Story 6

Conserving Our Natural Resources: A Balancing Act

Dr. Satie Airame
Scientific Advisor, Channel Islands National Marine Sanctuary

Research Focus
What are the species of concern in the Channel Islands National Marine Sanctuary? How can marine reserves conserve biodiversity and sustain local fisheries?

Tim Coonan
Biologist, National Park Service, Channel Islands National Park

Research Focus
How healthy are the ecological communities and key species on the Channel Islands? How can we monitor and manage island fox populations to bring them back to viable levels?

Team JASON Online	Video	Live Broadcast
• **Digital Lab:** Marine Reserves: Where Do You Fit In? • Conservation Story Page • Chat Sessions • Message Boards	• Alien Invasion: Island Foxes	Use JASON XIV components to prepare for the live broadcast. Visit Team JASON Online for the latest details.

Story 6 takes look at **land and marine conservation** efforts underway in the Channel Islands. Host researchers Tim Coonan and Satie Airame will be our guides to two programs that are working to protect the Channel Islands. The first program is trying to save the rare Channel Island fox from extinction. The second program involves helping Channel Island communities work together and develop areas called marine reserves (where marine life may not be harvested).

Conserving Our Natural Resources: A Balancing Act

Research Article

Channeling Our Efforts: A Balancing Act . . . . . .page 149

Exercise 6.1 — **Ecology, Math**
1½ to 2¼ hours (two or three 45-minute periods) — ***Model Building, Drawing Conclusions***

The Rise or Fall of the Island Fox . . . . . .page 153

Students will model the effects of different factors on the island fox population, using data based on Tim Coonan's research. Starting with a small population on each island, students will see if captive breeding can offset environmental factors to restore fox populations to viable levels.

Exercise 6.2 (Digital Lab/Classroom Collaboration) — **Technology, Economics, History/Culture**
2¼ to 3 hours (three or four 45-minute periods) — ***negotiating, communicating***

Marine Reserves—Where Do You Fit In? . . . . . .page 157

In this role-playing simulation, students will participate in a process similar to that of an actual working group to establish marine reserves in the Channel Islands. Each student or student group will take the part of one of the stakeholders of the region, collect customized data from the Digital Lab to inform their plan, and then submit the plan to the class for consensus.

Exercise 6.3 — **Ecology**
1½ to 2¼ hours — ***Applying Knowledge, Communicating***
(two or three 45-minute periods, plus time for research and execution)

Design Your Own Sanctuary . . . . . .page 162

In this activity, students apply the concepts of management and reserves to their local area. Using what they have learned, students will identify stakeholders and uses for a particular area, then develop a land use plan that takes into account their local resource, biodiversity, cultural, and educational goals.

Student Self-Assessment
45 minutes — ***Drawing Conclusions, Applying Knowledge***

Channel Islands National Park—A Model for Park Management . . . . . .page 163

Students will be presented with a scenario involving development on Anacapa Island. They must determine a proper course for development, taking into account differing perspectives, and justify their decision.

> *"Although the ocean is enormous relative to a single human being, as a collective group humans have fished many species to the point of population collapse."*
>
> **—Dr. Satie Airame, JASON host researcher**

> *"What we learn from studying the Channel Islands region is the interconnectedness of marine and terrestrial systems. One might think that separation of the Channel Islands from the mainland allows the islands to be protected from adverse environmental influences, but it does not."*
>
> **—Tim Coonan, JASON host researcher**

Teacher *preparation*

STANDARDS AND ASSESSMENT

Student Name: _____

National Education Standards	Exercise
Science Standard C: Life Science Students should develop an understanding of structure and function in living systems, reproduction and heredity, regulation and behavior, populations and ecosystems, and diversity and adaptations of organisms.	The Rise or Fall of the Island Fox Marine Reserves—Where Do You Fit In?
Science Standard F: Science in Personal and Social Perspectives Students should develop an understanding of populations, resources, and environments, natural hazards, risks and benefits, and science and technology in society.	The Rise or Fall of the Island Fox Marine Reserves—Where Do You Fit In? Design Your Own Sanctuary
Math Standard: Data Analysis and Probability Students should develop an understanding about how to collect, organize, display, and interpret data. Students should also be able to apply the basic concepts of probability.	The Rise or Fall of the Island Fox Marine Reserves—Where Do You Fit In?
Math Standard: Problem Solving Students should develop an understanding of mathematical concepts by working through problems that allow applications of mathematics to other concepts.	The Rise or Fall of the Island Fox
Geography Standard 1: The World in Spatial Terms Students should understand how to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective.	Marine Reserves—Where Do You Fit In?
Geography Standard 6: Places and Regions Students should understand how culture and experience influence people's perceptions of places and regions.	Marine Reserves—Where Do You Fit In? Design Your Own Sanctuary
Geography Standard 14: Environment and Society Students should understand how human actions modify the physical environment.	The Rise or Fall of the Island Fox Marine Reserves—Where Do You Fit In? Design Your Own Sanctuary
Geography Standards 17 and 18: The Uses of Geography Students should understand how to apply geography to interpret the past and present and to plan for the future.	The Rise or Fall of the Island Fox Marine Reserves—Where Do You Fit In? Design Your Own Sanctuary

Performance Indicators: The Rise or Fall of the Island Fox	Novice	Apprentice	Researcher
Models population dynamics over time in response to key factors.			
Graphs changes in population.			

Performance Indicators: Marine Reserves—Where Do You Fit In?	Novice	Apprentice	Researcher
Collects and analyzes geographic, ecological, and socioeconomic data.			
Achieves consensus among diverse perspectives.			

Performance Indicators: Design Your Own Sanctuary	Novice	Apprentice	Researcher
Assesses and attributes values and goals for a particular land area.			
Designs a management plan.			

Student Self-Assessment: Channel Islands National Park—Model for Park Management
Skills: Drawing Conclusions, Applying Knowledge

	Score
Multiple Choice Test—Team JASON Online at www.jasonproject.org	

Channeling Our Efforts: A Balancing Act

Focus *questions*

Why is conservation and management of the Channel Islands region necessary?

How is the value of an ecosystem or species measured? Does it depend on who is being asked?

What management strategies are being used to protect native plants and animals on the land and in the sea?

Look out at the Channel Islands region today, and its beauty will take your breath away. These unique islands and coastal habitats host seals, sea lions, seabirds, tiny foxes, and plants with colorful names like paintbrush, shooting star, lemonade berry, and live-forever. In the sparkling waters, kelp forests shelter neon-orange garibaldis and boldly striped sheephead, as well as teeming communities of shrimp, brittle stars, and spiny lobster. We would like to believe that these treasures are forever safe. But are they?

Channel Islands National Park, established in 1980, covers five of the eight Channel Islands: Anacapa, Santa Cruz, Santa Rosa, San Miguel, and Santa Barbara. The park protects a total of 49,646 hectares (124,115 acres) of land. It also protects 49,760 hectares (124,400 acres) of sea that extend 1 nautical mile (almost 2 kilometers) from the coastlines of the five islands. (See Map 5 in the JASON XIV Atlas.) The Channel Islands National Marine Sanctuary, also established in 1980, extends 6 nautical miles (11 kilometers) from the high tide line of each of the five islands, covering a total of 1,252 square nautical miles (4,294 square kilometers). With the protection of both a national park and a **marine sanctuary,** shouldn't the wildlife and habitats of the Channel Islands be secure?

The answer to this question is complex. Although hunting is not allowed in national parks, **terrestrial** wildlife is still threatened by pollution, pesticide residues, destructive non-native animals and plants (known as **alien invasive species**), and the results of careless past land use. For example, cattle and sheep ranching on several islands destroyed native plants and caused erosion. Alien invasive plants, such as European grasses and fennel, have crowded out native grasses and shrubs that wildlife depend on for food and shelter. And alien invasive animal species, such as **feral** pigs, still uproot island vegetation and compete with native animals for food.

A sharp fence line shows the boundary between undegraded (left) and degraded (right) habitat.

Marine areas face their own problems. The National Marine Sanctuary is protected from some of these, but others may threaten it. Though hunting of marine mammals or birds is forbidden, people are allowed to fish and to harvest shellfish, lobster, and kelp. Overfishing, together with offshore pollution and natural events such as El Niño, could be a serious problem for some species. Recently, scientists and fishermen have noticed fewer cowcod, lingcod, and other fish. White abalone, once a staple of the Chumash diet, are now practically extinct.

Serial Depletion

In the past, a species might be fished in one area until it was almost gone. Then the fishermen would find a new area or target a new species. This process—fishing out areas or species one at a time—is known as serial depletion. It has caused serious problems. For example, on the southwest side of Anacapa Island (in an area called the "Footprint"), rockfish have been totally fished out.

Research article

History of Federal Protection for the Channel Islands

1938 President Franklin D. Roosevelt proclaims Santa Barbara and Anacapa a national monument to preserve mammoth fossils.

1949 President Harry Truman adds submerged lands within 1 nautical mile of Anacapa and Santa Barbara Islands to the monument.

1980 Five Channel Islands (Anacapa, Santa Cruz, Santa Rosa, San Miguel, Santa Barbara) become the 40th national park.

1980 Waters within 6 nautical miles of the islands designated as the Channel Islands National Marine Sanctuary.

Today, people at the Channel Islands National Park and National Marine Sanctuary are working hard to preserve the **biodiversity** of this unique area. Park projects, such as an island fox recovery effort led by JASON host researcher Tim Coonan, are part of this work. Mr. Coonan's goal is to bring back the population of this endemic fox to a **viable** level. His work to restore the island's ecological balance will benefit all native species.

Host researcher Satie Airame works with the Sanctuary on a project to establish **marine reserves.** Reserves are even more protected than marine sanctuaries: they are "no take" areas, places where marine resources may not be fished or harvested. Dr. Airame believes that marine reserves provide a safe haven in which threatened species can thrive. In the long run, marine reserves can help not only those who enjoy the sea's beauty and diversity, but also those who depend on it for their food and livelihood.

The terrestrial story: what happened to the island fox?

The Channel Islands have a unique ecology, including endemic species such as the island fox. In order to fill specific niches or adapt to an island environment, some large species gradually evolved into smaller ones (**dwarfism**), while small species evolved into larger ones (**gigantism**). The island fox is an example of dwarfism. Although it is the island's largest native mammal, the island fox is one of the smallest foxes in the world. Only 30 to 33 centimeters (12 to 13 inches) in height and weighing less than 2 kilograms (4 pounds), it is about the size of a small house cat—far smaller than its closest mainland relative, the gray fox.

This island fox looks tiny next to researcher Tim Coonan.

The story of the island fox shows how a single factor can start an ecological chain reaction with devastating results. Once abundant on six of the eight Channel Islands, the fox population fell in the mid-1990s on San Miguel, Santa Rosa, and Santa Cruz. Mr. Coonan and his team set out to track what was happening. On San Miguel, they captured and marked foxes with tiny, rice-sized electronic ID tags. When the foxes were recaptured, researchers read the tags with a device like a grocery store barcode reader. Then, using the ratio of marked to unmarked foxes, Tim Coonan was able to estimate the size of the current fox population. He determined that fox numbers had dropped from 436 in 1994 to 15 in 1999!

Fox Decline on San Miguel Island

Year	# of Foxes
1993	305
1994	436
1995	303
1996	101
1997	70
1998	47
1999	15

Tim Coonan's team had to find out what was killing the foxes. In 1998, they fitted eight foxes with radio collars and tracked them. Over the next 4 months, four of the foxes were attacked and eaten. Scientists found a golden eagle feather at one of the scenes. But this was only a piece of the puzzle. Why were golden eagles suddenly threatening the foxes?

Golden eagles are not native to the Channel Islands. Until recently, bald eagles were the top predators. But bald eagles do not harm foxes, because they eat mostly fish and carrion (dead animals). Bald eagles have disappeared from the Channel Islands because of DDT in the environment. (DDT is a pesticide, now

An island fox in the captive breeding program.

banned in the United States, that causes eggshell thinning.) Eagles that ate fish in which DDT was concentrated laid eggs that were more fragile and likely to break before the eaglets hatched. As a result, fewer and fewer bald eagles lived in the Channel Islands.

Gradually, golden eagles moved into the niche vacated by bald eagles. Unlike bald eagles, golden eagles catch live birds and mammals. Because island foxes are **diurnal,** they were easy prey. The foxes also had little plant cover in which to hide, because alien invasive plant species, such as fennel and alien annual grasses, had largely replaced the more protective native chapparal and woody plants. Feral pigs provided another food source for the golden eagles, attracting even more of them. Because they don't eat fish, golden eagles were also less affected by DDT. The golden eagles settled in to stay.

DDT was the factor that began the chain of events that almost brought the island fox to extinction! But today there is hope for the foxes' return, thanks to a two-pronged program directed by Mr. Coonan. First, golden eagles are trapped on the islands and released in remote areas of northeastern California. Second, foxes are being bred in captivity on the Channel Islands to be released back into the wild. Park managers also plan to remove feral pigs, thus making the area less attractive to golden eagles. Finally, they plan to bring back bald eagles, remove alien invasive plants, and replant native species. If these management techniques succeed, the Channel Islands' ecosystems may again function smoothly without further human intervention.

Marine Reserve Success Stories

Scientific studies show that marine reserves are good for biodiversity. Throughout the world, reserves have larger, more abundant sea life, and a far greater variety of species than their neighboring waters. In a tiny reserve off Anacapa Island (the only marine reserve currently in the Channel Islands), the density of red sea urchins is nine times greater than in nearby fished areas. Off the northeast Atlantic coast, closing fishing in certain areas of Georges Bank has resulted in a 14-fold increase in scallops. Near Florida's Kennedy Space Center, fish in a marine reserve are larger and more than twice as abundant as in unprotected nearby areas.

Research article

A kelp harvesting boat in the Channel Islands.

The marine reserves story: can everyone benefit?

Once scientists zeroed in on the mystery of the island fox, they solved it fairly easily. The solution to the marine reserves mystery is a little harder to see. One problem is that many of its players live underwater. Also, the marine mystery involves thousands of species of sea life, as well as thousands of people with different points of view. While the island fox story deals mainly with the effects of a pesticide and relationships among endemic and alien plant and animal species, the marine reserves story involves a large group of people called **stakeholders,** each of whom has a vital interest in the ocean's resources.

In 1999, the Sanctuary and the California Department of Fish and Game began the process of establishing marine reserves. A large part of this process involved weighing the needs of all the different stakeholders.

To that end, the Marine Reserves Working Group was formed. This 17-member group included federal and state resource managers, commercial and sport fishermen and divers, kelp harvesters, conservationists, and other people from the community: in short, representatives of everyone who had an interest in the Sanctuary's waters. The group's task was to decide what percentage of the Sanctuary should be made into marine reserves and where reserve areas should be located. Dr. Airame served as a scientific advisor for the working group.

The members of the working group discovered that although they all supported the idea of marine reserves, they couldn't agree on where to put the reserves or how big the reserves should be. Some groups felt they would lose too much income if reserves were established in prime fishing and recreation areas. Other members felt that certain areas must be protected no matter what.

Still others felt their industry didn't have a negative effect on fisheries and, therefore, shouldn't be restricted at all. (In Exercise 6.2, you'll learn more about stakeholder differences.) The 22-month effort ended without a final recommendation; the decision on where to put the reserves was passed to the California Department of Fish and Game. The input from this process, however, will help assure that the marine reserves, wherever they end up, will have long-term benefits for everyone.

Journal Question

Why is conservation and management of the Channel Islands necessary? What are the potential benefits and drawbacks of marine reserves?

Fact or *Fallacy?*

The bald eagle can definitely be reintroduced successfully to the Channel Islands, because the threat of DDT is over.

Fallacy: *Efforts to reintroduce bald eagles to Catalina Island have shown that DDT in the environment is still affecting eggshell thickness, even though this chemical has been banned in the United States since 1972.*

Vocabulary

Alien (Invasive) species *n.* A species that enters an area and occupies an ecological niche, succeeding within it so well that it replaces other species in the niche.

Biodiversity *n.* The variety of plant and animal species in a given area.

Captive breeding *n.* Capturing and mating animals to produce offspring that can eventually be released to the wild. Captive breeding's goal is to restore a depleted population.

Diurnal *adj.* Active during the day rather than the night.

Dwarfism *n.* An evolutionary adaptation in which a species develops a smaller-than-usual size in order to fill a niche or adapt to a specific, isolated environment.

Feral *adj.* Having returned to the wild after being domesticated.

Gigantism *n.* An evolutionary adaptation in which a species develops a larger-than-usual size in order to fill a niche or adapt to a specific, isolated environment.

Marine reserve *n.* A "no take" zone in which fishing or harvesting of any marine resources is prohibited.

Marine sanctuary *n.* An area in which fishing and harvesting of resources are regulated but not prohibited, and certain activities are restricted.

Stakeholders *n.* People, or groups, who have a particular interest, or "stake," in a process or outcome.

Sustainable *adj.* Able to be maintained over a long period of time.

Terrestrial *adj.* Living or growing on land.

Viable population *n.* A number of individuals that allows for successful mating and reproduction, so that a particular plant or animal species can continue to survive.

The Rise or Fall of the Island Fox

In the delicate terrestrial ecology of the Channel Islands, a series of small changes can have devastating results. In this simulation, you will model the effects of different factors on a population of island foxes. Using probability data based on Tim Coonan's research in the captive breeding program, see if you can bring your fox population to a viable level over a 10-year period.

Focus *questions*

Why are endemic species, such as the island fox, vulnerable? What is being done to protect them?

Why are population models useful to resource managers? When are they not useful?

Materials

For each player

Copy of Master A (fox population spreadsheet)

One set per group

Copy of Master B (wild/captive factors)

Graph paper

Calculators

Copy of JASON XIV Atlas Map 5 (land and marine management)

Procedure

1. Review the information on island foxes in the research story, then break up into four groups to play the simulation. Each group represents a different island where fox populations have declined: San Miguel, Santa Rosa, Santa Cruz, and Santa Catalina. Locate your island on Map 5 in the Atlas.
2. Take a copy of **Master A** and write your island in the blank. Then write your initial fox population in the square for Year 1:

   For San Miguel: 15 For Santa Cruz: 75
   For Santa Rosa: 25 For Santa Catalina: 150

   Your goal is to bring your island's population up to a viable level of 200 foxes.
3. Divide the cards into two piles: one for factors in the wild population (Wild Factors) and one for management factors in your captive breeding program (Captive Factors). Shuffle each pile and place the cards face down. These cards will tell you how much your fox population will increase or decrease each year and why.
4. Each student will run a separate simulation: a different model of what might happen on your group's island. Choose one person in your group to run a "control" simulation—that is, to simulate what might happen to your island's fox population without a captive breeding program. That student's population will be affected only by Wild Factors. The other students' simulations will include a captive breeding program: their populations will be affected by Captive Factors as well as Wild Factors. Circle "With Captive Breeding" or "Without Captive Breeding" at the top of **Master A.**
5. *Each player* in the group draws a card from the Wild Factors pile, performs the calculation, and writes the new number in the appropriate column on his or her spreadsheet. Then each player *except the control* draws a card from the Captive Factors pile, performs that calculation, and writes the total at the end of the row.
6. Repeat the procedure for each of the 10 years. Graph your results over the 10-year period using a line or bar graph. Then compare within your group.
   - How many people achieved a viable population of 200 foxes?
   - Did everybody end up with about the same number? If not, why not?
   - How did the control simulation's population compare with populations for the rest of the group?
   - Did the order in which you drew certain cards matter? (For example, drawing the canine distemper card early or later in the simulation.) Explain.

7. The cards were designed to mirror what actually happens in the fox populations Tim Coonan has studied. By looking at the cards, can you determine the probability that the following will happen in a given year (in a non-control simulation):
   - That the wild population (that is, the population as it stands before that year's captive fox release) will increase 7 percent from normal reproduction?
   - That the wild population will decrease due to Wild Factors?
   - That captive breeding will increase the population by 15 each year?
   - That disease will kill half the newly born foxes in your captive breeding program?

   Hint: "Probability" is the chance of any one outcome occurring. It can be expressed as a fraction, decimal, or percentage.

   Probability of a particular outcome =

   $$\frac{\text{Number of ways of that outcome ocurring}}{\text{Total number of possible outcomes}}$$

8. Now compare your population numbers and graphs with those of other groups. Were some islands more successful on average than others in reaching their goal? Did it always take the islands with smaller fox populations a longer time to reach viable levels? Why or why not?

Conclusion

1. How does the simulation predict what actually happens in fox populations on the Channel Islands? Does it have any limitations or drawbacks? Explain.
2. Do you think captive breeding is a valuable management technique? Why or why not?
3. What other outside factors or management techniques might affect the long-term recovery of the island fox?

For Further Exploration

Further explore population models by finding out how scientists agree upon a species' least viable population (LVP) size. What factors do they take into account and why do different species have different LVPs?

The U.S. Fish and Wildlife Service lists approximately 370 endangered and 130 threatened species of animals and 590 endangered and 140 threatened species of plants. Research the endangered and threatened species in your own area and find out what, if anything, is being done to protect them. Are there ways you or your classroom can help?

Using Population Models

The Wild and Captive Factor cards you draw are based on the island fox population model developed by Tim Coonan and his team. A population model is a mathematical formula based on past population size and factors that increase or decrease the population. Scientists use population models to predict the size of a population in the future. This may seem like magic, but it's really just good science and lots of hard work. First, Mr. Coonan and his team collected as much data as they could on island foxes. With the help of other population model experts, they used their data and observations on island foxes to develop a formula they could use to predict the effects of their management. This model assumes that all successfully raised captive foxes are released to the wild.

Fox Population Spreadsheet

Name of Island _____ **Circle One: With Captive Breeding**

Without Captive Breeding (Control)

Example

In Year 1, You draw a 7% increase Wild Factor card and a +15 Captive Factor card. The following calculation demonstrates how you would calculate the end of year total after year 1.

(initial population × Wild Factor) + Captive Factor = end of year total

(20 foxes × 1.07) + 15 foxes
(1.07 *is the decimal equivalent of 100 percent of the original foxes plus a 7 percent increase in population.)*

(21.4 foxes) + 15 foxes = 36.4 foxes

36.4 foxes? No, 36 foxes.
(Remember, a population model is just a prediction. There can't be 0.4 foxes, so round to the nearest whole number.)

Hint

For a 7 percent increase: initial population × 1.07
For a 50 percent decrease: initial population × 0.5
For a 90 percent decrease: initial population × 0.1
For a 30 percent decrease: initial population × 0.7

Year	Initial Population	Wild Factor	Wild Factor Calculation	Captive Factor	End of Year Total
Sample Year 1	20	1.07	21.4	15	36.4, round to 36

Year	Initial Population	Wild Factor	Wild Factor Calculation	Captive Factor	End of Year Total
Year 1					
Year 2					
Year 3					
Year 4					
Year 5					
Year 6					
Year 7					
Year 8					
Year 9					
Year 10					

Master A

Wild/Captive Factors

Wild Factor Your fox population increases by 7% due to normal reproduction.	**Wild Factor** Your fox population increases by 7% due to normal reproduction.	**Wild Factor** Your fox population increases by 7% due to normal reproduction.	**Wild Factor** Your fox population increases by 7% due to normal reproduction.
Wild Factor Your fox population increases by 7% due to normal reproduction.	**Wild Factor** Your fox population increases by 7% due to normal reproduction.	**Wild Factor** Your fox population increases by 7% due to normal reproduction.	**Wild Factor** Your fox population increases by 7% due to normal reproduction.
Wild Factor Your fox population increases by 7% due to normal reproduction.	**Wild Factor** Your fox population increases by 7% due to normal reproduction.	**Wild Factor** Your fox population decreases by 50% due to an epidemic of canine distemper.	**Wild Factor** Your fox population decreases by 90% due to a catastrophic disease event.
Wild Factor Your fox population decreases by 30% because golden eagles are killing them.	**Captive Factor** Add 15 foxes to your fox population from normal breeding.	**Captive Factor** Add 15 foxes to your fox population from normal breeding.	**Captive Factor** Add 15 foxes to your fox population from normal breeding.
Captive Factor Add 15 foxes to your fox population from normal breeding.	**Captive Factor** Add 15 foxes to your fox population from normal breeding.	**Captive Factor** Add 15 foxes to your fox population from normal breeding.	**Captive Factor** Add 15 foxes to your fox population from normal breeding.
Captive Factor Add 15 foxes to your fox population from normal breeding.	**Captive Factor** Add 15 foxes to your fox population from normal breeding.	**Captive Factor** Add 15 foxes to your fox population from normal breeding.	**Captive Factor** Add 7 foxes because disease killed half of them.

Master B

Marine Reserves—Where Do You Fit In?

Focus *questions*

What is a marine reserve and how does it differ from a marine sanctuary?

How is the value of an ecosystem or species measured?

The sea around Anacapa Island is one of the most biologically rich and economically important areas of the Channel Islands. Because Anacapa Island is close to mainland harbors, it is a very popular place to fish and dive. You have been asked to represent one of the stakeholders in a working group to establish new marine reserve areas near Anacapa. You must develop a plan that will satisfy the group you are representing yet be acceptable to the other groups' representatives.

The mission of your working group is:

> *To protect, maintain, restore and enhance living marine resources…through new management strategies that encompass an ecosystem perspective and promote collaboration between competing interests.*

Choose well. The fate of the sea near Anacapa and the people who live off that sea is in your hands!

Materials

For each student

Copies of Masters C–F (map, stakeholder profiles)

Blank overhead transparency sheets

Overhead projector (or computer projector)

Copy of JASON XIV Atlas Map 5 (land and marine management)

Procedure

Part A: Familiarizing Yourself with Your Role

1. Review the Channel Islands' marine reserve process, as described in the research article. Then look at Map 5, which shows the boundaries of the Marine Sanctuary and the National Park. Estimate the area of the Sanctuary in square nautical miles. Now look at the inset map on **Master C.** Estimate the total area being considered for marine reserves in this activity. What portion of the whole Channel Islands National Marine Sanctuary does this region around Anacapa Island represent?
2. In a group or as an individual, choose a stakeholder profile and read the background information provided on **Masters D–F.** This will remain your role throughout the activity. Prepare a 2- to 3-minute statement about who you are and what you think your greatest concern will be in siting marine reserves. Present this statement to the class.
3. Write a list of things you would like to find out before you make your decision about where to locate the marine reserves.

Part B: Formulating a Plan in the Digital Lab

4. Now that you understand your role and priorities, use the TJO Digital Lab "Marine Reserves: Where Do You Fit In?" to collect more data.
5. With your teacher, make transparencies of your data and proposed marine reserves.

Part C: Coming to a Solution

6. Present your plan to a meeting of the entire working group. Explain why you think your plan meets everyone's needs.
7. After considering the arguments, decide as a class the percentage of the Sanctuary to set aside for marine reserves. Then, comparing the plans of different groups by overlaying the transparencies, debate and come to consensus on a final proposal for protected areas.

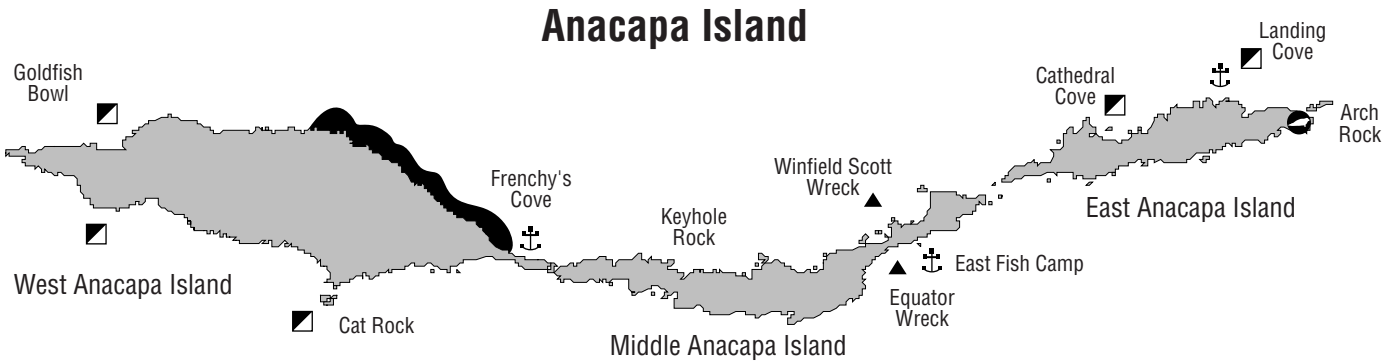
Conclusion

1. Who are the major stakeholders in the Channel Islands process and what are their concerns?
2. Why are marine reserves important? Do you think marine reserves benefit everyone? Explain.

For Further Exploration

Go online to TJO for more links to information on marine reserves from the Channel Islands National Marine Sanctuary. How did the process used there differ from your simulation? Are there other marine reserves being established around the world? Find out!

Anacapa Island and Surrounding Waters



LEGEND

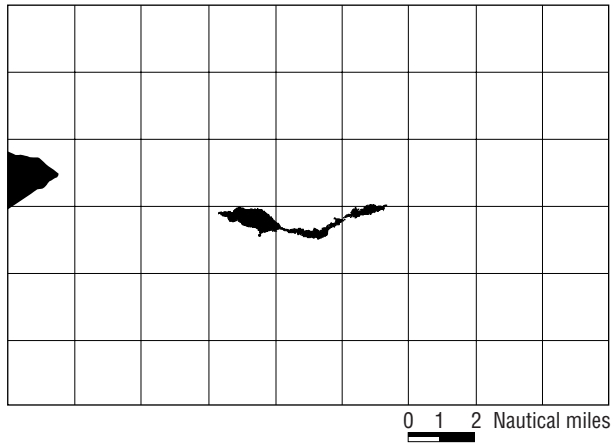
- Anchorage
- Shipwreck
- SCUBA diving spot
- Brown pelican fledgling area
- Sea lion colony

N

0 1 2 Kilometers

0 1 Nautical mile

Anacapa Island with Surrounding Sanctuary Waters



Stakeholder Profiles

Recreational Fishing Boat Captain

Who am I? I started working in the Channel Islands 27 years ago as a deckhand on a recreational fishing boat out of Santa Barbara. After a few years, I became the captain of my own boat. I fish all the Channel Islands, in depths to 150 meters (500 feet), and spend some time along the coast, near the city of Santa Barbara.

What have I observed? White sea bass populations vary seasonally, and from year to year. I have seen large numbers in spring and early summer. Halibut seem to be increasing in the Channel Islands. Rockfish, however, have been declining. Overfishing seems to be the major cause of the rockfish decline, but El Niño, swells, currents, and seismic blasting have also had an effect. The greatest effects from overfishing have been near Anacapa and the south side of Santa Cruz. Five species (canary rockfish, Pacific Ocean perch, bocaccio, cowcod, and lingcod) are considered overfished by the Pacific Fisheries Management Council. In 2000, the Department of Fish and Game banned taking rockfish in January and February.

What do I support? Marine reserves could be devastating for charter fishing boat operators. I am worried that my clients will not be interested in fishing the Channel Islands if sport fishing is restricted. On the other hand, marine reserves may benefit the recreational fishery, particularly around Anacapa, where overfishing has depleted fish populations. I've heard that all the world records for three kinds of game fish are coming from areas next to a marine reserve in Cape Canaveral in Florida. I hope that a marine reserve would have the same effect on rockfish populations here, but I am skeptical. I strongly oppose marine reserves on the south side of Anacapa and Santa Cruz Islands, because these traditional fishing grounds provide shelter to boats fishing in prevailing winds.

Conservation Group Member

Who am I? I am a professional environmental advocate, working for a national nonprofit ocean conservation organization, The Ocean Conservancy. My job is to work with citizens, organizations, political leaders, and the news media to inform, inspire, and empower citizens to better protect the ocean and its wildlife. I try to improve programs, policies, and laws of local, state, and federal governments to reduce pollution and protect the habitat and living resources of the ocean. National marine sanctuaries, such as the one in the Channel Islands, are a high priority for The Ocean Conservancy.

What have I observed? Over the past 20 years, abalone have virtually disappeared in the Channel Islands region. Many other species, such as rockfish, have declined by 50 to 90 percent. Those that remain are much smaller than those that lived there before. Our deepest concern is the decline in the number and size of marine life in the Channel Islands region. Overfishing is believed to be a major reason for this decline in the diversity and abundance of sea life. Pollution, disease, and global climate change are other important factors. My data come from those who know the most about the ocean environment, including divers, fishermen, and scientists.

What do I support? The Ocean Conservancy supports establishing a network of "no take" marine reserves covering 30 to 50 percent of the waters within the boundaries of the Sanctuary. We would place the reserves in areas that represent many different types of ocean habitat, from shallow to deep water, including kelp forests, rocky reefs, and soft, sandy sea floor. We want these reserves to provide sufficient protection to fish and other wildlife so that they can grow in size and numbers. The reserves will provide a place to study what the ocean might look like without the impacts of fishing. Our hope is that the greater diversity of ocean life in the reserves will produce additional eggs and larvae to help repopulate areas next to the reserves.

Recreational Diver

Who am I? For more than 20 years, I have been diving near Anacapa Island and the eastern end of Santa Cruz Island. For my photography and research, I observe marine habitats and species.

What have I observed? My favorite habitat, the kelp forest, has been disappearing over the last 20 years. The only substantial kelp forest left is in the "no take" reserve at the northeastern end of Anacapa. Fish associated with kelp forests (rockfish, giant sea bass, and California sheephead) have also declined. Black and white abalone are down to record low numbers, and white abalone are now endangered.

What do I support? I believe that overfishing of sea urchin predators, such as lobster, has caused urchin populations to explode. Urchins have consumed the kelp forest, and so species that live in that habitat have declined. I would like to establish marine reserves in at least 50 percent of the area under consideration, to protect all represented habitats and species of concern.

Squid Fisherman

Who am I? I use purse seine nets to fish for squid throughout the Sanctuary, including near Anacapa.

What have I observed? Squid populations vary with environmental conditions. Currently, they are healthy, but El Niño can have a devastating effect. After the El Niño cycles in 1992–1993 and 1997–1998, squid declined dramatically. The Department of Fish and Game established weekend closures of squid fisheries to prevent overfishing. Weekend closures let squid spawn; they also increase the demand for squid, making the prices I get higher. The squid fleet gets bigger every year. More people are willing to fish for less money. I am also concerned that lights I use to attract squid to the surface at night may disturb seabirds. I hope that decreasing the wattage of light and using light shields will keep squid closer to the boat and reduce impacts on nesting seabirds.

What do I support? Marine reserves are not needed to sustain the squid fishery. I recommend a reserve in a place that is scientifically valuable but not economically disastrous to any group. Establishing marine reserves might concentrate fishing efforts in areas outside reserves. This could reduce the impact of squid boat lights on seabirds.

Resource Manager, California Department of Fish and Game

Who am I? I am the Department's coordinator for the Marine Life Protection Act. I work with the Sanctuary staff on marine protection area matters. During 4 years working in the Channel Islands, I have studied sharks, abalone, and sea urchins.

What have I observed? Some species (such as cowcod and abalone) have declined, but others (such as black sea bass and halibut) have increased. There has been a big increase in public awareness of marine issues and public involvement with policy-making. People are learning that the Channel Islands are a unique ecosystem where northern and southern species mix. I have seen northern species, such as lingcod and vermilion rockfish, swimming alongside southern species, such as treefish and kelp bass. In the small marine reserve area already set aside, I have glimpsed what populations of lobster, sea urchin, and other species looked like years ago.

What do I support? The Department supports a plan for marine reserves developed jointly with the Sanctuary. This proposal sets aside 25 percent of the Sanctuary as a "no take" reserve. Our department is responsible for regulating "take" within State waters, which would include areas 0 to 3 miles (about 5 kilometers) from shore. When a reserve plan is implemented, we will monitor reserve performance and enforce closed areas. We will also educate the public about "fishing the edge" and other benefits of marine reserves.

Kelp Processor

Who am I? I work for the largest kelp harvesting company in California. Our harvest accounts for 90 percent of the kelp gathered off the California coast. Between 25 and 50 percent of our annual harvest comes from within Sanctuary boundaries. We've been working in California for 70 years, and I've been in and around the Channel Islands thousands of times. Our company continually monitors the condition of kelp forests and has supported or taken part in kelp restoration since the 1950s.

What have I observed? While kelp distribution changes from year to year, we have not seen a decline in total kelp biomass while we have been harvesting around the Channel Islands. Kelp has declined in a few areas: closer to the coast, where the kelp grew mainly in sandy-bottomed areas. But the kelp that grows around the Channel Islands grows on rocky substrates and continues to thrive. Our vessels harvest only the kelp that reach close to the sea's surface, and the vessels can only harvest in areas that aren't too close to shore or to dangerous exposed rocks. I have seen some reductions in certain animal species, such as abalone, which were probably overfished. I've also observed fewer large lobsters and red sea urchins, although smaller individuals are still abundant.

What do I support? I understand the need to establish marine reserves to protect marine animal species and habitat, but am concerned about the effect on kelp harvesting companies and employees. Our harvesting methods are sustainable, our processing is environmentally friendly, and we actually save communities money and time by harvesting kelp that would otherwise have to be cleaned from beaches and burned or put in landfills. The species we harvest does not migrate as other species do, and though it is a plant, we are managed as a fishery. Since we harvest in a relatively small area of the Sanctuary, setting aside as little as 5 percent of the Sanctuary as a reserve could devastate our industry. We support the establishment of reasonable "no take" reserves that serve the purpose of protecting biodiversity while maintaining fisheries.

Sanctuary Manager

Who am I? I am a scuba diver, boat captain, and pilot. These skills help me to investigate the different habitats in the Sanctuary. I lead a team of experts that includes marine scientists and teachers, who help me to make decisions about management. I also talk with commercial and recreational fishermen and divers who use the Sanctuary's resources. I understand the importance of listening to different perspectives in order to enforce the Sanctuary's mission: to manage areas of special significance and to protect their ecology and culture for current and future generations.

What have I observed? Over the last 25 years, I have seen declines in marine resources. The causes include fishing, El Niño cycles, disease, and increased pollution. The populations of some species, such as squid and red sea urchin, vary from year to year. Other species, such as rockfish, sharks, abalone, California sheephead, black sea bass, and sea cucumber, have declined. Rockfish are particularly vulnerable to fishing because they grow slowly and have relatively few offspring. In addition, changes in the population of fished species affect other species that are their predators or prey. I have gathered data that show that, on average, the size and numbers of fish and other species in marine reserves are larger than in fished areas. In some places where marine reserves were established, fishing has gotten even better in surrounding waters.

What do I support? I am appointed by the U.S. government to enforce the National Marine Sanctuaries Act of 1972 at the Channel Islands National Marine Sanctuary. The Sanctuaries Act requires that we protect the natural environment while allowing people to use the islands for recreation and commercial activity. The Sanctuary supports designating between 30 and 50 percent of Sanctuary waters as marine reserves. This recommendation is based on information gathered during years of experience.

Design Your Own Sanctuary

In this activity, you will bring together all you have learned about management and reserves to focus on your local area. Identify stakeholders and uses for a location near you, then develop a plan that takes into account local resource, biodiversity, cultural, and educational goals.

Focus *questions*

What management strategies can be used to protect native plants and animals on land and in the sea?

Exercise 6.3

Materials

Local maps

Procedure

1. Select an area near your school or on your school grounds as the focus of a management plan. Visit the site and describe it:
   - Is it in a rural, urban, or suburban environment?
   - Is it mostly land or water?
   - What types of vegetation and wildlife do you observe? Are they native or alien? Are they endemic? Are there any alien invasive species?
   - What portion of the area is cultivated or set aside for recreation or other uses?

   Sketch or make notes on a map of the area, identifying all important features and characteristics.
2. Back in the classroom, discuss who uses the area currently. List stakeholders on the board. (You might want to look for parallels with Channel Islands National Marine Sanctuary stakeholders. For example, land developers, council members, or town managers.)
3. Consider the goals in the Channel Islands process (sustainable fisheries, socioeconomic issues, biodiversity, historical and cultural issues, and education). Use these five categories to outline present and potential uses for your area.
4. Divide into five groups—one for each category—to research your goals. Consider an additional field trip or trips to the land to explore. Or, interview local resource managers and historians. Each group should develop a presentation of their research. Your presentation might include a guest speaker and should definitely include which uses should be promoted, which limited, and which banned. (You may also wish to set aside subsets of the area for special protection or special development projects.) Present data to support each decision.
5. Give your presentations and observe other groups' presentations. Then work together as a class to prioritize goals and develop a management plan for the area.
6. If this is a school area, ask the administration for permission to begin implementation of your plan. If it is a public area that is currently under debate, consider choosing one aspect of the plan that you feel is the most important and submitting it to a city council or town meeting.

Conclusion

1. Which of your local management strategies are similar to those used in the Channel Islands? Which are different?
2. Why is it important to consider all stakeholders when making management decisions?

For Further Exploration

1. Is there a conservation commission in your own area, or any local conservation groups? What problems are they currently addressing? Attend a public meeting, or invite representative members into your classroom.
2. Prepare a detailed map and guide showing what your location will look like after implementation of the management plan. Show important features, along with the area's restrictions. Make a mission statement for the area and a list of rules.

SHOW WHAT YOU KNOW!

Channel Islands National Park—A Model for Park Management

Skills Drawing Conclusions, Applying Knowledge

Your Challenge

The park is just starting to revise its current general management plan, which was put into action in 1985. This new plan will guide the park's management policies and direction over the next 15 to 20 years. Your challenge is to help steer the direction of the new plan by sharing your thoughts based on what you have learned in Story 6.

Words, Words, Words

Think about these vocabulary words as you work: *management, stakeholders, conservation, reserves, native species, alien species, ecological restoration, tourism, sustainable development.*

Helpful Hints

1. Understand the park's mission: to protect and interpret the natural ecosystems and cultural value of the Channel Islands and adjacent marine waters and to give present and future generations appropriate opportunities to experience and understand park resources and values.
2. Here are a few things that the park is considering with regard to human use:
   - Building lodging for tourists such as small inns (right now there are only camping sites with pit toilets).
   - Improving existing campgrounds.
   - Building youth hostels.
   - Establishing interpretive (nature) centers.
   - Improving the park's system of roads and trails.
   - Renting mountain bikes or kayaks to visitors.
3. Record your point of view. What do you think about these proposed changes? Will they compromise the natural or cultural resources of the park?
4. For more information on the Channel Islands National Park general management plan, go to the park's Web site: **www.nps.gov/chis** (at the Web site, go to "General Management Planning," then select newsletter #1).

Assess Your Work

Use this chart to assess your work.

Skills and Steps	Yes	No	Not Sure
Understood the purpose and mission of Channel Islands National Park.			
Recorded and defended my opinion about a human use project that might become part of the park's plan.			

Conclusion

Why is it important for the park to have a general management plan?

Self assessment

TEACHER LINKS 6

Mathematics Links

Apply Math to Local Wildlife Issues. Have students obtain data on local endangered and threatened plant and animal species. Tell students to choose a local species that they would like to protect. Students should draw a line graph showing the decrease of species over time, then compute the average rate of decrease per unit of time. Students should also draw a line graph projecting the species' desired rate of recovery over time. Have students do a cost analysis of recovery efforts, both current and projected; they should include an itemized budget of major initiatives and costs.

Language Arts Links

The Island Fox Story. Have students work in groups of four to six to compose a story about the island fox for performance. Have them write using the structure of a play, with setting, characters, and description of the action, then bring their stories to life with actors and choreographed movements. One student can narrate. Stories can show any aspect of the foxes' history—predation by eagles, life in captivity, or just a day in the life of a wild fox.

Arts Links

Populate Channel Islands Habitats. Obtain field guides with pictures of the wildlife from the Channel Islands region. Have students make a list of representative species that have been discussed throughout the curriculum: pinnipeds, island foxes, eagles, sea urchins, rockfish, garibaldis, abalone, and others. Tell students to build three-dimensional models of species to populate the kelp forest created in Story 4 and/or the island setting for the fox dramatization above. You may wish to limit the activity to native and endemic species, or invite students to create alien invasive species as well. Label them with their English and scientific names, and with N for native, E for endemic, or I for invasive. You may also use this activity to create costumes and props for the dramatization.

Novel Links

20,000 Leagues under the Sea. How does Captain Nemo utilize the resources of the ocean? What rules has he established to ensure the future? Who do you think owns the sea? Who should decide its fate?

Island of the Blue Dolphins. Make a timeline of Karana's life, the events that altered her view of and/or use of her surroundings. Compare this timeline with the research story.

***The Voyage of the* Frog.** Using David's observation, evaluate the human impact of various seagoing vessels. Then find evidence online to support your theories.

The Case of the Missing Cutthroats. What are some pros and cons of logging? How did the logging impact the cutthroats' environment? How could these impacts be minimized?

Zia. How is managing a park or sanctuary similar to managing the mission in *Zia?* Develop rules for the mission that will meet human needs and protect the environment.

Web Links

www2.ucsc.edu/scpbrg/Island_Eagles.htm Background information on efforts to relocate and track golden eagles.

www.cinms.nos.noaa.gov Web site of the Channel Islands National Marine Sanctuary.

www.iws.org/island_fox_conservation.htm Information on island fox conservation, history, and captive breeding program.

See Team JASON Online for more Web links.

Technology Links

Fox population spreadsheet. Work with students to create a spreadsheet that will do the arithmetic to calculate year-to-year changes in fox population. Use the spreadsheet to generate graphs of the fox population.

Have students record Exercise 6.3 using a digital camera, taking notes on a computer. Encourage them to use image processing software or drawings based on their photographs to show what an area might look like after their plan goes into effect. Have them use these images in their presentations.

Teacher Preparation 6.1

The Rise or Fall of the Island Fox

Time Required

1½ to 2¼ hours (two or three 45-minute periods)

Level of Complexity High

Additional Preparation

1. Prepare card sets by copying **Master A** onto sheets of sturdy paper or cardstock and cutting apart the cards. Use different-colored paper for Wild and Captive Factors. Make as many sets as there are groups. (You may choose to make two sets per group, so students don't have to reshuffle as often during the simulation. If you do, be sure to keep the ratios of different cards the same: *double sets rather than adding a partial set to a complete set.*)
2. Introduce the activity by having students graph, on paper or on the board, the island fox decline on San Miguel from the research story. Discuss the pattern of decline and possible reasons for it (e.g., why isn't it steady?). (Do this during period 1 of the exercise.)
3. Review the research story with students. Have them discuss different factors that affect the island fox population. The simulation includes only the most important factors. You might collect fox and habitat images from magazines, encyclopedias, or the Internet. (Period 1.)
4. Assign a different island where populations have declined to each group. Populations have declined on San Miguel, Santa Rosa, Santa Cruz, and Santa Catalina.
5. During period 2, conduct the simulation. During period 3, have students compare graphs and discuss.
6. You may wish to explain to students that they are using a spreadsheet in this simulation. The Wild Factors represent *geometric rates* of increase or decrease; students will calculate them by multiplying the current population by a percentage, then adding or subtracting the product to or from the starting number. The Captive Factors represent *arithmetic rates* of increase. Students will simply add 7 or 15 foxes to their current population, depending on whether the reproduction rate was normal or affected by disease. Remind students to round their totals.

Answers to Questions

Procedure questions

6. Answers will vary. People came up with different numbers because of chance. No population model is 100 percent accurate; models are only predictors. The control population should have the fewest foxes because no foxes were added through captive breeding.
7. There is a 10 in 13 chance of normal reproduction (approximately 80 percent), and a 1 in 13 chance (approximately 8 percent) of effects from each of the other Wild Factors. There is a 10 in 11 chance (approximately 91 percent) that 15 foxes will be added, and a 1 in 11 chance (approximately 9 percent) that disease will kill half.
8. Answers will vary. Usually, islands with larger populations will reach the goal faster.

Conclusion questions

1. The model is a good predictor, because it is based on past experience with known factors. Unknown factors could appear; known factors could change due to new circumstances.
2. Answers will vary. According to the exercise, captive breeding is successful in increasing fox numbers.
3. The ability to remove all golden eagles, removal of feral pigs, changes in vegetation.

Adaptations

For elementary school students

Play the game as a class and let students volunteer the answers. Or work them out using equation hints on the spreadsheet. Then fill them in on an oversized spreadsheet or overhead. Show how you arrived at the equations.

For high school students

After students play the simulation, encourage them to design a board game for younger students based on

simulation data. Cards could indicate how many spaces to move; spaces could give instructions about population growth or decline. Then have students teach younger students their game. Add an economic dimension to the game: give each group a certain amount of money and assign a monetary value to the management techniques of captive breeding and eagle removal.

Teacher Preparation 6.2

Marine Reserves—Where Do You Fit In?

A Digital Lab/Classroom Collaboration

Time Required

2¼ to 3 hours (three or four 45-minute periods)

Complexity High

Additional Preparation

1. Explain to students that they are about to begin a new type of JASON activity, one that combines classroom participation with a Digital Lab simulation. You may want to divide up the entire class into the seven stakeholder groups, so that each group has two or three students. Alternatively, divide the class into different-size groups to reflect real-world dynamics. For example, the squid fishermen could be a larger group than the federal managers. If you are working with a smaller group, have each student play a role individually or role-play only some of the seven stakeholders.
2. You may want to divide your time as follows: one period to choose roles, read synopses, and prepare presentations; one to present; one to do the Digital Lab; one to reach consensus.
3. Before using the Digital Lab, make sure students know their roles. As necessary, help them get their maps prepared for display in the classroom.

Teacher Take Note

If you do not have access to a computer lab, you can still do this activity in the classroom:

- **Part 1.** Have students use the stakeholder profiles and the maps on **Master C** to develop their arguments about which areas should be protected. If you can go online yourself, visit TJO for more maps to print and distribute to student stakeholders. You may also get additional materials for the classroom to further enhance the activity. *Fully Protected Marine Reserves: A Guide* (**www.panda.org/resources/publications/water/mpreserves/mar_dwnld.htm**) and the *Facilitator's Report Regarding the Channel Islands Marine Reserves Working Group* (**www.cinms.nos.noaa.gov/pdf2/MRWGfacilRpt2.pdf**) are excellent online sources.
- **Part 2.** Make blown-up copies of **Master C** for each group. Have groups mark off their selected protected areas on the map. You can make these into overheads.
- **Part 3.** Compare plans submitted by each group on the overheads. Try overlapping plans and coming up with a workable compromise.

Note: The Teacher Key on page [page with the key] at the end of the story shows the actual "Preferred Alternative Marine Reserve Plan" for the whole Sanctuary developed by the California Department of Fish and Game and the Channel Islands National Marine Sanctuary. It was developed using information gathered by scientists, economists, fishermen, and other local people. Managers recommended setting aside 25% of the Sanctuary in a network of 11 marine reserves. In addition, managers recommended establishing two protected areas that allow some limited recreational and commercial fishing.

Answers to Questions

Procedure questions

1. Sanctuary is 1,252 square nautical miles; Anacapa area is 216 square nautical miles. About 17 percent.

Conclusion questions

1. Fishermen, boat operators, divers, kelp processors, conservationists, state and federal sanctuary managers. People who make a living from Channel Islands resources are concerned that marine reserves could limit their ability to harvest fish or kelp, or their earnings from those who do.

Managers and conservationists are concerned that if reserves are too small or poorly sited they will fail to restore biodiversity in the area.

2. Marine reserves provide a safe haven for species to reproduce and grow. Studies have shown that marine reserves have greater numbers and size of species within them. Answers will vary, but marine reserves could benefit everyone by replenishing the supply of species for divers, fishermen, and kelp processors so that harvests will be better in the future.

Adaptations

For elementary school students

Perform the activity as a class, introducing students to each stakeholder group together. Provide additional guidance for students in the lab and help students to reach a possible marine reserve plan.

For high school students

Send students to the CINMS Web site (**www.cinms.nos.noaa.gov/nmpreserves.html**) and other sources to gather more supporting data, as well as information about their roles. Give them time outside class to prepare, and access to video, overhead, and other media to reinforce their arguments.

Teacher Preparation 6.3

Design Your Own Sanctuary

Time Required

1½ to 2¼ hours (two or three 45-minute periods: one for planning and one or two for presentations); additional class or out-of-class time for research and execution.

Complexity

Low to High

Additional Preparation

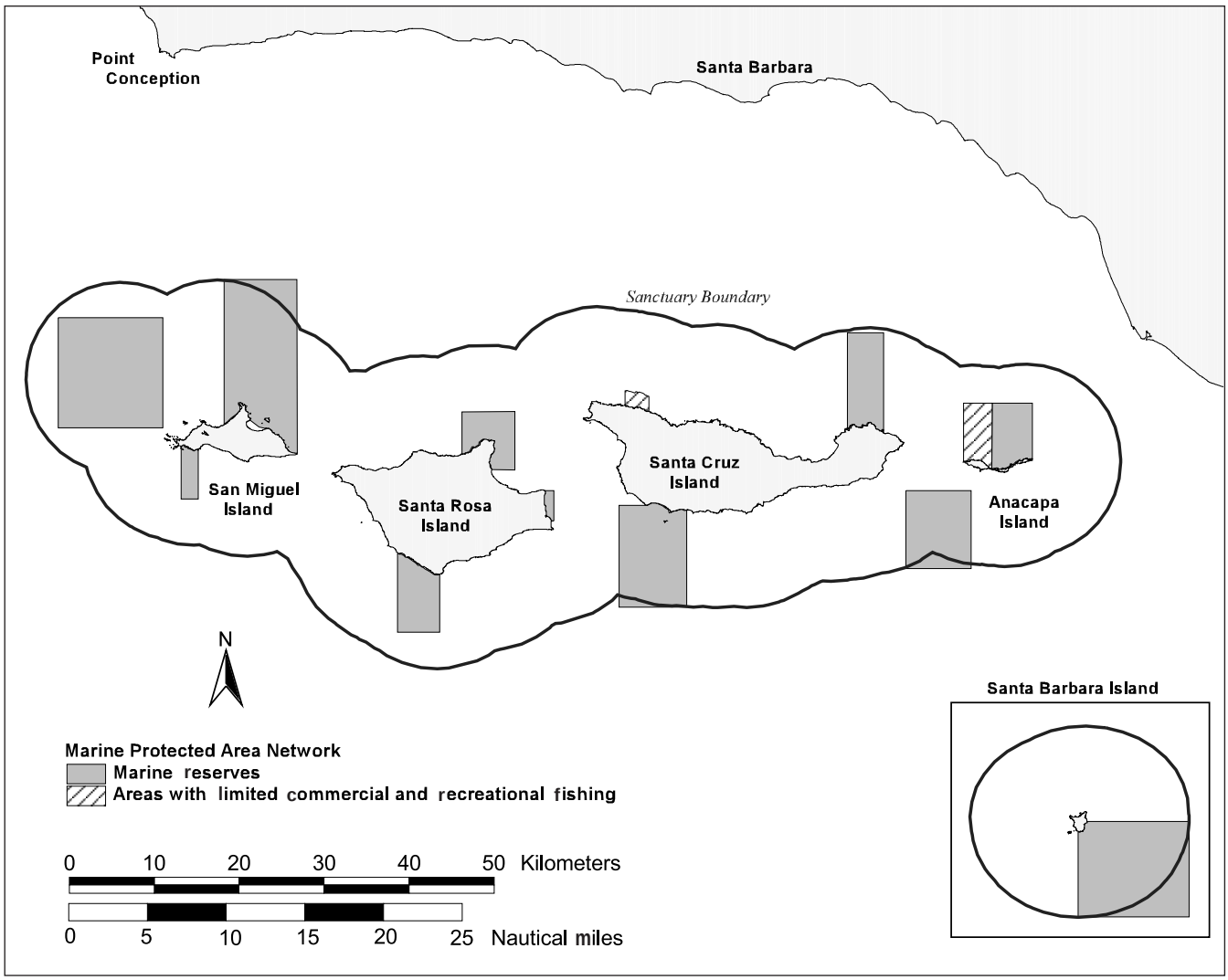
In picking a location, consider the time and resources you have to devote to the activity. This project can be scaled up or down. The area could be as large as a town park or conservation area (for which your class will develop a comprehensive plan) or as small as a school courtyard (in which your class may plan to build birdhouses or feeding stations). Other options might include an empty lot, a lake or beachfront, a pond, or an unused corner of school property.

Answers to Questions

Procedure questions

2. Stakeholders (with parallel roles from the Channel Islands process): the town conservation commission (federal and state resource managers); any "harvester" of plants or animals, e.g., hunters (commercial and sport fishermen); boaters of any kind, trail bike riders, skateboarders, dog walkers, soccer or baseball groups, etc. (commercial and sport divers); possibly a garden club or community gardeners (kelp harvesters); local land trusts, birdwatching groups (conservationists); any other users—families with small children who seek playground space, people who want to use the area for a festival, community gathering, public sculpture (community representatives).
3. Issues of importance will vary depending on the area your class chooses, but may include commercial uses of the land for stores, agriculture, amusement areas, historical or cultural features of the land, educational opportunities, and transportation issues.
4. Possible policies might include removing alien invasive plants, banning or restricting dog walking, banning motorized vehicles or boats, limiting how many people may use the area for an event, setting aside portions of the area for a reserve that allows no uses except foot traffic, and banning picnicking. In a small area, a plan may consist simply of adding a park bench or bird feeder.

Conclusion questions

1. Answers will vary.
2. If all stakeholders are not satisfied, they may not cooperate with the management goals and seek to change them. They may also suffer unnecessarily from policies that did not consider their needs. If all agree on a policy, it will be supported by everyone and have a better chance of success.

Teacher Key: Preferred Alternative Marine Reserve