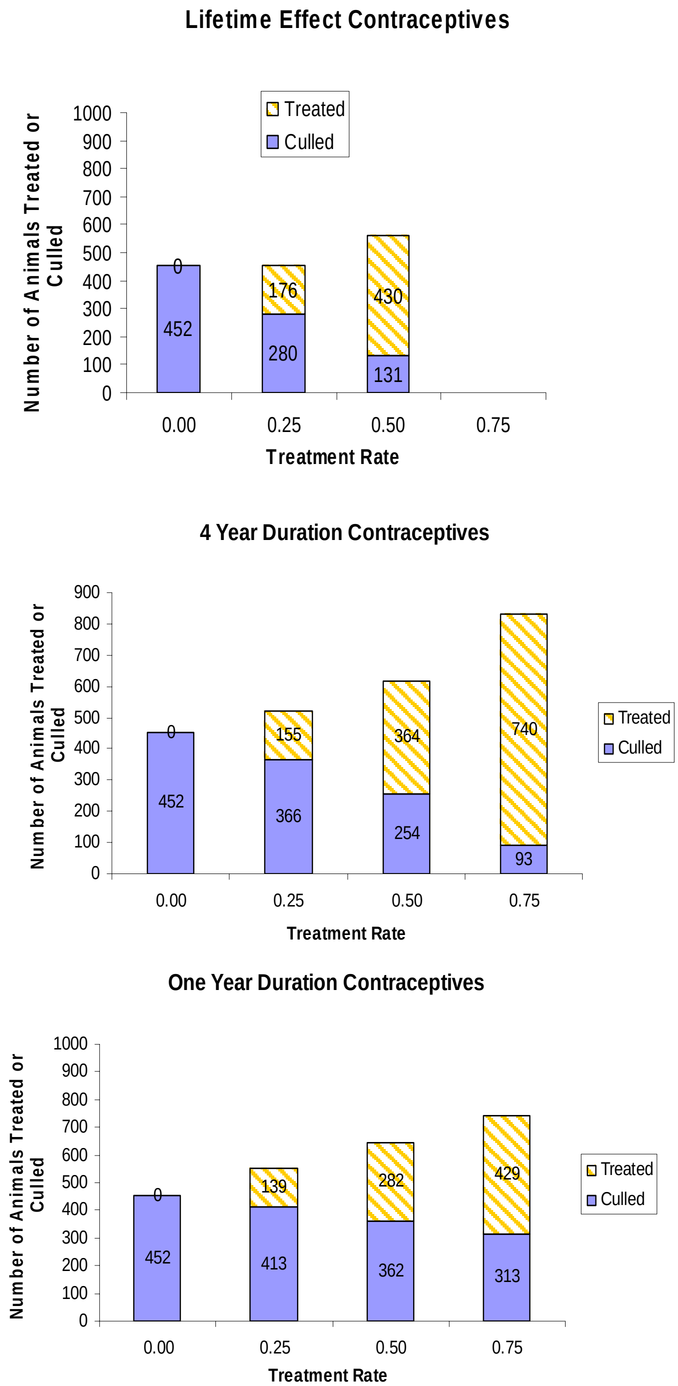


Figure 8. Total number of animals treated and/or culled during simulated 15 year campaign to reduce the fallow deer population at Point Reyes National Seashore to 350 animals in and total fertile females = 50. It was not feasible to treat 75% of the fertile females and maintain 50 fertile

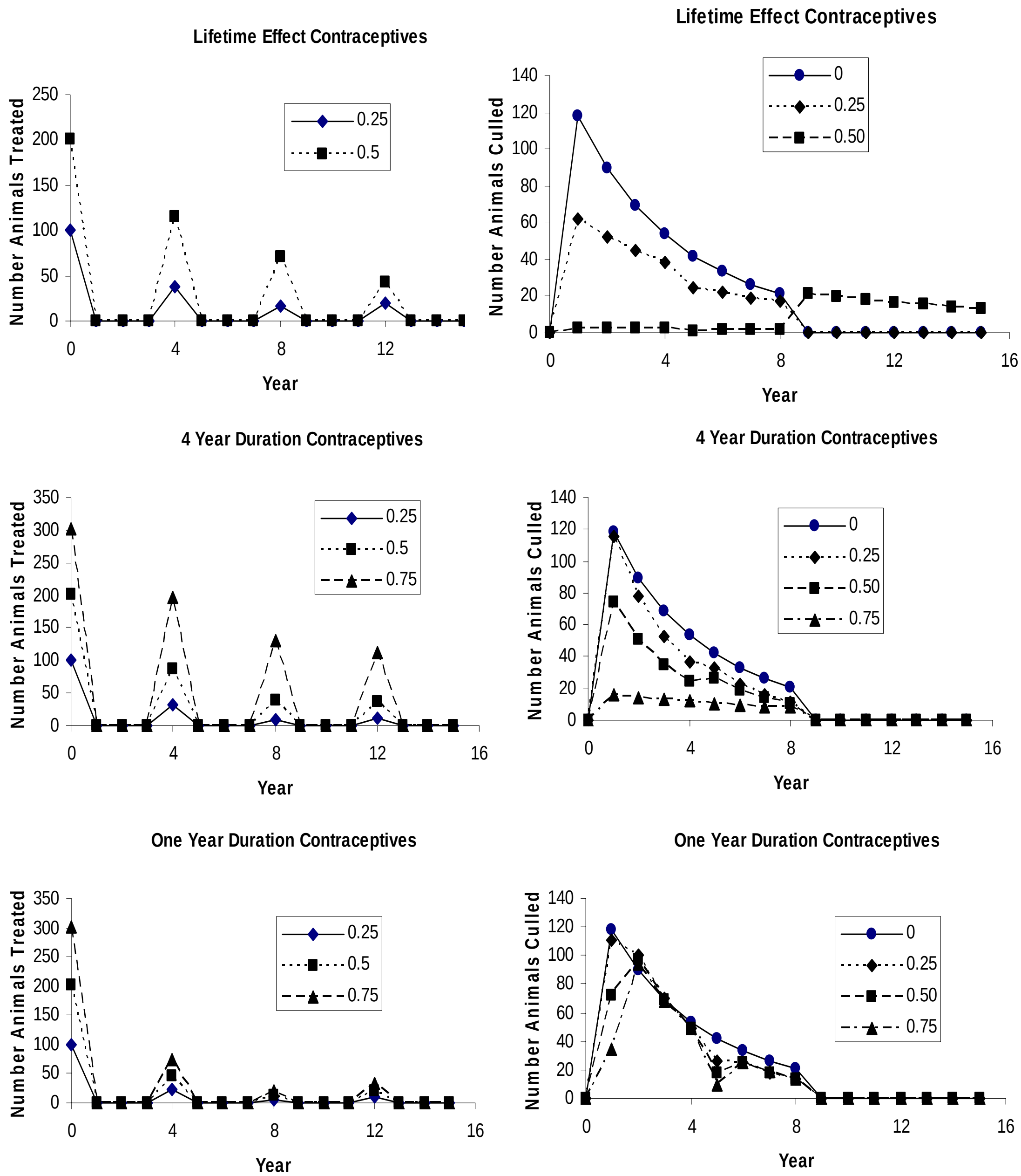


Figure 9. Number of animals annually treated (left column) or culled (right column) at Point Reyes National seashore during simulated 15 year campaign to reduce the fallow deer population to 350 animals, including 50 fertile females. The data in these plots are tabulated in Appendix Tables 4-6.

Discussion

Simulation modeling revealed that a sustained effort could feasibly eradicate fallow deer from Point Reyes National Seashore. It would also be feasible to reduce the population to approximately half the current size. However, the amount of effort required to achieve the two population targets (0 or 350) was not proportionate to the magnitude of the reduction. I estimated that about 650 animals would need to be culled (assuming no fertility control) to eradicate the population, while only 200 fewer would need to be culled to reduce the population to 350 animals.

Although simulations portrayed a 15 year effort, results suggested that eradication in 10 years would be plausible if 50% of the fertile females could be culled annually (Figure 7, 9). Treating animals with contraceptives could substantially reduce the number of animals that would need to be culled if animals could be marked such that only infertile animals were culled in initial phase of reductions. If animals could not be marked, then fertility control had nominal effects on the number of animals culled. However, fertility control did not reduce the total number of animals that would need to be treated and culled, which means that it did not increase the efficiency of culling. The model strongly supported the logical contention that fertility control alone was not a feasible approach to eradication, even when using long duration contraceptives.

There are many uncertainties in the values of parameters used in the model, but error analysis suggested that while these uncertainties might change the quantitative results of simulation, the qualitative conclusions drawn from them remain robust. This means that the absolute number predicted by the model should be viewed with caution, but we can have substantial confidence in the conclusion that sustained efforts at eradication will achieve the desired result. It will be important that such efforts be conducted with careful attention to monitoring the population. Monitoring data should be analyzed with a model like this one, incorporating uncertainty, to guide control efforts. An effort to calibrate estimates of population size with catch per unit effort would likely prove extremely worthwhile over a 10 + year campaign.

Literature Cited

Gogan, P. J. P., R. H. Barrett, W. W. Shook, and T. E. Kucera. 2001. Control of ungulate numbers in a protected area. Wildlife Society Bulletin 29:1075-1088.

Hobbs, N. T., D. C. Bowden, and D. L. Baker. 2000. Effects of fertility control on populations of ungulates: General, stage-structured models. Journal of Wildlife Management 64:473-491.

Appendix Table 1. Simulated number of fallow deer treated with lifetime effect contraceptives and culled during 15 year eradication campaign at Point Reyes National Seashore.

	Treated				Culled			
	Proportion Treated				Proportion Treated			
Year	0	0.25	0.5	0.75	0	0.25	0.5	0.75
0	0	101	201	302	0	0	0	0
1	0	0	0	0	208	156	104	52
2	0	0	0	0	113	84	56	28
3	0	0	0	0	62	46	30	15
4	0	6	8	6	34	25	17	8
5	0	0	0	0	19	11	5	1
6	0	0	0	0	11	6	3	1
7	0	0	0	0	6	3	1	0
8	0	0	0	0	4	2	1	0
9	0	0	0	0	95	104	114	125
10	0	0	0	0	49	53	58	63
11	0	0	0	0	26	27	29	32
12	0	0	0	0	13	14	15	16
13	0	0	0	0	7	7	8	8
14	0	0	0	0	4	4	4	4
15	0	0	0	0	2	2	2	2
All years	0	108	211	309	653	545	446	354

Appendix Table 2. Simulated number of fallow deer treated with 4 year duration contraceptives and culled during 15 year eradication campaign at Point Reyes National Seashore.

	Treated				Culled			
	Proportion Treated				Proportion Treated			
Year	0	0.25	0.5	0.75	0	0.25	0.5	0.75
0	0	101	201	302	0	0	0	0
1	0	0	0	0	208	156	104	52
2	0	0	0	0	113	84	56	28
3	0	0	0	0	62	46	30	15
4	0	23	74	154	34	25	17	8
5	0	0	0	0	19	25	24	16
6	0	0	0	0	11	14	14	9
7	0	0	0	0	6	8	8	5
8	0	5	27	78	4	5	4	3
9	0	0	0	0	95	99	108	121
10	0	0	0	0	49	51	55	61
11	0	0	0	0	26	26	28	31
12	0	1	2	5	13	14	14	12
13	0	0	0	0	7	7	8	8
14	0	0	0	0	4	4	4	4
15	0	0	0	0	2	2	2	2
All years	0	129	304	540	653	567	476	374

Appendix Table 3. Simulated number of fallow deer annually treated with 1 year duration contraceptives and culled during 15 year eradication campaign at Point Reyes National Seashore.

	Treated				Culled			
	Proportion Treated				Proportion Treated			
Year	0	0.25	0.5	0.75	0	0.25	0.5	0.75
0	0	101	201	302	0	0	0	0
1	0	0	0	0	208	156	104	52
2	0	0	0	0	113	111	109	107
3	0	0	0	0	62	61	60	59
4	0	8	17	25	34	34	34	33
5	0	0	0	0	19	14	9	5
6	0	0	0	0	11	10	10	9
7	0	0	0	0	6	6	6	5
8	0	1	2	2	4	3	3	3
9	0	0	0	0	95	91	87	84
10	0	0	0	0	49	47	46	44
11	0	0	0	0	26	25	24	23
12	0	0	0	0	13	13	13	12
13	0	0	0	0	7	7	7	7
14	0	0	0	0	4	4	4	4
15	0	0	0	0	2	2	2	2
All years	0	110	220	330	653	585	518	450

Appendix Table 4. Simulated number of fallow deer treated with lifetime duration contraceptives and culled during 15 year campaign to reduce the population to 350 animals (including 50 fertile females) at Point Reyes National Seashore. It was not feasible to treat 75% of the fertile females and meet the target objectives.

	Treated			Culled		
	Proportion Treated			Proportion Treated		
Year	0	0.25	0.5	0	0.25	0.5
0	0	101	201	0	0	0
1	0	0	0	118	62	2
2	0	0	0	90	52	2
3	0	0	0	69	45	2
4	0	38	115	53	38	2
5	0	0	0	42	25	1
6	0	0	0	33	22	1
7	0	0	0	26	19	1
8	0	17	71	21	17	1
9	0	0	0	0	0	21
10	0	0	0	0	0	19
11	0	0	0	0	0	18
12	0	20	43	0	0	17
13	0	0	0	0	0	15
14	0	0	0	0	0	14
15	0	0	0	0	0	13
All Years	0	176	430	452	280	131

Appendix Table 5. Simulated number of fallow deer treated with 4 year duration contraceptives and culled during 15 year campaign to reduce the population to 350 animals (including 50 fertile females) at Point Reyes National Seashore.

	Treated				Culled			
	Proportion Treated				Proportion Treated			
Year	0	0.25	0.5	0.75	0	0.25	0.5	0.75
0	0	101	201	302	0	0	0	0
1	0	0	0	0	208	156	104	52
2	0	0	0	0	113	84	56	28
3	0	0	0	0	62	46	30	15
4	0	23	74	154	34	25	17	8
5	0	0	0	0	19	25	24	16
6	0	0	0	0	11	14	14	9
7	0	0	0	0	6	8	8	5
8	0	5	27	78	4	5	4	3
9	0	0	0	0	95	99	108	121
10	0	0	0	0	49	51	55	61
11	0	0	0	0	26	26	28	31
12	0	1	2	5	13	14	14	12
13	0	0	0	0	7	7	8	8
14	0	0	0	0	4	4	4	4
15	0	0	0	0	2	2	2	2
All years	0	129	305	540	653	568	476	374

Appendix Table 6. Simulated number of fallow deer treated with 1 year duration contraceptives and culled during 15 year campaign to reduce the population to 350 animals (including 50 fertile females) at Point Reyes National Seashore.

	Treated				Culled			
	Proportion Treated				Proportion Treated			
Year	0	0.25	0.5	0.75	0	0.25	0.5	0.75
0	0	101	201	302	0	0	0	0
1	0	0	0	0	118	111	72	35
2	0	0	0	0	90	100	97	94
3	0	0	0	0	69	70	69	68
4	0	23	47	74	53	50	50	50
5	0	0	0	0	42	27	18	9
6	0	0	0	0	33	25	25	25
7	0	0	0	0	26	18	18	19
8	0	6	13	21	21	13	14	14
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	10	20	32	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
All years	0	139	282	429	452	413	362	313

Appendix E: Section 7 Consultation, US Fish and Wildlife Service and National Oceanic and Atmospheric Administration

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In Reply Refer to:
1-1-05-I-0035

April 7, 2005

Memorandum

To: Park Superintendent, Point Reyes National Seashore, National Park Service, Point Reyes, California (Attn: Ranger Natalie Gates)

From: Deputy Assistant Field Supervisor, Endangered Species Program, Sacramento Fish and Wildlife Office, Sacramento, California Cay Nagano

Subject: Concurrence with Not Likely to Adversely Affect Determination for Nine Listed Species and Proposed Critical habitat for the California Red-legged Frog as a result of the Non-Native Deer Management Plan at the Point Reyes National Seashore and Golden Gate National Recreation Area in Marin County, California

This memorandum is in response to the U. S. National Park Service's March 10, 2005, request for the concurrence of the U.S. Fish and Wildlife Service (Service) for the proposed Non-Native Deer Management project at the Point Reyes National Seashore and Golden Gate National Recreation Area in Marin County County, California. Your request was received by this Field Office on March 14, 2005. Additional information was received from the National Park Service in a letter to the Service dated March 30, 2005, that was received by us on April 6, 2005. At issue are the potential effects of the proposed project on the threatened California red-legged frog (*Rana aurora draytonii*), threatened western snowy plover (*Charadrius alexandrinus nivosus*), threatened northern spotted owl (*Strix occidentalis caurina*), endangered California freshwater shrimp (*Syncaris pacifica*), endangered Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*), endangered Sonoma alopecurus (*Alopecurus aequalis* var. *sonomensis*), endangered beach layia (*Layia carnosa*), endangered clover lupine (*Lupinus tidestromii*), endangered Sonoma spineflower (*Chorizanthe valida*), and proposed critical habitat for the threatened California red-legged frog. This response is provided pursuant to section 7(a) of the Endangered Species Act, as amended (16 U.S.C. 1531 *et seq.*)(Act), and in accordance with the regulations governing interagency consultations (50 CFR § 402).

This document is based on your March 10, 2005, letter and associated information; your March 30, 2005, letter; *Point Reyes National Seashore Threatened and Endangered Species Locations as of 2001*, undated, that was prepared by the National Park Service; and other information available to the Service.

TAKE PRIDE IN AMERICA

It is our understanding the proposed project consists of the lethal removal and fertility control of all axis deer (*Axis axis*) and fallow deer (*Dama dama dama*) by the year 2020. A percentage of the fallow deer would be treated with an existing long-acting contraceptive, and both species of deer would be removed via shooting. The proposed management activities will take place in open flat grassland or scrub areas where deer can be safely handled for contraceptive administration or safely culled. No management activities will take place in creeks, waterways, or riparian areas. The culling would be conducted by National Park Service staff specifically trained in wildlife sharpshooting. Deer carcasses will be removed when possible; in cases where carcasses could not be accessed, they will be left in place to recycle nutrients into the ecosystem. Monitoring would continued until all non-native deer area eradicated by the year 2020.

The measures in the proposed project are sufficient to reduce any direct, indirect, and cumulative effects on the California red-legged frog, western snowy plover, northern spotted owl, California freshwater shrimp, Myrtle's silverspot butterfly, endangered Sonoma alopecurus, endangered beach layia, endangered clover lupine, endangered Sonoma spineflower to an insignificant or discountable level, or result in adverse modification or destruction of the proposed critical habitat of the California red-legged frog. Critical habitat for the other eight species has not been proposed, designed, or is located in the action area. Therefore, the Service concurs that the project, as described within your March 10, 2005, and March 30, 2005, letters and accompanying material, is not likely to adversely affect these nine listed species and proposed critical habitat for the California red-legged frog. If project work descriptions or time frames change, or were not evaluated, it is our recommendation that the changes be submitted for our review. This concludes our review of the actions outlined in the March 10, 2005, and March 30, 2005, letters and accompanying material, and no further coordination with the Service under the Act is necessary at this time. Please note that this memorandum does not authorize the take of listed species.

As provided in 50 CFR § 402.14, initiation of formal consultation is required where there is discretionary Federal agency involvement or control over the action (or is authorized by law) and if: (1) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this review; (2) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (3) a new species is listed or critical habitat designated that may be affected by the action.

We appreciate your proactive efforts to conserve and recover endangered species. Please contact Chris Nagano, Deputy Assistant Field Supervisor (Endangered Species Program), at the letterhead address or at 916/414-6600 if you have questions regarding this response.

cc:
Ranger D. Hatch, GGNRA, NPS, San Francisco, California
Ranger N. Hornor, GGNRA, NPS, San Francisco, California
Ranger D. Fong, GGNRA, NPS, San Francisco, California
Ranger S. Allen, PRNS, NPS, Point Reyes Station, California
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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802- 4213

May 3, 2005

In Response Refer to:
151422SRW05SR00250:DL

Don L. Neubacher, Superintendent
National Park Service
Point Reyes National Seashore
Point Reyes, California 94956

Dear Mr. Neubacher:

This letter is in response to your request for written concurrence from the NOAA's National Marine Fisheries Service (NMFS) regarding the National Park Service's (NPS) three determinations related to its Non-native Deer Management Plan for the Point Reyes National Seashore: 1) the project is not likely to adversely affect threatened California Coastal (CC) Chinook salmon (*Oncorhynchus tshawytscha*), Central California Coast (CCC) coho salmon (*O. kisutch*), or CCC steelhead (O. mykiss); 2) the project is not likely to result in adverse effects to designated critical habitat for CCC coho salmon or the proposed critical habitat of CC Chinook salmon and CCC steelhead; and 3) the project is not likely to result in adverse modification of Essential Fish Habitat. NPS proposes to eradicate nonnative axis deer (*Cervus axis*) and fallow deer (*Cervus dama*) on its holdings throughout the Lagunitas Creek watershed in Marin County California. The proposed eradication efforts will occur in grassland or scrub areas where deer can be handled or culled safely. No management actions will occur in streams or riparian areas. Therefore, I concur with NPS's three determinations stated earlier in this paragraph.

This concludes informal section 7 consultation for this proposed project in accordance with 50 CFR section 402.14(b)(1). Consultation must be reinitiated if new information becomes available revealing the effects of the action on listed species in a manner or to an extent not previously considered, the project plans change, if the action is subsequently modified in a manner that causes an effect to listed species that was not considered, or if a new species or critical habitat is designated that may be affected by this action.

If you have questions concerning this consultation, please contact Daniel Logan at (707) 575-6053.

Sincerely,

for Rodney R. McInnis
Regional Administrator

cc: ARA-PRD, NMFS

Appendix F: Projects Considered in Cumulative Impacts Analyses

The projects listed here are past, present and reasonably foreseeable future actions at PRNS and the PRNS-managed lands of GGNRA considered by the Interdisciplinary Team (IDT) in assessing the cumulative impacts of the five analyzed alternatives. Cumulative impacts, or the combined incremental effects of human activities which may accumulate over time and affect resources, are discussed in Chapter 4, Environmental Consequences. In addition to the following projects, the IDT also considered interagency information and wider ranging issues such as human development, pollution, economic trends etc. in analyzing cumulative impacts.

Tule Elk Management. The 1998 *Point Reyes National Seashore Tule Elk Management Plan and Environmental Assessment* (NPS 1998) directs management of tule elk throughout the park. The plan includes:

- Maintaining viable populations of tule elk at PRNS (ongoing).
- Managing elk to regulate population size using minimal intrusion, where possible, as part of the natural ecosystem processes (i.e. natural regulation - ongoing).
- Establishing free-ranging tule elk in the park by 2005. (This objective was completed in 1999 with the relocation of 45 Tomales Point elk to the Limantour Wilderness Area (Phillip Burton Wilderness).
- Researching and monitoring the habitat and elk population over time (ongoing). This monitoring includes use of horses and aircraft for censuses and capture.
- Testing the efficacy of contraception for population control at Tomales Point. (This objective was completed in 2001).

The following is a summary of effects of the selected alternative from the 1998 Tule Elk Management Plan:

The maintenance and conservation of tule elk in Point Reyes National Seashore will have beneficial impacts by contributing towards ecosystem restoration of native fauna; will be compatible with protecting habitats for several endangered, threatened, and rare species and will assist in preventing impacts from overpopulation that could threaten biological diversity in native habitats.

Relocation of tule elk to other natural areas of the Seashore would not create any new zoning, land-use regulations, or changes to permitted uses. The relocation of tule elk and their subsequent dispersal would not impact private landowners or Seashore visitors. Local jurisdictions would be under no Service requirement to amend their land-use plans to conform with the project. Relocation of tule elk to other areas of the state would be conducted in cooperation with the California Department of Fish and Game, per subsequent CEQA process to be conducted by the State.

Managing elk using relocations and scientific techniques would not result in the displacement of ranching activities with the Seashore. Existing conditions would continue within the Seashore as a result of the ability to manage elk as described in the document.

The proposed action would have a short-term adverse effect by the limited use of motorized equipment in wilderness under the minimum tool concept. The localized use of helicopters or motor vehicles for short duration may have effects on wilderness users. Such transitory effects are deemed negligible and are clearly outweighed by the long term enhancement of this key attribute of the Seashore’s wilderness.

Based on the analysis in the Environmental Assessment (NPS 1998) and the capacity of the mitigation measures to reduce or avoid potential impacts, the National Park Service determined that managing tule elk at Point Reyes National Seashore using relocations and scientific techniques was not a major Federal action that would significantly affect the quality of the human environment. The Plan was determined to have no major cumulative impacts.

Fire Management Program. In July 2004, Point Reyes completed a *Fire Management Plan (FMP) and Environmental Impact Statement for the Seashore and for the Northern District of Golden Gate National Recreation Area* (NPS 2004a). The plan provides a framework for all fire management activities within the Parks, including suppression of unplanned ignitions, prescribed fire, and mechanical fuels treatments. It is intended to guide the fire management program for the next 10-15 years. In accordance with NPS policy, the plan is responsive to the parks' natural and cultural resource objectives, reduces risk of fire to developed facilities and adjacent communities, and provides for public and staff safety. Up to 3,500 acres annually could be burned or mechanically treated over the next decade as a result of the Fire Management Plan.

A brief summary of the potential impacts from the approved FMP/EIS (NPS 2004a) follows.

Impacts to soils from the actions anticipated include changes in soil productivity and chemistry, as well as erosion following the removal of vegetation. The impacts on soils from increased erosion of prescribed burning and average wildland fires (no more than about 30 acres per year) under the selected alternative would be negligible to minor. Moderate to major, short to long term, adverse cumulative impacts to the physical, chemical, and biological properties of soils from a very large or catastrophic wildland fire are possible under the selected alternative. Suppression activities could have additional adverse, short to long-term moderate to major impacts from soil compaction, mixing, reduced infiltration, loss of vegetation, and changes in soils that prevent quick revegetation. Actively suppressing wildland fires before they reach sensitive resources could keep impacts from becoming major and adverse.

$PM_{2.5}$ (particulates less than 2.5 microns in size)is the air quality parameter measured at PRNS, and the park is well below state and federal standards. Other air pollutants are not measured in the study area, so those from the closest rural locations (Santa Rosa and Vallejo) were used as an approximation. Santa Rosa meets the federal average standard for particulates smaller than 10 microns, but is higher than California's more strict standards. It is well below both the maximum one-hour and eight-hour average federal and state standards for carbon monoxide, and the state and federal one-hour (state) and annual average (federal) standards for nitrogen dioxide. Vallejo is also well below the federal and California maximum 24-hour and annual average standards for sulfur dioxide. Santa Rosa has exceeded the state's maximum 24-hour ozone average of 50 $\mu g/m^3$ twice over the three-year period measured, and the California one-hour ozone standard once.

On an annual basis, the selected alternative would generate particulate emissions into the air. This is because of the number of acres treated with prescribed fire each year and the potential treatment of forested acres, which produce the highest emission levels. The selected alternative would produce an average 5.3 pounds of PM_{10} per acre managed, resulting in a long-term, adverse, moderate effect on regional haze. This additional contribution would be offset by the long-term opportunity presented by this alternative to achieve a major, beneficial, cumulative effect on regional haze by reducing the risk of a catastrophic fire. Nuisance smoke would be an infrequent, short-term, adverse, negligible to moderate air quality impact for residents near prescribed burns during the duration of the burn.

In the context of the 90,000 acre study area, the impacts to water quality and watershed characteristics would provide a combined moderate to major benefit to watersheds through the use of prescribed burning and mechanical treatment to reestablish natural hydrological processes and reduce the potential for catastrophic wildfire. The selected alternative would result in minor, adverse, short-term impacts to water quality from ash or increases in erosion and suspended solids.

In areas treated with prescribed fire, minor, short-term adverse impacts associated with loss of vegetation, as well as the possibility of introduction or spread of non-native plants would occur. However, the burns also would result in minor to moderate beneficial impacts as burning would stimulate growth of many native plant species, and would eliminate non-native vegetation.

Mechanical fuel reduction would have minor short-term adverse impacts on native vegetation through crushing or other physical impacts, but clearing of dense vegetation also would have possibly long-term, minor to moderate benefits on most plant communities as well. In light of observed consumption by non-native deer of rare bulb species after the 1995 Mount Vision fire, grazing pressure on Fritillaria sp. and other rare species in burned areas could increase after prescribed burns.

The selected alternative will result in minor to moderate localized benefits to native vegetation from the removal of non-native Monterey pine and cypress trees. For these beneficial impacts to persist, however, follow-up activities must be conducted to remove new recruits that come into the site in years following prescribed burning or mechanical treatments.

The selected alternative will have short-term, minor adverse impacts from unintentional burning of vegetation, especially in dry years. However, research and observations at the Seashore indicate wetland vegetation can be thinned and stimulated to reproduce by low or moderate intensity fires. These same fires can destroy non-native plants in wetlands. Minor to moderate short to long-term benefits to wetland vegetation from prescribed burning or even small wildfires are therefore possible. For both adverse effects and beneficial effects, the degree of impact is greater when more acreage is treated.

Some wildfire suppression activities or actions to control prescribed burns, such as spike camps, access or creating fire lines, would have minor short-term adverse impacts on wildlife. Other activities, such as creating helispots or the use of helicopter buckets of water or retardants, may have longer lasting adverse impacts. Overall, these activities are not expected to have more than minor adverse impacts to wildlife.

Treatment with prescribed fire and through mechanical means in the selected alternative would result in short to long-term, minor to moderate benefits to wildlife from the reestablishment of the natural fire cycle, reduction of fuel loads, and reduction of the potential for catastrophic wildfire. In the context of the entire study area, The FMP would result in minor short to long-term benefits to wildlife from creating open habitat.

The FMP will result in moderate short-term benefits to historic buildings by reducing fuels around these structures, both through prescribed burns and mechanical treatment. There would be moderate long-term benefits to cultural landscapes from restoration or maintenance through prescribed fire or mechanical treatments. The FMP could have negligible to major adverse impacts on cultural resources, including historic structures and archeological resources, from suppression activities associated with even average sized wildfires. Impacts to cultural landscapes, however, would be minor to moderate, as only a small portion of the landscape would be burned. Larger wildfires would be much more likely to result in major permanent adverse impacts from the burning of historic structures, damage to buried resources, and the loss of a significant portion of cultural landscapes.

Prescribed burning would have minor beneficial effects by opening and restoring scenic vistas, but also short-term adverse effects on some visitor activities from blackening of vegetation with prescribed fires. The impact would be adverse and moderate and may last up to 50 days per year.

Mechanical treatment may adversely affect park visitors through noise and closures. Impacts would be short-term and moderate.

An overall 5.9% increase in budget and additional 5 FTEs in staffing required in the FMP to conduct additional prescribed burning and thinning would have minor adverse impacts to park operations and management.

The actions in the FMP will have direct adverse, short-term and minor impacts upon the health and safety of both the public and firefighters, except during large, high severity fire events, when the proximity of people to smoke and flame would result in major, short-term, and unavoidable adverse impacts.

Direct fire funding and staffing would have long-term, beneficial impacts compared to dollars and staff positions generated from tourism in the local economy. These benefits would be minor.

Giacomini Wetlands Restoration. The proposed Giacomini Restoration is described in a separate Giacomini Restoration Plan, Environmental Impact Statement to be released in 2006. The following information is from the Giacomini Wetlands Restoration Project, Project Description (NPS 2005).

The project is to restore 550 acres of wetlands at the head of Tomales Bay within Golden Gate National Recreation Area. The area is administered by Point Reyes National Seashore. The project would restore processes and functions to an area that represents as much as 12 percent of the wetlands present along the outer central California coast. More than 60 percent of the Tomales Bay vegetated intertidal wetlands were lost in the 1940s with diking of a 550-acre historic coastal marsh for a dairy operation. Wetlands play an important role in watershed health through functions such as nutrient and sediment retention. These functions are particularly important in Tomales Bay, which has been declared impaired by the Regional Water Quality Control Board for sediment, nutrients, pathogens, and mercury.

With this project, the National Park Service will restore natural tidal wetlands and associated functions to the Project Area, which it purchased in 2000. Restoring connectivity between Tomales Bay, Lagunitas Creek, and the active floodplain will improve water quality not only within the Project Area, but within the entire Bay.

Alternatives include both restoration and public access components, with restoration involving some degree of topographic and hydrologic alteration aimed at increasing or enhancing hydrologic connectivity, native vegetation, and habitat for common and special status wildlife species.

The project area is bisected by Lagunitas Creek. This property, once tidal wetlands, was diked and drained in the early 1940s to create pastures. For many years, a gravel dam was constructed annually just below the confluence of Lagunitas and Olema creeks for irrigation and stock watering. The dam created an abrupt transition from fresh to saline water for smolts and spawning adults, eliminating the transition zone found in an unimpaired estuarine system. The dam and the levees concentrated the area where spawning fish could remain and smolts could feed, and increased the potential for predation. A transition zone would allow smolting fish time to adjust to saline conditions and provide productive feeding zones where both freshwater and saltwater invertebrates are available. While the annual construction of the dam has been discontinued, the levees are still in place. Restoration is planned to begin after final acquisition in 2007.

The anticipated primary impacts of this project are:

Restored wetlands will not only filter nutrients, contaminants, and sediment in freshwater inflows from Lagunitas, Olema, and Bear Valley Creeks, but provide a source of food for estuarine and marine wildlife species for export to the Bay. Restoration of pasture to wetlands will also increase breeding, rearing, foraging, and refugia habitat for numerous common and special status wildlife species. In addition, hydrologic modeling indicates that the proposed restoration alternatives would have a considerable beneficial impact on flooding of adjacent properties and county roads, thereby supporting the Park Service's contention that restoration will improve wetland functions such as floodwater retention.

Some of the possible negative impacts of the proposed project include effects to special status species habitat. Increasing tidal influence has the potential to negatively affect populations of California red-legged frog (federally threatened) and tidewater goby (federally endangered). Also, removal of the levees could eliminate high-tide refugia for rails such as the California clapper rail (federally endangered) and California black rail (state threatened).

The project is proposing to create freshwater marsh habitat for the California red-legged frog near Tomasini Creek (Tomasini Triangle) in the East Pasture, thereby mitigating impacts to habitat in the West Pasture from increased tidal influence. Existing habitat for the tidewater goby will be maintained after restoration to allow time for new habitat to develop within the restored pasturelands. In addition, any impacts to rails will be mitigated by creating high-tide refugia.

The project would enhance water quality by creating a marsh filtration system and would increase natural resource protection over a local area, but would enhance the entire Tomales Bay area; therefore impacts would be beneficial and moderate for water quality.

The project would have minor beneficial effects on wildlife, by providing additional coastal habitat. The project's effects on vegetation, especially the creation of new wetlands, would be moderate because the project would restore an area that represents as much as 12 percent of the wetlands present along the outer central California coast. In addition, it would restore a major wetland that was lost on Tomales Bay in the 1940s with diking of a 550-acre historic coastal marsh for a dairy operation. Additional benefits to plants and wildlife would come from proposed riparian, native grassland, and marsh revegetation activities within selected portions of the East and West Pasture Project Areas.

Habitat for several listed species, including coho salmon and steelhead trout, would be improved. Therefore, because the effects could increase these species, the effects would be moderate and beneficial.

Dairy and Beef Ranching. Ranching on within NPS boundaries pre-dates the park and is specifically mentioned in the enabling legislation and general management plans of both PRNS and GGNRA as allowed (NPS 1980). The 1980 PRNS General Management Plan/Environmental Assessment (GMP) designates a "Pastoral Lands" zone of approximately 17,040 acres in the National Seashore "to permit the continued use of existing ranchlands for ranching and dairying purposes." The 1980 GGNRA GMP specifies that the northern Olema Valley (approximately 10,000 acres) be part of a Pastoral Landscape Management Zone in which "where feasible, livestock grazing will continue within limits of carefully managed range capacities." In addition, many of the ranch complexes and structures have been determined historic and eligible for the National Register of Historic Places. Through the Special Use Permit system, natural resource managers have been working with the agricultural community to modify operations within the lease areas to reduce adverse impacts associated with livestock concentration. Ranching operations have been reduced from their historic extent on the entire Point Reyes Peninsula to about 25% of the overall area within the boundary. Nearly all of the remaining 75% of Seashore area is managed as natural or wilderness areas. In addition, since the park was established in 1962, cattle stocking levels have been reduced from 10,500 dairy and beef cattle to 5,101 animal units within Point Reyes National Seashore (NPS 1961, NPS 2006) and 1,545 to 912 in GGNRA north district (NPS 2006). The total reduction of dairy and beef cattle from 12,045 to approximately 6,013 animal units represents a 50% reduction since the park was established. Total acreage under grazing permits is approximately

28,000. Of this total, approximately 21,000 acres can be grazed and excludes forest, stream areas, thick brush areas, and other non-grazable vegetation (NPS 2006).

Water quality, vegetation, wildlife, special status species, and soil impacts have been identified by NPS staff and are being mitigated by NPS projects and programs. Programs are guided by the Point Reyes National Seashore Range Management Guidelines (NPS 1990) that outline monitoring, resource protection programs, and resource goals.

The NPS Water Resources Division (WRD) completed the Baseline Water Quality Data Inventory and Analysis Report ("Horizon Report") for PRNS (NPS 2003b). According to the Horizon Report there were 141 STORET (Storage and Retrieval water quality database management system) stations within the park managed boundary covering virtually all of the watersheds. There were no long-term stations within PRNS boundaries. The cumulative date of record was 1901-1998 (with the majority of observations occurring after 1954). Point Reyes staff collected a significant amount of data including multiple observations for multiple stations since 1999. Much of the data collection occurred after the STORET retrieval date of 12/20/99. The WRD report does not include PRNS data that is summarized in PRNS Water Quality Monitoring Report (Ketcham 2001) or the UCB report A Review of the Water Quality Monitoring Programs in the National Parks (Stafford and Horne 2004). Other agencies conducting monitoring included the U. S. Geological Survey (USGS), San Francisco Regional Water Quality Control Board (SFRWQCB), and the Environmental Protection Agency.

Water quality monitoring by the State Department of Health Services of Tomales Bay and Drakes Estero has been ongoing since the early 1990s. Monitoring in these water bodies is mandated by shellfish production requirements. The USGS has monitored flow in Lagunitas since 1974 (Freeman et al, 2003). The USGS has conducted three intensive water quality survey efforts in the Seashore. Between 1999 and 2001, USGS staff conducted National Ambient Water Quality Assessment monitoring for sediment and nutrients on four watersheds (within GGNRA and PRNS) supporting coho salmon and steelhead trout. In 1999-2000, the USGS conducted an assessment of hydrology and water quality (Kratzer et. al. 2006) and fisheries and environmental conditions (Saiki and Martin 2001) within the Abbotts Lagoon watershed. In 2006, the USGS will finalize and report a three-year sediment investigation in Lagunitas and Walker Creek. The Seashore has cooperated with a number of state agencies and private researchers to facilitate water quality research and monitoring.

In 1999, the PRNS initiated the Ambient Surface Water monitoring program (quarterly and storm-event monitoring) at approximately 30 sites in five watersheds (Lagunitas Creek, Olema Creek, Pacific Ocean, Drakes Bay, and Drakes Estero). A report (Ketcham 2001) was produced by the park outlining results from 2000-2001. Monitoring has focused on evaluating the impacts of agricultural operations (dairy cattle, beef cattle, and equestrian operations). Parameters monitored through the ambient surface water program included pH, temperature, dissolved oxygen, specific conductance, flow, salinity, TSS (Total Suspended Solids), turbidity, fecal and total coliforms, nitrate, nitrite, ammonia and orthophosphorus. Orthophosphorus and nitrite was rarely detected. The report identified dairies as a primary source of pathogens, nutrients and sediment, with pollution from grazing lands as being a less concentrated source.

The ambient monitoring program proposed more frequent, focused monitoring at priority sites. With the listing of Tomales Bay as being impaired by pathogens, six sites on Olema Creek have been chosen for monthly monitoring as part of the San Francisco Bay Regional Water Quality Control Board's Tomales Bay Pathogen Total Maximum Daily Load (TMDL) Program. In addition to monthly monitoring, the sites have been monitored six consecutive weeks during the winter and six consecutive weeks during the summer. Monitoring for this program began in June 2003 and is ongoing.

An additional monitoring project was initiated in April 2004 as a response to the goals outlined in the NOAA Fisheries Biological Opinion (National Marine Fisheries Service 2004). This project includes monthly monitoring of bacteria, sediment, and flow at five key sites throughout the park (two tributaries to Olema Creek, one tributary to Lagunitas Creek, and two creeks in the Drakes Estero watershed). It also anticipated that TMDL monitoring would be used in the results analysis.

Tomales Bay is also on the Clean Water Act's Section 303d list for sediment impairment. The NPS initiated a project with the USGS to conduct ambient sediment monitoring at established USGS stream gages in the Tomales Bay watershed. This three year project was initiated in October 2003 and will be completed in September 2006. The results of the sediment monitoring program for 2004-2006 is anticipated from the USGS in fall 2006. These data will be used by the SFRWQCB for planning and development of a sediment TMDL for the watershed.

In 2006, the San Francisco Area Network Water Quality Inventory and Monitoring Protocol was approved for implementation. This includes ambient monitoring at sites throughout the eight-park Network. The protocols developed through this program are extensive and will be employed in all future water quality monitoring activities. They include sample collection, handling, analysis and reporting. Network sites within the Project Area include the Olema TMDL sites as well as sites on Pine Gulch Creek.

A study conducted through GGNRA (Beutel 1998) included sites on Pine Gulch. San Francisco Bay Network Inventory and Monitoring Program and PRNS initiated limited monitoring in late 2003. This monitoring covers the same parameters as monitoring on Olema Creek and the pastoral watersheds. However, due to private ownership of a portion of the watershed, site access has been sporadic.

Past and current recreational monitoring in the Seashore has included lagoons, ponds, beaches (mentioned previously), and a lake. Currently, three recreational areas are monitored in conjunction with the Marin County Environmental Health Services. These areas include Limantour Beach, Drakes Beach, and the kayak put-in at Drake's Estero. PRNS also monitors Kehoe Lagoon and Abbotts Lagoon in conjunction with watershed source area assessment efforts.

In 2001, an aquatic bioassessment was conducted at six sites in the Olema Creek watershed and six sites in the Drakes Estero watershed. In 2004, bioassessment was expanded to include Pine Gulch Creek, additional Olema Creek sites, and Lagunitas Creek. Network and park personnel completed benthic macroinvertebrate sampling in April 2004 following the California Stream Bioassessment Protocol (Harrington & Born 2003). Macroinvertebrate analysis was conducted and reported in 2005 (Lee and Cooprider 2005).

Synoptic or short-term water quality monitoring has also been conducted for various park restoration and research projects. For example, a Long-Term Monitoring Program is being developed for the Giacomini Wetland Restoration Project (Parsons 2003). Initial monitoring for this program is being conducted monthly.

The monitoring described above has identified several water quality issues related to cattle and other activities within the park. These issues involve fish migration and spawning and beneficial uses such as shellfish harvesting and contact recreation. Sediment and pathogens are the most significant problems related to the beneficial uses. Erosion due to unstable geology, cattle grazing, roads, culverts, and trails threatens the sediment balance and ecological health of several watersheds (most notably Olema Creek). Excess sediment can adversely impact salmonids by clogging their gills, degrading gravel beds used for spawning, and making food sources more difficult to find. Because of the significant amount of pastoral land within park boundaries, bacterial contamination is also a very serious issue. Bacteria inputs are primarily from dairy and beef cattle operations, but pet waste (particularly at beaches), stable operations, and septic systems may also be contributing. More details on these issues and the watersheds they impact can be found below.

Sediment. Tomales Bay and Lagunitas Creek are impaired by sediment. Lagunitas Creek (and its tributary, Olema Creek) are the subject of several sediment monitoring studies. In addition to the USGS sediment investigation on Lagunitas and Walker Creeks, PRNS has recently completed multiple streambank stabilization projects along Olema Creek. Collaboration with the USGS is expected to continue in the future. Additionally in 2006, the Seashore initiated a rangeland assessment with the intent of identifying and treating 10 priority nonpoint source pollutant sites on park lands within the Tomales Bay watershed through a three-year EPA grant. It is anticipated that site treatments (primarily in 2007) will result in site sediment and pathogen reductions.

Pathogens. Although the levels of fecal coliforms in Olema Creek are a focal point because of the Tomales Bay Pathogen TMDL Program, very high fecal coliform numbers also occur in the small coastal watersheds where dairy and beef cattle operations are located (including park designated pastoral lands and the Giacomini property). Work is in progress to determine exact sources which may include runoff from pastures and lots, direct cattle access to creeks, and faulty septic systems.

Water monitoring locations with degraded conditions Pollutants of concern (from Ketcham 2001)

Station	Watershed	PRIMARY	SECONDARY
PAC2	North Kehoe Creek	Fecal Coliform 90th percentile 147,000 MPN	• Conductivity
PAC2a	North Kehoe at Ranch	Fecal Coliform 90th percentile 1,380,000 MPN	• Conductivity
PAC1	South Kehoe Creek	Fecal Coliform 90th percentile 153,000 MPN	• Conductivity
ABB1	Abbotts Perennial	Fecal Coliform 90th percentile 26,200 MPN	
ABB2	McClure Drainage	Fecal Coliform 90th percentile 23,200 MPN	
DBY3	A-Ranch Drainage	Fecal Coliform 90th percentile 160,000 MPN Toxic Ammonia – 2 events	
DBY2	B-Ranch Drainage	Fecal Coliform 90th percentile 819,000 MPN Toxic Ammonia – 2 events	
OLM2	Giacomini Creek	Fecal Coliform 90th percentile 176,000 MPN	
OLM4	Quarry Gulch	Fecal Coliform 90th percentile 44,400 MPN	

Based upon the monitoring results, the Seashore considers conditions at nine sites (8 subwatersheds) as degraded. Data from water quality monitoring has provided impetus to conduct field reconnaissance and additional sampling aimed at determining direct sources of pathogenic bacteria (e.g., livestock with direct access to streams). Trouble-shooting, problem solving, and best management practices implementation plans are underway for septic systems and dairies. For example, fencing has been installed or repaired at locations throughout the park. Focused monitoring of Kehoe Creek and Abbotts Creek has been initiated in order to differentiate sources (NPS 2004b). In addition, the two "OLM" stations identified above are part of the Grazing Biological Opinion Monitoring Project. Discussions with permittees to improve conditions within these watersheds are ongoing. Additional monitoring sites have shown exceedence of fecal coliform standards. In most cases, these sites are downstream of the degraded sites, and the higher readings are a result of pollutant persistence in the water column. Two key watersheds in the park are highlighted below.

The Kehoe Lagoon watershed (including North Kehoe and South Kehoe Creeks and tributaries) is a major concern for the Seashore. Bacterial numbers throughout the watershed (combining data from five sites) range from an average of 35,000 MPN/100mL during the dry season to 350,000 MPN/100mL during the rainy season. Through the beach monitoring program (in conjunction with the County of Marin), Kehoe lagoon was "posted" several times in 2003 for exceeding contact recreation criteria for indicator bacteria (fecal coliforms, E.coli, and Enterococcus). Kehoe Beach itself (saltwater) has consistently met standards. A dairy cattle barn expansion to reduce water quality impacts is underway within this watershed. Since more cows will be housed inside the barn, their waste can be better managed. Water quality data before and after barn expansion will be compared to determine the efficacy of the barn as a management practice.

The Abbotts Lagoon watershed is also a concern. Again, combining data from throughout the watershed (3 sites) the average low (dry season) fecal coliform count is approximately 6,000 MPN/100mL. Winter rain season counts have exceeded 1.6 million MPN/100mL in one tributary and are commonly over 10,000 MPN/100 mL in other tributaries. A barn was built in the summer of 2003 to house cattle and better manage waste. Preliminary results from winter 2004 monitoring indicate a marked decrease in fecal coliforms at two of the three monitoring sites compared to fecal coliform results in previous winters. The average for the three sites was 8,700 MPN/100mL. Although this number still exceeds standards for non-contact recreation, additional decreases are anticipated in the next several years.

In areas that are managed for agriculture, tools to exclude livestock from sensitive areas, riparian zones and creeks have been implemented. For example, the park has installed more than nine miles of riparian protection fencing, reduced cattle stocking levels in the park, and enhanced waste pond storage and maintenance. In addition, water quality monitoring and range monitoring (NPS 1990) annually determines problem areas and target areas for treatment and improvements. Changes in park zoning are possible in the next cycle of general management planning, which is expected to begin in both PRNS and GGNRA within the next two years.

Recreational Monitoring Program. While the Seashore has not designated water bodies specifically for recreational use, sampling for fecal and total coliform was performed at three of the most heavily used sites during summers1999 and 2000 (Hagmaier Pond, Vision Pond, and Bass Lake). Results indicate that water bodies not influenced by cattle grazing, remained far below any level of concern for contact recreation (Vision Pond and Bass Lake). Monitoring at Hagmaier Pond, a cattle stock pond, indicated short-term spikes of fecal coliform associated with the presence of cattle. Of 29 samples collected over two summers at Hagmaier Pond, 14% (4 samples) exceeded contact recreational standards (400 MPN/100ml). The duration of these fecal coliform spikes was typically less than one week. In response, the Seashore posted warning signs at the pond and access points, indicating the use of the pond by livestock and the associated risks (Ketcham 2001).

Based on the above and ongoing mitigation measures, ranching effects on water resources are adverse, long-term and minor to moderate. Water quality problems are localized but have to potential to be regional in nature.

Park staff recently prepared a Biological Assessment in accord with Section 7 of the Endangered Species Act (NPS 2002c) to analyze the extent to which agricultural lease renewals in the Seashore might affect any of the federally listed Threatened or Endangered species at the Seashore. The U.S. Fish and Wildlife Service has reviewed this assessment and issued a Biological Opinion which found that, although permit renewals might adversely affect several threatened and endangered species at the park, they were "not likely to jeopardize" them. The species identified in the Biological Opinion included salmonids, red-legged frogs, western snowy plovers, and six species of threatened and endangered plants. Regarding special status species, the effects of ranching are primarily long-term, minor to moderate, and both beneficial and adverse. Some plant species benefit from grazing of competitive species. Ranching activities on other species has adverse effects.

Grazing and ranching impacts on wildlife are varied. Cessation of livestock grazing on sensitive natural resource areas in the park would be likely to have moderate long-term beneficial impacts to several wildlife species and the same level of adverse impacts to a few species. Such impacts would result from reduced vegetation loss, conversion of open prairie habitat, reduced trampling and manure deposition. Inventories of small mammals in non-wooded areas of the Seashore revealed fewer western harvest mice and California meadow voles captured in those pastures heavily grazed by cattle than in moderately grazed pastures or similar non-wooded areas (Fellers and Pratt 2002). Species that would benefit from cessation of livestock grazing are the: Pacific jumping mouse, dusky-footed woodrat, western harvest mouse, California vole, black-tailed jack rabbit, and brush rabbit. Heavy grazing has been shown to result in lowered reproduction in some birds of prey, because of the loss of rodent prey species. Cessation of livestock grazing would have beneficial impact on birds of prey such as great-horned owls, short-eared owls, western screech owls, long-eared owls, barn owls, American kestrels, red-shouldered hawks, red-tailed hawks, Northern harriers, black-shouldered kites , sharp-shinned hawks and Cooper's hawks. With respect to other birds, past research at PRNS has shown that in all habitat types except coastal scrub, cattle-grazed areas had lower diversity, lower species richness and lower relative abundance of passerines and near-passerines (hummingbirds, woodpeckers and doves) (Holmes et al. 1999). These species would be expected to benefit long-term from cessation of livestock grazing.

However, not all species decline with livestock grazing pressure. At PRNS, deer mice were found more often in pastures grazed by cattle than in pastures where cattle were excluded (Fellers and Pratt 2002). One bird species, the savannah sparrow, was found in higher numbers in grazed than ungrazed grasslands (Holmes et al. 1999). It is possible that with cessation of grazing in the park, deer mouse and savannah sparrow abundance would decrease. The Valley pocket gopher, another small mammal species that thrives in open grassland environments, could also remain unaffected or decrease.

Overall cattle grazing is considered to have moderate adverse impacts to several species of wildlife and moderate beneficial impacts to a few other species.

Pacific Coast Learning Center Building Rehabilitation. The Pacific Coast Learning Center has begun operations within existing buildings in Olema Valley, at the former Hagmaier Ranch. The site is used for office space and storage for fire-fighting and maintenance equipment. No new construction has occurred. Park and visitor use has continued on the site for over 20 years. The project has negligible adverse effects on transportation and no measurable impacts on water resources, park operations, soils, and the local economy. However, the research studies produced by staff at the site have a beneficial indirect minor impact on wildlife and special status species.

Sewage Systems Improvements. Sewage systems upgrades have been conducted at Tomales Bay Marine Station at Sacramento Landing, within Olema Valley and along Lagunitas Creek. The NPS headquarters buildings at Bear Valley also have received a new sewage system. New, major septic systems are planned at the Home Ranch and Point Reyes Lighthouse, and upgrades are planned for the Drake's Beach system. The Home Ranch sewage leach system for three houses will be moved to a location away from the Home Ranch Creek area to address water quality issues. The new leach field is directly north of the main Home Ranch complex. These projects will have minor beneficial long-term effects on water quality and resources and public health and safety by removing localized potential pollutions sources. These projects will have short-term negligible impacts to air quality, wildlife, vegetation, and visitor experience due to construction activity.

Small Restoration Projects. Small creek restoration protection projects for coho salmon and steelhead trout in watersheds supporting salmonids (e.g. Olema Valley) have been completed or are underway. These projects include removal of fish passage impediments, bank stabilization, and installation of fencing to protect riparian areas on Bear Valley Creek, Pine Gulch and Olema Creeks and their tributaries. These projects have a minor, beneficial, long-term effect on coho salmon and steelhead trout, two federally listed species. Riparian fencing also improves water quality for wildlife, public health and safety; these projects have beneficial direct minor long-term effects on these two impact topics.

Coastal Watershed Restoration (Geomorphic Sites) in Drakes Estero Watershed. The Coastal Watershed Restoration – Geomorphic Restoration Project Environmental Assessment (EA) (NPS 2004c) examines alternative means to restore natural hydrologic function at several locations and assesses the potential environmental effects of the implementation of each strategy. This EA addresses two water impoundments and one road crossing site within the Drakes Estero Watershed. These sites are included as part of the Coastal Watershed Restoration Project, a National Park Service (NPS) Line-Item Construction Program funded project scheduled to be obligated in FY2007. Project areas include the Glenbrook Road Crossing, a non-conforming structure in the Philip Burton Wilderness, Muddy Hollow Dam and Limantour Beach Pond Dam, both constructed across portions of Estero de Limantour.

The proposed project area is located on land adjacent to and within the Philip Burton Wilderness Area of the Seashore. Treatment proposed at these locations is intended to reduce or eliminate the long-term maintenance requirements associated with the existing earthen fill structures. A summary of the project follows.

The project will restore natural conditions and increase estuarine habitat at Point Reyes. At each of these sites, construction across stream or estuarine habitat impedes natural process and is not consistent with long-term park and NPS management objectives. These sites impede or block access to watersheds that support threatened Central California Coast Evolutionarily Significant Units (ESU) steelhead, or have the potential to support federally endangered central California coast ESU coho salmon. Muddy Hollow Dam and Limantour Beach dam restrict tidal action from more than five acres of coastal marsh habitat. The Glenbrook crossing is a non-conforming structure within the Philip Burton Wilderness and is a barrier to fish passage.

The project will eliminate the risk of catastrophic failure. Maintenance activities currently are necessary to prevent catastrophic failure at Glenbrook Crossing and Muddy Hollow Pond. The culvert at Glenbrook Crossing (within the Philip Burton Wilderness Area) is eroded and bowed, with water piping around the metal culvert. The outfall of the culvert is 11 feet above the bed of the creek, and is a total barrier to aquatic movement. Catastrophic failure is likely, and could result in large volumes of sediment entering the stream system and result in effects to natural resources. At Muddy Hollow Pond, more than 30 acre-feet of water are stored behind the dam facility. Catastrophic failure would result in loss of pond, estuarine, and upstream wetland habitat.

Under the selected alternative, short-term adverse minor impacts to visual resources would occur as a result of construction activities. The installation of signs describing the restoration activities and intent, as well as distribution of flyers and education at the Visitors Centers would mitigate some of these impacts. With these outreach activities in place, the long-term impacts would be beneficial as visitors become educated about restoration and natural processes.

The project would have localized moderate short-term adverse impacts to wilderness resources. In the long-term, the proposed actions would result in benefits to the wilderness by restoring natural process to a confined system.

NPS would require contractors to adhere to the Bay Area Air Quality Management District's (BAAQMD) Feasible Control Measures and meets applicable emissions standards. The analysis concludes that the project would result in short-term minor adverse impacts to air quality. The project would not result in long-term effects to air resources.

Evaluation of potential impacts to hydrology, hydraulics and water quality under the selected alternative shows the likelihood of short-term minor to moderate localized adverse impacts as hydrologic configurations and conditions adjust as a result of the restoration activities. Shifts in water regime, channel and estuarine configuration would occur, but would be muted in scale with proposed adaptive management measures.

In the long-term, the project actions are considered beneficial as natural hydrologic and estuarine process would be restored to a new, functional and dynamic equilibrium at these sites. The restoration actions would facilitate sustainable, naturally functioning hydrologic systems that would not require continued maintenance.

The project would result in similar short-term impacts to vegetation, wildlife, and habitat as a result of the direct construction activities. Overall the changes to vegetation and wildlife habitat are considered adverse and minor in the short term: with recovery, however, the long-term effects are considered beneficial.

The project would result in minor short-term adverse impacts associated with conversion or direct impacts as a result of construction. In the long-term, the recovery or conversion to more ecologically sustainable wetlands and habitat is considered a benefit to wetlands and wetland functionality at all the project sites.

Restoration actions under the project would result in increased sediment loading following deconstruction, but would restore habitat and habitat access for fish in the long-term. Based on this analysis, the project build alternatives would result in short-term minor effects to special status fish (namely steelhead) and essential fish habitat within the project watersheds. The proposed actions, intended to restore hydrologic connectivity and access to the Muddy Hollow and Glenbrook watersheds would result in long-term beneficial effects to steelhead, potential coho salmon habitat, and essential fish habitat.

The effects of changing habitat associated with the proposed restoration activities would result in localized short-term moderate adverse effects to California red-legged frogs and its critical habitat at Limantour Beach Pond and Muddy Hollow Pond. In the long-term, enhancement actions adjacent to Limantour Beach Pond are expected to result in minor adverse effects to the individuals. At the Glenbrook Crossing, non-breeding habitat would be effected, and only temporarily. The actions at Glenbrook Crossing would result in localized minor adverse effects in the short-term, with long-term beneficial effects as the system moves towards natural equilibrium. The proposed action would not result in impairment of park special-status amphibian species. The project would not jeopardize the persistence of California red-legged frogs in the project area or within the park.

The proposed restoration designs would avoid impacts to documented cultural resource areas. The analysis concludes that the project would result in no short-term or long-term effects on cultural resources.

The project would result in the removal of facilities that pond water. Based on the analysis undertaken in the EA, the action alternatives would result in short term minor adverse impacts to public health and safety as a result of construction activities and closures, and beneficial long-term effects with the removal of structures that could fail in a major rain event.

Coastal Watershed Restoration – Drakes Estero Road Crossing Improvement Sites. Point Reyes National Seashore proposes replacement or improvements to culverted road crossings at 6 locations within the Drakes Estero Watershed. These sites are included as part of the Coastal Watershed Restoration Project, a National Park Service (NPS) Line-Item Construction Program funded project scheduled to be obligated in FY2007. The project is needed to repair or replace existing road-crossing facilities (crossings) in a manner that is ecologically and hydrologically sustainable, with infrastructure that will require less maintenance for long-term park operations. Prior to acquisition of the land by the NPS, a network of roads and other infrastructure was constructed to support existing agricultural operations and planned residential development. Culverts comprise many of the park road crossings. Since the Seashore was established, the NPS has continued to manage the existing roads, drainage facilities, and other infrastructure. Many of these facilities are beyond their design life, and are either not compatible with current land use designations (e.g., Wilderness areas) or are in imminent danger of catastrophic failure.

This project focuses on 6 separate crossings of drainages and streams in the Drakes Estero Watershed. These 6 project areas fall within 3 coastal subwatersheds, which eventually drain to Drakes Estero and Drakes Bay. The Mt. Vision Road and Estero Road project areas are located on East Schooner Creek, which parallels Sir Francis Drake. The Upper Home Ranch project area is located on North Home Ranch Creek at its junction with Estero Road. The Lower Home Ranch project area is located on Home Ranch Creek at the Home Ranch facility. The remaining 2 project areas (Upper and Lower Laguna) are located on Laguna Creek, where access to the Laguna Trailhead and Coast Trail cross the stream channel. These creeks are perennial drainages or creeks that have flowing water throughout the year.

The impacts of this project are detailed in the Drakes Estero Road Crossing Improvements Environmental Assessment (NPS 2004d). A summary follows.

The potential effects of implementation of the selected alternative on geologic and soil resources, and on risks from geohazards are adverse, negligible to minor in the short term, and beneficial in the long term. Short-term impacts include minor excavation of stream channel banks and beds, and soil compaction and erosion due to heavy equipment traffic. Long-term benefits would be reduced risk of culvert failures and decreases in unnaturally accelerated channel erosion.

With mitigation measures in place, the project would result in minor, short-term, adverse impacts to air at the project sites. There would be no widespread or long-term impacts to air quality as a result of implementation of the action alternative.

The project has the potential for direct impact on natural quiet. Impacts would be minimized by Best Management Practices, and the relative acoustic isolation of individual project sites and the naturally high ambient noise levels at some project sites. Noise impacts due to incremental effects at each of the 6 project sites considered in this document vary by site and alternative. At all sites, heavy equipment use will create minor noise impacts at the sites and on access roads during construction activities. At some sites the potential need to anchor culvert structures with pilings could create additional noise impacts. At these sites, if pile driving is required, noise impacts would increase to moderate levels for very limited (1-2 day) period. Therefore, short-term impacts to natural quiet would be moderate in intensity and adverse. There would be no long-term impacts to natural quiet as a result of implementation of the project.

The potential impacts associated with implementation of the project on hydrologic process, geomorphic process, and water quality are adverse, and minor to moderate in the short term. Short-term impacts include excavation of stream channel banks and beds, soil compaction and erosion due to heavy equipment traffic. Localized moderate impacts are described at sites where boulder cross-vanes or large-scale riprap armoring would be installed. The restoration of more natural hydrologic and geomorphic processes to these watersheds would be beneficial in the long term. In the long term, there would be no effect on water quality.

Under this project, activities would result in localized effects to wildlife associated with vegetation removal, staging areas, and the noise of project activities. These short-term effects are considered minor and adverse. In the long term, the project would result in beneficial effects to aquatic species associated with expansion of stream conveyance capacity.

In general, short-term impacts from the project to habitat are followed by benefits to habitat in the long term. There is no proposed habitat conversion (e.g. pond to marsh). All sites are riparian and will recover to riparian habitat. Project mitigation measures would provide further protections to insure that potential for direct take is minimized.

Overall, the project would result in minor short-term adverse impacts to special status species and habitat, and beneficial long-term effects. Project activities would result in localized effects to wildlife associated with vegetation removal, staging areas, and the noise of project activities. These short-term effects are considered minor and adverse. In the long term, the project would result in beneficial effects to aquatic species associated with expansion of stream conveyance capacity.

The proposed actions would involve adverse, short-term, minor impacts to visitors because of temporary access road and trail closures, increased traffic, noise, and potential delays associated with construction equipment. However, these adverse impacts would be offset in the long term by beneficial impacts such as reductions in the potential for access road and trail closures due to flooding, emergency infrastructure replacement, and frequent repairs and maintenance. In addition, there would be an improvement in the overall aesthetic resources of the park that would increase the value of the visitor experience

The overall long-term effects of the project on public safety and transportation would be beneficial. Short-term effects on transportation and public safety would be minor. Improvements in public safety would range from minor to moderate, depending on the risk for catastrophic failure of the existing facilities and the potential for flooding. The NPS would ensure that impacts to residents remains minor by maintaining access to homes, ranches, and facilities during construction.

Cultural Resource Restoration Projects. Cultural resource preservation projects have been conducted in the Olema Valley and in the North District of PRNS within the last five years. The historic bunkhouse at Truttman Ranch in northern Olema Valley has been re-roofed and rehabilitated. The Giacomini Ranch house, in southern Olema Valley, and the main barn have received treatments to ensure long-term preservation. In 1997, the main barn at the Wilkins Ranch was stabilized. Improvements to the historic communications facilities at Commonweal and at the former RCA site in the north district have been completed. The C Ranch Barn has been stabilized and work stabilization work is planned at the Home Ranch in fiscal year 2006-07.

An Environmental Assessment (NPS 2001d) and a Finding of No Significant Impact have been completed for the Wilkins Ranch project. The selected alternative that was implemented had negligible adverse impacts on transportation and minor adverse impacts to housing. The selected alternative provided minor, long-term direct moderate cultural and natural resource beneficial impacts and provided for minor, long-tem beneficial visitor and education use. The project also had moderate beneficial impacts to public health and safety by the upgrade of the septic system.

North District Operations Center. impacts on water resources, park operations, soils, and the local economy. However, the research studies produced by staff at the site have a beneficial indirect minor impact on wildlife and special status species. Public access to the site would be a minor beneficial impact to The MCI building in the North District of Point Reyes National Seashore has been rehabilitated and will provide office space for district rangers and the exotic plant management team. Some public events are held there to demonstrate the historic radio systems. No additional construction has occurred. The project has negligible adverse effects on transportation and no measurable visitor experience, but would be used by only a small number of park visitors. The project has a direct long-term minor beneficial effect on cultural resources by the preservation of the historic structures.

Point Reyes Hostel Improvements. The Point Reyes Hostel has developed a proposal for upgrading housing, a new sewage system, and for providing additional overnight lodging. The proposal will increase lodging capability from 44 to 52 persons. Housing for staff will increase from two to four units. An Environmental Assessment and a Finding of No Significant Impact have been completed for this project. The National Park Service (NPS) completed an Environmental Assessment (EA) for construction and upgrade of facilities at the American Youth Hostel at Point Reyes National Seashore (NPS 1999b).

The preferred alternative was selected for implementation to bring the facility into compliance with state, federal and Marin County health and safety regulations. Because of utility, housing and septic improvements, there are beneficial long-term direct impacts to public health and safety. In addition, the EA determined that the action did not have long-term adverse impacts on park resources. However, the review did determine there were minor to negligible short-term impacts vegetation and visitor experience due to construction activity. There were no cumulative impacts identified (NPS 199b).

Red Barn Classroom. The Red Barn at park headquarters has been rehabilitated for curatorial storage and classroom space. There is also office space for existing Cordell Bank National Marine Sanctuary staff (approximately five staff members). The combined space is approximately 6,000 square feet. Public use of the spaces is permitted, but primary use is by staff (total of seven staff members) and for storage. The project had negligible adverse effects on transportation and no measurable impacts on wildlife, special status species, water resources, park operations, soils, and the local economy

Historic Point Reyes Lighthouse Rehabilitation. The Point Reyes Lighthouse has been rehabilitated by repairing key structures such as the stairway and other site features. The Lighthouse has received a new water system. The work was accomplished in fiscal year 2002-2003. Upgrades to the sewage system and to the restrooms at the Point Reyes Lighthouse are planned for fiscal year 2006 and 2007. The restrooms will be moved to an existing garage structure from a vault toilet near the visitor center. There will be no new buildings constructed. The sewage leach field system is located near the apartment complex. In addition, structural repairs are planned for the main historic lighthouse in 2009. The project has negligible adverse effects on transportation and no measurable impacts on wildlife, special status species, water resources, park operations, soils, and the local economy. The project has a minor beneficial impact to cultural resources because it renovates a National Register property.

Historic Life-saving Station Marine Railway Rehabilitation. The boat launching facility at the historic Lifeboat Station, a national historic landmark, will be rehabilitated and restored. The $1.5 million project involves replacement and rehabilitation of pilings and railway rescue boat launching structures. The structure was first constructed in 1927. The work is underway and will be completed in 2006. The project has negligible adverse to minor effects on transportation and no measurable impacts on wildlife, special status species, water resources, park operations, soils, and the local economy. The project has a minor beneficial impact to cultural resources because it renovates a national register property.

Coastal Dune Restoration. Point Reyes National Seashore contains some of the highest quality remaining coastal dune habitat in the nation. However, this habitat is seriously threatened by the rapid encroachment of two nonnative plant species, European beachgrass and iceplant. Over 70% (1,000 acres) of Point Reyes National Seashore's dune habitat is dominated by these plants which are rapidly spreading to other areas. Originally introduced in California in the 19th century to stabilize dune sands, and to prevent filling of shallow harbors and burial of roads and railroad tracks, the proliferation of these species has adversely affected the survival and spread of native species and altered the natural process of sand movement. European beachgrass affects dune formation and development by slowing sand movement and deposition, which results in large, stable dunes that form a ridge parallel to the beach. This ridge prohibits sand movement between the fore and rear dunes, reducing the amount and quality of habitat available for native dune species. Similarly, iceplant forms dense, monotypic mats across the dunes holding sand in place and completely displacing native dune plant species. Iceplant also spreads into adjacent coastal bluff and coastal prairie communities encroaching upon these sensitive plant communities and adversely affecting rare plant populations. The proliferation of European beachgrass and iceplant in coastal areas of California has significantly reduced native dune habitat, resulting in the listing of associated plant species and the wildlife species that depend upon this habitat for foraging and nesting. Point Reyes National Seashore's sand dunes provide habitat for 11 plant and wildlife species that are listed under the federal Endangered Species Act including the threatened western snowy plover, the endangered Myrtle's silverspot butterfly, Tidestrom's lupine, and beach layia. The dunes also provide occasional haul-out habitat for the threatened Steller sea-lion, and roosting habitat for the endangered brown pelican. Additionally, Point Reyes National Seashore's sand dunes support the largest remaining tracts of two rare native plant communities: American dunegrass and beach pea foredunes. Removal of European beachgrass and iceplant from dune habitat in Point Reyes National Seashore is part of the recovery plan for federally listed species occurring in these areas. In 2001 Point Reyes National Seashore initiated a three-year project to systematically remove iceplant and European beachgrass from approximately 30 acres in the area immediately surrounding and north of Abbotts Lagoon. Nonnative plants were removed manually by contracted work crews and volunteer groups. Approximately ten acres of European beachgrass were removed each year in 2001, 2002, and 2003, for a total of 30 acres over the duration of the project.

In 2008, the NPS is planning a 300-acre dune restoration project continuing north of Abbotts Lagoon. An environmental assessment is being developed for this project.

The coast restoration projects are expected to have major beneficial direct effects on special status species and native dune plants. The projects have the potential to reverse the loss of several federally listed species. One of the primary objectives of the restoration project is to restore habitat for the federally threatened western snowy plover and several federally listed plants.

The project's beneficial effect to date results directly from the restoration. Since March 2004, plovers have begun to nest in the 30 acres of dune restored with heavy equipment. This is the first time plovers have used these back dunes since research began in 1972. Normally, plover nesting activity has been restricted to a narrow strip of sand between the beachgrass formed sea wall and the high tide line. Plovers are using the area for chick rearing as well. Males have been seen moving chicks to this area from as far as a mile and a half away. The restored area is open enough for plovers to see approaching predators and provides areas of protection and native food sources.

The two federally Endangered plants Tidestrom's lupine and beach layia have begun natural recolonization of the restoration area. In the area restored by heavy equipment, almost 200 lupine and 18 layia seedlings were found, presumably growing from newly exposed seed. A total of 9 species of native dune plants have appeared within the heavy equipment restored area (Jones and Stokes 2004).

Tomales Bay Marine Station Rehabilitation. The Tomales Bay Marine Science Center was established in existing structures at Sacramento Landing on Tomales Bay. Major additional structural repairs and improvements will occur over the next five years, but no new construction is planned. Improvements are being conducted on the site's septic and waters systems. Housing structures are currently being rehabilitated and the site's dock will be rehabilitated in 2006. The site is used by visiting researchers to conduct ecological research and the dock is used by NPS to access Tomales Bay. The project to upgrade facilities and utility systems has negligible adverse effects on transportation and no measurable impacts on wildlife, special status species, water resources, park operations, soils, and the local economy. However, the research on Tomales Bay and other park resources will have a beneficial, long-term, minor indirect effect on natural resources by providing management information for science-based management.

Bolinas Lagoon Restoration. Bolinas Lagoon is a 1,100-acre shallow tidal estuary on California's coast, 15 miles northwest of the entrance to San Francisco Bay. It is a Wetland of International Importance, nominated as such by the United States Fish and Wildlife Service and so designated by an international body in 1997. Located on the Pacific Flyway, it provides critical habitats for hundreds of resident and migratory bird species as well as marine mammals, fish and invertebrates. Many rare, threatened and endangered species are found in and around the lagoon. The existence of these habitats and of the lagoon itself may be threatened due to the accumulation of sediment caused by overgrazing, logging and other human activities that previously occurred in the lagoon's watershed.

A Reconnaissance Study conducted by the United States Army Corps of Engineers in 1997 concluded that corrective action – dredging and/or other means of removing accumulated sediment or minimizing its entry into the lagoon – was in the national interest. The Corps of Engineers, with financial support from the federal government, the State of California and the Marin County Open Space District (the project's local sponsor), commenced a Feasibility Study in 1998 to develop a plan to restore the lagoon's habitats. The Corps released its Draft Feasibility Report and Draft Environmental Impact Report/EIS for the Bolinas Lagoon Ecosystem Restoration Project in 2002. The Open Space District, with funding from the State of California and private donations, is presently coordinating a rigorous scientific review of the report's assumptions and conclusions to ensure that intervention to restore the lagoon's ecosystems is warranted. Concurrently, and for the same purpose, the Corps is conducting additional studies concerning sediment transport in the lagoon (Marin County Open Space 2006).

A recent study titled Projecting the Future Evolution of Bolinas Lagoon by Philip Williams and Associates, Ltd and WRA, Inc in February 2006 has the following summary of key findings.

"Bolinas Lagoon has persisted as a tidally dominated estuarine landform for the past several thousand years, although its shape and volume have varied over time in response to large earthquakes and gradual changes in sea level and sediment transport processes. Although the lagoon tends to evolve toward a dynamic equilibrium form that balances erosive and depositional forces, large earthquakes along the San Andreas Fault punctuate its evolutionary trajectory every few hundred years. These earthquakes drop the bottom of the lagoon floor by vertical displacement and compaction of unconsolidated sediment and result in a nearly instantaneous increase in lagoon volume, or 'tidal prism', and modifications to the channel system. After large earthquakes, the delivery of 'littoral' sediment is enhanced due to strong flood tide currents and an increase in the amount of bluff-eroded silt deposited in newly formed subtidal sinks.

Evidence from recent sediment core analyses has confirmed that logging and grazing during the 1800s increased the rate of watershed derived sediments to the lagoon. However, following the last major earthquake of 1906, these data also show that beach sands and silt eroded from the ocean bluffs account for the majority of the sediment accumulated in the lagoon. The second finding is consistent with our understanding of the lagoon's relatively small supply of sediment from the watershed, and the ability for tidal currents to disperse beach sands and silt far into the lagoon interior. It is also clear that sediment delivery varies year to year; the majority of watershed delivery occurs during infrequent rainstorms, and intense coastal storms may transport large amounts of beach sand through the inlet.

We project that over the next 50 years, in the absence of another large earthquake, sediment accumulation will continue to outpace sea level rise and result in a continued reduction in tidal prism. However, the future rate of tidal prism loss will diminish as erosive forces of locally generated wind waves limits further mudflat accretion and the ability of tidal currents to disperse sand far into the lagoon interior as the tidal prism reduces. Although the tidal prism is projected to decline over the next 50 years, Bolinas Lagoon is expected to maintain an open connection to the ocean, except possibly under extreme combinations of strong El Nino storms and weak neap tides.

The projected changes show an increase in area of salt marsh and high mudflats, and a concurrent decline in low mudflats and subtidal shallows. Although shifts in the relative distribution of habitats are projected over the next 50 years, major changes to species abundance and diversity and ecological function are not expected. If closure did occur, rapid changes to estuarine conditions would reduce species diversity since fewer plants and animals could tolerate these large and sudden modifications.

Our projections of future conditions are based on rates of sediment delivery averaged over several decades, which include large pulses of littoral and watershed material during infrequent but intense rainstorms and coastal storms. Therefore, the illustrations of future lagoon habitats and tidal prism are approximations of future conditions and not intended to be exact predictions."

Based on the above findings, the project's goal is now being reviewed to determine if any intervention is warranted. Therefore, the potential beneficial and adverse impacts of this project cannot be determined at this time.

Appendix G: Summary, Public Informational Workshop, Non-Native Deer Management Plan, March 3, 2005, 6:30 to 8:30 p.m.

Approximately 60 people attended an informational workshop on the Draft Non-Native Deer Management Plan/Environmental Impact Statement at the Seashore's Red Barn Classroom on Mar 3, 2005. The following agenda was adhered to:

6:30 Welcome/Opening Remarks: Don Neubacher, Steve Christiano

6:45 Overview/Background on Non-Native Deer: Natalie Gates, D.V.M., Wildlife Biologist, PRNS

7:15 Contraception Model in Fallow Deer: Dr. Tom Hobbs, Ecologist, Colorado State University

7:45 Reading of submitted questions: Steve Christiano

8:15 Close/Next steps: Steve Christiano

8:30 Breakout Informational/Comment Sessions: NPS staff and biologists

A contracted moderator, Steve Christiano, set guidelines for the discussion format, kept discussion moving and read questions, submitted in writing from the audience on notecards, to the assembled staff and biologists, who sat in the front of the meeting room. In the interest of time, audience members were urged to hold their questions until the 2 presentations were finished.

The first presentation was given by Natalie Gates, wildlife biologist for PORE. It covered the definition of non-native species, described the history and past management of non-native deer at PORE, and described the Draft EIS. In particular, the objectives, need for action, five alternatives and impact analyses were described. Audience members were informed of a number of ways of submitting comments on the plan either that night at the meeting, or by mail/email before April 8, 2005.

The second presentation, by N. Thompson Hobbs, Professor of Wildlife Biology at Colorado State University, described a population model he completed for PORE in 2003. The model describes and predicts the effects of culling and fertility control on the abundance of fallow deer in the Seashore. In the presentation, he used the mathematical model to answer the following questions:

- How many animals must be culled or treated with contraceptives to eradicate or control the population?
- Does fertility control, alone, offer a feasible alternative to culling as a way to eliminate or control fallow deer?

After the presentations, Superintendent Neubacher, Dr. Hobbs and Dr. Gates, and the following biologists were available to answer audience questions:

- Reginald Barrett, Professor of Wildlife Biology, University of California, Berkeley
- Gary Fellers, Research Wildlife Biologist, U.S. Geological Survey

The following questions were asked and answered:

1. The plan mentions using the best, proven long-lasting technology available, which is Spayvac®. What happens if a better proven technology becomes available? How will it be considered?
2. How does the Organic Act and NPS regulations figure in the Seashore's preferred option?
3. Isn't it possible to use castration to permanently control the population?
4. Why did NPS include contraception in the preferred alternative instead of just lethal removal since contraception is very traumatic to the animals and only a few more would be shot in the lethal only alternative?
5. Why after 30 yrs of observing the fallow deer with no action being taken, is this species being removed? Which non profit charities can or have accepted to clean, prepare and serve these hundreds of dead deer?
6. Why are cows not being considered as part of the non-native ungulate issue? Was the disruption of contraceptives to other park animals addressed?
7. Is there any evidence that fallow and axis deer hybridize and if so how would it affect the contraception possibilities?
8. Is there any known research on sterilants for use in wildlife control by the Food and Drug Administration?
9. Don't the native deer eat the grasses also? Is this a good reason to kill the non native deer?
10. If many non-native deer take refuge in Vedanta, how will this be handled? Where is the money for proposed management coming from?
11. Which program ensures that some exotic deer will remain in the park?
12. What's the difference between the non native and native deer as to their effect on the park's ecology?
13. If goal is to eliminate them why not do it sooner (i.e., 5 vs. 15 years) and stop further destruction of resources?
14. Is there no drug for contraception of axis deer? Is this because none has ever been tried or has a drug been used and failed?
15. Has the blacktail population increased like the non natives?
16. Have you contacted animal organizations who can and are willing to contribute financially to the contraception?
17. How will you execute the shooting of the deer (helicopters or ground, night, season)? What becomes of the fawns of culled females?
18. How is it determined that the deer are impacting red legged frogs? Are agrochemical impacts also being considered as a cause of decline?
19. Do you think it is prudent to eradicate the deer when clearly a large majority of the general public and the local public would prefer to see them living here?
20. Is there any hard evidence that the fallow deer are having a negative impact in the park today?
21. If the axis deer were controlled to 350 until 1994, how have numbers fallen to 250 today?

Eight questions were submitted but not asked, either because they duplicated asked questions, were not pertinent to the draft non-native deer management plan, were turned in too late, or were not actually questions.

After the questions were asked, the audience was encouraged to break up into discussion groups with park staff and biologists, stationed in different areas of the meeting room. The audience was informed that all comments would be recorded on large paper "flip" charts and would be entered into the administrative record. In addition, one person provided comments on a comment form. See below the captured comments. All audience members had left by 9:30 p.m.

Questions/comments captured on flip charts:

1. "John Dell'Osso/Neubacher" station:

Why doesn't park spay instead of using contraceptives?

Control non-natives to protect natives.

Our country should conserve money (prefers lethal removal)

Ensure contractors hired are credible and use public process

Belief that killing deer is not necessary and fallow and axis deer should remain

Can the deer be relocated outside the park?

Humane Society is willing to provide potential funding.

2. "Natalie Gates" station:

Non-native deer appear to be more visible (i.e., in higher numbers) in recent years.

Is there currently any impact from existing population levels of non-native deer?

What about sterilizing males to allow the alpha males to continue to dominate the breeding but still remain sterile (i.e., vasectomies)?

What's the current fallow population outside the park? Would implementation push them outside the park during treatment only to return later?

What's the difference between native and non-native deer regarding impacts to park resources?

Are there "hard" studies on fallow deer behavior?

What is the population of black-tailed deer?

The numbers of axis deer in 1994 vs. current numbers needs further explanation (150 vs. 250).

Why isn't it higher than 250?

Let's get rid of the cattle.

It's hard to believe that the details regarding the culling and shooting are not yet known. Would you be corralling the deer and then shooting them? Use helicopters? Shoot at night? What season? Breeding season? What would happen to the fawns? How many of them could be affected? Why not time it to non-breeding season? Everyone in this group would agree that some management is needed. Prefers more research on long term contraception.

Can the deer be relocated outside park?

What's Spayvac® (chemical composition and action)? Is anyone researching an anti-sperm vaccine for females?

I see fallow bucks attacking a blacktail doe in Olema Valley (A. Stewart). Will get a photograph.

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(a) PRNS field monitoring data, non-native deer, 2001-2006
(b) PRNS tule elk contraception data, 1999-2001
(c) PRNS non-native deer necropsy records, 2000-2006
(d) PRNS tule elk necropsy records, 1978-2006
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Acronyms and Glossary

CDFG	California Department of Fish and Game
CFR	Code of Federal Regulations
DEIS	Draft Environmental Impact Statement
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
FEIS	Final Environmental Impact Statement
GGNRA	Golden Gate National Recreation Area
GIS	Geographic Information System
GMP	General Management Plan
NEPA	.National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
PL	Public Law
PRNS	Point Reyes National Seashore
sq. km.	square kilometers
U.S.C.	United Stated Code
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USDA	United Stated Department of Agriculture

Abiotic: characterized by the absence of life or living organisms.

Biodiversity: the diversity of plant and animal species in an environment.

Biotic: pertaining to life or living organisms.

Browsing: when used in reference to deer, describes the eating of shoots or twigs of shrubs and trees.

Carrying Capacity (K): sometimes called "biological carrying capacity," this is the maximum number of animals of a species that can live in a given environment. Carrying capacity is not a static number but an ever-changing target that will vary, short-term, with weather and range conditions, and long-term with gradual alterations in habitat and vegetation communities.

Cervid: a member of the deer family Cervidae, comprising deer, caribou, elk, and moose.

Compaction: the compression of soil layers reducing the ability of plants to survive, reducing water infiltration capacity, and increasing water runoff.

Critical habitat: as defined in the Endangered Species Act (1973), pertains to: "(i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of this Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of this Act, upon a determination by the Secretary (of the U.S. Department of the Interior) that such areas are essential for the conservation of the species."

Cumulative impacts: are actions that, when viewed with other actions in the past, the present, or the reasonably foreseeable future, regardless of who has undertaken or will undertake them, have an additive impact on the resource this project would affect.

Depredation: a term used by state wildlife agencies to describe animals that cause economic damage to private landowners by destroying structures, consuming feed or preying on domestic animals.

Direct impacts: occur as a result of the alternative in the same place and at the same time as the action.

Ecosystem: a system formed by the interaction of a community of organisms with their environment.

Endangered: defined by U.S. Fish and Wildlife Service and listed in the Federal Register as being in danger of extinction.

Estuarine: found in that part of the mouth or lower course of a river in which the river's current meets the sea's tide.

Erosion: the processes by which the surface of the earth is constantly being worn away.

Exclosure: a fenced area designed to exclude one or more species.

Exotic: see "non-native."

Extinction: disappearance from the earth.

Extirpation: disappearance from a specified geographic area.

Fecundity: the birth rate or number of live births per female, usually over one year.

Forbs: non-woody, broad-leaf, flowering plants that are neither grasses nor grasslike.

Genetic variability: the range of variation within the gene pool of a population, thought to reflect the possible range of genetic adaptations to changes in the environment.

Genotype: the genetic makeup of an organism or group of organisms with reference to a single trait, set of traits, or an entire complex of traits.

Geographic Information System (GIS): a specialized form of database that allows collection and manipulation of spatial information.

Guild: a classification of organisms based on common resource utilization, not taxonomy.

Home range: the area that an animal uses for obtaining food, mates and caring for its young.

Hydrologic: pertaining to the occurrence, circulation, distribution, and properties of the water.

Impairment: the NPS Organic Act of 1916 and the NPS General Authorities Act 1970, as amended, require park managers to ensure that park resources and park values remain unimpaired. Section 1.4.5 of the NPS Management Policies 2001 states: "The impairment that is prohibited by the Organic Act and the General Authorities Act is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values." See Section 4.4 (Definition of Terms).

Indirect impacts: are reasonably foreseeable impacts that occur removed in time or space from the proposed actions. These are "downstream" impacts, future impacts, or the impacts of reasonably expected connected actions.

Intradermal: going between the layers of the skin.

Intraspecific: between members of the same species.

Irruptive: pertaining to a relatively sudden and marked population fluctuation that occurs at irregular intervals and can have serious long-term ecological and /or economic consequences.

Keystone species: a species that enriches ecosystem function in a unique and significant manner through their activities, with an effect disproportionate to its numerical abundance. Its removal initiates changes in ecosystem structure and often a loss of diversity.

Mast: the fruit, including berries and acorns, of oak, beech or other forest trees.

Maximum Sustained Yield: the population level of a given species at which the output of young is highest. In deer, this population usually equals 50% - 65% of the carrying capacity.

Microclimate: the climate of a small area, such as a plant community or wooded area, which may be different from that in the general region.

Mitigation: defined in environmental regulations (NEPA) as a measure that will result in reduction of environmental impacts by altering the proposed action in some way. An EIS must include a discussion, but not adoption, of the "means to mitigate adverse environmental impacts" (40 CFR 1502.16(h)).

Native: as described by NPS *Management Policies* 2001, pertains to a species that has occurred or now occurs as a result of natural processes on lands designated as units of the national park system.

Natural Resources: as described by NPS *Management Policies* 2001, these include: physical resources (such as water air soils etc.), physical processes (such a weather, wildland fire etc.), biological resources (such as native plants, animals and communities), ecosystems, and highly valued associated characteristics such as scenic views.

Necropsy: a post-mortem examination performed on an animal, or the equivalent of an "autopsy" on a human.

Niche: the role a species plays in its natural habitat or ecosystem.

Non-native: as described by NPS *Management Policies* 2001, describes a species that did not evolve in concert with the species native to an ecosystem, and occupies or could occupy park lands directly or indirectly as the result of deliberate or accidental human activities. Sometimes called "exotic," "alien," or "invasive."

Recruitment: birth and survival of young to the age at which their survival rates approximate those of adults in the population.

Range: the geographical extent of a species or subspecies.

Riparian: pertaining to, situated or dwelling on the bank of a river or other body of water.

Rut: the mating season for certain species, usually wild ungulates.

Scoping: the early stage of the NEPA process is called the "scoping" period. During scoping input is gathered on issues the public feels should be addressed in the upcoming EIS. This input is important to help park managers determine what types of alternative should be considered.

Scrub: a large area covered with low trees and shrubs.

Sedimentation: the deposition or accumulation of mineral or organic matter by water, air, or ice.

Species richness: the sum total of species in an area.

Steroid: any of a large group of fat-soluble compounds, such as bile acids and sex hormones, most of which have specific physiological actions.

Subspecies: sometimes called a "race", a genetically distinct geographical subunit of a species.

Threatened: defined by U.S. Fish and Wildlife Service and listed in the Federal Register as likely to become endangered within the foreseeable future (see "endangered").

Understory: the plants growing beneath the main canopy of a forest.

Ungulate: belonging to the group of hoofed animals (the former order Ungulata), including the odd-toed perissodactyls (including horses and rhinoceros) and even-toed artiodactyls (including cows, deer, and pigs).

Watershed: the region or area drained by a river, stream, etc.

Zona Pellucida: the proteinaceous layer surrounding the ovum of mammals.

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