A Species Action Plan for the Sanibel Island Rice Rat
Oryzomys palustris sanibeli

Final Draft
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EXECUTIVE SUMMARY

The Florida Fish and Wildlife Conservation Commission (FWC) developed this plan in response to the determination that the Sanibel Island rice rat (*Oryzomys palustris sanibeli*) be classified as a Threatened species in the state of Florida. This plan was developed by the FWC in collaboration with identified partners. Revision of this plan will be required upon identification of presently unknown management and research needs. Any significant changes to this plan will be made with the continued involvement of stakeholders.

The goal of this plan is to maintain or improve the conservation status of the Sanibel Island rice rat to the point that the species is secure within its historic range. Objectives are to maintain or increase the population size and to increase the area of occupancy for the Sanibel Island rice rat within its historic range. The range of the subspecies is limited to only Sanibel Island, so some factors for listing related to extent of range will likely always meet listing status requirements. Since much is unknown about the subspecies, achieving these objectives will require substantial research and monitoring efforts by cooperating agencies on conservation lands. Specific actions proposed to increase understanding of the subspecies and its habitat requirements include implementing a monitoring program to verify presence or absence on all suitable sites, determining the population size or trend of the species, improving the condition of at least 25% of sites through management activities like prescribed fire, and further examining genetic flow between populations of rice rats on Gulf Coast islands. Additional actions include examining fragmentation of habitat caused by roads. Achieving the conservation goal for the subspecies will require cooperation among local, state, and federal governmental agencies; non-governmental organizations; development and industrial interests; private landowners; academic institutions; and the public. Fortunately, on Sanibel Island a memorandum of understanding allows for coordinated management between the 3 entities primarily responsible for managing this subspecies.

This plan details the actions necessary to improve the conservation status of the Sanibel Island rice rat. A summary of this plan will be included in the Imperiled Species Management Plan (ISMP), in satisfaction of the management plan requirements in Chapter 68A-27, Florida Administrative Code, Rules Relating to Endangered or Threatened Species. The ISMP will address comprehensive management needs for 60 of Florida’s imperiled species and will include an implementation plan; rule recommendations; permitting standards and exempt activities; anticipated economic, ecological, and social impacts; projected costs of implementation and identification of funding sources; and a revision schedule. The imperiled species management planning process relies heavily on stakeholder input and partner support. This level of involvement and support is also critical to the successful implementation of the ISMP. Any significant changes to this plan will be made with the continued involvement of stakeholders.

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GLOSSARY OF TERMS AND ACRONYMS

Area of Occupancy: The area within its extent of occurrence (See Extent of Occurrence), which is occupied by a taxon, excluding cases of vagrancy. This reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats (as defined by the International Union for Conservation of Nature [IUCN]).

BRG: Biological Review Group, a group of taxa experts convened to assess the biological status of taxa using criteria specified in Rule 68A-27.001, Florida Administrative Code, and following the protocols in the Guidelines for Application of the IUCN Red List Criteria at Regional Levels (Version 3.0) and Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1).

BSR: Biological status review report, the summary of the biological review group's findings. Includes a Florida Fish and Wildlife Conservation Commission (FWC) staff recommendation on whether or not the species status meets the listing criteria in Rule 68A-27-001, Florida Administrative Code. These criteria, based on the IUCN criteria and IUCN guidelines, are used to help decide if a species should be added or removed from the Florida Endangered or Threatened Species List. In addition, FWC staff may provide within the report a biologically justified opinion that differs from the criteria-based finding.

DDNWR: J. N. "Ding" Darling National Wildlife Refuge

Ecotone: A transition area between two biomes. It is where 2 communities meet and integrate.

F.A.C.: Florida Administrative Code. The Department of State's Administrative Code, Register and Laws Section is the filing point for rules promulgated by state regulatory agencies. Agency rulemaking is governed by Chapter 120, Florida Statutes, the Administrative Procedures Act. Rules are published in the Florida Administrative Code.

Fragmentation: A process of environmental change, usually caused by human-related land (habitat) conversion, where once connected habitats become divided into separate fragments.

FWC: Florida Fish and Wildlife Conservation Commission, the state agency constitutionally mandated to protect and manage Florida's native fish and wildlife species.

GFC: Florida Game and Fresh Water Fish Commission, the predecessor of the FWC.

GIS: Geographic Information System

ISMP: Imperiled Species Management Plan

IUCN: International Union for Conservation of Nature, a professional global conservation Network.

IUCN Red List: (IUCN Red List of Threatened Species) An objective, global approach for evaluating the conservation status of plant and animal species, the goals of which are to: Identify and document those species most in need of conservation attention if global extinction rates are to be reduced; and provide a global index of the state of change of biodiversity.

SIRR: Sanibel Island rice rat

SCCF: Sanibel-Captiva Conservation Foundation

USFWS: United States Fish and Wildlife Service

INTRODUCTION

Biological Background

This Species Action Plan is for the Sanibel Island rice rat (SIRR), a subspecies of the marsh rice rat (*Oryzomys palustris*). The Sanibel Island rice rat (*Oryzomys palustris sanibeli*) was identified as a unique subspecies by Sptizer and Lazell (1978). In 2010, Indorf completed genetic analysis of marsh rice rats throughout the southeast and confirmed the SIRR as a unique subspecies.

Species Description

The SIRR (Figure 1) is a medium-sized rat with a sparsely haired tail about equal to the length of the head and body. Adult total length ranges from 230 to 318 mm (9 to12.5 in). Fur on the upper side is brownish to buff, with black sprinkles. The underside is grayish white and the feet are white. The tail is brown above and grayish white below, and the ears are medium sized and round (Florida Natural Areas Inventory [FNAI] 2001).

Figure 1. The Sanibel Island Rice Rat (*O. p. sanibeli*).
Photograph courtesy of United States Fish and Wildlife Service.

Life History

There is virtually nothing known about the life history, behavior, and biology of the Sanibel Island rice rat. Much of this information is summarized using information on the mainland

species, *Oryzomys palustris*, taken from Wolfe (1982). More information on the life history of the species still needs to be collected.

The rice rat (*O. palustris*) is semi-aquatic and occurs in coastal marshes, hydric hammocks, swamps, and freshwater marshes and meadows. Rice rats also use mangrove swamps in coastal areas of Florida. The related silver rice rat (*O. p. natator*), which occurs in the Florida Keys, typically uses freshwater marshes, saltwater marshes, and transitional mangrove habitats (United States Fish and Wildlife Service [USFWS] 1999). *O. p. sanibeli* has been documented only within freshwater marsh communities on Sanibel Island. These areas typically are dominated by cordgrass (*Spartina* spp.), leather fern (*Acrostichum danaeifolium*), and other herbaceous species (Figure 2). In the absence of fire, these marshes can develop a shrubby component dominated by wax myrtle (*Myrica cerifera*) and buttonwood (*Conocarpus erectus*). Questions remain about the use of mangrove or adjacent upland communities by SIRRs, particularly during periods of extreme drought or flooding. Studies of rice rats in other coastal communities suggest upland communities may be used when wetlands are flooded, resources are scarce, or be important sites for juveniles (Kruchek 2004). Alternatively, Abuzeineh et al. (2007) found that densities of rice rats within a wetland inundated by water for several months were not significantly different than during normal hydroperiods.

Figure 2. Typical SIRR wetland habitat containing cordgrass and leather fern. Photograph by FWC.

Breeding can occur throughout the year although it may be affected by population size and environmental variables. Gestation lasts between 21 and 28 days, and the average litter size is around 4 or 5. Neonates weigh between 3 and 4 g (0.1 to 0.14 oz). Weaning occurs sometime between day 11 and 20, and sexual maturity is reached at 50 to 60 days of age. *Oryzomys* spp. generally live less than 1 year (Nowak 1999). Rice rats typically nest in grapefruit-sized spherical nests that are built on the ground or slightly elevated in grasses like *Spartina* (USFWS 1999). Rice rats eat a wide variety of foods including insects, crabs, snails, fishes, clams, birds, fungi, vegetation, and seeds. Rice rats are preyed upon by owls, hawks, snakes, weasels, foxes, and raccoons.

Studies of *O. p. natator* indicate that rice rats have large home ranges (including nightly movements of up to 1 km [0.62 mi]) and require large, contiguous areas of mangrove and salt marsh for sustaining viable populations (USFWS 1999). In the absence of other information, it is assumed that the same need for large, contiguous areas is true for the SIRR. Densities of rice rats are known to range from 0.1 to 3.3 individuals/ha (1 ha equals 2.5 ac) in a sedge–shrub community on coastal dunes, to 50 individuals/ha in the Florida Everglades (Wolfe 1982). Whitaker and Hamilton (1998) indicate “not usually above 10/ha.” Kruchek (2004) found densities along the Texas coast were not seasonally dependent, but varied by habitat. Estimates for wetland densities were 10.5 individuals/ha and upland densities were 3.1 individuals/ha. Upland sites were dominated by juveniles and may have functioned as ecological sinks. Bloch and Rose (2005) found densities to be seasonally dependent at 2 different saltmarsh sites, with densities at site one ranging from 3 individuals/ha in the spring to 15 individuals/ha in the winter. At Site 2, densities were greatest in the fall (87 individuals/ha) and lowest in the winter (8 individuals/ha). Home range sizes of 0.25 and 0.37 ha (0.6 and 0.9 ac) and have been calculated for males and 0.23 and 0.33 ha (0.57 and 0.8 ac) for females (Wolfe 1982).

Geographic Range & Distribution

The SIRR is endemic to Sanibel Island, Florida (Figure 3). Although the SIRR is a geographically isolated subspecies, rice rats occur throughout the mainland of Florida, on Pine Island, and in the Florida Keys.

Conservation History

The SIRR was listed as a Species of Special Concern by the Florida Game and Fresh Water Fish Commission (GFC; predecessor to the Florida Fish and Wildlife Conservation Commission [FWC]) in 1984, based on the limited range and subspecies status as identified by Spitzer and Lazell (1978). However, no population estimates were done for the SIRR, so population size, trend, and distribution were unknown.

Humphrey and Setzer (1989) used morphological analyses and concluded that the SIRR is not a separate subspecies, but instead should be subsumed within *O. p. natator*. Despite this suggested change, the GFC (and later the FWC) retained the SIRR as a Species of Special Concern. More recent genetic analysis by Indorf (2010) supported the SIRR as a subspecies and did not find evidence of recent population expansion; nucleotide and haplotype diversity was low, which may indicate a small or isolated population. A limited monitoring program was undertaken in 1984 by Humphrey et al (1986), and 33 rice rats were captured during a 2-week period at multiple sites, leading to the conclusion that rice rats were widespread in the interior wetlands of Sanibel Island.

This monitoring continued from 1986 through 1994 (J. Buckley, formerly with the Department of Natural Resources [a predecessor agency of the Department of Environmental Protection], unpublished data) to examine rice rat response to habitat modification. No population estimates were made based on either of these studies, and they did not include range-wide monitoring. More recent monitoring by staff of J. N. "Ding" Darling National Wildlife Refuge (DDNWR) in the last decade has resulted in the capture of some rice rats, but no population estimate has been made.

Although Sanibel Island is heavily developed, land acquisition by DDNWR, the City of Sanibel, and the Sanibel Captiva Conservation Foundation (SCCF) has protected much of the wetlands used by the SIRR (Figure 3). Although Figure 3 indicates that some wetland areas remain in private ownership, these are mostly small, fragmented patches that may have little value for the SIRR. Regulations protecting wetlands and city ordinances that minimize exotic plants on the island also benefit the SIRR. Management and conservation of the SIRR is also improved by a Memorandum of Understanding (Appendix 2) between the 3 conservation landowners to coordinate land management and surveying efforts.

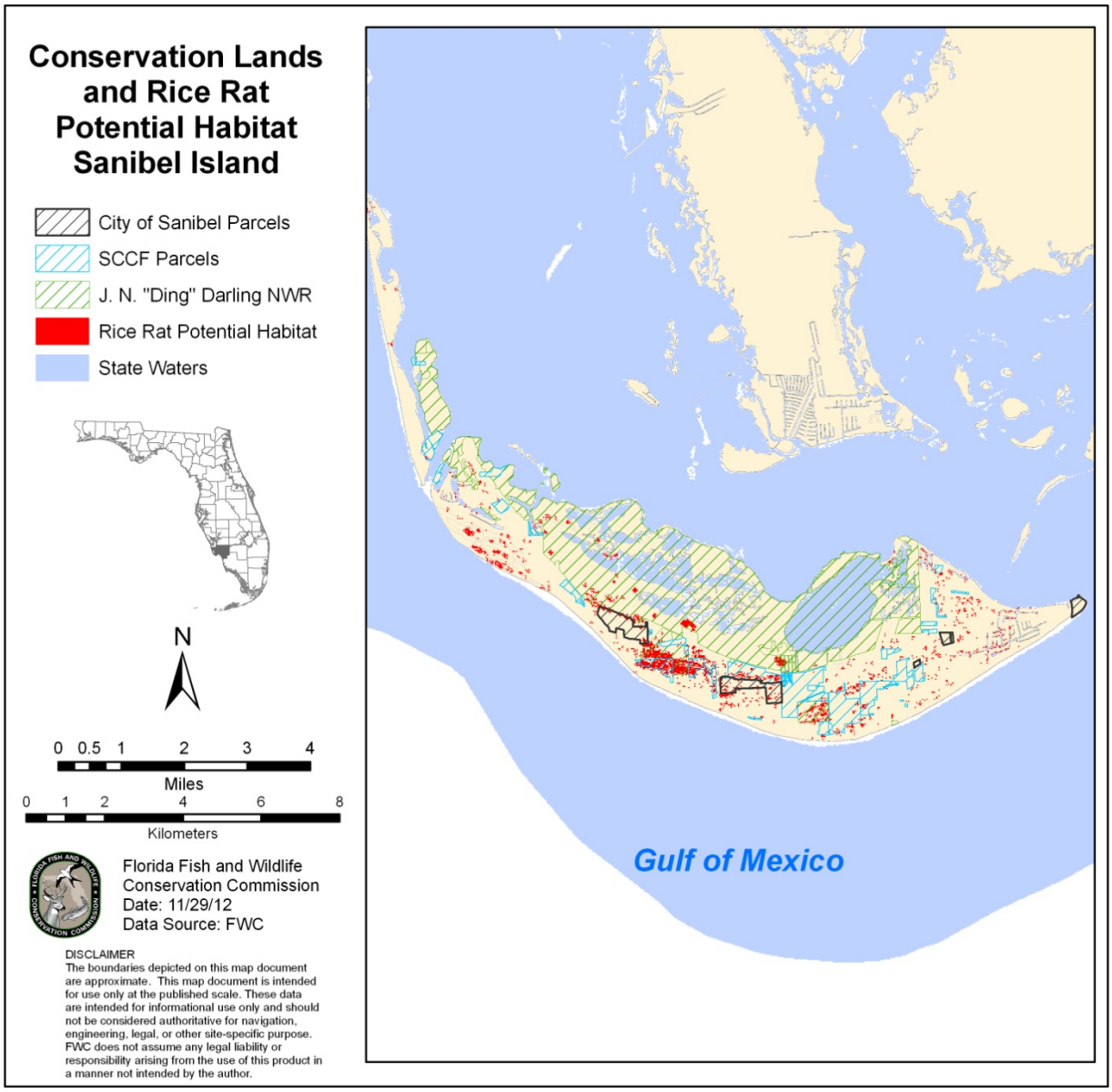

Figure 3. Potential habitat for SIRR and conservation lands on Sanibel Island.

Threats and Recommended Listing Status

Threats to SIRR identified in the Biological Status Review (BSR) are habitat loss, habitat degradation, habitat fragmentation, predation by free-ranging cats, and competition with black rats (*Rattus rattus*). Habitat loss has been reduced by wetland protection regulations, and preservation of land in conservation areas, primarily at the DDNWR and properties owned by the SCCF. Degradation and fragmentation are ongoing problems. The increased urbanization of Sanibel Island complicates the use of prescribed fire as a management tool, even on conservation lands. In the absence of fire, vegetation changes and becomes less suitable for the SIRR, compounding the issues of habitat loss and fragmentation. No estimate is given of the threat of free-ranging cats or competition with other exotics; the City of Sanibel works to prevent the establishment of cat colonies on the island, however free-ranging pets may have an impact. Sea

level rise and climate change impacts will become an increasing threat if the interior freshwater marshes the SIRR depends on become inundated with seawater. The National Wildlife Refuge system has undertaken some sea level rise modeling for refuges in the southeast, but no results are available yet for DDNWR.

In November 2010, the FWC directed staff to evaluate all species listed as Threatened or Species of Special Concern that had not undergone a status review in the past decade. Public information on the status of the SIRR was sought from 17 September to 1 November 2010. The members of the Biological Review Group (BRG) met on 3 through 4 November. Group members were Melissa Tucker (FWC lead), Jack Stout (University of Central Florida), and Amanda Bryant (SCCF). In accordance with Rule 68A-27.0012, Florida Administrative Code (F.A.C.), the BRG was charged with evaluating the biological status of the SIRR. The FWC convened a biological review group (BRG) of experts on the SIRR to assess the biological status of the species using criteria specified in Rule 68A-27.001, Florida Administrative Code (F.A.C.). This rule includes a requirement for BRGs to follow the Guidelines for Application of the International Union for Conservation of Nature (IUCN) Red List Criteria at Regional Levels (Version 3.0) and Guidelines for Using the IUCN Red List Categories and Criteria (Version 8.1). For more information, view the listing process rule, and the criteria found in the definitions.

The BRG concluded from the biological assessment that the SIRR met 3 listing criteria using estimated and inferred data. Criteria for population size and trend were triggered by an estimated population size of less than 10,000 mature individuals, a projected continuing decline with all mature individuals in a single subpopulation. Criteria for a very small or restricted population were also met by an estimated area of occupancy less than 20 km^2 (8 mi^2) with all individuals in fewer than 5 locations. Additionally, a population modeling exercise indicated the probability of extinction was greater than 10% within 100 years, a third factor that met listing criteria. No information about the status of SIRR was received from the public. Based on the literature review and the BSR, staff recommended that the SIRR be listed as a Threatened species.

CONSERVATION GOALS AND OBJECTIVES

The BRG found that the SIRR met the criteria to warrant listing as a Threatened species. Staff identified the following conservation goal and objectives:

Goal

The conservation status of the SIRR is improved to the point that the species is secure within its historical range.

Objectives

I. Maintain or increase the population size of the SIRR within its historic range within the next 10 years.

Rationale

Actions to achieve this objective focus on habitat management and research and monitoring. Research and monitoring actions will develop robust monitoring protocols that will provide the data needed to develop population estimates and quantify the threats to the SIRR. Habitat management actions will improve habitat suitability and connectivity to increase or maintain the population. This objective is warranted as it provides critical information on the current population status of the SIRR, and once this is better understood actions can address the improvement of habitat conditions and minimization of specific threats, such as changes in hydrology, competition from exotic rodents, and impacts of free-ranging cats.

II. Increase the area of occupancy by improving 25% of potential habitat for the SIRR within its historic range.

Rationale

Most, if not all, potential habitat for the SIRR already occurs on conservation lands (Figure 3). These sites occur on DDNWR, City of Sanibel properties, and within parcels owned and managed by SCCF. Although much of this habitat appears to be suitable, the only site currently occupied by the SIRR is the Bailey Tract, owned by DDNWR. Actions to achieve this objective focus on research to understand the habitat characteristics needed by the SIRR and the impacts of management actions in restoring potential sites to suitable habitat. Management actions will focus on restoring habitat and improving connectivity between patches of suitable habitat. Understanding causes of decline followed by improvements in habitat and connectivity should increase the current area of occupancy.

CONSERVATION ACTIONS

The best available information suggests that the SIRR remains on Sanibel Island. This conclusion is largely due to its recent re-discovery on DDNWR in November 2012. Prior to that, individuals were last detected in 2008. However, there remains a need to better understand site occupancy of Sanibel Island, develop more knowledge of habitat associations, and fully understand how management actions like prescribed fire affect the conservation of SIRRs.

The following sections describe the conservation actions that will make the greatest contribution toward achieving the conservation objectives. Actions are grouped by category (e.g., Habitat Conservation and Management, Population Management). The Conservation Action Table (Table 1) provides information on action priority, urgency, potential funding sources, likely effectiveness, identified partners, and leads for implementation.

Habitat Conservation and Management

Action 1 Identify and map all potential sites suitable for the SIRR.

Most, if not all, significant freshwater marsh habitat on Sanibel Island is currently in conservation status (Figure 2). This acreage is either on DDNWR, City of Sanibel properties, or on various parcels managed by SCCF. A single Geographic Information System (GIS) geodatabase identifying all potential SIRR acreage should be created and updated as new information becomes available. Although Figure 2 provides a rough estimate of potential habitat, the model used to create this map has not been ground-truthed, and is limited to FWC data. Incorporating data layers on occupancy and habitat management actions from SCCF and DDNWR will improve the quality of the mapping effort. This information will need to be expanded when SIRR use of upland or mangrove communities is better understood (Action 7). The purpose of this geodatabase is to ensure that DDNWR, SCCF, and FWC staffs understand where rice rats have potential to occur on Sanibel Island, identify any landscape-scale patterns to their distribution, and assess conditions that may affect site occupancy. Developing this geodatabase supports the achievement of Objective II, to increase the area of occupancy of the SIRR. The geodatabase should be housed and maintained so that it is accessible to all partners; FWC currently has the capacity to do this.

Action 2 Determine which management activities will correct causes of population decline by implementing management techniques, evaluating response, and adapting actions as needed.

The total amount of potential rice rat habitat on Sanibel Island is not likely to change significantly; most of the significant potential habitat currently occurs on conservation lands, although almost none of this habitat is currently occupied by the SIRR. Because of this, staff with DDNWR and SCCF likely can best manage rice rats through activities that focus on improving habitat conditions and reducing any potential fragmentation to improve both area of occupancy and increase population size. Unfortunately, little is known about the specific habitat requirements of the SIRR, what management activities are beneficial, or whether or not habitat for rice rats is truly fragmented. Prescribed fire is believed to be the most beneficial habitat management tool for the SIRR; however, other management actions such as mechanical and chemical vegetation control of native upland or exotic plants could benefit the species. Control

of exotic plant and animal species is a strong component of the City of Sanibel's natural resource protection. Water level manipulation (if feasible) could also benefit this species. For *O. p. natator*, alternation of natural hydrologic cycles in wetland communities has disrupted nesting, foraging, and movement behaviors (USFWS 1999). It is unknown whether hydrologic manipulation has had a similar impact on the SIRR. Ultimately, monitoring protocols (Actions 7 and 8) should help provide more information on key habitat characteristics and population response to habitat management. Regardless of the habitat management activity (e.g., prescribed fire), a process to track population response must be in place to gauge the value of the action. It is anticipated that the revised monitoring protocol (Actions 7 and 9) should be adequate to track rice rat response to management activities. Action 2 will address management needs for maintaining or increasing the SIRR population. Staffs from DDNWR, SCCF, and FWC should be prepared to examine monitoring results and revise additional monitoring to evaluate the success of habitat-based management actions for this subspecies.

Action 3 Improve the condition of >25% of potential sites experiencing encroachment from upland vegetation through prescribed fire or other habitat management techniques.

Encroachment of upland vegetation into the freshwater marshes known to support the SIRR is believed to be a major threat. Sand cordgrass (*Spartina bakeri*) is the historically dominant species, and these areas were open, grassy, and lacked any tree canopy due to natural factors like wind, salt spray, salinity, fire, changes in water table, and periodic inundation from tropical storms and hurricanes (USFWS 2010). Studies of *O. p. natator* indicate individuals most often forage and nest in salt marsh communities or along the ecotone between marsh–mangrove or marsh–buttonwood uplands (Goodyear 1987, Forys et al. 1996). It is assumed that *Spartina* marshes function in a similar manner for the SIRR.

On Sanibel Island, an altered fire regime and a lack of water management has reduced the dominance of *Spartina* in rice rat habitat. Shrubby species like wax myrtle, buttonwood, and even cabbage palm (*Sabal palmetto*) now occur throughout much of these marshes. Brazilian pepper (*Schinus terebinthifolius*), a noxious invasive exotic, is rapidly colonizing many areas of freshwater marsh. The increasing dominance of these shrubby and non-native species is believed to be reducing foraging habitat and potential nesting substrate for the SIRR, and may increase perching sites for aerial predators such as hawks and owls. Staff with DDNWR has been in the process of developing a habitat management plan that will guide burn interval and future management actions. Although prescribed fire is a useful tool for habitat management, a successful prescribed fire is dependent on weather conditions. The island's wind patterns, road locations, level of development, and recreational focus make conducting a prescribed fire difficult, both technically and from a public relations standpoint. Prescribed fire events are carefully planned and managed, with staff pulled from nearby refuges and with public meetings held in advance of the planned burn dates. When resources and timing have allowed, DDNWR and SCCF have begun to implement management activities like prescribed fire and herbicide use to reduce the shrub component to improve these wetland communities.

DDNWR and the City of Sanibel are planning to restore natural hydrology in some of the cordgrass wetlands within the next 5 years. In the past, there were many attempts to move water quickly and directly off the wetlands. These efforts left ditches and deep pools in areas that

historically had been shallow cordgrass wetlands. DDNWR, in cooperation with the City of Sanibel natural resources managers, hopes to block or fill some of the ditches that transect the cordgrass marshes. They are also exploring the possibility of re-contouring the landscape to grade on portions of the DDNWR to restore a more natural flow of shallow water across the area. Some trails and access roads may be removed, re-located, or elevated to establish a more natural water flow. This action will increase area of occupancy by improving habitat quality and creating habitat that is suitable for rice rats; higher-quality habitat should also increase the number of rice rats able to use each site, and maintain or increase the population of the subspecies.

Action 4 Examine mechanisms to connect fragmented habitats.

Some studies suggest rice rats have large home ranges and can travel widely during nightly foraging but little is known about barriers to movement. On Sanibel Island, Rabbit Road and Tarpon Bay Road may be functional barriers that separate large areas of potential wetland habitat (Figure 4). Both of these roads are single lanes without sidewalks or significant curbs, although both have a shared-use path nearby. Residential speed limits apply on both roads. SIRR has never been documented in freshwater marshes east of Tarpon Bay Road. Rabbit Road is bordered by residential development, which along with the road, separate 2 large tracts of freshwater marsh that have been historically occupied along the west side. While a research project (Action 11) can determine if these roads do serve as barriers, staffs with DDNWR, SCCF, and FWC should be prepared to identify other potential habitat management actions to aid movement of SIRRs between marsh communities. Action 11 will be able to help target future management actions to minimize barriers, but possibilities include influencing landowners to create connecting habitats and eliminate potential barriers. For example, many of the homes along Rabbit Road have extensive vegetation, which could provide cover for rice rats moving across the road and along the developed perimeter. The City of Sanibel encourages native planting through city ordinances, and these ordinances could include rice rat-friendly yard management in areas between fragmented habitats. Reduced lighting at some sections of road may also improve connectivity and movement between fragmented marshes. Connecting potential habitat patches can help increase area of occupancy by improving dispersal abilities of individual rice rats.

Figure 4. Potential barriers to SIRR movement on Sanibel Island.

Population Management

Action 5 Develop a decision support system for implementing an emergency response plan to capture, store, and repatriate individuals when disasters could result in significant population loss.

The limited range and area of occupancy of the SIRR increases the potential for disasters to impact the survival of the subspecies. The impacts of natural disasters such as hurricanes and tropical storms, or manmade disasters such as oil spills, may be exacerbated by the increased human infrastructure on the island, the fragmentation of the remaining habitat, and the presence of barriers to dispersal. Although captive propagation of this species is not deemed necessary at this time nor is it a practical long-term solution, guidelines and protocols should be established to support decision-making in the event of a disaster. Based on discussion with staffs at DDNWR and SCCF, the desired focus of a response plan is on manmade disasters (such as an oil spill) as opposed to natural disasters. For natural disasters, staff is focused on human safety concerns, and additional manpower to capture rice rats is not available. Staff concerns also include the potential genetic impacts of “assisting” the survival of individuals in ways that may not be the best fit for survival of the natural disaster. Staff concerns of the land management agencies need to be

incorporated into any decision-support system; however, the potential impacts of natural disasters need to be fully considered and included in the response plan if it threatens a significant proportion of the population. Resources for implementing a response plan also need to be identified in advance. A response plan should include a decision tree for when to capture and then release animals; a method for capture, including a diversity of sites to maximize genetic diversity; locations to store animals; captive holding procedures; and if breeding of captive animals will be allowed. For the response plan, a trapping protocol that can be executed quickly needs to be formulated. Captive animals should be kept on Sanibel Island if possible. The captured individuals should be kept only as long as necessary and kept in as natural of conditions as possible to facilitate their release. In the event of a disaster, having a well-developed response plan can assist in achieving Objective I, to maintain or improve the population of the SIRR.

Action 6 Develop a long-term plan to address potential population impacts to the SIRR from sea level rise.

The fact that the SIRR seems to exclusively inhabit freshwater *Spartina* marshes makes the threat of sea level rise an apparent risk to their long-term persistence. As sea levels rise, preservation of freshwater marshes will become increasingly important and may require specific management actions. Agencies responsible for management of these marsh communities should examine and determine, where practical, management activities that will promote the continued vegetative community and structure preferred by the SIRR. Maintaining high-quality, connected habitats in the face of climate change will address Objective I, to maintain or increase the population of the SIRR.

Monitoring and Research

Action 7 Modify the existing monitoring protocol to determine population trend and implement on all sites suitable for SIRR.

Accomplishing the research and habitat management needs identified in other actions will require the development of a reliable method for detecting rice rats, and will be the initial focus of plan implementation. Prior to November 2012, when 2 individuals were detected on the Bailey Tract of DDNWR, SIRRs had not been captured on any properties since 2008 despite bi-annual trapping efforts. Once the protocol is established and rice rats are reliably captured across seasons and years, it can be implemented at multiple sites, in conjunction with mark/recapture, to assess population and trend. The frequency of needed recapture efforts combined with limitations in staff resources may limit population studies to a subset of sites with rice rats. Coordination with statisticians and species experts is needed to develop a protocol that is scientifically rigorous; additional resource needs (funding or staff) should be identified prior to undertaking any studies. Development of the protocol and population assessment could be accomplished through coordination between DDNWR, SCCF, and FWC research staffs, or in conjunction with university researchers. DDNWR and SCCF provide funds for interns, and these interns could be tasked with conducting some of the surveys with staff supervision and appropriate training.

DDNWR and SCCF currently monitor rice rats on their properties and have cooperative agreements to assist one another and to monitor City of Sanibel properties (Appendix 2). Monitoring is currently conducted biannually using transects and small-mammal traps (i.e., Sherman traps). Rice rats are believed to occur primarily in the swales located in the interior portions of the island, and these are the sites trapped. Although all properties are trapped using similar trapping designs, there are some variations that may bias results.

A monitoring protocol should be developed that will be feasible to implement across all properties. Current staffing levels at DDNWR and SCCF need to be considered when developing the protocol, and additional resource needs should be identified in advance. Trapping these habitats can be logistically difficult since movement through the thick swales is labor intensive and time consuming, and can impact vegetation by leaving visible trails. Water levels vary depending on rainfall, and some sites are often flooded, exacerbating the difficulties of trapping this habitat. On SCCF properties, trapping transects are spread throughout the habitat, but on DDNWR sites, transects often follow the higher road beds; this approach could influence species captured and detectability of the SIRR. Cotton rats (*Sigmodon hispidus*) have been caught often at the road bed sites with no rice rat captures. Traps have not been set in mangrove habitats on Sanibel Island, although this habitat type is used by the silver rice rat in the Florida Keys and should be considered in future trapping efforts. Use of camera traps may improve the ability to detect rice rats in difficult habitats.

Factors to consider in adapting the current protocol would include trapping across ecotones and expanding trapping to include mangrove or other marginal habitats. Placement of traps on floating platforms to prevent drowning of individuals due to sudden changes in water levels may be warranted at some sites. Use of cameras in bucket traps, as has been done with the Florida saltmarsh vole, may be a less labor-intensive way to identify sites with rice rats for future trapping efforts, particularly at sites with logistical difficulties. The seasonality of trapping should be addressed; currently, most trapping occurs in the dry season, which may impact the species composition and detectability of rice rats. Additional trapping during the wet season should be considered.

Once the monitoring protocol is finalized, the implementation of the monitoring protocol will allow management agencies to gather trend information for the SIRR on a site-by-site basis. Trend information on a site-by-site basis is needed to meet the objectives and allow for assessment of the SIRR's status with IUCN criteria. It is also an integral step in developing targeted habitat management actions that will help to achieve objectives by increasing area of occupancy and populations. The development and implementation of the protocol should be coordinated with statisticians to ensure that it is statistically sound to identify trends. Staff resources for implementing the protocol should be considered, and if they are limiting, the monitoring should be coordinated between DDNWR, SCCF, FWC, and other partners to increase available resources.

Action 8 Identify potential causes of decline and investigate the impact of cause(s) on population trend.

Staffs at DDNWR and SCCF suggest that the number of rice rats trapped appears to be negatively correlated with an increase in the cover of woody vegetation within the interior swale areas. Other potential causes of decline include changes in hydrology and competition with cotton rats (see Action 2 for management of declines). However, until rice rats can be reliably captured or detected, research into causes of decline is difficult to undertake; distribution data and occupancy modeling may serve as alternatives to surveying at levels that would detect trend. Even without initiating new research, data exist from studies during 1984 (Humphrey et al. 1986) and 1986-1994 (J. Buckley, unpublished data) on habitat and small-mammal captures. These data, combined with capture and management data from the last decade, may be used in a modeling program to identify those factors that might have the greatest impact or to focus new research.

Other threats identified in the BSR as possibly having caused past declines included competition with black rats and predation by feral cats. No information exists on the extent of either of these threats, although trapping records (J. Buckley, unpublished data) and the last decade can provide some information on the presence of black rats. There are no known feral cat colonies on Sanibel Island (D. Century, SCCF, personal communication); if free-ranging cats are a cause of decline, additional education or coordination with the City of Sanibel and SCCF may be warranted to decrease presence of free-ranging cats on the island. Impacts of rodenticides on rice rats has not been studied, but may also need to be considered if other factors are eliminated as causes of declines in the population. This action will address both objectives, by increasing area of occupancy and population numbers.

Action 9 Evaluate the SIRR population response to the implementation of management activities.

Once Action 1 is accomplished, the monitoring protocols should be implemented in a subset of habitats with varying conditions, including hydrology and plant community and in combination with directed management activities like prescribed fire. Monitoring of rice rats in this context should aid in determining the effects of targeted management on population trends. It also should provide additional information on key habitat factors that promote occupancy of sites by the SIRR. Coordination with statisticians is needed to develop a study design that can assess causes of decline or impacts of habitat management. Although funding and staff resources are important considerations and should be discussed when developing study design, the studies must provide the information needed. If scaled-down studies don't provide the information needed, then additional resources should be obtained or studies should be delayed until the resources are available. This action addresses Objective I, to maintain or increase the population size.

Action 10 Examine genetic flow within rice rat populations on Gulf Coast islands.

Additional studies are needed to study gene flow between the SIRR, the nearby Pine Island, and mainland subspecies to determine if they are distinct subspecies. The SIRR was originally identified as a subspecies by Spitzer and Lazell (1978), but the subspecies status was rejected by

Humphrey and Setzer (1989). Recent analysis by Indorf (2010) indicates that the SIRR is a distinct subspecies; however, questions remain regarding the Pine Island rice rat. Using both mitochondrial and nuclear DNA analysis, Indorf (2010) concluded that a moderate level of differentiation had occurred between the SIRR and other mainland rice rats, comparable to differentiation accepted for subspecies status in other rodents. As time and resources allow, trapping should be conducted along areas closest to Pine Island and on other Gulf Coast islands to gather genetic material. Tissue of captured rice rats should be collected for genetic studies. Trapping at specific islands and at mainland sites could be conducted in conjunction with researchers and graduate students or as part of undergraduate research projects. A better understanding of rice rat genetics will assist in identifying the limits of the population and improve our ability to address objectives for increasing area of occupancy.

Action 11 Determine if Rabbit Road and Tarpon Bay Road are barriers to SIRR movement.

Roads have been identified as barrier to dispersal for many small mammals, with impacts varying by width of road, level of traffic, and condition of right of way (Oxley et al. 1974, Dickman and Doncaster 1987, Forman and Alexander 1998). Rabbit Road and Tarpon Bay Road are single-lane, heavily used roads that fragment large blocks of wetland habitat and may be barriers to the movement of the rice rats (as identified in Action 4). Despite very similar habitat characteristics and trapping efforts, rice rats have not been documented to the east of Tarpon Bay Road. Genetic analysis of samples collected on Sanibel Island may provide some insight into how much of a barrier these roads may be. If rice rats are found in numbers that permit experimental studies, additional data may be collected from radio-collaring rice rats to study dispersal or by moving individuals across perceived barriers and tracking their movements.

Rule and Permitting Intent

The BRG group found that the SIRR met the criteria for listing as Threatened, and FWC proposes to move the SIRR from Florida's list of Species of Special Concern under Rule 68A-27.002, F.A.C., to Threatened under Rule 68A-27.003, F.A.C.

Action 12 Add the SIRR to the list of Threatened species in Rule 68A-27.003, F.A.C.

The protections provided in Chapter 68A-27, F.A.C., are sufficient for the SIRR, and this plan proposes no additional protections. As described in rule, habitat management actions, including prescribed fire, mechanical treatment in wetlands, and herbicide use, undertaken by DDNWR or SCCF should be exempt from any FWC take permitting requirements, since these actions provide long-term benefit to the continued survival of the SIRR. Although not currently occupied by the SIRR, almost all habitats currently available to rice rats are contained within conservation lands, and no additional permitting structure beyond what is contained in Chapter 68A-27, F.A.C., is proposed for incidental take of this species. As monitoring and research actions are implemented, new information may be incorporated into permitting guidelines as needed. If conservation properties undertake infrastructure development (road widening, parking areas, etc.), they should assess the potential impact and contact the FWC's Protected Species Permitting office if a take permit is needed or the Office of Conservation Planning Services if technical assistance is needed. Direct take as defined in Rule 68A-27.001, F.A.C., is managed through the issuance of scientific collecting and education permits (as provided for in Rule 68A-

27.007, F.A.C.) for the SIRR and will continue to be issued to individuals and research organizations if the proposed take helps to meet the objectives of the plan. No specific permit criteria have been developed for the SIRR, but research undertaken by any organization that will benefit the survival of the subspecies and assist in achieving the conservation objectives in the action plan, including population monitoring conducted by DDNWR and SCCF, meets the conditions necessary for direct take. Permit conditions should specify the timing and method for submitting to FWC data collected during research activities.

Voucher permits should be issued to DDNWR and SCCF to retain any specimens that they encounter during management or population monitoring activities or as a result of incidental mortality during population monitoring or management activities. These specimens can be used for education purposes in the educational centers for each organization or as reference specimens for training staff on the differences between rice rats and cotton rats.

Law Enforcement
No SIRR-specific actions are proposed. If research and monitoring actions determine that take from human-related causes pose a potential impact to the SIRR population, the need for law enforcement actions may be re-evaluated.

Incentives and Influencing
No SIRR-specific actions are proposed, since most of the potential habitat is already held within conservation lands. Some actions, such as improving connectivity of habitat patches, have components that will require influencing, but these are covered in more detail in the actions and in Coordination with Other Entities.

Education and Outreach
If an education and outreach component is not included, the implementation of many management activities to benefit the SIRR may be misunderstood by the general public.

Action 13 Produce or assist in production of educational materials about habitat requirements and management actions that benefit the SIRR.

Prescribed fire, which benefits many species in addition to the rice rat, is believed to be critical for ensuring population persistence on Sanibel Island. DDNWR staff and staff from SCCF should continue to educate the public on the benefits of fire in these wetland communities. The presence of free-ranging or feral cats or an increased population of raccoons and non-native black rats could result in high rice rat mortality rates. In the Florida keys, black rats occupy the same niche as does the silver rice rat (a close relative of the SIRR), and black rats prey on young rice rats, which means that there is the potential for black rats to compete with SIRR and to prey on the young of the SIRR (USFWS 1999). Education and outreach on the potential impacts of these factors to rice rat and other small-mammal populations should be implemented. FWC staff (biologists and staff from the Office of Community Relations) can develop basic information to be included on the FWC website and partner sites, such as the University of Florida's Institute of Food and Agricultural Sciences extension site. Alternatively, staff from DDNWR and SCCF may wish to build rice rat-specific educational materials into their existing programs. Educational information could be distributed through social media, kiosks at recreational sites, expert

scientist talks sponsored by the Friends of DDNWR, and displays in the educational centers at DDNWR and SCCF.

Key points to include in outreach are:

- The Sanibel Island rice rat is found only on Sanibel Island.
- The Sanibel Island rice rat lives in freshwater wetlands and avoids areas of human habitation.
- Rice rats use small, spherical nests (about the size of a softball) located in the wetland vegetation.
- Maintaining habitat for the Sanibel Island rice rat requires the use of prescribed fire in the freshwater wetlands.
- The interior freshwater wetlands on Sanibel Island are unique and limited.
- Free-ranging cats can kill rice rats (and other small mammals, lizards, small snakes, and birds).

Coordination with Other Entities

The restoration of open freshwater marshes on Sanibel Island is believed to be the single most important action for the survival of the SIRR (see Habitat Conservation and Management). Due to the juxtaposition of property ownership containing marshes, it is important that there is coordination with the property owners and governmental entities to complete restoration in continuous patches that may cross property boundaries. Fortunately, a memorandum of understanding exists between DDNWR, SCCF, and the City of Sanibel to facilitate management of natural communities (Appendix 2). DDNWR has a fire management plan and existing coordination with the Florida Forest Service (FFS). This coordination with FFS may provide some additional resources for conducting prescribed fire and the needed outreach to the community.

Sea level rise due to climate change is a threat to many coastal species. The SIRR is particularly susceptible as it relies on freshwater marshes within a coastal environment. Action on the part of the local governments and DDNWR will be necessary if the potential sea level rise threatens these freshwater marshes. As described in Action 6, the best available science should be used to inform decision making, land management, and acquisition. Any solution should involve all 3 owners of conservation land on Sanibel Island.

As described in Action 5, an emergency response plan should be considered for the capture and housing of SIRRs in the event a manmade disaster threatens all or a significant portion of their habitat. This plan should be designed with the assistance of DDNWR, the SCCF, and the City of Sanibel. These entities have the best knowledge of how to capture the rice rats and the localities where they occur.

Action 14 Coordinate maintenance of a GIS file that identifies all potential habitat for the SIRR and update the occupancy status of each site.

A single GIS shapefile or geodatabase identifying all potential habitat for the SIRR should be created and updated as new information becomes available (Action 1). At a minimum, this file is to be shared among the 3 entities that manage land with potential habitat: DDNWR, SCCF, and

the City of Sanibel. The purpose of this shapefile or geodatabase is to ensure that DDNWR, SCCF, staff of the City of Sanibel, and FWC staffs understand where rice rats occur on Sanibel Island, can identify any landscape-scale patterns to their distribution, and can determine how habitat management activities affect occupancy of sites. The centralized data will inform local land managers about future management needs at the landscape level. Maintaining this database will help in measuring achievement toward the objectives, by tracking increased area of occupancy, improved habitat conditions, and increasing populations. The database may also become the primary source of information for future status assessments.

Table 1. Sanibel Island Rice Rat (*Oryzomys palustris sanibeli*) Conservation Action Table

NOTE: An explanation of acronyms used is below the table.

Objective(s) Addressed	Team Assigned Priority Level	Action Item Number	Action Items	Conservation Action Category	Ongoing, Expanded or New Effort?	Authority	Man Power	Estimated Cost To Implement	Funding Source(s)	Lead for Implementation: FWC Program(s) and/or Section(s)	External partners	Likely Effectiveness	Feasibility	Urgent?
1,2	1	1	Identify and map all potential sites suitable for SIRR.	Habitat Conservation & Mgmt, Coordination with Other Entities	ONGOING	YES	YES	TBD	UNKNOWN	FWRI and SCP	USFWS, SCCF	Very effective.	Very feasible.	YES. Mapping has already occurred by multiple entities, however these need to be consolidated and ground truthed.
1,2	3	2	Determine which management activities will correct causes of population decline by implementing management techniques, evaluating response and adapting actions as needed.	Habitat Conservation & Mgmt	NEW	YES	YES	TBD	UNKNOWN	SCP, FWRI	USFWS, SCCF	Very effective.	Feasibility is dependent on the ability to identify the causes of decline; multiple factors may be responsible for declines which can complicate implementation of management techniques.	NO. This is dependent on accomplishing actions identified in Research and Monitoring section. Agencies responsible for management (e.g., USFWS, SCCF, City of Sanibel, FWC) should be aware of causes of decline of SIRR population and develop appropriate management activities.
1,2	1	3	Improve the condition of >25% of potential sites experiencing encroachment from upland vegetation through prescribed fire or other habitat management techniques.	Education & Outreach, Coordination with Other Entities	ONGOING	NO	NO	TBD	UNKNOWN	UNKNOWN	USFWS, SCCF, City of Sanibel	Very effective.	Feasibility dependent on the actions needed and community support for burning or other activities.	YES. This is considered urgent for SIRR and for ecosystem management.
2	4	4	Examine mechanisms to connect fragmented habitats.	Monitoring & Research	NEW	NO	NO	TBD	UNKNOWN	SCP?	USFWS, SCCF, City of Sanibel	Somewhat effective.	Feasibility depends on ability to detect rice rats and determine how and if habitat is fragmented.	NO. This is not considered immediately urgent, but is needed for increasing connectivity between habitat patches, and addressing potential impacts of sea level rise.
1	4	5	Develop a decision support system for implementing an emergency response plan to capture, store, and repatriate individuals when disasters could result in significant population loss.	Population Mgmt, Coordination with Other Entities	NEW	NO	YES	TBD	UNKNOWN	UNKNOWN	USFWS, SCCF, City of Sanibel	Somewhat effective. Planning should help prepare for a man-made disaster and minimize decisions made with limited time for evaluation	Feasibility for storing individuals during an emergency is low, due to staff responsibilities in these situations. USFWS would prefer not to explore this option in relation to a natural disaster.	NO. Development of a response to a man made disaster is not a high priority, but will be helpful in determining level of response needed.
1	4	6	Develop a long-term plan to address potential population impacts to the SIRR from sea level rise.	Population Mgmt, Coordination with Other Entities	NEW	NO	YES	TBD	UNKNOWN	SCP, possibly the Florida Wildlife Legacy Initiative	USFWS, SCCF, City of Sanibel	Somewhat effective.	Feasible to review literature, make predictions, and develop a list of potential mitigation measures such as connectivity of habitats, etc.	No. Planning should help to prepare for level of response needed and resources required.
1,2	1	7	Modify the existing monitoring protocol to determine population trend and implement on all sites suitable for SIRR.	Monitoring & Research	EXPANDED	NO	YES	TBD	UNKNOWN	FWRI and/or SCP	USFWS, SCCF, City of Sanibel	Very effective.	Feasible to modify protocol, with additional support to USFWS and SCCF from FWC staff. May need additional resources in the form of traps and staff to dedicate their time to implementing survey protocol.	YES. Monitoring is currently conducted bi-annually using transects and small mammal (Sherman) traps. Although all properties are trapped using similar trapping designs, there are some variations that may bias results. Management actions depend on completing this research action.

Table 1. Sanibel Island Rice Rat (*Oryzomys palustris sanibeli*) Conservation Action Table

Objective(s) Addressed	Team Assigned Priority Level	Action Item Number	Action Items	Conservation Action Category	Ongoing, Expanded or New Effort?	Authority	Man Power	Estimated Cost To Implement	Funding Source(s)	Lead for Implementation: FWC Program(s) and/or Section(s)	External partners	Likely Effectiveness	Feasibility	Urgent?
1,2	1	8	Identify potential cause(s) of population decline and investigate the impact of cause(s) on population trend.	Monitoring & Research	EXPANDED	NO	YES	TBD	UNKNOWN	FWRI and/or SCP	USFWS, SCCF	Very effective.	Feasibility depends on identifying cause or causes of decline, which may be difficult if there are multiple contributing factors. Additional support to USFWS and SCCF from FWC staff in study design and implementation is needed.	YES. Identifying causes of population decline is needed prior to implementing actions to reverse decline.
1,2	2	9	Evaluate the SIRR population response to the implementation of management activities.	Monitoring & Research, Habitat Conservation & Mgmt	NEW	NO	YES	TBD	UNKNOWN	FWRI and/or SCP	USFWS, SCCF	Very effective.	Feasibility depends on the activities needed. Expertise beyond cooperating agencies may be needed to fully develop an evaluation process.	YES. This is dependent on adequate monitoring. Agencies responsible for management (e.g., USFWS, SCCF, City of Sanibel, FWC) should be aware of how threats can affect the SIRR population and develop appropriate management activities.
2	5	10	Examine genetic flow within rice rat populations on Gulf Coast islands.	Monitoring & Research	NEW	YES	YES	TBD	UNKNOWN	FWRI and/or SCP	USFWS, SCCF, Universities	Somewhat effective.	Feasible to collect specimens for genetic analysis.	NO. This is not considered immediately urgent for SIRR based on Indorf (2010) analysis, however there are remaining questions about Pine Island rice rat uniqueness.
1,2	5	11	Determine if Rabbit Road and Tarpon Bay Road are barriers to Sanibel Island Rice Rat movement.	Habitat Conservation & Mgmt, Population Mgmt, Monitoring & Research	NEW	YES	YES	TBD	UNKNOWN	FWRI and/or SCP	USFWS, SCCF, City of Sanibel, Universities, FDOT	Somewhat effective.	Feasibility depends on the ability to capture rice rats and use radio telemetry to assess movements. May be able to translocate animals into areas east of Rabbit Road to see if road poses a barrier to returning to original habitat patches.	NO. This is not considered immediately urgent, but is needed for increasing connectivity between habitat patches, and addressing potential impacts of sea level rise.
1,2	1	12	Add the SIRR to the list of Threatened species in Rule 68A-27.003, F.A.C.	Protections & Permitting	NEW	YES	YES	$0-25k	N/A	SCP	FWC	Effective.	Very feasible.	YES. Action is needed for species conservation.
1,2	3	13	Produce or assist in production of educational materials about habitat requirements and management actions to benefit the SIRR.	Education & Outreach	NEW	YES	YES	TBD	UNKNOWN	OPAWVS and OCR	SCCF, USFWS, City of Sanibel	Somewhat effective, if education can help build support for habitat management such as prescribed fire.	Very feasible.	YES. Helpful for education of residents on species and building support for habitat management activities.
1,2	1	15	Coordinate maintenance of a GIS file that identifies all potential habitat for SIRR and update the occupancy status of each site.	Monitoring & Research	NEW	YES	YES	$0-25k	UNKNOWN	FWRI	SCCF, USFWS, City of Sanibel	Somewhat effective.	Very feasible.	YES. This will aid in developing better knowledge of site occupancy, habitat requirements, and fragmentation issues.

Acronyms used in this table:

FWC:	Florida Fish and Wildlife Conservation Commission
FWRI:	Fish and Wildlife Research Institute, the research branch of the Florida Fish and Wildlife Conservation Commission
GIS:	Geographic information system
OCR:	Office of Commmunity Relations, administered by the Florida Fish and Wildlife Conservation Commission
OPAWVS:	Office of Public Access and Wildlife Viewing Services, administered by the Florida Fish and Wildlife Conservation Commission
SCCF:	Sanibel-Captiva Conservation Foundation
SCP:	Species Conservation Planning, a Section of the Florida Fish and Wildlife Conservation Commission's Division of Habitat and Species Conservation
SIRR:	Sanibel Island rice rat
TBD:	To be determined
USFWS:	United States Fish and Wildlife Service

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APPENDICES

Appendix 1. Trapping protocol for *O. p. sanibeli* developed and used by J. N. "Ding" Darling National Wildlife Refuge and the Sanibel-Captiva Conservation Foundation.

SMALL MAMMAL TRAPPING PROTOCOL – J. N. "DING" DARLING NATIONAL WILDLIFE FOUNDATION
Updated: February 2011

I. Justification and Objectives:

Small mammals are a food source for many other species, including raptors, bobcats, and snakes. Therefore, they can serve as an indicator for the health of the habitat and effects of habitat manipulation. In 1984 the status of the Sanibel Island rice rat (*Oryzomys palustris sanibeli*) on Sanibel Island was evaluated (Humphrey et al. 1986). Then from 1984 to 1994 there was an annual winter small mammal trapping survey conducted to estimate population levels and evaluate the effects of exotic plant removal and prescribed fire on the small mammal populations over time. They concluded that the survival status of the rice rat was threatened and appeared to be declining and that current and future habitat changes (development, draining, and management of the interior wetlands) could negatively affect the species. Nevertheless, there were no small mammal surveys conducted from 1994 to 2002. Therefore, since the reinstatement of the project in 2003 to the present, the objectives are to estimate the species abundance and document occurrence of small mammals in specified burn units, pre and post habitat manipulation. These data will be compared to historic data to evaluate past management effectiveness and develop future management recommendations.

II. Study Sites:

J.N. "Ding" Darling NWR has 18 burn units and with the exception of the San-Cap burn units, are interior wetlands, dominated by cordgrass (*Spartina bakeri*), leather fern (*Acrostichum danaeifolium*), saltbush (*Baccharis halimifolia*), and buttonwood (*Conocarpus erectus*) (Figures 1 and 2 [*A and B in Appendix 1*]). The San-Cap (Figure 5, [*E in Appendix 1*]) units are more upland and are considered a scrub habitat, dominated by gumbo limbo (*Bursera simaruba*), sabal palm (*Sabal palmetto*), wax myrtle (*Myrica cerifera*), and white stoppers (*Eugenia axillaris*).

Humphrey et al. (1986) sampled the Bailey Tract and Legion Curve burn units. The refuge study sites consist of: four of the burn units at the Bailey Tract (BT1 T(17), BT2 G(16), BT4 T(21), BT5 T(50)) (Figure 1 [*A in Appendix 1*]), one at the Botanical Site (BS1 G(20)) (Figure 2 [*B in Appendix 1*]), and three of the Legion Curve units (LC1 G(16), LC2 T(08), LC2 G(16)) (Figures 3 and 4 [*C and D in Appendix 1*]).

III. Equipment Needed:

Sherman live traps, paper clips, old fashioned rolled oats, flagging, mesh bag, 300-g (10.58-oz) hand-held spring scale (torn to the weight of the mesh bag), metric measuring tape, leather gloves, rubbing alcohol, ear tags, tag applicator, first aid kit, small mammal identification sheet, data sheets, watch, and pencils.

IV Methods:

Trapping

Trapping will be conducted in the fall (November and December) and spring (March and April) on grids and transects setup in each burn unit generally corresponding with methods described in Humphrey et al. (1986). Traps will be placed on site in such a manner as to avoid subjecting animals to extremes in temperature, predation, flooding or other hazards. Traps will be 10m apart from one another. Sherman traps, baited with rolled oats will be checked for four days at each site. Traps will be set late in the day (1500-1700 hrs) and checked in the morning (0730 to 0930 hrs), at which time traps will be closed. If heavy rainfall or flooding occurs during the night, two people will check the traps in the morning.

Data Recording

In the event of a capture, the animal will be moved from the trap to the mesh bag and weighed. To move the animal, place the open end of the mesh bag around the back of the trap, and while holding trap horizontal—and making sure no part of the animal is sticking through the bottom of the door—open the back door. Turn trap vertically so the mesh bag is underneath the trap, and blow a few quick bursts of air into the front door of the trap: usually this will make the animal fall through back door into the bag. Quickly close the bag tightly with your hand, then cinch the top. Clip the scale onto the bag, record weight. Roll down the closed bag to restrict movement in order to sex the animal, identify capture status, and take measurements before marking the individual if a new capture. Record the tag number, along with all other data, on the Small Mammal Trapping Data Sheet (Fig. 3 [*not included in Appendix 1*]).

Marking

If Sanibel Island rice rat or hispid cotton rat is a new capture, the individual will be marked with a 1005-1 National Band and Tag Co. tag using a standard tag applicator. Record the tag number before soaking the tag in rubbing alcohol. Place the tag so that the side with the hole is flat against the jaw of the applicator with the indentation. Also prepare a cotton ball to clean the ear with rubbing alcohol. Roll the closed bag down most of the way, leaving enough room for the animal to maneuver, and turn the bag upside down. The animal should turn so that its back faces the bottom of the bag. Roll the bag tight so the animal cannot move and scruff the animal by the back of the neck, being careful not to grab the ears. After a satisfactory grip is established, unroll the bag and open the top to expose an ear. Wrap the bag around the rest of the animal like a straight-jacket so it cannot struggle but be careful not to apply excessive pressure. Gently clean the exposed ear with the damp cotton ball using circular motions. Using the applicator, place the tag at the base of the ear near a cartilage ring. The tag should not cause the ear to fold out of normal shape. Apply pressure to the applicator and check to be sure the tag point has come through the hole and bent around for proper sealing.

V. Restrictions/Special Considerations:

Handling

Trapping will only be conducted only when temperatures are between 13° to 27°C (55° to 81°F). Personnel handling the small mammals should be made aware of potential disease transmission, be properly trained, and take all precautions to avoid being bitten. All captured animals will be

handled in a healthful and humane condition for the minimum time it takes to mark, examine, and sample the animal. All animals will be released at their point of capture. All requirements of the state permit will be followed (Figure 4 [*not included in Appendix 1*]).

Mortality

If mortality occurs, freeze the specimen so that staff can attempt to determine the cause of death from the available evidence. If disease is suspected, the specimen will be refrigerated and sent to the National Wildlife Health Center (NWHC) for diagnostic evaluation. Grace McLaughlin is the East Coast representative of the NWHC and can be reached at 608-270-2448 or gmclaughlin@usgs.gov and should be notified prior to the specimen being shipped. If predation becomes a problem (i.e., regular raccoon predation) then the traps will either be relocated or closed.

VI. Data Analysis and Reporting Procedures:

Species abundance, species occurrence, adjusted trap nights, and capture per unit effort (CPUE) data will be analyzed using these formulations:
Species abundance = # species captured/total captures
Species occurrence = # sites species captured/total # sites
Adjusted trap nights = (# traps * # nights) – (# tripped traps * 0.5)
Capture per unit effort (CPUE) = # new captures/# adjusted trap night. Further, this data will be entered into a Microsoft Access database and will be summarized in the monthly activity reports, annual narrative, and as part of evaluating the prescribed fire program. A detailed report of all activity and research conducted under the state permit will be reported to the Florida Fish and Wildlife Conservation Commission upon application for permit renewal (Figure 4 [*not included in Appendix 1*]).

VII. Data Storage Procedures:

At the end of each calendar year the data is incorporated into the administrative office filing system.

VIII. Literature Citations:

Humphrey, S. R., R. W. Repenning, H. W. Setzer. 1986. Status survey of five Florida mammals. University of Florida Cooperative Fish and Wildlife Research Unit. Technical Report No. 22, Research Work Order No. 16, Gainesville.

Bill Smith, Florida Fish and Wildlife Conservation Commission, St. Martins Marsh Aquatic Preserve 320-563-0450

IX. Review and Approvals:

Prepared by:_____ Date: _____
Reviewed by: _____ Date: _____
Management Approval: _____ Date: _____

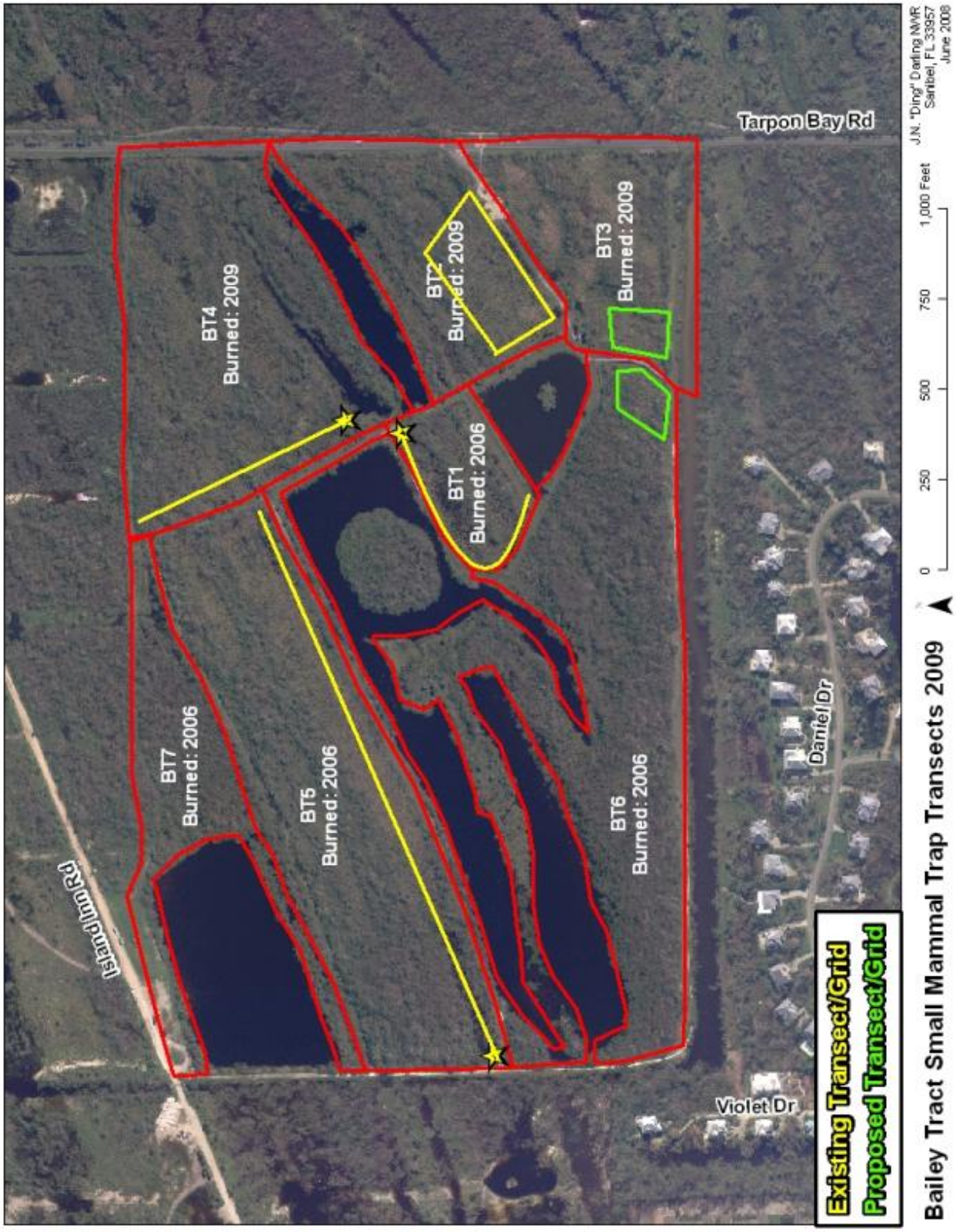

Figure A: Bailey Tract Burn Units and small-mammal trap transects

Figure B. Botanical Site Burn Units, transects, and grids.

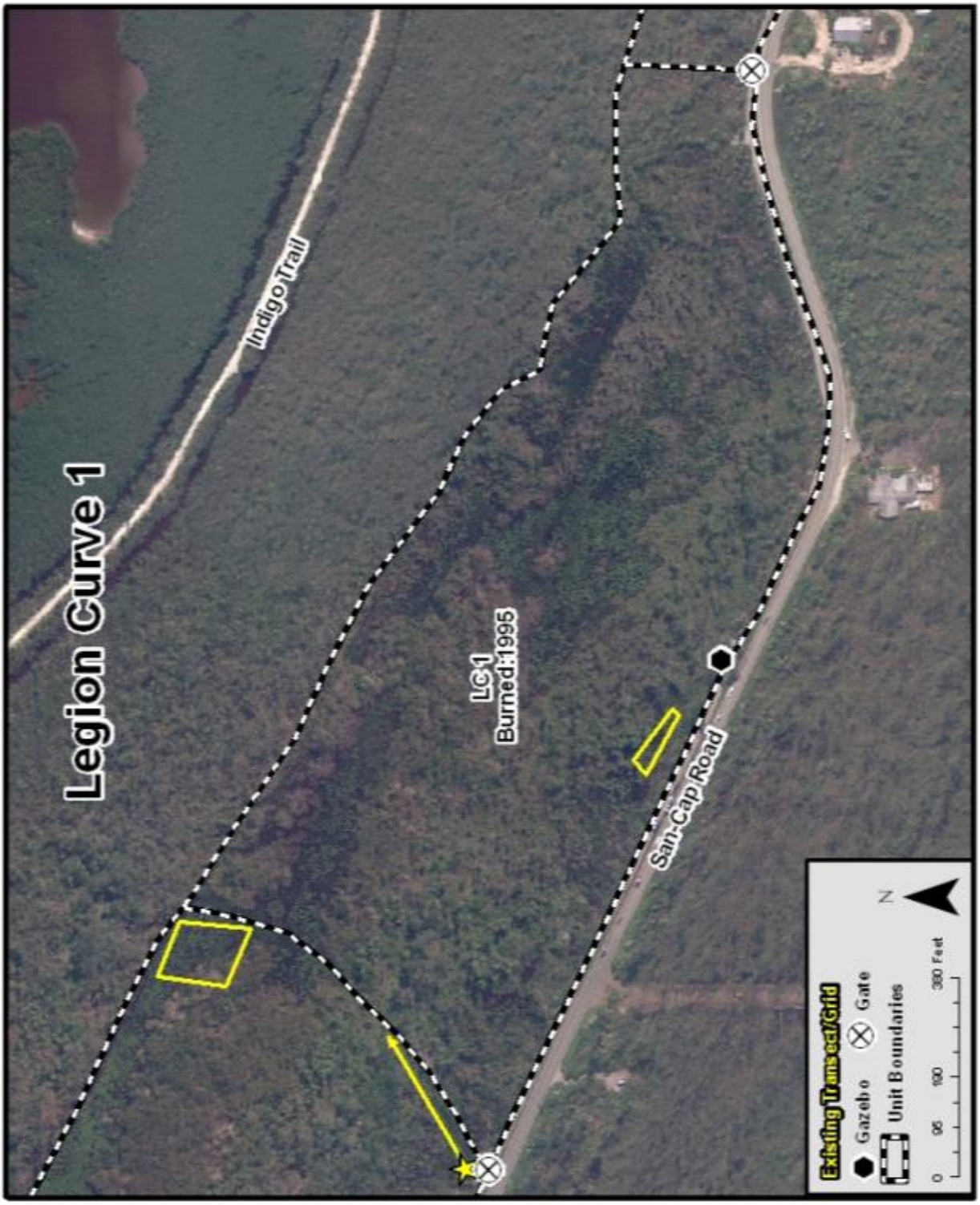

Figure C. Legion Curve 1 Burn Unit, transects, and grids

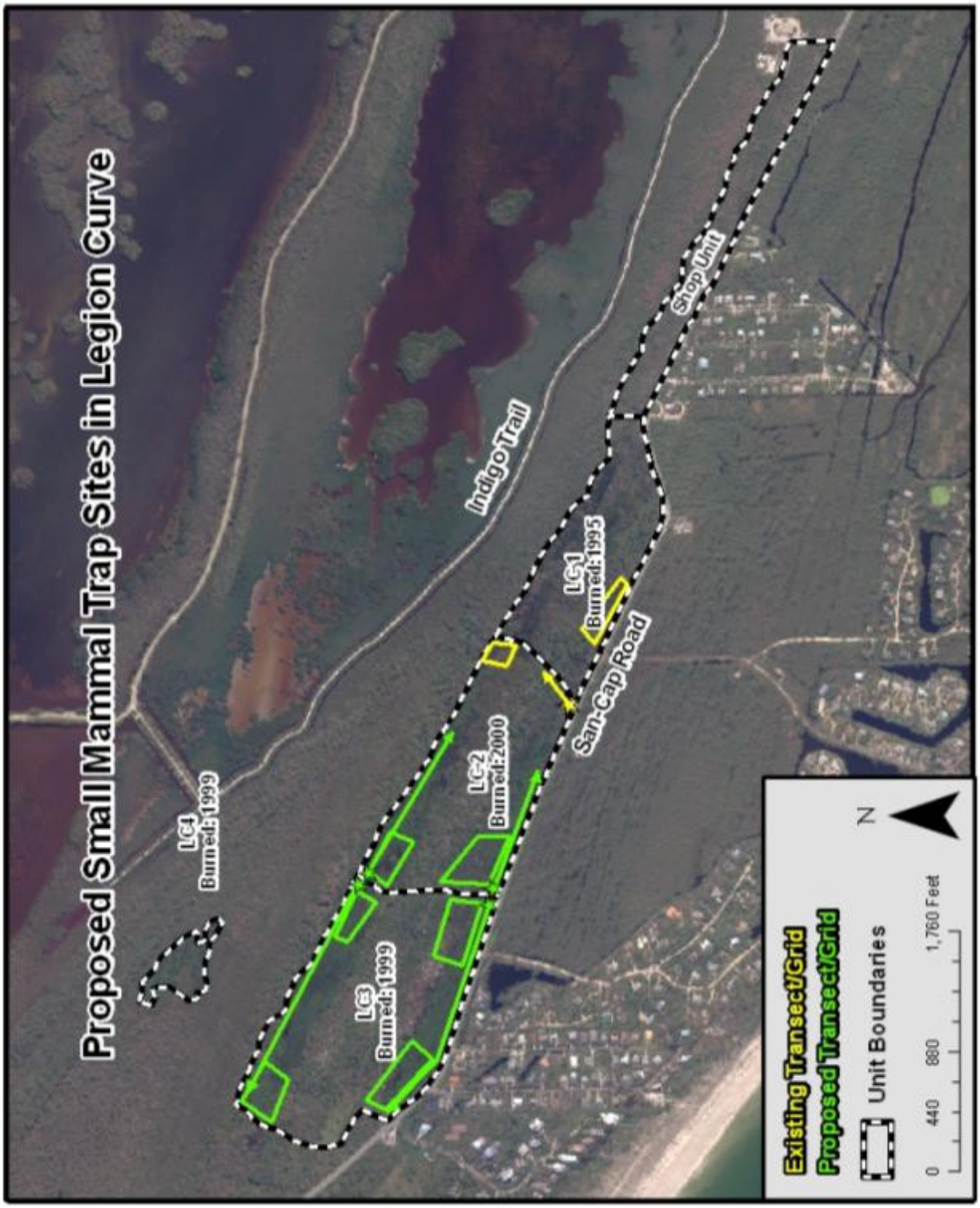

Figure D. Legion Curve Burn Units and proposed trap sites

Figure E. San-Cap Burn Units and possible traps sites in the San-Cap vicinity

Appendix 2. Memorandum of Understanding for Trapping and Management between DDNWR, City of Sanibel, and SCCF.

AGREEMENT NO. 40181BK004

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE U.S. FISH AND WILDLIFE SERVICE
J.N. "DING" DARLING NATIONAL WILDLIFE REFUGE
AND
THE CITY OF SANIBEL
AND
THE SANIBEL-CAPTIVA CONSERVATION FOUNDATION

This Memorandum of Understanding ("Agreement"), is entered into between the City of Sanibel, hereinafter referred to as the "City", the Sanibel-Captiva Conservation Foundation, hereinafter referred to as the "Foundation", and the U.S. Fish and Wildlife Service, hereinafter referred to as the "Service".

WITNESSETH

WHEREAS, the City has the authority to engage in this Agreement by virtue of Florida Statutes Chapter 163 and 166, and Section 1.03 of the City Charter; and

WHEREAS, the Service has the authority to engage in this Agreement by virtue of the National Wildlife Refuge System Administration Act of 1966; and

WHEREAS, the Foundation has the authority to engage in this Agreement by virtue of its By-Laws, Article IV. Section 2. Functions, and Section 4. Delegation of Authority; and

WHEREAS, the City, the Service and the Foundation are all involved in the important work of land management and environmental restoration including such activities as invasive non-native plan removal and the use of prescribed fire on managed conservation lands; and

WHEREAS, such management activities could in many instances be more efficiently and economically accomplished by the joint and cooperative use of resources including staff and equipment among the City, the Service and the Foundation; and

WHEREAS, the management goals of the City, the Service, and the Foundation in protecting natural resources and enhancing wildlife habitat on conservation lands on Sanibel Island are similar; and

WHEREAS, successful individual restoration projects on any part of the island are mutually beneficial to all three entities and residents of the island, the following provisions are hereby agreed to:

I. <u>Purpose</u>

This agreement is for the purpose of more efficiently and economically managing conservation lands of Sanibel Island.

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II. Scope of Work

For a period hereinafter set forth, the City, the Service, and the Foundation are authorized on a case-by-case and mutually agreed-upon basis, to furnish the necessary personnel, materials, services, facilities, or otherwise for the performance of work as follows:

A. Specifically, the City, the Service, and the Foundation will:

Provide personnel and/or equipment, materials, services, and facilities to assist in the management of conversation lands owned or managed by either of the other two entities on an as-needed, mutually agreed-upon basis. Such assistance will typically consist of, but is not limited to, invasive non-native plant control projects, prescribed burning efforts or wildlife research.

B. Nothing in this Agreement obligates any party to expend funds not appropriated and administratively allocated for such purposes. Each party to the Agreement retains the right to decline to offer or accept assistance on any project on a case-by-case basis and for any reason.

C. The value of the services provided to the Foundation by the City shall not exceed the value of the services provided by the Foundation so as not to violate the prohibition against lending of aid and credit to private organizations under the Florida Constitution.

III. Required Clauses

During the performance of this Agreement the participants agree to abide by the terms of Federal Executive Order 11246 on non-discrimination.

This Agreement is effective from the date of the last signature and shall remain in effect through 31 December 2015. It may be canceled by any party upon 90 days written notice.

U.S. FISH AND WILDLIFE SERVICE

By: _____ Printed Name: Paul Tritaik
Title: Refuge Manager Date: 22 November 2010

SANIBEL-CAPTIVIA CONSERVATION FOUNDATION, INC., a Florida not-for-profit Corporation

By: _____ Printed Name: Erick Lindblad
Title: Executive Director Date:

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CITY OF SANIBEL, a Florida municipal corporation

By: _____
City Clerk

By: _____
Mayor

Date: 3/15/11

Approved as to form: _____
City Attorney

10/3/2011
Chief, Contracting & Grant Services Division

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