Project Synopsis Report

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Restoration of *Jacquemontia reclinata* to the South Florida Ecosystem (Agreement No. 1448-40181-99-G-173)

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Project Support: CESI, Fairchild Tropical Garden, Cooperators (including: governmental land managers, Florida International University, and Valdosta State University)

PROJECT ABSTRACT

Coastal ecosystems of Florida are listed as critically imperiled because of degradation and fragmentation by human use (USFWS 1999). Coastal areas provide habitat for many rare species including the Federally endangered *Jacquemontia reclinata* (Convolvulaceae). A successful recovery of *J. reclinata* will need to expand existing natural populations, increase the number of populations in protected natural habitat, and create out-of-habitat conservation holdings of genetically representative germplasm (including seeds) for study and insurance against extinction. The proposed biological research is designed to achieve these goals of a successful recovery as well as to improve habitat management practices for the benefit of this and other coastal species. The broad biological understanding necessary for the successful recovery of this species involves:

- Accurate mapping and monitoring of an estimated 733 plants in seven populations;
- Ecological studies including: characterizing suitable habitat and demographic studies;
- Description of the genetic and reproductive biology of the species;
- Germplasm collection and storage;
- Development of new horticultural techniques for propagation and nursery production of plants.
- Habitat restoration studies including out-plantings with *J. reclinata*

These inter-related research projects are carried out through the collaboration of at least seven researchers, three graduate student assistants, and seven local land managers. A concerted effort is made to partner biologists and conservation managers so that results of biological studies will be available for rapid application. Communication among these parties is facilitated by a website and periodic meetings. The projects are coordinated by Fairchild Tropical Garden, a regional botanical center with long experience in native plant conservation, research, and horticulture.

INFORMATION NEEDS AND USES

- Biological and horticultural research on *Jacquemontia reclinata* are critical for implementing the Multi Species Recovery Plan.
- Experimental out plantings will both define and test protocols for future full-scale restoration efforts.
- Research results are efficiently communicated to land managers for implementation of best habitat management practices.

KEY FINDINGS

- Exact GPS locations for all known surviving plants.
- Extent of genetic diversity within and among the surviving populations based on DNA techniques.
- Understanding of the breeding system and pollination biology.
- Description of demography and phenology.
- Understanding of the seed and seedling biology.
- Correlations of plant distribution with microhabitat and habitat gradients.
- Appropriate protected habitat for reintroductions.
- Responses to different habitat management practices.
- Best horticultural methods for propagation and establishment.
- Production of propagules that represent natural genetic diversity for use in restoration.
- Recommendations for habitat management practices by land managers.

PROJECT DESCRIPTION

PURPOSE AND GOALS

Importance

The project clarifies the distribution and biology of *Jacquemontia reclinata* and initiates experimental restoration of this critically endangered species. Thus, the project closely follows the recommendations and guidelines given for *J. reclinata* in the Multi-Species Recovery Plan (Fish &Wildlife Service 1999: page 4-1057). The goal is the successful management and augmentation of this species that will lead to its delisting. This will be the first delisting of a plant species in South Florida and will serve as an important model for future efforts towards the recovery of other endangered plant species in the greater Everglades ecosystem.

The habitats of *J. reclinata* include coastal dunes, beach coastal strand, and maritime hammock scattered along the coast of Miami-Dade, Broward and Palm Beach counties. Coastal development within these counties continues unabated. Such development led to the listing of this species in 1993 and continues to contribute to its decline. Of its 12 known sites in 1991, only seven have surviving plants at present. We have now mapped

733 plants, with most in only two large populations (Lane et al. 2001). All remaining populations are on public lands and survive in remnant habitats surrounded by development.

Land managers are actively seeking advice on proper management of these sites, especially control and removal of exotic plant species, controlled burning, and out planting protocols for augmentation and the restoration of *Jacquemontia* populations at suitable new sites. Thus, land management practices for this endangered species will apply to the management of multiple plant species (both rare and common) that make up these threatened coastal habitats. Being sensitive to habitat quality, *Jacquemontia* may be a good indicator of community and ecosystem recovery.

These same habitats are both highly impacted by development and heavily visited by people. *Jacquemontia reclinata* is a small but attractive plant that can serve well as a "poster" plant for conservation education. Public support can be mobilized for expanding preservation actions for these coastal habitats by using *Jacquemontia* as symbol of the environment being preserved.

Urgency or Timelines

As noted above, the species is in decline and regional land managers are aware of its critical status. From the start of the project, we have partnered closely with land managers on decisions that relate to *Jacquemontia* populations because of the close proximity of those populations to public beaches, school education programs, and construction projects being now implemented or planned. For example, our new GIS maps of plants at Crandon Park (Miami-Dade County) are being used for the siting and construction limits of foot trails and a boardwalk near the new Margorie S. Douglas Nature Education Center. New signage and the closing of some footpaths are now being implemented. The Park manager is awaiting our recommendations for future management actions, which might include burning and tree removal to promote recovery. Preliminary recommendations will be made at the end of the first year of the project based on our descriptive and experimental biological studies.

At Cape Florida State Park, a large post-Hurricane Andrew restoration project continues. This is an appropriate protected habitat and within the historic range of *Jacquemontia.* There, the land manager is eager to include an out planting of this species as part of the general habitat restoration. We will have well-defined germplasm (propagated plants in our nursery) and biological information to set up experimental plantings that both give new ecological understanding and establish appropriate new populations. Such populations can give full restoration a head start.

Other cooperating land managers, associated with city, state and federal agencies distributed in the three counties, are all impatiently waiting for advice on best management actions. Our biological information will direct them, and we will plan and help to implement active augmentation and restoration efforts after the first year. These various land managers are ready to act now on habitat preservation and restoration.

Effectiveness
Under the CESI program category, Ecological Process/Indicator Species, we are carrying out the restoration work proposed in the Multi-Species Recovery Plan (Fish &Wildlife Service 1999: page 4-1057) for *J. reclinata*. We are now mapping and monitoring all individuals in known populations. We are beginning a detailed description of seed storage and germination, population genetics through DNA analyses, and the role of mycorrhizae in seedling establishment and growth. Studies of demography, microhabitat variables, pollination biology, and breeding system will begin before the end of the year. This wide-ranging, cross-disciplinary research is achievable through of the close cooperative effort among researchers and graduate student assistants at three institutions (Fairchild Tropical Garden, Florida International University, Valdosta State University), coordinated by Fairchild as the lead NGO. By the end of the first year, we will have enough information about many aspects of the biology of natural populations to evaluate responses to present management activities and give preliminary advice to land managers.

Our findings will be disseminated immediately on the *Jacquemontia* website (www.ftg.fiu.edu) and through meetings between biologists and conservation managers. Such open communication will coordinate restoration across disparate agencies, institutions, and jurisdictions, and maintain among them an ecosystem perspective on a single species restoration. Our understanding will improve in the following years with continued monitoring of native and experimental plants.

Although the status of this species has deteriorated in the seven years since listing, there are still sufficient numbers that permit us to define and collect the genetic diversity of the species, and to understand the effects of microhabitat on natural recruitment. Thus, there is every reason to predict successful out plantings and effective management protocols that will allow the removal of *J. reclinata* from the endangered species list in the next few years.

SYNOPSIS OF RESEARCH METHODS

Use of surviving wild populations

- All plants in all known populations are GPS mapped, numbered, and tagged with wire around each rootstock. Permanent reference markers are placed at each population site. Plants are surveyed annually and categorized as seedling, juvenile or reproductive adult. The individual identifying number of the wild plant follows the records of its cuttings (clone), seeds, and offspring (seedlings).
- Because individual plants inter-twine as irregular masses, phenology and growth measurements are made on selected populations described as patches on a grid system, rather than as individual plants. Dynamic of flowering, fruiting and growth/contraction of these patches are followed quarterly. Fewer selected stems will be monitored biweekly to refine phenological observations and correlate them to local environmental variables, in particular rainfall.

- Habitat variables (shade, litter depth, slope, elevation, distance from beach, soil pH, etc.) are correlated to both plants (site of rootstock) and patches (site of plant canopy). Environmental gradients and potential suitable habitats are thereby defined.
- Genetic variation within and among populations is determined by DNA fingerprinting, using RAPDs, and especially AFLP and microsatellite data.
- Natural pollinators are observed and identified. Microsatellite DNA may be used to define the degree of selfing and out-crossing within one natural population, as an extension of the controlled pollinations described below that will show whether the species is an obligate outcrosser or can self.
- Seeds are collected to represent the genetic diversity of the populations, as based on the DNA analysis, and stored. The effects of temperature and moisture content on germination rates are tested experimentally.
- Survivorship of seed *in situ* is followed by periodic burial, retrieval, and germination of samples enclosed in mesh bags. We know that seeds are viable after three years of lab storage.
- Small plots are irrigated at appropriate sites near large populations to test effect of moisture on germination of the presumed natural seed bank. Soil samples will also be removed and watered in the nursery to determine seed bank composition.
- Similar plots are managed to test the effect of tree removal, fire, and soil disturbance on natural regrowth and seedling recruitment.

Use of experimental *ex situ* plants

- Greenhouse experiments define the best horticultural conditions (watering, soil, mycorrhizae, light intensity) for propagation of cuttings and seedlings. All seedlings are from known wild seed parent plants.
- Dependency on mycorrhizae for seedling establishment in nutrient poor native soils is clarified by greenhouse experiments. Timing of colonization by mycorrhizal fungi is determined and related to future out plantings.
- Protocols for best seed storage and germination are developed in the FTG Seed Lab.
- Type of breeding system is defined using controlled pollination of *ex situ* plants of known genetic origin.
- Nursery plants from known seed sources are out planted into natural habits far removed from natural populations using guidelines of the Center for Plant Conservation (1991). Experimental plantings are made along microhabitat gradients and habitat parameters that are indicated by correlation and multivariate analyses of non-experimental data. Response is measured by rates of vegetative growth, flowering, and seed production. All experimental plants are mapped and can be later removed.
- Using similar out plantings of nursery plants, variations in management practices (cool backing fires, manual removal of shading thickets of sea grape, etc.) are tested in more detail than is possible on wild plants.
- Both descriptive and experimental results are organized and accessible through GIS.

KEY RESULTS

Research Results	Application to Restoration
Determination of exact GPS locations for all known surviving individual plants.	Part of the continuing long-term monitoring. Identifying and mapping plants is the foundation for tracking all other research by relating all cultivated plants to a wild parent.
Estimate of genetic diversity within and among the surviving populations based on DNA techniques.	Collection of seed for propagation and experimentation is determined by the diversity of natural populations.
Understanding of the breeding system and pollination biology.	Restoration depends upon self-sustaining natural reproduction. Possible genetic barriers or pollinator limitations must be well understood for proper management recommendations.
Description of demography and phenology.	The present and future status of natural populations is predicted by demographic models. Phenological patterns determine timing of management practices (e.g. burning) and are the foundation for understanding and predicting reproductive success.
Understanding of the seed and seedling biology.	This information is necessary for successful propagation of nursery plants for restoration. Limitations on natural recruitment are identified and reduced by appropriate management practices.
Defining the degree of dependency on arbuscular mycorrhizae on native soils.	This symbiotic associate is important for survival of out plantings in natural habitats where irrigation and fertilizers are inappropriate or forbidden.
Correlation of plant distribution with microhabitat and habitat gradients.	Knowledge of appropriate microhabitat conditions is essential to predict potential new habitats for successful reintroductions and augmentations.
Identification of appropriate protected habitat for reintroductions.	We need new locations for increasing the number of viable populations.
Measurement of responses to different habitat managements.	These findings point to immediate applications by land managers.
Development of best horticultural methods for propagation and establishment.	These methods are necessary to produce large numbers of plants for research and restoration out plantings. Hardier propagules will have improved survivorship and better cost-effectiveness of investment into restoration.
Recommendations for habitat management activities by land managers.	Immediate application of research results to improve the conservation status of existing natural populations.

INFORMATION PRODUCTS

TECHNICAL REPORTS

Interim Report for Grant Agreement (submitted 15 March 2000) by Jack B. Fisher.
Year 1 Final Report (submitted 30 April 2001) by Cynthia Lane

DATA & MODELS

Databases, including GIS maps, are compiled and stored at the Fairchild Tropical Garden Research Center. Maps with location of plants are distributed to the appropriate land manager of each site as the maps are completed. To date, the following property managers have received maps of *J. reclinata* locations:

- Steve Bass, South beach Park and Red Reef Park, City of Boca Raton Department of Parks and Recreation;
- Ernie Lynk and Jim King, Crandon Park, Miami-Dade County Department of Parks and Recreation;
- Joe McGuire and Linda McDonald, Miami-Dade County Natural Areas Management;
- Jim Gibson, Jim Higgins, and Janice Duquesnel, Hugh Taylor Birch State Park, Florida State Division of Parks and Recreation;
- Carol Morgenstern, Broward County, Department of Parks and Recreation;
- Frank Griffiths and Paul Davis, South Inlet Park, Loggerhead Park, and Carlin Park, Palm Beach County Environmental Resource Management.

PERMITS

Miami-Dade County Dept. of Environmental Resources Management. Feb. 99 – Feb. 01. renewed March 01, expires March 02. Collecting herbarium vouchers, plant parts and seeds.

Florida Dept. of Agriculture and Consumer Services, Division of Plant Industry. Feb. 00 – Dec. 00 renewed Jan 01, expires Jan 02. Collecting of plant parts.

Florida Dept. of Environmental Protection, Division of Recreation and Parks. Mar. 00 – Dec. 00, Hugh Taylor Birch Mar 01, expires Dec. 01). Collecting vouchers, leaves and seeds.

City of Boca Raton. Feb. 00 – Dec. 00, renewed through December 01. Research (including collection) of plants.

Palm Beach County Dept. of Parks and Recreation. No end date. Collecting samples of soil, plant parts and seeds.

Miami-Dade County Dept. of Park and Recreation, Natural Areas Management. May 00 – May 01. Collecting of plant parts, seeds, and soil.

Broward County Dept. of Parks and Recreation. 2000 – 2002. General research activities.

PUBLICATIONS – None to date. A *Jacquemontia reclinata* website has been established at: www.ftg.fiu.edu.

LITERATURE CITED AND RELATED REFERENCES

Center for Plant Conservation. 1991. Genetic sampling guidelines for conservation collections of endangered plants. Pp. 225-238. *In* D.A. Falk and K.E. Holsinger (eds.) *Genetics and Conservation of Rare Plants.* Oxford University Press, New York.

Fish and Wildlife Service. 1999. *South Florida Multi-Species Recovery Plan.* Southeast Region, U.S. Fish and Wildlife Service. Atlanta, GA.

Lane, Cynthia, Jack Fisher, Dena Garvue, Susan Carrara, Suzanne Koptur, Javier Francisco-Ortega, K. Jayachandran, John, Pascarella, Elena Pinto-Torres, Hannah Thornton, and David LaPuma. 2001. Final Year One Report for Grant Agreement 1448-40181-99-G-173: Restoration of Jacquemontia reclinata to the South Florida Ecosystem.