Habitat Conservation Plan
for Florida Key Deer
(*Odocoileus virginianus clavium*)
and other Protected Species on
Big Pine Key and No Name Key,
Monroe County, Florida

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ACRONYMS AND ABBREVIATIONS

Act	Endangered Species Act
ADID	Advanced Identification of Wetlands
CARL	Conservation and Recreation Lands
CCP	Comprehensive Conservation Plan
CFR	Code of Federal Regulations
Corps	U.S. Army Corps of Engineers
County	Monroe County
CWA	Clean Water Act
DA	Department of Army
DCA	Florida Department of Community Affairs
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
F.S.	Florida Statutes
FWC	Florida Fish and Wildlife Conservation Commission
GIS	Geographic Information System
H	Harvest
HCP	Habitat Conservation Plan
ITP	Incidental Take Permit
K	Carrying Capacity
LCP	Livable CommuniKeys Program
LDR	Land Development Regulations
LOS	Level of Service
MCLA	Monroe County Land Authority
MM	Mile Marker on US-1
MOA	Memorandum of Agreement
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
NRCS	National Resource Conservation Service
PD&E	Project Development and Environment
Plan	Habitat Conservation Plan
Preserve	Coupon Bight Aquatic Preserve and Preserve Buffer
PVA	Population Viability Analysis
Refuge	National Key Deer Refuge
ROGO	Rate of Growth Ordinance
Service	United States Fish and Wildlife Service
US-1	U.S. Highway 1

EXECUTIVE SUMMARY

The Florida Department of Transportation (FDOT), Monroe County, and the Florida Department of Community Affairs (DCA)(the Applicants) submit this Habitat Conservation Plan (HCP or Plan), which addresses impacts to covered species resulting from potential development activities over a 20-year year period in Big Pine Key and No Name Key, Monroe County, Florida. Efforts to address Key deer and other protected species in Big Pine Key and No Name Key through an HCP started in the mid-1980s. In 1998, the Applicants signed a Memorandum of Agreement in which they committed to develop this HCP.

The species covered under this HCP are the Florida Key deer (*Odocoileus virginianus clavium*), the Lower Keys marsh rabbit (*Sylvilagus palustris hefneri*) and the eastern indigo snake (*Drymarchon corais couperi*). Activities covered under this HCP include residential and commercial development, as well as transportation improvements to meet the community needs of Big Pine Key and No Name Key.

The Applicants' objectives in developing this HCP were to allow for limited additional development activities on Big Pine Key and No Name Key, which will satisfy safety, functional, and recreational needs of a rural community, while maintaining the long-term viability of covered species and their habitat. The primary, measurable goals of this HCP are: a) to ensure future development does not have a negative impact on covered species habitat, and b) to limit the increase in human-related mortality of Key deer and Lower Keys marsh rabbit to a level that would make quasi-extinction (defined as the probability that the population fall to 50 or fewer females at least once in 50 years) unlikely. Additionally, the Plan aims at keeping secondary impacts to Lower Keys marsh rabbit to current levels or below.

Concurrently with the HCP, Monroe County carried out a planning effort based on community participation, the Livable CommuniKeys Program (LCP). Like the HCP, the overall goal of the LCP was to determine the appropriate amount, type and location of development in the project area that would provide for community needs, while maximizing conservation of the Key deer and other covered species through appropriate avoidance, minimization and mitigation.

HCP Covered Area

The HCP project area encompasses 7,031 acres: 5,840 acres on Big Pine Key and 1,191 acres in No Name Key. These two islands support more than two-thirds of the Key deer population. Sixty-six percent of the project area is in conservation, including Federal lands within the National Key Deer Refuge (Refuge), state-owned lands and lands owned by the Monroe County Land Authority (MCLA). Although these lands currently receive protection, they are included within the Plan's covered area because the effects of development on Key deer are evaluated throughout Big Pine Key and No Name Key. The main landowner is the Federal government with 55 percent, all of which is within the Refuge. Federal, state, and county agencies purchase and manage lands within the project area for the purpose of environmental protection and conservation. The Service owns 52 percent of Big Pine Key and 71 percent of No Name Key. The State of Florida purchases land under the Conservation and Recreation Lands (CARL) program, which is administered by the Florida Department of Environmental Protection (FDEP).

State-owned lands within the project area include the Coupon Bight Aquatic Preserve and Preserve Buffer Lands and lands within the Coupon Bight/Key Deer CARL project area, which combined are less than ten percent of the project area. The Monroe County Land Authority (MCLA) purchases a wide variety of vacant lands as directed in the Monroe County Comprehensive Plan and owns two percent of the land within the project area.

Public Involvement

The development of the HCP included extensive public involvement activities. The public information and participation plan included identification of stakeholders, periodic project-update mailings, several public meetings, and an open-door policy for public input. Three public meetings were held in Big Pine Key between February 2000 and March 2001. The objectives of the meetings were to inform the public about the scientific basis of the HCP, describe how land development alternatives were evaluated, and obtain input to ensure that all points of view were considered.

Scientific Basis of the HCP

Biological studies performed for this HCP focused on the Key deer, and emphasized a habitat-based approach for covered species. The Key deer and the eastern indigo snake are wide ranging and utilize virtually all available habitat in the project area, including developed areas. In contrast, the Lower Keys marsh rabbit is restricted to wetland and surrounding habitats. Therefore, the Plan focused on the Key deer as an "umbrella species" and operated under the assumption that avoiding and minimizing impacts to Key deer habitat, would also provide direct protection to both populations and habitats of other terrestrial species. The HCP also applies the most recent data on the distribution and habitat utilization of the Lower Keys marsh rabbit, provided by the Service.

Lopez (2001) studied the ecology and population dynamics of the Key deer for three years. He followed the movement, habitat utilization and fate of over 200 deer using radio-telemetry and census procedures. The study produced a Population Viability Analysis (PVA) model to evaluate the impacts of development scenarios on the Key deer population. The PVA model incorporated Key deer movements, habitat utilization, ecology and demographic data and included two main components: a) a matrix model of population dynamics and b) a spatial habitat model of carrying capacity and secondary impacts.

The PVA model is a tool to evaluate the likelihood that the species will persist for a given time into the future under different scenarios. Land development alternatives produced by the community were evaluated using the PVA model to quantify the associated impacts to Key deer in the project area. The model has the following characteristics:

- It includes a spatial component, which addresses the spatial differences in habitat quality and human-related effects on the Key deer, and a matrix model of population dynamics.
- The effects of development activities can be described as changes in the spatial model. In turn, changes in the spatial model affect the parameters of the matrix model.

- The unit of impact in the spatial model, termed "H", can be applied to any type of development activity. For any development activity, the spatial model estimates an H value.
- H measures both direct habitat loss and indirect human-related effects on Key deer.
- For any H value, the matrix model estimates the effects on the Key deer population in terms of a) the probability of quasi-extinction and b) the number of additional human-related Key deer deaths per year.

The spatial component of the PVA model provides a reliable predictor of development impacts on the Key deer: Harvest (H), which is highly correlated with estimates of impacts. Therefore, we use H to measure impacts and mitigation in this HCP. The Key deer PVA yielded equations that relate H to estimates of risk and additional human-related mortality; therefore, if we can assign an H value to a development activity, then we can evaluate the effect of that development activity on the Key deer. The Applicants developed a method to assign H to any development activity based on the following three main premises:

1. *If development occurs on an undeveloped parcel, the impact equals the H of the parcel:* The Applicants assumed that an undeveloped parcel is fully available to the Key deer and that new development affects the habitat value of the entire undeveloped parcel. Therefore, the impact of such development equals the H of the entire parcel.

2. *If development occurs on a developed parcel (e.g., expansion or redevelopment), the impact of development equals the H of the footprint of the additional development:* The Applicants assume that the impact of existing development has been already realized; therefore, the H of development that occurs in parcels that are already developed is associated with the footprint of the additional activity instead of the entire parcel area.

3. *The effect of the development activity depends on the type of development or land use:* Because roadway mortality is the largest cause of human-related mortality of Key deer, the H value for a development activity is multiplied by a factor that accounts for the traffic generated by the specific land use or type of activity.

The Tier System: A Planning Tool to Manage Development and Conservation

Based on the Key deer studies done under this HCP and the resulting spatial model, Monroe County developed a conservation priority classification for private undeveloped lands in the study area. The private undeveloped lands in the study area are classified into three "Tiers." Tier 1 lands are higher quality Key deer habitat. Tier 3 lands are the lowest quality Key deer habitat. Most of the parcels in Tiers 2 and 3 are interspersed among developed parcels and among canals, and provide little habitat value to the covered species. The tier classification helped in determining the location of potential new development and prioritizing mitigation areas.

Covered Activities

This HCP addresses the incidental take of protected species that may result from development activities in Big Pine Key and No Name Key in the next 20 years. The types of activities covered under this HCP include residential development, commercial development and expansion, community and institutional facilities, and transportation improvements.
The Applicants anticipate the following development activities will occur in the covered area in the permit period and within a total H = 1.1:

- *New Residential Development:* A maximum of 200 residential units.
- *Non-Residential Private Development:* The county will authorize limited non-residential development as well as expansion or redevelopment of commercial facilities and community organizations such as religious institutions and civic clubs. The Applicants anticipate that no more than 60,000 square feet of floor area will be added over 20 years.
- *Recreational and Community Facilities:* The county anticipates the development of recreational and community center facilities, including passive public parks, and neighborhood "pocket" parks, as well as the expansion of the existing public library.
- *Public Facilities:* Several public facilities are anticipated over the next 20 years, such as a sewage treatment plant, public office space, and the expansion of the existing emergency response facility. The Applicants anticipate that no more than 24,000 square feet of floor area will be allocated to recreational and community facilities and other public facilities.
- *Local Road Paving or Widening:* Over the next 20 years, some local dirt roads may be paved and some paved roads may be widened to accommodate a bike path.
- *Three-Laning US-1:* The DOT will complete the addition of a third lane, a scramble lane, on the developed segment of US-1 on Big Pine Key. This involves the extension of the newly constructed turn lane east and west of the intersection improvement project.

In addition to limiting the total amount of development over 20 years to a maximum, cumulative H = 1.1, covered activities will comply with the avoidance and minimization guidelines established in this HCP. New development will be concentrated on already disturbed lands in order to minimize the loss of prime habitat for the covered species. New commercial development will be limited to infill areas mainly along the existing commercial corridor on US-1. The Applicants estimate that no more than 7 acres of native vegetation will be cleared over the permit period. Wetland impacts, estimated at no more than 3 acres over 20 years, will be limited to roadside swales and ditches. A limited number of fences and other accessory uses will be permitted. No new fences in Tier 1 habitat unless authorized by the Service.

The Master Plan for Future Development of Big Pine Key and No Name Key, developed in accordance with this HCP, regulates the amount and extent of each type of covered activity over the next 20 years in the project area. Other activities not described in this HCP are not authorized under this HCP.

Summary of Take and Its Effects on the Covered Species

All development activities combined over the 20-year period will have a maximum total impact of H = 1.1. For H = 1.1, the resulting probability that the population fall below 50 females at least once in 50 years and the average additional total annual human-related mortality are, respectively:

$$\text{Percent Risk}_{(50)} = 2.2e^{0.58*1.1} = 4.2\%$$

$$\text{Additional Annual Human-Related Mortality} = -0.65*1.1^2 + 4.85*1.1 - 0.34 = 4.2 \text{ deer/year}$$

Thus, the PVA model predicts that the combined effect of 20 years of development for a total H = 1.1 would raise the probability that the population will fall under 50 females at least once in 50 years by 2.0 percent over the risk under current conditions (from 2.2 to 4.2 percent) and increase human-related Key deer mortality by 4.2 deer a year. Additionally, the probability of extinction in 100 years is less than 0.1 percent, nearly indistinguishable from current conditions.

The Applicants anticipate no direct loss of Lower Keys marsh habitat as a result of covered activities. No development impacts to identified marsh rabbit habitat will be permitted. Indirect effects to marsh rabbit may result if development occurs near marsh rabbit habitat patches. The potential effect of this level of development is ameliorated because the majority of available lots within 500 meters of marsh rabbit habitat are adjacent to canals, in subdivisions already heavily developed.

Take of eastern indigo snake habitat is expected in the covered area of the HCP. The Applicants estimate that development activities over 20 years may occur on parcels totaling 168 acres (2.4 percent of the covered area).

Mitigation and Implementation

The Applicants propose to mitigate for the incidental take of covered species mainly by acquiring and managing native habitat areas within the HCP project area. The harvest grid used in the PVA provides a measure of habitat quality and potential indirect effects (i.e., increased human-related mortality) on the Key deer. It also provides a simple currency to compare impacts versus mitigation.

This HCP proposes a level of incidental take that results in a total H = 1.1. The Applicants will mitigate incidental take impacts by acquiring and managing habitat areas at a 3:1 ratio, using H as the unit of measurement. Therefore, over 20 years, lands for a maximum H = 3.3 will be acquired and managed. Land acquisition will occur in advance of or simultaneously with development activities. Should the cumulative $H_{acquired}$ lag the cumulative H_{impact} by 5 percent at any time during the permit period, Monroe County will halt development permit issuance until $H_{acquired}$ is within 5 percent of H_{impact}.

Monroe County will manage all natural lands acquired under this HCP, either directly or indirectly through agreements with other managing entities. Lands in the project area acquired for the HCP will comprise lands purchased by the Monroe County Land Authority (MCLA) for

the Florida Forever Program and lands purchased by the MCLA in accordance with the Monroe County Comprehensive Plan.

Monroe County will enact land development regulations, which will follow the guidelines for a rate of growth and development standards described in this HCP. Since 1992, Monroe County has successfully administered a Rate of Growth Ordinance that directs growth into disturbed lands and protects environmentally sensitive lands. The county has awarded 2,014 Rate of Growth Ordinance (ROGO) allocations since July 1992, of which only about six percent of the total were awarded to parcels with environmentally sensitive characteristics. Nearly half of this six percent was awarded to affordable housing projects.
With this HCP, the Applicants consolidate their efforts to provide for the protection of the Key deer and other covered species in the project area. For example, ongoing land acquisition has increased the amount of habitat protected in perpetuity. Beginning in 1993, FDOT invested approximately $12 million to study, plan, and execute projects to reduce highway mortality of Key deer and improve safety on US-1 in Big Pine Key.

The Applicants will carry out biological and compliance monitoring to ensure that the biological goals and the commitments made in this HCP are met. Biological monitoring of the Key deer will focus on assessing the relative occurrence of human-related mortality. The main objective of the biological monitoring is to determine if human-related mortality is increasing beyond the levels observed in recent years. Specifically, the biological monitoring will test the null hypothesis that, as development activities proceed in the project area, there will be no significant increase in the relative incidence of human-related mortality. Compliance monitoring will include an annual compilation of the amount of development completed and acres converted, number of acres acquired, and a summary of habitat management activities by Monroe County. The total H for development and acquisition will be determined using the spatial model and the appropriate land use H conversion factors.

Monroe County will prepare and submit an annual HCP Report to the Service at the end of the reporting year. The reporting period will cover January 1 through December 31 and will be submitted by March 31 following the end of the reporting period. The report will address both the biological monitoring and the compliance monitoring.

Adaptive management provisions in the HCP's aim at reducing risk to the species due to significant data, information gaps, or to circumstances which arise requiring a change in species management or acquisition strategies. The Key deer has been extensively studied (Lopez 2001) and ongoing research programs at Texas A&M University are addressing the Key deer, the silver rice rat and the Lower Keys marsh rabbit. The Key deer PVA model is the state-of-the-art and will likely be fully applicable unless conditions change dramatically. No further studies are proposed as part of this HCP.

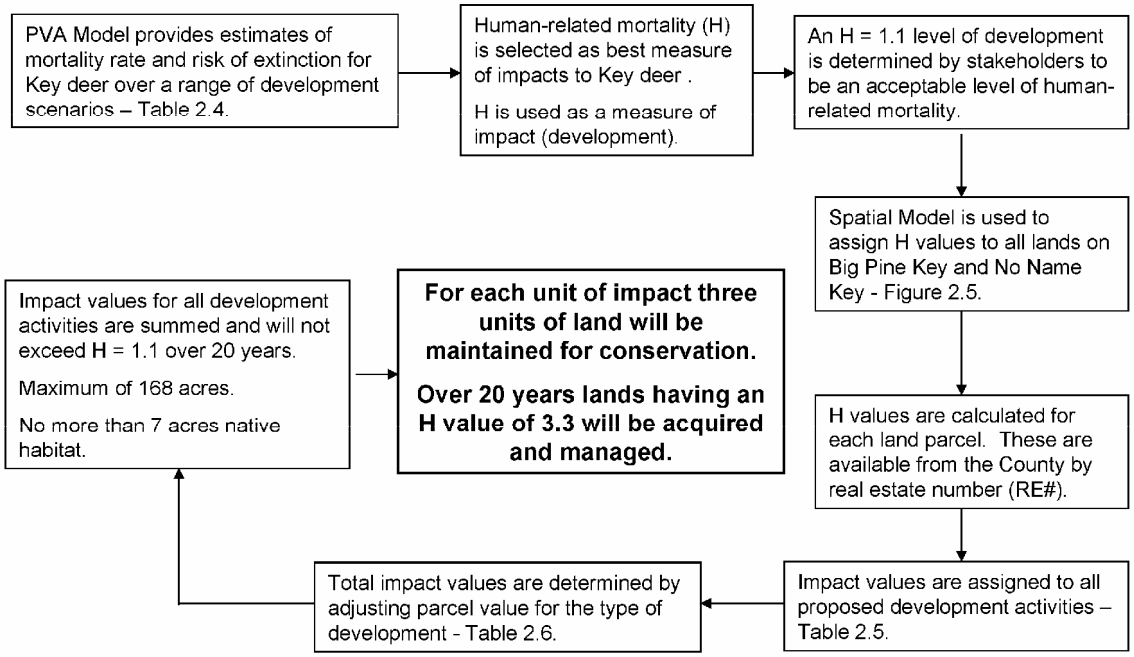
Reasonably foreseeable circumstance, which may occur in the project area or to the covered species include hurricanes, flooding, fire, or sudden population decline due to disease or habitat degradation.

Upon approval of the HCP and issuance of the ITP, the county will amend its Comprehensive Development Plan (Comp Plan) and Land Development Regulations (LDR) to codify the development guidelines described in this HCP. The Master Plan for Future Development of Big Pine Key and No Name Key determines the rate of growth and development standards in the project area, in accordance with the guidelines described in this HCP.

Monroe County will act on behalf of the Applicants in conducting the Plan's mitigation program and for all reporting activities under this HCP. In addition, Monroe County will be responsible for the following activities: approving development consistent with the covered activities in the HCP; maintaining a Geographic Information System (GIS) database on the number, habitat type and location of development activities and mitigation actions including acquisition and management activities; funding or providing staff for biological monitoring and annual reporting activities; establishing and maintaining an annual budget and budget amendments for HCP adoption and implementation; and all other duties and responsibilities relating to the execution of the HCP. Moreover, the county will be responsible for ensuring that all mitigation activities are implemented concomitant with development activities. Finally, Monroe County will coordinate with FDOT and DCA to ensure that the provisions of this HCP are met.

Monroe County will fund land acquisition and management under this HCP through existing funding mechanisms. Since 1986, the MCLA has been tasked with acquiring lands for the county in accordance with the Monroe County Comprehensive Plan Land Authority Ordinance (Ord. No. 31-1986, 1), and by s. 380.0661-380.0685, F.S., s. 125.0108, F.S. The MCLA was established to conduct land acquisition activities necessary to deal with property rights of small landowners, environmental protection, park and recreational space, affordable housing and public infrastructure should there be an environmental component. The MCLA provides a mechanism to "deal with the challenges of implementing comprehensive land use plans pursuant to the area of critical state concern program, which challenges are often complicated by the environmental sensitivity of such areas (and to provide) a stable funding source and the flexibility to address plan implementation innovatively and by acting as an intermediary between landowners and the governmental entities regulating land use" (Section 1-3, Rule 02-1991, MCLA).

Big Pine Key HCP Flowchart



November 10, 2004

1. INTRODUCTION AND BACKGROUND

1.1 Background and Purpose of the Plan

The Florida Department of Transportation (FDOT), Monroe County, and the Florida Department of Community Affairs (DCA)(the Applicants) submit this Habitat Conservation Plan (HCP or Plan), which addresses impacts to covered species resulting from potential development activities over a 20-year year period in Big Pine Key and No Name Key, Monroe County, Florida (Figure 1.1). Activities covered under this HCP include residential and commercial development, as well as transportation improvements to meet the community needs of Big Pine Key and No Name Key. The HCP establishes the guidelines under which covered activities may occur and describes a conservation and mitigation strategy to minimize and mitigate for the incidental take of threatened and endangered species during the execution of covered development activities. The Plan has been developed in accordance with the Federal Endangered Species Act of 1973 (ESA), as amended (87 Stat. 884; 16 U.S.C. 1531 *et seq.*).

Several species listed at the Federal and/or state level(s), including the endangered Florida Key deer (*Odocoileus virginianus clavium*), have been documented to occur, or have the potential to occur, within the project area. The Applicants have determined that the incidental take of Key deer may occur as a result of development activities during the next 20 years. Incidental take coverage is also requested for the Lower Keys marsh rabbit (*Sylvilagus palustris hefneri*) and the eastern indigo snake (*Drymarchon corais couperi*), which may be indirectly affected mainly through habitat loss by urban development activities throughout the 20-year period.

This HCP and accompanying Incidental Take Permit (ITP) application support the Applicants' request for the incidental take of Key deer, Lower Keys marsh rabbit, and eastern indigo snake from the U.S. Fish and Wildlife Service (Service). In compliance with the ITP issuance criteria listed in Section 10(a)(1)(B) of the ESA, the HCP provides for the minimization and mitigation of the incidental take. The Applicants believe that the amount of incidental take requested is not likely to jeopardize the survival and recovery of the covered species in the wild.

The Applicants understand that the ITP itself does not authorize development activities. Instead, the ITP authorizes the incidental take of covered species that may occur as a result of covered activities during the permit period.

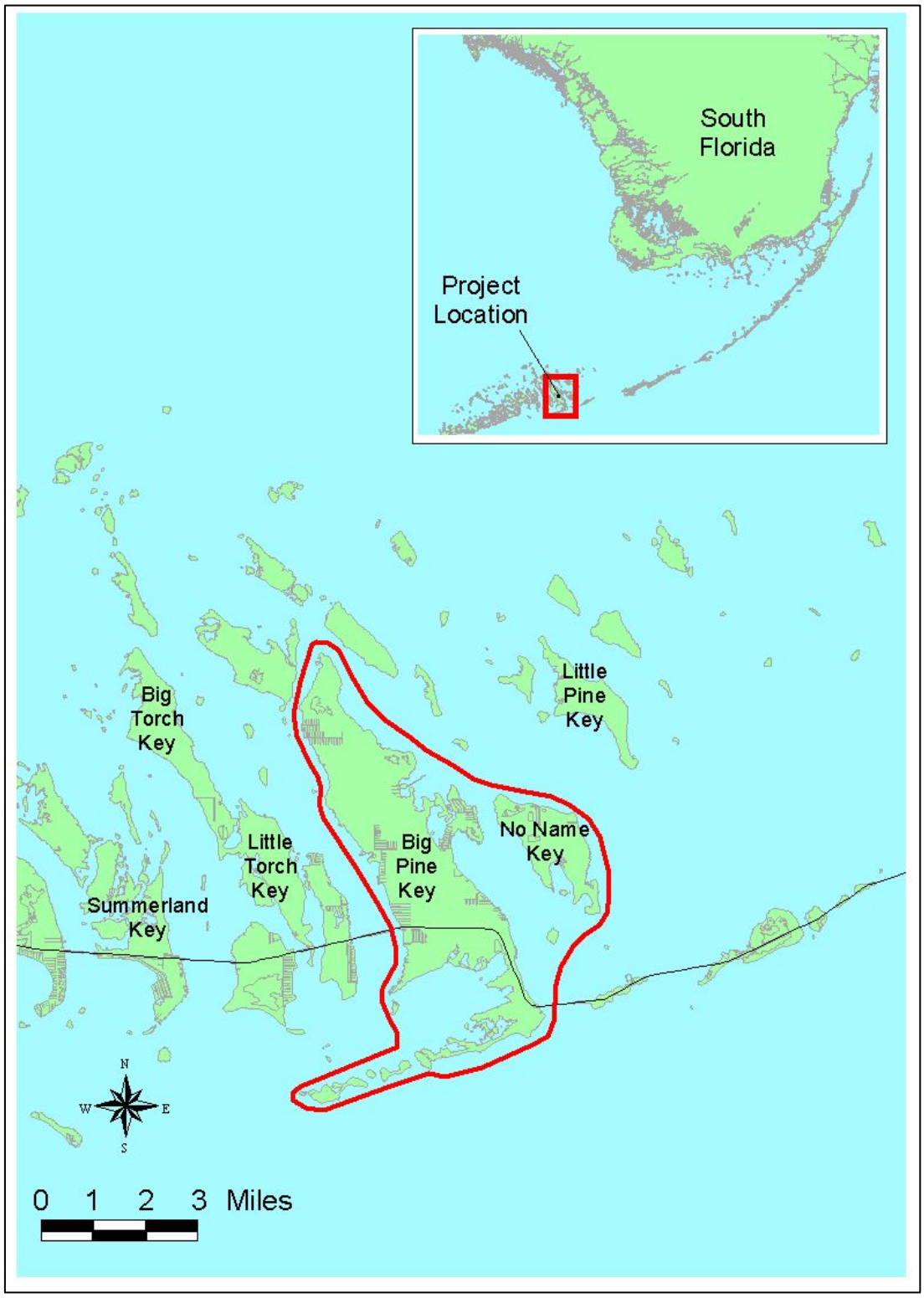


Figure 1.1. Project area

1.1.1 Historical Background and Memorandum of Agreement

Several listed species, including the Key deer, occur on Big Pine Key and No Name Key. The Key deer are wide-ranging and use a variety of habitats, including developed areas; consequently, they share much of their range with the human population. The Key deer was listed as endangered at the Federal level in March 1967 [32 Code of Federal Regulations (CFR) 4001]. Following the establishment of the National Key Deer Refuge (Refuge) in 1957, population levels began to recover. In 1951, there were an estimated 25 to 80 individuals; by 1973 the population had recovered to approximately 300 to 400, including 151 to 191 deer on Big Pine Key alone (FDOT 1999). However, mortality from road kills and habitat loss continued to threaten the population and, by 1982, population numbers were down to between 250 and 300 individuals (Klimstra 1985, Service 1985).

In the late 1980s, the FDOT began consultation to find a solution to the high road mortality of Key deer along portions of US-1 on Big Pine Key. In September 1993, FDOT convened a stakeholders meeting, after which an Ad Hoc Committee pursued solutions to the highway mortality of the Key deer. FDOT funded a Concept Study to examine viable alternatives for reducing Key deer mortality caused by vehicle collisions. The study focused on consensus building via public involvement and agency coordination, coupled with scientific analyses, and identified a series of structural and non-structural alternatives (FDOT 1996). The Concept Study recommended that wildlife underpasses be installed to allow the Key deer to move safely across the undeveloped segment of US-1 (approximately MM 33.0 to MM 31.0) and that a series of non-structural options, including signage, be implemented in the developed portion of US-1 in Big Pine Key (approximately MM 31.0 to MM 29.5).

Following the recommendations of the Concept Study, FDOT funded a Project Development & Environment (PD&E) Study to further evaluate the alternatives identified in the Concept Study (FDOT 1998). During the course of the PD&E Study, a Technical Task Force developed possible solutions for alleviating traffic congestion on US-1 on Big Pine Key. The Task Force recommended an intersection improvement project in the vicinity of the signalized intersection at US-1 and Key Deer Boulevard. Intersection improvements included adding a northbound through lane on US-1, both east and west of the traffic signal; extending the intersection's existing southbound left-turn lane on US-1; and improving the traffic signalization timing.

The PD&E Study included extensive public involvement and formal consultation with the Service. In January 1999 and April 2001, the Service issued Biological Opinions for the Key deer (Service 1999, 2001a). The wildlife underpasses and intersection improvement project were constructed after consultation for the Key deer was completed.

Since 1995, Big Pine Key has been under a building moratorium due to a lack of concurrence with State of Florida transportation requirements, as the level of service (LOS) of US-1 was insufficient. (The moratorium was lifted temporarily in 1996.) Improvements to US-1 would improve the LOS, thereby alleviating the building moratorium. The Service agreed to allow the intersection improvement project to proceed on the condition that an HCP be prepared. In 1998, the Applicants, the Service and the Florida Fish and Wildlife Conservation Commission (FWC) signed a Memorandum of Agreement (MOA) to develop an HCP for the Key deer and other

protected species in the project area. The purpose of the MOA was to direct an interagency approach to the conservation of Federally protected species on Big Pine Key and No Name Key. Specific objectives of the MOA were to define the relationships and cooperative agreements between signatory parties, determine appropriate growth and build out levels for the project area and establish a multi-agency HCP Coordinating Committee.

1.1.2 Coordinating Committee

In accordance with the MOA, the Applicants established a multi-agency HCP Coordinating Committee at the outset of the HCP process. The Coordinating Committee included representatives from the Applicants, the Service and the FWC, and two citizen representatives from Big Pine Key and No Name Key. The objectives of the Coordinating Committee were:

- To acquire and manage consultants tasked with developing the HCP;
- To establish funding obligations among the HCP Applicant Agencies;
- To define the desired outcome of the HCP; and
- To define Applicant roles.

The HCP Coordinating Committee met approximately every other month, beginning in late 1999 and continuing through December 2002.

1.1.3 Objectives of the Plan

The Applicants' objectives in developing this HCP are to allow for limited additional development activities on Big Pine Key and No Name Key, which will satisfy safety, functional, and recreational needs of a rural community, while maintaining the long-term viability of protected species and their habitat. Concurrently with the HCP, Monroe County carried out a planning effort based on community participation, the Livable CommuniKeys Program (LCP) (Monroe County 2004). Like the HCP, the overall goal of the LCP was to determine the appropriate amount, type and location of development in the project area that would provide for community needs, while maximizing conservation of the Key deer and other covered species through appropriate avoidance, minimization and mitigation.

At the outset of the study, the Applicants worked in consultation with the Service to establish clear and measurable biological goals for the HCP. Initially, a 5 percent probability of extinction in 100 years for the Key deer was established as the biological threshold to measure the effect of development activities. During the development of the HCP, this threshold was modified to a 5 percent probability of quasi-extinction (defined as the probability that the population fall to 50 or fewer females at least once in 50 years), instead of the 5 percent probability of extinction in 100 years previously proposed (see Section 5).

Biological studies performed for this HCP focused on the Key deer, and emphasized a habitat-based approach for covered species. The Key deer and the eastern indigo snake are wide ranging and utilize virtually all available habitat in the project area, including developed areas (Lopez

2001). In contrast, the Lower Keys marsh rabbit is restricted to wetland and surrounding habitats. Therefore, the Plan focused on the Key deer as an "umbrella species" and operated under the assumption that avoiding and minimizing impacts to Key deer habitat, would also provide direct protection to both populations and habitats of other terrestrial species.

The Plan aims at providing for the protection of covered species in the project area, while allowing development activities that satisfy community needs in Big Pine Key and No Name Key.

1.2 Plan Development Process and Methodology

The development of the HCP included scientific studies, developing and evaluating alternatives, and implementing a public information and participation program. Concurrently with the HCP, Monroe County carried out a planning effort, the LCP, based on community participation, in order to determine community needs. Monroe County initiated the LCP in April 2000 and adopted the Master Plan for Future Development of Big Pine Key and No Name Key in December 2004 (Monroe County 2004). The LCP addressed the needs of the local citizens and examined all development alternatives in the context of the Key deer's biology. The LCP helped determine the community's preferred type, location, and amount of development in the project area. A Development Alternatives Report, produced in March 2001 (Monroe County 2001), provides a detailed description of the final LCP alternatives, the methods used to develop these alternatives and the planning criteria by which alternatives were evaluated. The LCP for Big Pine Key and No Name Key, as well as this HCP, provide the basis of a Master Growth Management Plan, which will constitute the main tool to implement growth controls in order to meet the requirements of the HCP and the ITP for future development within the project area.

1.2.1 Technical Studies

Lopez (2001) studied the ecology and population dynamics of the Key deer for three years. He followed the movement, habitat utilization and fate of over 200 deer using radio-telemetry and census procedures. The study produced a Population Viability Analysis (PVA) model to evaluate the impacts of development scenarios on the Key deer population.

The PVA model is a tool to evaluate the likelihood that the species will persist for a given time into the future under different scenarios. Land development alternatives produced by the community were evaluated using the PVA model to quantify the associated impacts to Key deer in the project area. Dr. Resit Akcakaya (Applied Biomathematics, Inc.), an expert in population models and PVA reviewed and critiqued the PVA model in June 2000 and August 2001. Additionally, two technical workshops were held in Miami, Florida among the Applicants, the Service and the FWC to review the Key deer PVA model. For a description of PVA model development, see Section 2.4.

1.2.2 Public Information and Involvement

The development of the HCP included extensive public involvement activities. The public information and participation plan included identification of stakeholders, periodic project-update mailings, several public meetings, and an open-door policy for public input. Stakeholders are those individuals and organizations with an economic, cultural, social or environmental interest in the HCP. They include property owners, elected officials and other community leaders, Federal, state and local governments, permitting and reviewing agencies, environmental organizations, members of the media, and interested private citizens. Using the 1999 Monroe County Property Appraiser database as a foundation, a stakeholder database containing the names and addresses of more than 4,400 landowners was developed.

Public feedback helped identify over 100 additional stakeholders, who were included in the database. These additional stakeholders represent individuals or groups that did not own land within the project area but were interested in the process and outcome of the HCP, including non-profit and environmental organizations. The list of stakeholders was used to distribute public meeting invitations and project status reports. The stakeholder database was continually updated and maintained, per input received at public meetings from private landowners, citizen letters to the FDOT, and forwarding addresses provided by the U.S. Postal Service.

Three public meetings were held in Big Pine Key between February 2000 and March 2001 (Table 1.1). The objectives of the meetings were to inform the public about the scientific basis of the HCP, describe how land development alternatives were evaluated, and obtain input to ensure that all points of view were considered. Meetings were announced through direct mailings to property owners and other stakeholders, radio announcements, and newspapers. Generally, the public meetings included a presentation and a question and answer session. Public comments were recorded in every meeting. Meetings were held in accordance with applicable state and Federal laws, including provisions for the disabled as required by the Americans with Disabilities Act.

1.3 HCP Covered Area

The Florida Keys, including the project area, comprise a 113-mile long chain of islands extending southwest from the southern tip of the Florida mainland peninsula to the Dry Tortugas. Key Largo (25.1 square miles) and Big Pine Key (10.4 square miles) are the largest islands in this chain and possess the greatest diversity and acreage of habitats. Big Pine Key and No Name Key are situated in the southern third of the Florida Keys, also known as the Lower Keys. Long narrow channels separate the islands and connect the Gulf of Mexico with the Straits of Florida (Figure 1.1).

Table 1.1. HCP public meetings

	First Public Meeting	Second Public Meeting	Third Public Meeting
Date	February 1, 2000	April 17, 2000	March 27, 2001
Time	7:00 pm	7:30 pm	Two sessions: 4:30 pm and 7:30 pm
Venue	Big Pine Key United Methodist Church	Big Pine Key United Methodist Church	Big Pine Key Neighborhood School
Number of Attendees	Approximately 400	Approximately 100	Approximately 35 at each session (70 total)
Meeting Objectives	• Introductory meeting • Present background material and the HCP process • Present the project schedule and upcoming activities • Provide opportunity to identify public concerns	• Present the model, its opportunities and constraints • Present current status of the Key deer • Discuss land acquisition programs, land use regulations and traffic analyses	• Present preliminary model results for biological analysis of the Key deer and Lower Keys marsh rabbit • Discuss how the Livable Communi-Keys Program's scenarios will interrelate with the knowledge of the species biology

The HCP project area encompasses 7,031 total acres, including 5,840 acres on Big Pine Key and 1,191 acres No Name Key. No Name Key is only connected by a two-lane bridge to Big Pine Key. These two islands support more than two-thirds of the Key deer population. Sixty-six percent of the project area is in conservation, including Federal lands within the National Key Deer Refuge (Refuge), state-owned lands and lands owned by the Monroe County Land Authority (MCLA). Although these lands currently receive protection, they are included within the Plan's covered area since the effects of development are evaluated on Key deer throughout Big Pine Key and No Name Key.

1.4 Regulatory Basis of the HCP

1.4.1 Endangered Species Act

The U.S. Congress enacted the Endangered Species Act in 1973 (ESA), as amended (87 Stat. 884; 16 U.S.C. 1531 et seq.), to protect plant and animal species that are in danger of extinction throughout all or a significant portion of their range. Under Section 7 (a)(1) of the ESA, Federal agencies are required to use their authority to further the conservation of listed species. The Service is responsible for administering the ESA for those species under its jurisdiction. Section 9 of the ESA prohibits unauthorized take of Federally listed species. The ESA defines the term "take" as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such activity. "Harm" is defined to include significant habitat modification or degradation that results in the death or injury of listed species by significantly impairing essential behavioral patterns, which include, but are not limited to breeding, feeding or sheltering (50 CFR

Part 222). "Harass" is defined as actions that create the likelihood of injury to listed species to an extent as to significantly disrupt normal behavior patterns (50 CFR Part 17.3). The Section 9 prohibitions against "take" apply to states, counties, municipalities, and individuals.

The ESA provides two regulatory methods for development activities on lands containing Federally listed species. The first method is for Federal activities, which include, but are not limited to, development or work that requires the issuance of Federal permits, authorization, or funding. The authorization for take is accomplished through interagency consultation required under Section 7 of the ESA. The second method, Section 10 of the ESA, provides exceptions to Section 9 prohibitions, addressing non-Federal activities such as private development concerns.

The Applicants' proposed activities fall within the regulatory mechanism authorized under Section 10(a)(1)(B) of the ESA, which allows the incidental take of a listed species that results from, but is not the purpose of, carrying out an otherwise lawful activity. The proposed project must meet 1) the statutory and regulatory permit issuance criteria under ESA Section 10(a)(2)(B) and 2) the Service's regulatory issuance criteria pursuant to 50 CFR 17.22 (b)(2)(i)(A-F). These criteria provide that the taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild. Under Section 10 of the ESA, the ITP applicant is required to submit an HCP. The HCP must identify and ensure that the effects of the authorized incidental take will be adequately minimized and mitigated to the maximum extent practicable (the Service and National Marine Fisheries Services [NMFS], 1996). The HCP will specify the impact to the species or habitat that is likely to result from the proposed action and the measures that would be taken to minimize and mitigate such impacts. The Congressional intent of the HCP Program was to institute a process that would integrate non-Federal development and land use activities with conservation goals, resolve conflicts between endangered species protection and economic activities on non-Federal lands and create a climate of partnership and cooperation. The Big Pine Key HCP, as presented herein, is designed to comply with the Congressional intent of the HCP program.

1.4.2 Clean Water Act

Wetlands are present in the project area; however, no authorization is requested for wetland impacts under this HCP. Section 404 of the Clean Water Act (CWA) requires a permit for the discharge of dredged or fill material into Waters of the United States (33 U.S.C. Section 1344). The U.S. Environmental Protection Agency (EPA) and the Department of the Army, Corps of Engineers, are responsible for administering the Section 404 program. Department of the Army (DA) permitting policies and procedures for regulating such activities can be found in 33 CFR parts 320 through 330.

1.4.3 Section 10 of the Rivers and Harbors Act

The proposed development activities on Big Pine and No Name Keys may involve the placement or construction of structures or activities including dredging activities in waters of the United States. These activities may require authorization under Section 10 of the Rivers and Harbors Act of 1899, (33 U.S.C. 403), which prohibits the unauthorized obstruction or alteration of any navigable water of the United States. The placement or construction of any structure or activities including dredging in or over any Waters of the United States requires recommendation by a

representative of the Chief of Engineers and authorization by the Secretary of the Army in the form of a permit.

Work in most wetlands (including isolated wetlands) may require separate approval by regulating agencies. The covered project area for this HCP contains areas which would be considered jurisdictional wetlands or Waters of the United States by the Department of the Army; however, the Applicants are not requesting coverage for impacts to listed species for any activities requiring authorization pursuant to Section 404 of the CWA or Section 10 of the Rivers and Harbors Act. The Applicants will not exempt individual landowners from coordinating with the agencies on impacts to listed species or from obtaining any state, local, other Federal, or special district authorization prior to the start of any activities in wetlands, State Waters, or Waters of the United States.

1.4.4 Other Federal Actions

The Federal Emergency Management Agency (FEMA) administers the National Flood Insurance Program (NFIP) throughout Monroe County, Florida. During consultation on the effects of FEMA's Federal action required under 7(a)(2) of the ESA, the Service issued a biological opinion on June 16, 1997. The Service recommended a "reasonable and prudent alternative" whereby Monroe County, with the assistance of the Service and FEMA, would identify habitat and assist with regulation of development. The Service and FEMA generated a list administered by the county of specific lots on Big Pine Key and No Name Key, which were considered to contain important Key deer habitat. The county coordinates with the Service on behalf of FEMA on permit application activities on the designated lots.

1.5 Key Elements of the HCP

The HCP is organized into sections that describe the background, technical studies, baseline conditions, proposed activities, potential impacts, avoidance and minimization measures, mitigation measures, and implementation measures. Key elements of the HCP include the following:

1.5.1 Background and Studies

Efforts to address Key deer and other protected species in Big Pine Key and No Name Key through an HCP started in the mid-1980s. The Applicants signed a Memorandum of Agreement in 1998 in which they committed to develop this HCP. The development of the HCP, which focused on the conservation of the covered species, was concurrent with the development of the Livable CommuniKeys Program (LCP), a Monroe County planning and community involvement process to address community needs in the HCP area.

The Applicants partially funded a three-year study of the population dynamics of the Key deer. Roel Lopez, working at times as a Ph.D. student and later, professor, at Texas A&M University and as a consultant to the Applicants developed a state-of-the-art PVA model for the Key deer. The model has the following characteristics:

- It includes a spatial component, which addresses the spatial differences in habitat quality and human-related effects on the Key deer, and a matrix model of population dynamics.
- The effects of development activities can be described as changes in the spatial model. In turn, changes in the spatial model affect the parameters of the matrix model.
- The unit of impact in the spatial model, termed "H," can be applied to any type of development activity. For any development activity, the spatial model estimates an H value.
- H value measures both direct habitat loss and indirect human-related effects on Key deer.
- For any H value, the matrix model estimates the effects on the Key deer population in terms of a) the probability of quasi-extinction and b) the number of additional human-related Key deer deaths per year.

The HCP also applies the most recent data on the distribution and habitat utilization of the Lower Keys marsh rabbit, provided by the Service.

1.5.2 Covered Activities: Avoidance and Minimization of Impacts

The HCP addresses the incidental take of protected species that may result from development activities in Big Pine Key and No Name Key in the next 20 years. The types of activities covered under this HCP include limited residential development, commercial development and expansion, community and institutional facilities, and transportation improvements. These activities will occur under stringent guidelines in order avoid and minimize impacts to the covered species. For example:

- The total H_{impact} over 20 years will be limited to a maximum of H = 1.1. For this level of H, the PVA model estimates a probability of quasi-extinction of 4.2 percent (two percent higher than current conditions) and 4.2 additional human-related deer deaths per year.
- Development will be concentrated on low quality habitat, such as infill lots located in already-developed subdivisions, lots located among canals, and areas near US-1. No more than 7 acres of native habitat will be affected over 20 years.
- No direct impacts to Lower Keys marsh rabbit will be permitted.
- No direct take of eastern indigo snake will be permitted.
- In total, the Applicants estimate that no more that 168 acres will be affected by development in the HCP area (about 2.4 percent of the HCP area).

1.5.3 Mitigation and Implementation

The main mitigation measure will be the acquisition and management of lands for conservation. Land acquisition will occur concurrently with development. The mitigation goal is to acquire lands on 3:1 ratio based on H. Therefore, over 20 years, Monroe County will acquire lands with a total H = 3.3.

Monroe County will establish land development regulations to manage growth within the requirements of the HCP. The Master Plan for Future Development of Big Pine Key and No Name Key has been approved by the county.

2. BIOLOGICAL CONDITIONS

2.1 Covered Species

The HCP provides for a conservation strategy for three Federally listed species that may be affected by proposed development (Table 2.1). Based on the best available scientific information on each of the covered species, future development on Big Pine Key has the greatest probability of impacting the Key deer. The Florida Key deer has been used as umbrella species in the analysis conducted for this Plan. A brief description of the covered species follows.

Table 2.1. Covered species

Common Name	Scientific Name	Federal Status
Key deer	*Odocoileus virginianus clavium*	E
Lower Keys marsh rabbit	*Sylvilagus palustris hefneri*	E
Eastern indigo snake	*Drymarchon corais couperi*	T

E=Endangered, T=Threatened

2.1.1 Florida Key Deer (*Odocoileus virginianus clavium*)

Description

The Florida Key deer is the smallest race of North American white-tailed deer. Key deer are morphologically distinct from other races of white-tailed deer: their body is stockier, their legs are shorter, and their skull is wider. Mature adults measure between 25 to 30 inches at the shoulder, with average weights of 55 to 75 pounds for males, and 45 to 65 pounds for females. Lopez (2001) estimated that the current Key deer population on Big Pine Key and No Name Key is 453 to 517 animals. In contrast, Silvy (1975) estimated a population size of 151 to 191 animals in the 1970s and Dickson (1955) estimated a population size of 25 to 80 animals in 1955.

Key deer are more solitary than northern white-tailed deer (Harding 1974). Home ranges average about 299 acres (greater during the breeding season) for male deer and 138 acres for females. The breeding season begins in September, peaks in October, and declines through December and January, while the peak of fawning coincides with the onset of the rainy season in April and May (Harding 1974, Silvy 1975). Factors resulting in the low reproductive performance of Key deer include low fecundity and reproductive activity as well as high fetal sex ratios and mean age of initial reproduction (Folk and Klimstra 1991).

Distribution

The Key deer are wide ranging and utilize virtually all available habitat in the project area, including developed areas (Figure 2.1, Lopez 2001). The location and availability of fresh water greatly influences the distribution and movement of Key deer. Deer swim easily between keys and use all islands during the wet season, when drinking water is available. Conversely, they aggregate on large islands during the dry season (Folk and Klimstra 1991, Silvy 1975).

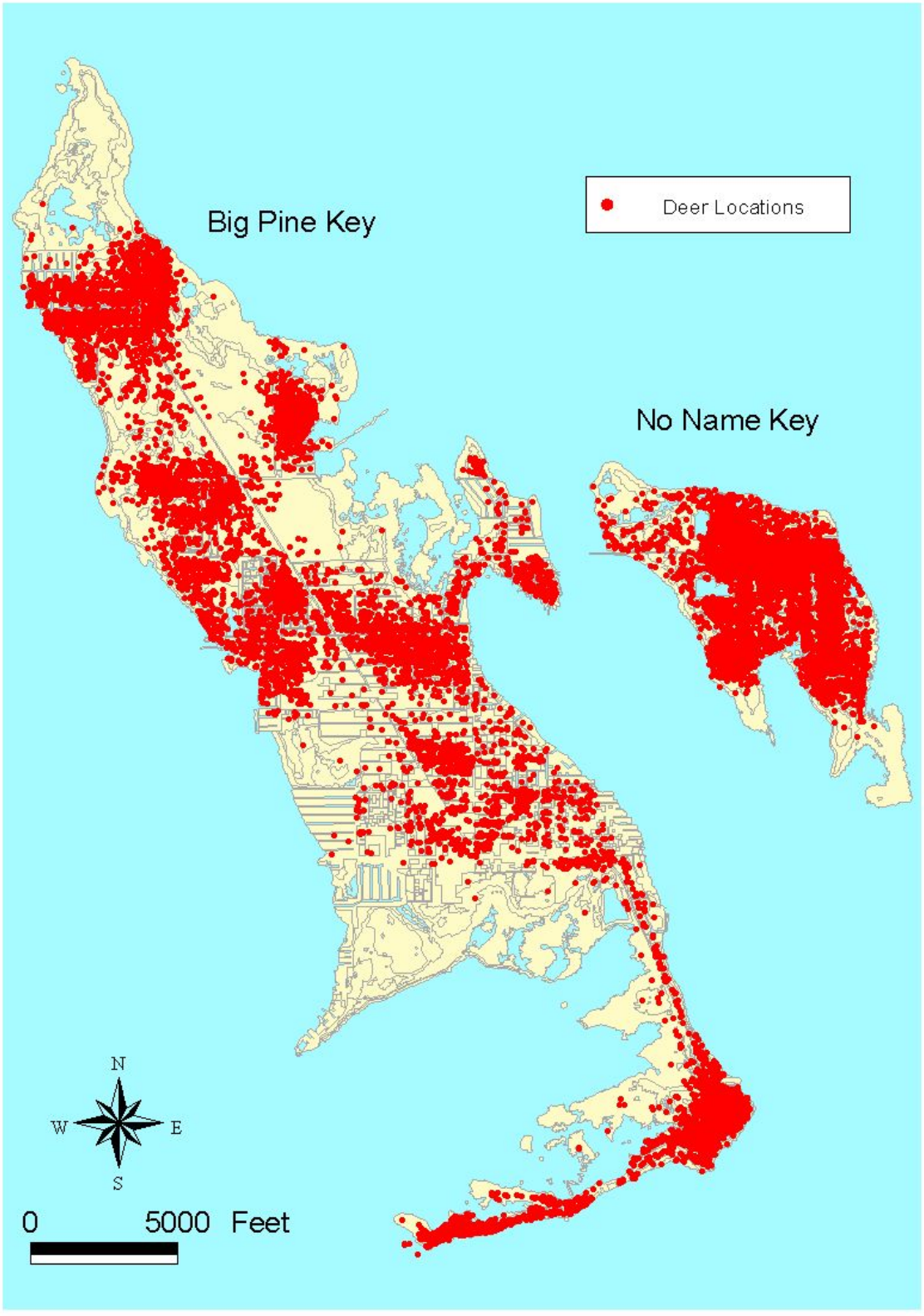


Figure 2.1. Key deer locations from telemetry data (Lopez 2001)

Permanent deer populations are found on islands with extensive pine and hardwood habitats and year-round supply of fresh water (Klimstra 1985). Hammocks provide important cover for fawning and bedding, whereas open developed areas provide feeding and resting opportunities.

Key deer are permanent residents throughout Big Pine, Big Torch, Cudjoe, Howe, Little Pine, Little Torch, Middle Torch, No Name, Sugarloaf, and Summerland Keys. Big Pine Key (5,840 acres) and No Name Key (1,191 acres) support more than two-thirds of the entire population; both islands have permanent fresh water and extensive pineland habitat. Key deer use keys with no permanent supply of fresh water as transients.

Habitat

Key deer utilize all habitat types including pine rocklands, hardwood hammocks, buttonwood salt marshes, mangrove wetlands, freshwater wetlands, and disturbed and developed lands (Lopez 2001). Pine rocklands are especially important to Key deer conservation because they hold freshwater year-round. Key deer use disturbed and developed lands extensively for foraging, travel, loafing, and socializing. The Key deer feed primarily on red and black mangrove, but also feed on approximately 160 other plants to meet nutritional requirements (Klimstra and Dooley 1990).

Threats to the Species

The greatest long-term threat to the Key deer population is the loss of habitat due to human development. Loss of habitat relates to loss of carrying capacity and can only be offset by providing suitable habitat. Development has fragmented Key deer habitat, creating habitat patches where not all deer requirements are met. Therefore, Key deer range across larger areas, increasing their exposure to human related threats (Silvy 1975).

Human-related mortality, primarily road kills, is the greatest known source of deer mortality and accounts for about 50 percent of identified deaths, or an average of 44 animals per year (Lopez 2001). Although road mortality is high, the loss can be offset through reproduction. Other types of human-related mortality include drowning in man-made ditches, predation by free roaming domestic predators, and entanglement in fences.

2.1.2 Lower Keys Marsh Rabbit (*Sylvilagus palustris hefneri*)

The Lower Keys marsh rabbit is listed as endangered by both the Service and the FWC.

Description

The Lower Keys marsh rabbit is a subspecies of the marsh rabbit (*Sylvilagus palustris*) and differs from the adjacent Upper Keys subspecies (*Sylvilagus palustris paludicola*) by its skull proportions and sculpturing (Lazell 1984). The Lower Keys marsh rabbit has a shorter molariform tooth row, higher and more convex frontonasal profile, broader cranium, and elongated dentary symphysis. The body is 12 to 15 inches long, with short dark brown dorsal fur and gray-white ventral fur. The tail is dark brown and inconspicuous.

The Lower Keys rabbit is most active at night, in early morning or late afternoon, or during overcast weather. It feeds on the leaves, shoots, buds, and flowers of grasses, herbaceous, and woody plants. In late summer, adult rabbits may chase young from the nest area.

Distribution

The Lower Keys marsh rabbit occurs in many of the larger Lower Keys, including Sugarloaf, Saddlebunch, Boca Chica, and Big Pine Keys, as well as in the small islands near these keys (Forys et al. 1996). Historically, the species was present on Middle Torch Key, Big Torch Key (Lazell 1984), Cudjoe Key (Howe 1988), and may have occurred on Ramrod Key, and Key West, but it has been extirpated from these areas. The Lower Keys marsh rabbit probably occurred on all of the Lower Keys that supported suitable habitat but did not occur east of the Seven-Mile Bridge, where it is replaced by *S. p. paludicola*. Known localities for the rabbit are on privately owned land, state-owned land, and Federal land within the National Key Deer Refuge and Key West Naval Air Station. A comprehensive survey for Lower Keys marsh rabbits was conducted in 1995 (Forys et al. 1996). Suitable habitat for this species is highly fragmented across all of the Lower Keys.

Habitat

Lower Keys marsh rabbits inhabit saltmarsh and buttonwood transition areas, freshwater wetlands, and coastal beach berms. Recent unpublished data suggest that the species may range into the edges of pinelands and other surrounding habitats (C. Faulhaber, pers. comm.). Freshwater wetlands are located in the northern and central portions of Big Pine Key, and are present in one parcel on No Name Key. Freshwater wetlands occupy 689.4 and 3.4 acres, respectively. A 2002 survey of Lower Keys marsh rabbit habitat on Big Pine Key and No Name Key (Faulhaber 2003) provided the most recent data on its distribution within the covered area (Figure 2.2). The Lower Keys marsh rabbit builds mazes of runs, dens, and nests in coastal (saline to brackish) or freshwater, inland marsh habitats. Two plant species, fringerush (*Fimbristylis* sp.) and buttonwood (*Conocarpus erectus*), are often present in the rabbit's habitat. In freshwater marshes, cattails (*Typha latifolia*), sawgrass (*Cladium jamaicense*), and sedges (*Cyperus* sp.) are common associates. Sometimes, spikerush (*Eleocharis* sp.) is also found. In coastal marshes, common associates include cordgrass (*Spartina* sp.), saltwort (*Batis maritima*), glasswort (*Salicornia virginica*), sawgrass, and sea ox-eye daisy (*Borrichia frutescens*). The rabbit’s runs, dens and nests are made in cordgrass or sedges.

Threats to the Recovery of the Species

In the last few decades, development for residential, commercial, or military-related purposes has reduced the total area of marsh rabbit habitat in the Florida Keys. Habitat loss is the main cause of the marsh rabbit’s endangered status. Currently, the Lower Keys marsh rabbit occurs in small, relatively disjunct populations and has a low population density because of predation by domestic cats. Although predation by domestic cats is the principal cause of mortality, some road mortality occurs as rabbits attempt to move among increasingly isolated Lower Keys marshes (Forys 1995). In the past, hunting of Lower Keys rabbit occurred; however, hunting is not known to be a current threat.

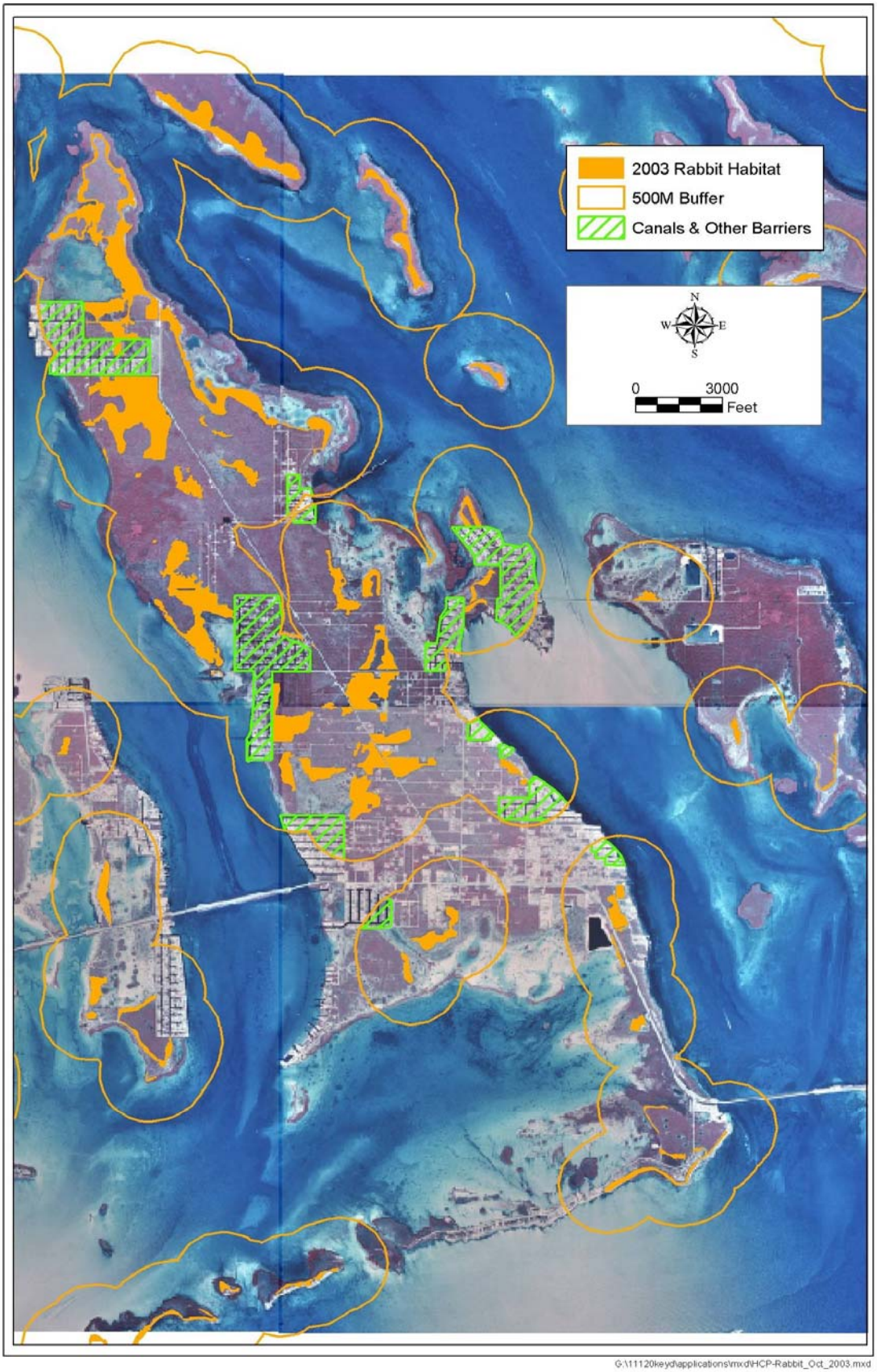


Figure 2.2. Lower Keys marsh rabbit habitat (Source: United States Fish and Wildlife Service).

A PVA Study (Forys 1995, Forys and Humphrey 1999) stated that habitat on Big Pine Key consists of eight relatively large patches; Big Pine Key has the largest freshwater wetlands and more transitional habitat of the Lower Keys. The study showed that improving survival rates is very important to recovery of the species; however, during the study period survival rates among adult rabbits were low. For the Boca Chica Key study area, mortality due to domestic cats was 53 percent of total mortality and mortality due to motor vehicles was approximately 33 percent of total mortality. The model predicted a high probability of extinction if mortality from either vehicles or cats was not controlled. The model predicted a greater persistence of the population on Big Pine Key because of larger habitat patch size. A 1996 report prepared for the Service and Florida Game and Fresh Water Fish Commission identified recovery actions for the Lower Keys marsh rabbit. The report recommended that a plan to decrease domestic cat predation be established and implemented, or the marsh rabbit will face extinction in the next 20-30 years. Connectivity among suitable habitat patches is necessary for marsh rabbit dispersal among patches, and isolation from domestic predators is perhaps the main factor to help this species survive (Forys and Humphrey 1994).

2.1.3 Eastern Indigo Snake (*Drymarchon corais couperi*)

On January 31, 1978, the eastern indigo snake was designated as Federally threatened throughout its entire range.

Description

The eastern indigo snake is a large, non-poisonous snake that grows to a maximum length of eight feet. The color in both young and adults is shiny bluish-black, including the belly, with some red or cream coloring about the chin and sides of the head. The indigo snake subdues its prey with its powerful jaws and swallows the prey, usually while it is still alive. Food items include snakes, frogs, salamanders, toads, small mammals, birds, and young turtles. Indigo snakes probably reach sexual maturity at three or four years of age. Based on observations of captive animals, mating begins in November, peaks in December, and continues into March. Clutches averaging eight to nine eggs laid in late spring hatch approximately three months later.

The recovery plan objective is to delist the species by ensuring that numerous indigo snake populations exist and are reproducing and protected where suitable habitat still exists in the historical range of the species. Recovery tasks currently being implemented include habitat management through controlled burning, testing experimental miniature radio transmitters for tracking of juvenile indigo snakes, maintenance of a captive breeding colony, recapture of formerly released snakes to confirm survival in the wild, presentation of education lectures and field trips, and efforts to obtain landowner cooperation in indigo snake conservation efforts.

Distribution

Historically, the species ranged throughout Florida, except in the Marquesas and Dry Tortugas. Museum records document specimens from the Upper Keys and the Lower Keys, but not from the in the Middle Keys (Moler 1992). The species has declined throughout its range and has been extirpated from some areas due to habitat fragmentation, decline in the gopher tortoise populations, and other factors. Indigo snakes have not been documented in Big Pine Key for several years, despite the presence of suitable habitat throughout Big Pine and No Name Keys.

Habitat

The indigo snake seems to be strongly associated with high, dry, well-drained sandy soils, closely paralleling the sandhill habitat preferred by the gopher tortoise. The indigo snake can occur in most types of hammock in Florida and southeastern Georgia, often near wetlands, and often in association with gopher tortoise burrows. It is also known to occur in mangrove swamps, seepage swamp, flowing water swamp, pond swamp, wet prairie, xeric pinelands and scrub, flatwoods, dry glades, tropical hardwood hammocks, beach dune/coastal strand, pine rockland, and muckland fields in southern Florida (Cox and Kautz 2000). Gopher tortoise burrows, tree stumps, piles of debris, land crab burrows, and other subterranean cavities are commonly used as dens and for egg laying.

Threats to the Species

The species has declined throughout its range and has been extirpated from some areas due to habitat fragmentation, decline in the gopher tortoise populations, over-collecting, direct human-related mortality, and road mortality.

2.2 Species Not Covered

2.2.1 Federally Listed Species Not Covered

Several Federally listed species will not be covered under the HCP. These species include the silver rice rat (*Oryzomys argentatus*), Schaus swallowtail butterfly (*Heraclides aristodemus ponceanus*), Stock Island tree snail, (*Orthalicus reses*), Garber's spurge (*Chamaesyce garberi*), and Key tree-cactus (*Pilosocereus robinii*).

Silver Rice Rat (*Oryzomys argentatus*)

The silver rice rat is classified as Federally endangered and is known to occur on 11 islands in the Lower Keys: Little Pine, Howe, Water, Middle Torch, Big Torch, Summerland, Raccoon, Johnston, Cudjoe, Upper Sugarloaf, and Saddlebunch Keys (Vessey, et al. 1976, Wolfe 1986, Goodyear 1984, 1995). Suitable habitat is available on many islands including Big Pine Key and No Name Key, but no occurrence has been documented. Extensive trapping efforts on Big Pine Key have failed to detect silver rice rat. Therefore, the Applicants believe that the lack of documented occurrence on Big Pine Key and No Name Key has made coverage under the HCP unnecessary. It is unlikely any take of silver rice rats or their designated critical habitat will occur.

Schaus Swallowtail Butterfly (*Heraclides aristodemus ponceanus*)

The Schaus swallowtail butterfly was listed as threatened on April 28, 1976, due to population declines caused by habitat destruction, mosquito control practices, and over-harvesting by collectors. It was reclassified to endangered on August 31, 1984, because its numbers and range had declined dramatically since its listing. Critical habitat has not been designated. The Schaus swallowtail is a large blackish-brown butterfly with contrasting markings that are mostly dull yellow. There have been two unverified sightings of Schaus swallowtails in the Lower Keys. One Schaus swallowtail was seen on Big Pine Key in 1966. The present distribution of the Schaus is limited to undisturbed tropical hardwood hammocks in insular portions of Miami-Dade

and Monroe counties from Elliott Key in Biscayne National Park to northern Key Largo. There are no recent documented occurrences on Big Pine Key and No Name Key and the Applicants believe coverage under the HCP is unnecessary as it is unlikely any take of Schaus butterfly will occur.

Stock Island Tree Snail (*Orthalicus reses reses*)

The Stock Island tree snail is a subspecies classified as threatened by the Service. Historically, the Stock Island tree snail was found in several locations throughout Stock Island and Key West. Hardwood hammocks were probably the primary habitat before colonization by humans. A 1996 report by the Florida Game and Freshwater Fish Commission, which researched extant populations of Stock Island tree snails, found no evidence or documentation of Stock Island tree snails on Big Pine or No Name Key. The Applicants are not requesting coverage under the HCP based on a lack of documented occurrence on Big Pine Key and No Name Key.

Garber's Spurge (*Chamaesyce garberi*)

Garber's spurge is known only to exist on government protected lands within the covered area of the ITP and HCP. The National Key Deer Refuge on Big Pine key contains most of the remaining pine rocklands in the Keys. In pine rocklands, Garber's spurge is found growing in crevices in oolitic limestone. Pine rocklands in private ownership receive protection under the Monroe County Comprehensive Plan, and almost all remaining pinelands are targeted for acquisition. Therefore, the Applicants are not requesting coverage under the HCP, as take is unlikely.

Key Tree-Cactus *(Pilosocereus robinii)*

The Key tree-cactus was listed as endangered on July 19, 1984 due to severe population declines caused by destruction of upland tropical hardwood hammocks areas in the Keys for commercial and residential development. Critical habitat has not been designated. The Key tree-cactus is a large, tree-like cactus with erect columnar stems, reaching 10 meters (33 feet) in height. The Key tree-cactus grows in the hammocks of the Florida Keys and in the coastal thickets of the Matanzas and Habana provinces of Cuba. The historical distribution of this species in the Florida Keys, which included populations that are now extinct on Key West, Boca Chica, and Windley Keys, has been substantially diminished by the destruction of hardwood hammocks in the Lower Keys, particularly Key West. One known Key tree-cactus population exists on public lands on Big Pine Key. Therefore, the Applicants are not requesting coverage under the HCP based on a lack of documented occurrence of the species on private lands on Big Pine Key and No Name Key.

2.2.2 State Listed or Protected Species Not Covered

Coverage is not requested under the HCP for species such as the white-crowned pigeon (*Columba leucocephala*), mangrove terrapin (*Malaclemys terrapin rhizophorarum*), and striped mud turtle (*Kinosternon baurii baurii*). The habitats supporting these species are not expected to be impacted by the proposed development activities covered under the HCP. Therefore, the Applicants are not requesting coverage under the HCP for these species.

2.3 Vegetation and Habitat

Combined, mangroves and buttonwood saltwater wetlands are the most abundant habitat types in the project area (Table 2.2), and account for 40 percent and 48 percent of Big Pine Key and No Name Key, respectively (Figure 2.3). Uplands, including pinelands and hammocks, are the second most abundant habitat type and cover 29 percent of Big Pine Key and 48 percent of No Name Key. Developed areas are the least abundant habitat type and cover 19 percent of Big Pine Key and five percent of No Name Key. Freshwater wetlands are found in the central and northern portions of Big Pine Key and cover 12 percent of the island.

Table 2.2. Habitat type distribution within the project area

		Percent Area	
Habitat Type	**ADID Categories[1]**	**Big Pine Key**	**No Name Key**
Pinelands	Pinelands	22	12
Hammocks	Hammocks, ridge/hammock	7	36
Freshwater Wetland	Freshwater marsh, freshwater hardwoods, freshwater pine	12	-
Buttonwoods	Buttonwoods, grasslands, saltmarsh	15	12
Mangrove	Mangrove, scrub mangrove	25	36
Developed	Developed, exotics	19	4
	Total	**100**	**100**

[1] ADID: Advance Identification of Wetlands (McNeese and Taylor 1998).

The Florida Keys Advance Identification of Wetlands (ADID) Project (McNeese and Taylor 1998) was the source map used to develop a vegetation map of the project area. All land with the project area was field-verified and ADID habitat types were merged into six categories: pineland, hammock, freshwater wetland, buttonwood, mangrove and developed (Silvy 1975, Lopez 2001; Table 2.2). Water and Dune habitat categories were deleted from the vegetation map because the Key deer rarely uses these types of habitat.

2.3.1 Pinelands

Pinelands are upland forest communities with an open canopy dominated by the native slash pine (*Pinus elliottii* var. *densa*). Keys pinelands are fire-adapted and dependent on periodic fires for their long-term persistence. Surrounded by wet prairie habitats and/or mangroves, pinelands typically occur on locally elevated areas of bedrock, which may flood seasonally or during extreme storm events. Xeric conditions in this habitat are partly caused by locally low rainfall and the exposed rock ground cover.

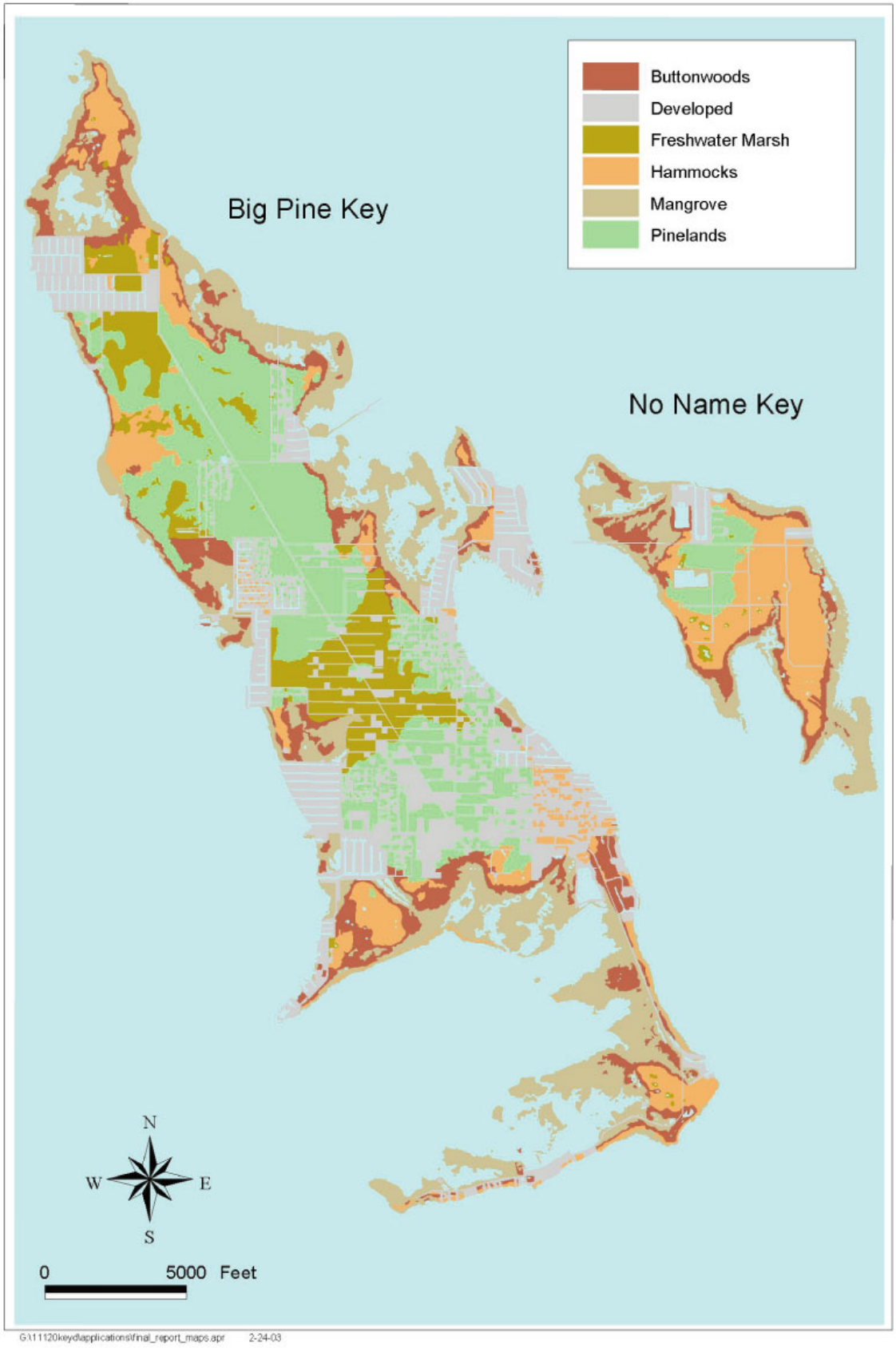


Figure 2.3. Vegetative cover of Big Pine Key and No Name Key (after McNeese and Taylor 1998).

The extent of subcanopy development in a pineland is dependent upon the frequency of surface fires. Pinelands on Big Pine Key typically have a well-developed subcanopy consisting of palms (silver thatch palm, *Coccothrinax argentata*; Key thatch palm, *Thrinax morissii*; thatch palm, *T. radiata*; saw palmetto, *Serenoa repens*) (Bergh and Wisby 1996). Other species found in the pineland understory include strongbark (*Bourreria cassinifolia)*, locust berry (*Byrsonima lucida*), silver thatch palm, pineland croton (*Croton linearis*), rough velvetseed (*Guettarda scabra*), wild sage (*Lantana involucrata*), and long-stalked stopper (*Psidium longipes*). Shrub vegetation in Lower Keys pinelands varies in composition and density. For example, Big Pine Key pinelands have a low and sparse ground covering of grasses and bare limestone, whereas on Cudjoe, Little Pine, and No Name Keys a continuous hardwood understory of 6 meters height or more is present due to prolonged absence of fire.

More tropical plant species also occur in the Lower Keys pineland shrub stratum including Caesalpinia (*Caesalpinia pauciflora)*, dune lily-thorn (*Catesbaea parviflora)*, pisonia (*Pisonia rotundata*), and pride-of-Big-Pine (*Strumpfia maritima)*. Plant species from adjacent habitats may invade at the pineland margins. For example, gumbo limbo (*Bursera simaruba*), inkwood (*Exothea paniculata*), and wild tamarind (*Lysiloma latisiliquum*) occur in pinelands sited adjacent to a hammock. Only four plant species endemic to South Florida pinelands (partridge pea, *Chamescista lineata*; small-leaved melanthera, *Melanthera parvifolia*; rockland spurge, *Chamaesyce deltoidea* var. *serpyllum*; and sand flax, *Linum arenicola*) occur on Big Pine Key (Ross and Ruiz 1996), likely as a result of water table depth, salinity, and other physical variables.

Pinelands in the Lower Keys have declined markedly in recent history, primarily as a result of development. Coverage in Big Pine Key has decreased by 50 percent since 1940 (Ross 1989). At present, somewhat extensive pinelands occur on Big Pine, Little Pine, No Name, Cudjoe, and Sugarloaf Keys. Distribution of pineland vegetation in the Keys appears to coincide with the presence of freshwater lenses (McNeese and Taylor 1998). Other limiting factors on the establishment, growth, and persistence of pinelands appear to be lack of fire (Alexander and Dickson 1970, Snyder et al. 1990, Carlson et al. 1993) and salt-water intrusion into freshwater lenses (Ross et al. 1994). Without prescribed burning, the 2,268 acres of pinelands remaining in the Lower Keys could succeed into hardwood hammock in the next 50 years.

Pinelands occur throughout the project area. Key deer preferentially utilize this habitat for the permanent freshwater sources that are critical to survival of the species. Key deer also feed on herbaceous species and the fruits of woody species found in pinelands (Monroe County 1987). The fire regime of pinelands creates an environment of easily accessible food resources for the Key deer (Monroe County 1987).

2.3.2 Hammocks

Along with pinelands, tropical hardwood hammocks represent the climax upland community type in the Florida Keys and are second to pinelands in terms of biodiversity (Ross et al. 1992). Tropical hardwood hammocks in the Florida Keys are closed, broad-leaved forests that occupy elevated, well-drained and relatively fire-free areas. Hammocks in the Lower Keys are more widespread than pinelands, except for Big Pine Key where the area of pineland is greater than

that of hammock. Approximately 560 acres of hammock occur on Big Pine Key and 385 acres on No Name Key (Figure 2.3). The greatest limiting factor on hardwood hammocks in the Florida Keys has been human influence, in particular from development.

Canopy trees of the Lower Keys hammocks tend to be smaller than those in hammocks occurring in other parts of Florida, and are often referred to as "low hammock" or "Keys hammock thicket." Trees commonly found in low hammock generally have a smaller trunk diameter and grow closer together. Species include poisonwood (*Metopium toxiferum*), buttonwood (*Conocarpus erectus*), blolly (*Guapira discolor*), Key thatch palm, Spanish stopper (*Eugenia foetida*), wild dilly (*Manilkara bahamensis*), Jamaica dogwood (*Piscidia piscipula*), and white stopper (*Eugenia axillaris*). Other species present on the windward side of low hammocks, referred to as transitional hammock or thorn scrub, include black torch (*Erithalis fruticosa*), saffron plum (*Bumelia celastrina*), sea grape (*Coccoloba uvifera*), blackbead (*Pithecellobium guadalupense*), indigo berry (*Randia aculeata*), tallowwood (*Ximenia americana*), darling plum (*Reynosia septentrionalis*), joewood (*Jacquinia keyensis*), barbed-wire cactus (*Cereus pentagonus*), and prickly pear cactus (*Opuntia stricta*).

Herbaceous plants are largely absent from Keys hammocks. Grasses include low panicum (*Panicum* spp.) and sour paspalum (*Paspalum conjugatum*) (NRCS 1989). In addition, hammocks support a diverse flora of orchids, ferns, bromeliads, and other epiphytes (Snyder et al. 1990, USEPA Undated 12), and are home to the Federally endangered Key tree-cactus (*Pilosocereus robinii*).

Tropical hammocks provide shelter for many animals during periods of high water and also nesting, feeding and roosting sites for many local and migratory birds (NRCS 1989). Key deer primarily utilize this habitat for cover, cool shelter, fawning and bedding (Silvy 1975). Other endangered and threatened species found in these areas in the Florida Keys include the Lower Keys marsh rabbit and eastern indigo snake (NRCS 1989). Additionally, tropical hardwood hammocks in south Florida provide essential habitat for the white-crowned pigeon (*Columba leucocephala*), Schaus' swallowtail butterfly (*Papilio aristodemus ponceanus*), and tree snails (*Liguus* spp.).

2.3.3 Freshwater Wetlands

Throughout the Keys, freshwater wetlands are restricted to areas landward of the seasonal high tide line and in the Lower Keys are found in areas underlain by freshwater lenses (McNeese and Taylor 1998). The persistence of freshwater ecosystems is limited primarily by freshwater availability, tidal influence, and human activities, including direct and indirect effects of development such as draw-down and contamination (McNeese and Taylor 1998, Folk 1991). During the dry season, freshwater lenses of Big Pine Key can diminish by as much as 50 percent (Stewart et al. 1989). Freshwater wetlands are located in the northern and central portions of Big Pine Key but are present in one parcel on No Name Key and represent 689.4 and 3.4 acres, respectively.

This habitat type is dominated by sawgrass (*Cladium jamaicense*) and spikerush (*Eleocharis* spp.). Forested freshwater systems in the Keys are generally pinelands with a sawgrass

understory (McNeese and Taylor 1998). Freshwater wetlands are typically found in isolated, seasonally flooded depressions with elevations of +3.0 feet National Geodetic Vertical Datum (NGVD) or less and may be found in conjunction with pinelands. Freshwater wetlands provide critical habitat for several listed species, in particular the Key deer and Lower Keys marsh rabbit (*Sylvilagus palustris hefneri*). These habitats and surface waters represent the only dry season source of freshwater for wildlife (McNeese and Taylor 1998, NRCS 1989) and play an important role in attenuating nutrients and other contaminants in surface water runoff.

2.3.4 Saltwater Marsh/Buttonwood Marsh

Throughout the Florida Keys, salt marshes and buttonwood associations occur in coastal locations similar to mangrove wetlands (Montague and Wiegert 1990). Salt marshes are non-woody, salt-tolerant communities occupying supratidal zones that are occasionally inundated with salt water. Two types of salt marsh are found in the Florida Keys, low marsh and high marsh. Low marsh species include salt-tolerant herbs such as glasswort (*Salicornia* spp.) and Keygrass (*Monanthochloe littoralis*), while high marsh is dominated by Gulf cordgrass (*Spartina spartinae*), fringe rushes (*Fimbrystylis* spp.), and sea-oxeye daisy (*Borrichia frutescens*) (McNeese and Taylor 1998).

Buttonwood associations border high marsh communities and have similar ecological characteristics (McNeese and Taylor 1998). Plant species that inhabit this community prefer low-energy waves with little tidal disturbance. Buttonwood forests are dominated by the silver buttonwood (*Conocarpus erectus)*. Other species include salt-tolerant herbaceous perennials and woody shrubs such as fringe-rushes, Keygrass, Gulf cordgrass, and seashore dropseed (*Sporobolus virginianus*). There are approximately 685 acres of buttonwood marsh on Big Pine Key and 170 acres on No Name Key (Figure 2.3).

Salt marsh/buttonwood marsh communities provide important habitat for terrestrial species including the Federally endangered Lower Keys marsh rabbit, silver rice rat (*Oryzomys argentatus*), and diamondback terrapin (*Malaclemys terrapin*). Buttonwood areas provide herbaceous foods and loafing areas for Key deer. Common residents include polychaetes, gastropod mollusks, bivalve mollusks and crustaceans. Birds tend to use the marsh for feeding rather than for nesting. A few species of birds, fish, reptiles, or mammals can be considered residents of salt marshes; larger longer-lived organisms are not tolerant of the environmental fluctuations (Montague and Wiegert 1990).

2.3.5 Mangroves

Mangrove communities consist of facultative halophytes, which are tolerant of anaerobic saline soils and tidal inundation. Three species are found in Florida: the red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), and white mangrove (*Laguncularia racemosa*).

In general, the zonation of mangrove communities is regulated by elevation. Red mangroves occur in the middle and lower intertidal zone and upper subtidal zone. Black mangroves dominate the upper intertidal zone and are generally found between the red and white species. White mangroves occur on the landward edge of mangrove forests, throughout the intertidal and

in the upper portions of the swamp. Ground cover within a mangrove forest consists of leaf litter and decomposing forest debris.

Throughout the Florida Keys, mangrove forests form the predominant coastal vegetation community. Mangroves are found along the edges of shorelines, bays and lagoons and on overwash areas throughout the Keys. Major limiting factors on mangrove establishment, growth and persistence in the Florida Keys appear to be water quality, substrate, and development (Lewis 1980, Snedaker and Lugo 1973, Strong and Bancroft 1994, Odum et al. 1982). Mangrove habitat occurs on approximately 1,495 acres of Big Pine Key and 374 acres of No Name Key (Figure 2.3).

Mangrove communities in the Florida Keys provide essential habitat for numerous ecologically and economically important species (FWC Undated 7). The leaves and fruits of red and black mangroves are a primary food source for the Key deer, which spend considerable time foraging in tidal wetlands (Monroe County 1987, Silvy 1975). In South Florida, mangroves are important habitat for at least 220 fish species, 24 reptile and amphibian species, 18 mammal species, and 181 bird species (Odum et al. 1982), and provide nesting habitat for a number of threatened and endangered species. Dissolved organic matter from mangroves serves as an alternate food source, the basis for heterotrophic microorganism food webs, and a source of chemical cues for estuarine species (Snedaker 1989).

2.4 Scientific Basis of the HCP: The Key Deer PVA Model and Its Application

2.4.1 Field Studies of Key Deer Population Dynamics

Silvy (1975) had conducted the most recent, comprehensive population study of Key deer population dynamics in the early 1970s. Between 1998 and 2001, Lopez (2001) studied the Key deer population on Big Pine Key and No Name Key. To determine the fate of individual Key deer through time, Lopez placed radio transmitters on over 200 deer (Table 2.3) and monitored the status of individual deer for up to three years. Information on individual deer provided an assessment of the year-to-year probability of mortality and fecundity (average number of fawns produced by females). Radio telemetry data also provided a clear picture of habitat utilization, deer movement, and deer distribution in the study area.

Table 2.3. Gender and age-classes[1] of radio collared Key deer in Big Pine Key and No Name Key, 1998-1999 (after Lopez 2001)

	Adults	**Yearlings**	**Fawns**	**Total**
Male	52	35	9	96
Female	82	32	12	126
Total	**134**	**67**	**21**	**222**

[1] Fawns: <1 year old; Yearlings: 1-2 years old; Adults: >2 years old.

From March 1998 to December 1999, Lopez (2001) also performed weekly censuses along 10 miles of roads and bi-monthly censuses along 44 miles of roads in Big Pine Key and No Name Key. The censuses provided information on deer number and density.

2.4.2 Development of the Key Deer PVA Model

Numerous models have been developed for estimating the risk of extinction for small populations (Akcakaya 2000). A PVA model is a collection of methods for evaluating the threats faced by populations or species, their risk of extinction or decline, and their chance for recovery (Akcakaya and Sjogren-Gulve 2000). Species viability is often expressed as the risk or probability of extinction, population decline, expected time to extinction, or expected chance of recovery (Akcakaya and Sjogren-Gulve 2000). PVA models use demographic and habitat data and typically involve the use of computer simulations to assess extinction threats. PVA modeling is becoming one of the primary tools for managing threatened and endangered species. Akcakaya and Sjogren-Gulve (2000) recommended that critical population levels (quasi-extinction), instead of risk of extinction, should be used to express long-term population viability of species because of limitations inherent in modeling small populations. Following Akcakaya and Sjogren-Gulve, the Applicants of this HCP chose to express the probability of long-term viability of the species in terms of critical population level (quasi-extinction). Specifically, the probability that the population fall below 50 individuals at least once in 50 years was used as the criterion to determine an unacceptable level of development.

Lopez (2001) developed a PVA model to evaluate development impacts on the Florida Key deer population. The model incorporated Key deer movements, habitat utilization, ecology and demographic data and included two main components: a) a matrix model of population dynamics and b) a spatial habitat model of carrying capacity and secondary impacts.

Matrix Model

Quantitative information on mortality and fecundity for deer of different stages (e.g., fawn, yearling, adult) was used to create a matrix model that allows for simulating the fate of the population under different scenarios (Lopez 2001). In a matrix model, changes in mortality or fecundity result in changes in population size through time. A stage-based population matrix model represents the dynamics of the population as a function of annual estimates of fecundity (average number of fawns produced by females) and survival (probability of surviving from one year to the next). The Key deer model is applied only to females and takes the form:

$$\begin{bmatrix} & F_y & F_a \\ S_f & & \\ & S_y & S_a \end{bmatrix},$$

Where S_f, $S_{y,}$ and S_a are fawn, yearling, and adult survival, respectively, and F_y and F_a are yearling and adult fecundity estimates, respectively.

The stage-based matrix model allows for the analysis of stochasticity (i.e., the haphazard, year-to-year variation in fecundity and survival associated with changes in the environment). Stochastic events are particularly significant for small populations and, therefore, the model includes estimates of the variability of the population parameters. For example, annual female survival and variance estimates for each stage class were determined using a known-fate model framework in the computer program MARK (White and Burnham 1999, Lopez 2001). The

model also allows for evaluating the effects of stochastic events, such as hurricanes. A detailed discussion of the methodology to estimate model parameters is found in Lopez (2001, 2004) and Lopez et al. (2003).

Spatial Model

While the matrix model represents the overall dynamics of the Key deer population in the study area, the spatial model represents the location-specific contribution to the matrix model parameters. For example, localized changes in habitat quality and distribution, or in the number and location of paved roads may affect both fecundity and survival.

The spatial model also sought to address the anticipated impacts of development. For example, urban development causes two main types of impacts on the Key deer:

1. A change in carrying capacity. Urban development displaces and modifies Key deer habitat, therefore affecting the capacity of the remaining habitat to sustain Key deer.
2. An increase in human-related Key deer mortality. A change in the amount of development and resulting changes in the human population may, in turn, result in changes in the mortality of Key deer caused by motor-vehicle collisions, entanglement in fences, and other human-related effects.

Therefore, in order to address impacts to carrying capacity and mortality, the spatial model includes a carrying capacity and a "harvest" (i.e., human-related mortality) grid in a Geographic Information System (GIS). The grids represent the entire study area as an array of 10x10 meter cells; each cell's value represents its contribution to the total carrying capacity or harvest of the study area.

A weighting factor grid supported the development of the carrying capacity and harvest grids. The objective of the weighting grid was to address location-specific conditions that affect carrying capacity and harvest. For example, two grid cells of the same vegetation type may contribute differently to the carrying capacity of the Key deer depending on their proximity to canals: a pineland cell located in the middle of a large pineland area would provide better habitat to the Key deer than an isolated pineland cell surrounded by canals. Similarly, development of a pineland cell near US-1 would create a lesser vehicle collision impact (due to shorter travel distance to US-1) than development of a pineland cell located far from US-1 (due to the longer travel distance to US-1).

Six parameters entered into the weighting factor grid (Figure 2.4):

- House density. Development in areas with higher house density would be less harmful to the Key deer than development in areas with lower house density.
- Deer corridors. Development outside Key deer corridors would be less harmful to the Key deer than development in areas within Key deer corridors.
- Patch quality: Development in smaller, fragmented habitat areas would be less harmful to the Key deer than development in larger, uninterrupted habitat areas.

- Deer density: Development in areas of low Key deer density would be less harmful to the Key deer than development in areas of high density.
- Distance from US-1. Development near US-1 would be less harmful to the Key deer than development farther from US-1.
- Water barriers. Development in areas with canals would be less harmful to the Key deer than development in areas without canals.

Because more than one factor may affect the value of a given cell, the final cell value in the weighting factor grid was the average of the six parameters, where 0 represented the lowest value to the Key deer and 2 represented the highest value to the Key deer.

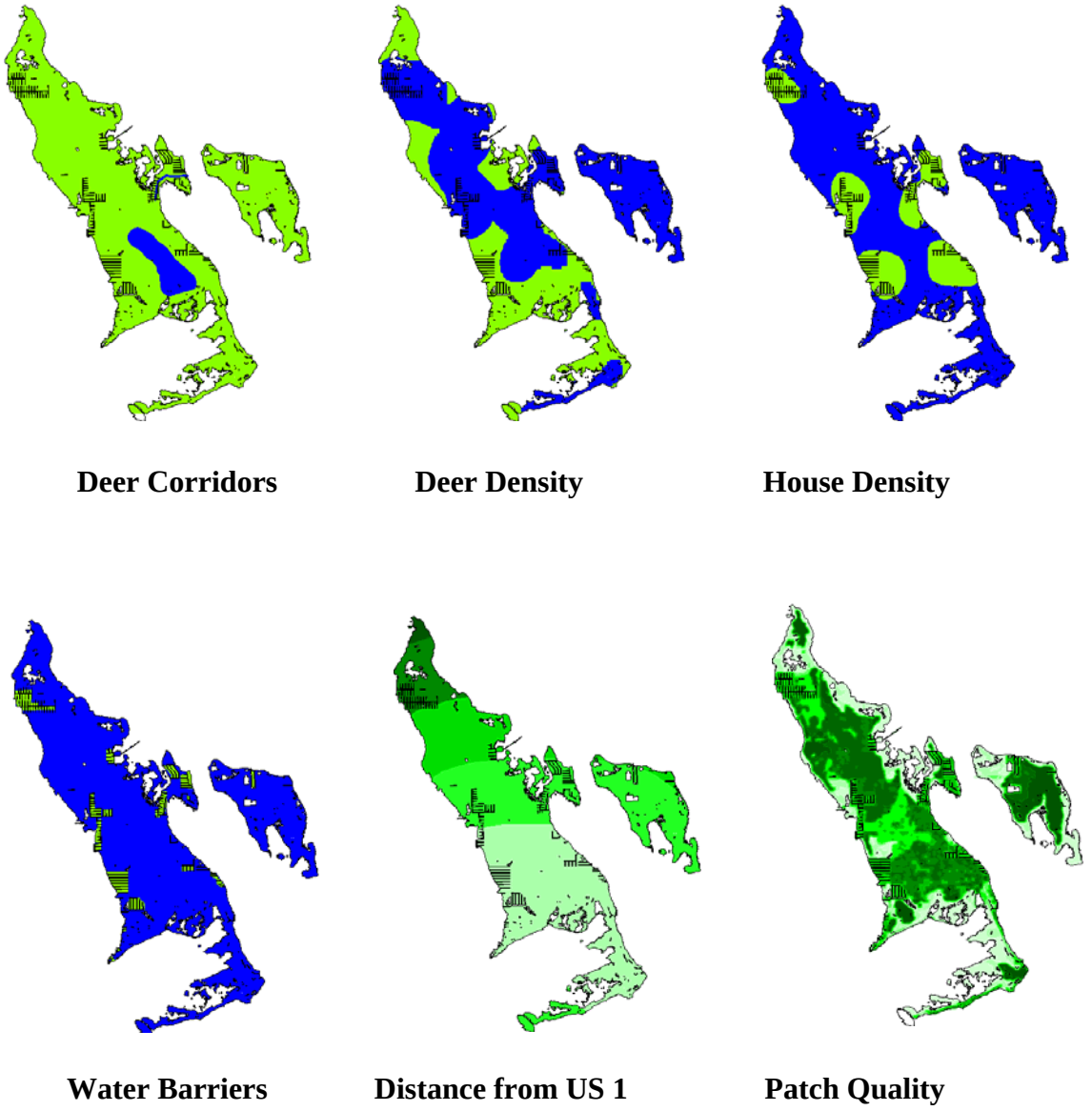
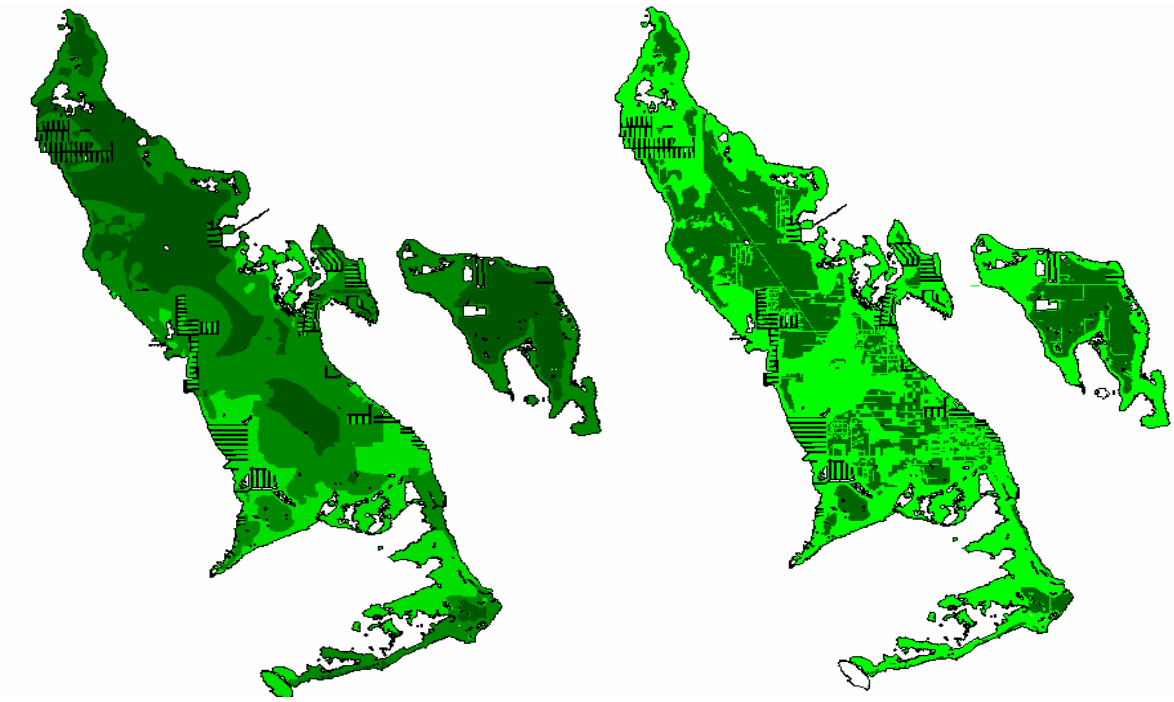


Figure 2.4. Six grid layers used to generate weighting factor grid
(darker shades = higher value for the deer)

The final carrying capacity grid (Figure 2.5) represents the contribution of each 10x10 meter cell to the total carrying capacity of the study area after applying the weighting factor. Lopez (2001) estimated the number of Key deer that could be supported by available habitat in Big Pine Key and No Name Key. Initially, this total number was divided among the 10x10 meter cells, so that each cell would have the same number. Then, the weighting factor was applied to each cell; the result was a differential contribution of the cells to the total carrying capacity. To ensure that the method was consistent, the sum of the value for all the cells was confirmed the same before and after the application of the weighting factor.

Similarly, the final harvest grid represents the proportional contribution of each 10x10 meter cell to the total harvest in the study area. Lopez (2001) determined that approximately 8.4 percent of the deer population dies from human-related causes (total mortality is about 17 percent). He allocated this percentage equally among all the 10x10 meter cells for the study area. Then, he applied the weighting factor to each cell; the result was a differential contribution of the cells to the total human related mortality, or harvest, H. The sum of the values of all cells was the same in the initial grid and the final grid. For any given scenario, the location and intensity of development affect both the carrying capacity and the mortality of the Key deer.



Harvest Grid **Carrying-Capacity Grid**

Figure 2.5. Key deer PVA model grid layers
(darker shades = higher value for the deer)

2.4.3 PVA Model Analysis and Results

The final PVA model includes the matrix model of population dynamics and the spatial model, which allows for addressing development impacts. The program RAMAS Metapop (Applied Biomathematics, Inc.) was used to run the model. The model provides estimates of population size, probability of extinction, and other risk estimates.

In a model "run," the model multiplies the initial population number per stage class by the matrix; the result represents the number of Key deer in each stage class one year later. The model then multiplies this new number by the matrix again to generate the population number for year two. The model run simulates 100 years. This process is repeated 10,000 times. To account for stochastic events, the computer randomly varies matrix parameters and hurricane probabilities, within documented ranges (Lopez 2001). The final model run result represents the average of the 10,000, 100-year iterations.

To estimate the effects of increasing levels of development on the Key deer population, 10 scenarios were evaluated with the Key deer PVA model, beginning with a no action scenario, which represents initial conditions (prior to the construction of the US-1 projects). For any given scenario, the model chose the least valuable vacant parcels and assumed the parcels were developed. As parcels are selected, the spatial model calculated the change in carrying capacity (K) and harvest (H), under the assumption that the total K or H of the parcel was affected. The total K or H for a parcel is the sum of the value for each 10x10-m grid cell inside the parcel. A cell is counted within a parcel if more than 50 percent of its area is inside the parcel.

The change in K and H values, which represent the direct effects of development, are then input into the matrix model. The change in K represents the reduction in the carrying capacity of the area due to habitat loss; the change in H represents the additional percent of human-related mortality, or "harvest," due to the combined effect of habitat loss and increased human activity. Therefore, the model run simulates the effect of development on the Key deer population through time.

The model runs provide an estimate of the risk of extinction in 100 years and the risk of quasi-extinction, here defined as the risk that the population falls below 50 individuals (females) at least once in 50 years (Table 2.2). Both are expressed as probabilities. The model also estimates the average additional human-related mortality (number of female deer).

Results suggest that the probability of extinction of the Key deer in 100 years is less than one percent, even in the presence of levels of development above initial conditions unlikely to occur in the project area (Table 2.4). Model results also indicate the probability that the Key deer population will fall below 50 females at least once in 50 years is 2.2 percent, even with no further development and without the US-1 projects already completed. As expected, the model suggests that annual human-related mortality is likely to increase with the intensity of development.

Table 2.4. Effect of development on Key deer

Scenario	Number of Residential Parcels Developed[1]	Habitat Loss[2] (decrease in K)	Total Harvest[3] (increase in H)	Risk of Extinction in 100 years (percent)	Risk of Falling Below 50 Females at Least Once in 50 Years (percent)	Additional Average Annual Mortality[4]
No Action	0	0	0.00	0.03	2.2	0
S1	200	0	0.42	0.04	2.8	1.6
S2	300	4	0.73	0.04	3.4	2.9
S3	400	6	1.07	0.05	4.1	4.1
S4	500	8	1.47	0.06	5.2	5.4
S5	600	10	1.99	0.07	7.0	6.7
S6	700	12	2.59	0.10	9.9	7.9
S7	800	14	2.90	0.11	11.8	8.3
S8	900	24	3.27	0.13	14.7	8.6
S9	1,000	27	3.70	0.16	18.0	8.7

[1] The model selected parcels with lowest total habitat value to the Key deer.
[2] From the carrying capacity grid in the spatial model. It is an input to the matrix model.
[3] From the harvest grid in the spatial model. It is an input to the matrix model.
[4] Males and females.

The matrix model is more sensitive to changes in H than to changes in K. In turn, changes in H are highly correlated with predicted impacts measured as either the risk of falling under 50 female individuals in 50 years or additional annual human-related mortality. The equations that relate H with these impact assessment variables are:

$$\text{Percent Risk}_{(50)} = 2.2e^{0.58H}$$

and

$$\text{Additional Annual Human-Related Mortality (males plus females)} = -0.65H^2 + 4.85H - 0.34$$

In both cases, the equations explain 99 percent of the variance; therefore, H is an excellent predictor of development impacts to the Key deer.

Through discussion with stakeholders an H level of 1.1 was determined to be an acceptable increase in human-related mortality that will not jeopardize the Key deer.

2.4.4 Application of the PVA Model to the HCP

The spatial component of the PVA model provides a reliable predictor of development impacts on the Key deer: Harvest (H), which is highly correlated with estimates of impacts. Therefore, H is used to measure impacts and mitigation in this HCP.

The Key deer PVA yielded equations that relate H to estimates of risk and additional human-related mortality; therefore, if an H value is assigned to a development activity, then the PVA model can evaluate the effect of that development activity on the Key deer.

Assigning an H Value to Development Activities

First, the method to assign H to a development activity must address the diversity of development types. The model runs assume development on vacant parcels and further assumed that the impact of development was equal to the entire H of the parcel. However, development activities will also occur on already developed parcels and may involve expansion of existing facilities or redevelopment of the parcels to the same or a different land use. Also, road paving or widening must be addressed.

Second, the method to assign H to a development activity must recognize that different land uses cause different levels of human activity (and, therefore, different potential effects on Key deer). For example, other things being equal, a single family residence and a 3,000 square foot store would have different effects on the level of traffic generated and, therefore, on the risk of Key deer road mortality.

In order to assign H to any development activity, the Applicants developed a method that meets the two conditions described above. The main premises of the method are:

1. *If development occurs on an undeveloped parcel, the impact equals the H of the parcel:* The Applicants assume that an undeveloped parcel is fully available to the Key deer and that new development affects the habitat value of the entire undeveloped parcel. Therefore, the impact of such development equals the H of the entire parcel (see Appendix A for definition of new structures).

2. *If development occurs on a developed parcel, the impact of development equals the H of the footprint of the additional development:* The Applicants assume that the impact of existing development has been already realized; therefore, the H of development that occurs in parcels that are already developed is associated with the footprint of the additional activity instead of the entire parcel area (see Appendix A for definition of replacement structures).

3. *The effect of the development activity depends on the type of development or land use:* Because roadway mortality is the largest cause of human-related mortality of Key deer, the H value for a development activity is multiplied by a factor that accounts for the traffic generated by the specific land use or type of activity (Table 2.5).

When unique development conditions are encountered that are not covered by the H-calculation formulas the county will propose a formula and explanation for the calculation to the Service for review and concurrence.

Table 2.5. H multiplier for land use development categories[1]

Land Use	Average Daily Trip Generation[2]	H Multiplier	Variable Name
Single family residential	9.5	1	M_{SRF}
Fences only	--	0.2[3]	
Accessory uses	--	0.2[3]	M_{ACC}
Retail	70	7.4 (per 1,000 sq. ft.)	M_{LU1}
Hotel/Motel	7.9	0.8 (per room)	M_{LU2}
Office	5.9	0.6 (per 1,000 sq. ft.)	M_{LU3}
Institutional	13	1.4 (per 1,000 sq. ft.)	M_{LU4}
Industrial	5	0.5 (per 1,000 sq. ft.)	M_{LU5}
Recreational	67	7	M_{REC}

[1] The multiplier is based on traffic generation because vehicle collisions with Key deer are the most important human-related cause of mortality for the Key deer.

[2] Average daily trip generation was estimated from the Institute of Traffic Engineers Manual; daily trip generation by land use has not been verified for the Florida Keys.

[3] Fences and accessory uses, as defined in the Monroe County Land Development Regulations, are assumed to cause no additional traffic impacts; they were assumed to cause habitat loss (change in K), which has a lesser effect on the matrix model than changes in H.

Based on these three premises, an H value can be assigned to any anticipated development activity (Table 2.6). Multiplier variables (M) described in Table 2.5.

Table 2.6. Calculation of H for different development activities

Type of Parcel	Type of Development	H Calculation	Description
Undeveloped	Residential construction (single family)	$H_{impact} = H_{parcel} * M_{SFR}$	Construction on vacant parcels incurs a new impact, both as loss of habitat and as causing secondary effects.
	Non-residential construction	$H_{impact} = H_{parcel} * M_{LUx}$	For non-residential land uses, the total impact is a function of both the amount and type of development.
	Accessory Use	$H_{impact} = H_{parcel} * M_{ACC}$	Accessory uses only cause loss of open habitat (reduction in K); the effect of K on the model is 0.2 times the effect of H.
	Open space (passive parks)	$H_{impact} = (H_{parcel} * 0.2) * M_{REC}$	Parcels will be revegetated with native vegetation, thus improving habitat value. Recreation use will increase secondary impacts.
Developed	Expansion	$H_{impact} = H_{parcel} * (sq.ft._{expansion}/sq.ft_{parcel}) * M_{LUx}$	In developed parcels, expansion causes an increase on the footprint of development; impact is a function of the additional footprint and the type of land use.
	Redevelopment (different use)	$H_{impact} = H_{parcel} * \{[M_{LUx} * (sq.ft._{dev}/sq.ft._{parcel})]_{new} - [M_{LUx} * (sq.ft._{dev}/sq.ft._{parcel})]_{old}\}$	The impact is the difference between the effect of the new footprint/land use and the old footprint/land use.
	Accessory Use	$H_{impact} = H_{parcel} * M_{ACC}$	Accessory uses only cause loss of open habitat (reduction in K); the effect of K on the model is 0.2 times the effect of H.
	If parcel is already fenced	H_{parcel} is multiplied by 0.8; otherwise the equations above remain unaltered.	The H grid was built without field verification of fencing.
Roads	Paving (dirt roads)	H_{impact} = 0.03720 * length of paving (in miles)	Calculation is based on the estimated H of 1 mile of paved road (H = 0.0372)
	Widening (paved roads; including US-1)	H_{impact} = 0.03720 * (additional width/existing width) * length (in miles)	

2.4.5 The Tier System: A Planning Tool to Manage Development and Conservation

Based on the Key deer studies done under this HCP and the resulting spatial model, Monroe County developed a conservation priority classification for private undeveloped lands in the study area. The private undeveloped lands in the study area are classified into three "Tiers" (Table 2.7 and Figure 2.6). Tier 1 lands are higher quality Key deer habitat. Tier 3 lands are the lowest quality Key deer habitat. Most of the parcels in Tiers 2 and 3 are interspersed among developed parcels and among canals. These areas provide little habitat value to the covered species. The tier classification helped in determining the location of potential new development and prioritizing mitigation areas.

Table 2.7. Tier classification system (vacant privately-owned lands)

Tier	Description	Area (acres) Big Pine Key	Area (acres) No Name Key
1	Lands where all or a significant portion of the land area is characterized as environmentally sensitive and important for the continued viability of HCP covered species (mean H per 10x10 meter cell = 0.259×10^{-3}). These lands are high quality Key deer habitat, generally representing large contiguous patches of native vegetation that provide habitat for other protected species as well.	973.4	217.0
2	Scattered lots and fragments of environmentally sensitive lands that may be found in platted subdivisions (mean H per 10 x10 meter cell = 0.183×10^{-3}). A large number of these lots are located on canals and are of minimal value to the Key deer and other protected species because the canal presents a barrier to dispersal.	101.6	0
3	Scattered lots within already heavily developed areas that provide little habitat value to the Key deer and other protected species (mean H per 10x10 meter cell = 0.168×10^{-3}). Some of the undeveloped lots in this Tier are located between existing developed commercial lots within the US-1 corridor or are located on canals.	58.5	0
	Total	**1,133.5**	**217.0**

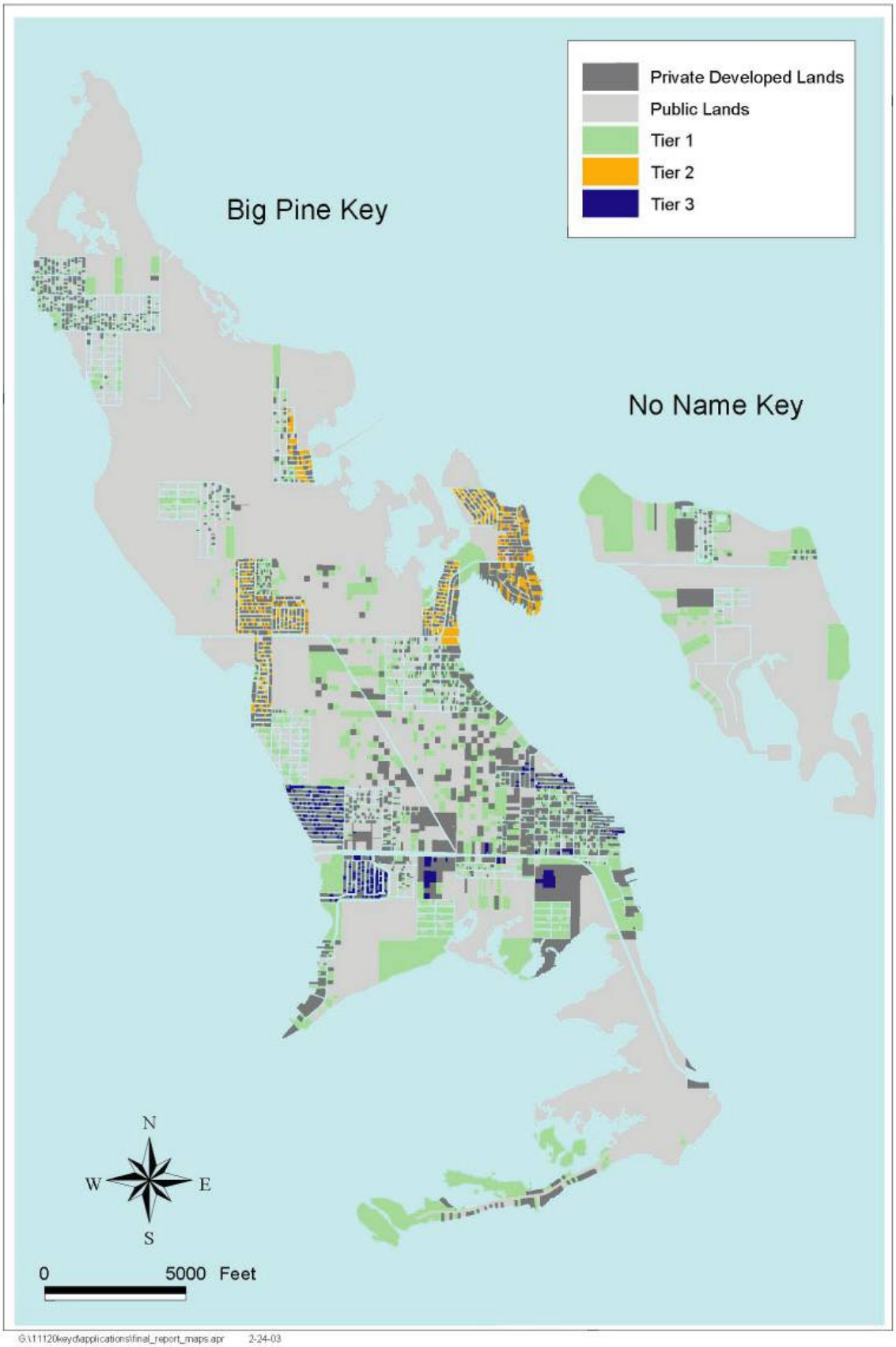


Figure 2.6. Tier classification system in the project area

3. LAND USE CONDITIONS

3.1 Introduction

The Florida Keys encompass a group of islands and, therefore, terrestrial habitats are naturally fragmented. Development has greatly increased the degree of habitat fragmentation mainly by reducing patch size, increasing distances among patches, and in some cases, creating barriers to dispersal (Strong and Bancroft 1994). Development in the Florida Keys has occurred primarily in upland areas, resulting in the loss of almost half of the upland habitats, from 20,038 acres in pre-development times to 10,353 acres in 1995 (URS 2001).

Lower Keys islands developed at a slower pace than the Middle and Upper Keys, but many subdivision plats were filed throughout the 1950s and 1960s. As human alteration of the habitat on Big Pine Key and No Name Key progressed, land was set aside for preservation, establishing the National Key Deer Refuge (Refuge) in 1957. Habitat removal and alteration on remaining private lands continued through the 1970s and the population on Big Pine Key and No Name Key increased steadily. A "housing boom" during the late 1970s and early 1980s brought about significant changes in the configuration of native habitat on the islands and the composition of the human community. In the project area commercial development is primarily found along US-1. The remaining private lands are residential with a few industrial sites, such as rock quarries. No Name Key is less developed and no public electrical service is available on the island. Presently 15 percent and 4.5 percent of the total landmass of Big Pine Key and No Name Key, respectively, are developed.

This chapter provides an overview of the land use and planning conditions in Big Pine and No Name Key, and focuses on future land use changes that are expected to occur over the next 17 years. The information contained herein provides the basis for the assessment of impacts to protected species and habitat in the project area that are likely to occur as the result of planned urban development in the future. Development occurring within the project area is used to model the amount of "take" that will be permitted under this HCP.

3.2 Land Ownership

Approximately 69 percent of the land within the project area is in public ownership (Figure 3.1; Table 3.1). Of which 66 percent are managed for conservation. The main landowner is the Federal government with 55 percent, all of which is within the Refuge. Federal, state, and county agencies purchase and manage lands within the project area for the purpose of environmental protection and conservation. The Service owns 52 percent of Big Pine Key and 71 percent of No Name Key. The State of Florida purchases land under the Conservation and Recreation Lands (CARL) program, which is administered by the Florida Department of Environmental Protection (FDEP). State-owned lands within the project area include the Coupon Bight Aquatic Preserve and Preserve Buffer Lands and lands within the Coupon Bight/Key Deer CARL project area, which combined are less than ten percent of the project area. The Monroe County Land Authority (MCLA) purchases a wide variety of vacant lands as directed in the Monroe County Comprehensive Plan and owns two percent of the land within the project area.

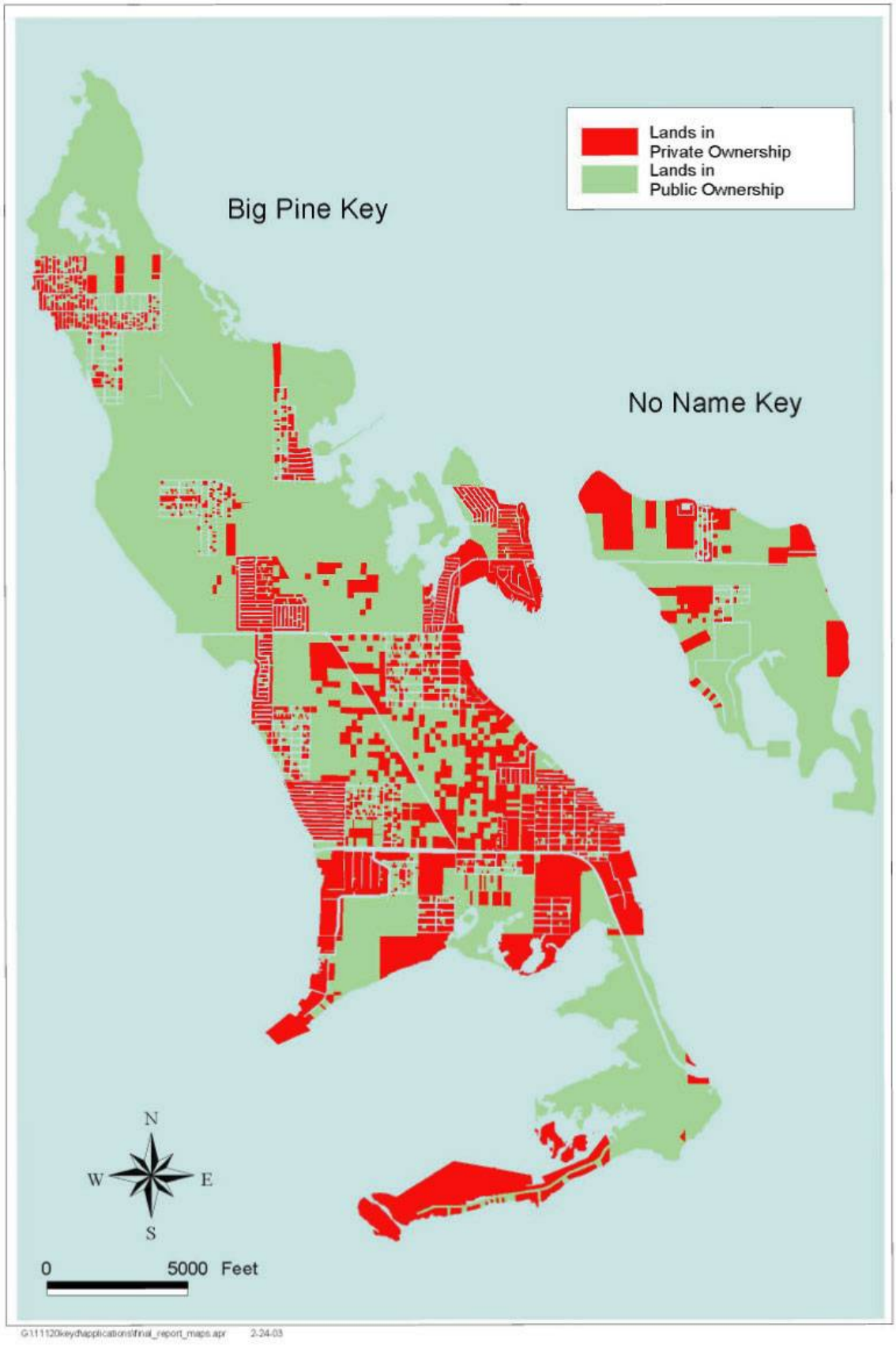


Figure 3.1. Land ownership in the project area

Table 3.1. Land ownership in the project area as of mid-2002[1].

	Big Pine Key		No Name Key		Total	
	Acres	**%**	**Acres**	**%**	**Acres**	**%**
Federal	3,184	51.8	801	70.8	3,985	54.8
State	856	13.9	50	4.4	906	12.5
County	135	2.2	12	1.0	147	2.0
Private Developed	836	13.6	52	4.6	888	12.2
Private Undeveloped	1,134	18.5	217	19.2	1,351	18.5
Total	**6,145**	**100.0**	**1,132**	**100.0**	**7,277**	**100.0**

[1]Includes submerged lands.

3.3 Habitat Management Activities

Federal, state, and county agencies conduct habitat management activities within the project area. The Federal government, through the National Key Deer Refuge, is the main landowner in the study area. The Refuge also manages most of the land within the project area. Management activities include prescribed burning, mowing and clearing of fire breaks, filling of ditches to prevent deer drowning and limit salinity intrusion, habitat restoration, and development and protection of habitat corridors. The Refuge is developing a Comprehensive Conservation Plan (CCP), scheduled for completion in 2006. The CCP will outline a vision for the Refuge, guide management decisions, and outline goals, objectives, and strategies to achieve the visions and purposes of the Refuge. Development of the CPP is a requirement of the National Wildlife Refuge System Improvement Act of 1997.

The FDEP Office of Coastal and Aquatic Managed Areas manages state-owned lands within the Coupon Bight Aquatic Preserve and Preserve Buffer (Preserve), whereas the Service manages state-owned lands within the Coupon Bight/Key Deer CARL project area under an existing lease agreement. A management plan developed for the Coupon Bight Aquatic Preserve (Nielsen 1990) states that research and habitat restoration are primary needs for the Preserve. Current management activities include the installation of mooring and warning buoys, seagrass restoration, treatment of coral band disease, and sea turtle nesting beach surveys. Research activities within the Preserve include juvenile fish studies, larval recruitment of the spiny lobster, and studies on the effectiveness of fishing exclusion zones.

The Monroe County Land Steward is responsible for the management of county-owned public lands within the project area and throughout the Florida Keys. Currently no formal management plan exists for these lands; however, several small habitat restoration and management plans have been developed for individual parcels and subdivisions within the project area. Ongoing management efforts are conducted as needed or when funding becomes available. Primary responsibilities include trash removal, invasive exotic plant control, prescribed burning and other issues related to natural resource management. The Land Steward works in conjunction with the Monroe County Public Works Division, the MCLA, and volunteer groups to implement management activities.

Habitat management of county lands started Keys-wide during FY 2002-2003. Larger tracts of land received priority for management. These lands are primarily conservation lands acquired through grants from the Florida Communities Trust, for which contract requirements necessitate immediate management. Management of remaining county lands throughout the Keys was prioritized depending upon several factors including logistics, habitat quality, presence of rare species, and the character of the adjoining lands.

Federal, state, and county agencies also work together to jointly manage larger tracts of undeveloped land in which all are landowners. Within the project area this land is primarily pinelands. Management of pineland habitat will be addressed in a Fire Management Plan for Big Pine Key and No Name Key, which is currently being developed by the Lower Keys Wildland Fire Hazard Reduction Initiative. Prescribed burning will be conducted by all three agencies in the project area where there is contiguous pineland habitat. Individual undeveloped lots that cannot be burned because they are between developed properties will be maintained free of solid waste and non-native invasive plants and allowed to grow to hammock vegetation.

3.4 Covered Activities

This HCP addresses the incidental take of protected species that may result from **all non-Federal** development activities in Big Pine Key and No Name Key in the next 17 years. The types of activities covered under this HCP include residential development, commercial development and expansion, community and institutional facilities, and transportation improvements.

The Applicants anticipate the following development activities will occur in the covered area in the permit period and within a total H = 1.1:

- *New Residential Development:* A maximum of 200 residential units.
- *Non-Residential Private Development:* The county will authorize limited non-residential development as well as expansion or redevelopment of commercial facilities and community organizations such as religious institutions and civic clubs. The Applicants anticipate that no more than 60,000 square feet of floor area will be added over 20 years.
- *Recreational and Community Facilities:* The county anticipates the development of recreational and community center facilities, including passive public parks, and neighborhood "pocket" parks, as well as the expansion of the existing public library.
- *Public Facilities:* Several public facilities are anticipated over the next 20 years, such as a sewage treatment plant, public office space, and the expansion of the existing emergency response facility. The Applicants anticipate that no more than 24,000 square feet of floor area will be allocated to recreational and community facilities and other public facilities.
- *Local Road Paving or Widening:* During the permit period, some local dirt roads may be paved and some paved roads may be widened to accommodate a bike path.
- *Three-Laning US-1:* The DOT will complete the addition of a third lane, a scramble lane, on the developed segment of US-1 on Big Pine Key. This involves the extension of the newly constructed turn lane east and west of the intersection improvement project.

In addition to limiting the total amount of development over 20 years to a maximum, cumulative H = 1.1, covered activities will comply with the avoidance and minimization guidelines established in this HCP (see Section 5.3). New development will be concentrated on already disturbed lands in order to minimize the loss of prime habitat for the covered species. New commercial development will be limited to infill areas mainly along the existing commercial corridor on US-1 (Appendix B). Redevelopment and expansion activities may be authorized within the guidelines listed in Section 5.3 and within the total allowed H = 1.1 over 20 years. The Applicants estimate that no more than 7 acres of native vegetation will be cleared over the permit period. Wetland impacts, estimated at no more than 3 acres over 20 years, will be limited to roadside swales and ditches. A limited number of fences and other accessory uses will be permitted. Fencing will follow the guidelines in the Appendix C. Fences in Tier 1 may be permitted upon approval from the Service.

The Master Plan for Future Development of Big Pine Key and No Name Key, was developed in conjunction with this HCP, adopted in December 2004 (Monroe County 2004). The Master Plan provides guidance on the amount and extent of each type of covered activity over a 20 year period in the project area. Other activities not described in this HCP are not authorized under this HCP.

4. ALTERNATIVE PLANNING STRATEGIES

4.1 Introduction

Monroe County initiated the LCP in April 2000. The LCP was developed concurrently with the HCP and, while it focused on addressing the needs of the local citizens, all development alternatives were discussed in the context of the Key deer's biology. Like the HCP, the overall goal of the LCP was to determine the appropriate amount, type and location of development in the project area and the associated mitigation that would provide for community needs while maximizing conservation of the Key deer and other covered species.

Monroe County held public workshops and open houses to ascertain public views on planning and conservation issues; it used local media outlets and mailings to alert the public and to distribute surveys. Public workshops were held on April 6, May 25, and September 21, 2000 (Monroe County 2001). The public's understanding of the habitat needs of the Key deer was facilitated during presentations and open discussion at three HCP meetings held in tandem with LCP meetings (see Section 1.2.2). Results of the community workshops and meetings were used to identify key community issues, develop planning objectives and generate conceptual land use alternatives and conservation strategies for the project area.

In the LCP workshops, the following key community issues were identified:

1. Ascertain the distribution of future residential development within the project area;
2. Maintain the rural character of the project area while still allowing some future development;
3. Implement solutions to the traffic congestion on US-1 and minimize the need for local trips on US-1;
4. Develop a community gathering facility and/or more active recreation facilities on Big Pine Key; and
5. Discourage new development on No Name Key.

During the LCP process, Monroe County developed planning objectives to evaluate potential development scenarios. These objectives were based on the combined key issues expressed by the community, existing planning constraints and the existing habitat needs of the Key deer and other covered species. The ten objectives are:

1. Minimize the need for local vehicular trips on and across US-1, from north to south;
2. Improve the level of traffic service on US-1 to a standard that, in accordance with local regulations, would allow some development and to maintain that level of service over the planning horizon;
3. Discourage new development on No Name Key;

4. Encourage additional commercial development to be oriented to the local community rather than to the regional or tourist communities;
5. Continue to allow some development but generally keep the level low to achieve the maintenance of a "rural community" envisioned by the citizens;
6. Provide for a community gathering center and some active recreation;
7. Provide for a conservation plan with a reasonable level of implementation costs and logistics;
8. Provide for a conservation plan which complies with current regulatory constraints (for example, wetlands protection);
9. Provide greater certainty to the property owners and Key deer herd managers as to the location of future development; and
10. Minimize the alteration of undisturbed natural habitat.

The Master Plan for Future Development of Big Pine Key and No Name Key was adopted in December 2004 (Monroe County 2004).

4.2 Planning Strategies Analyzed

4.2.1 Alternative #1: No Action Alternative/No Take

Under this alternative, no HCP would be prepared. With no improvement in the LOS for US-1, the building moratorium would likely continue indefinitely. No new residential, commercial, or recreational development would occur within the project area. The community would retain its rural character, but no additional community facilities would be provided. Private landowners would have little or no recourse to obtain development approvals. With no regional HCP, it is likely that many smaller HCPs would be proposed by individual landowners or groups of landowners.

4.2.2 Alternative #2: Reduced Take

Alternative 2 included a reduced amount of development that, in turn, would result in a smaller level of impact, H. Under this alternative, important community needs would remain unsatisfied, such as community and government facilities expansions.

4.2.3 Alternative #3: Preferred Alternative

The preferred alternative provides for development activities that alleviate the building moratorium, improve the level of service on US-1, restore a low rate of growth in the study area, and offer community and public facilities improvements that satisfy community needs (see Section 1.2.1). The avoidance, minimization, and mitigation measures described in this HCP should ensure that populations of the covered species remain viable.

4.3 Comparison of Alternatives

Both the no action and reduced take alternatives were rejected mainly because they would impose undue restrictions on the community's ability to meet community needs, such as traffic improvements, while not providing significant added value to the conservation of the covered species. Both development alternatives (reduced take and preferred) limit development to disturbed, low quality habitat areas. The proposed alternative provides for a development program that satisfies the community's needs for growth and infrastructure, while ensuring habitat protection in perpetuity for the conservation of covered species.

5. CONSERVATION STRATEGY AND PROCEDURES

5.1 Biological Goals

The primary, measurable goals of this HCP are: a) to ensure future development does not have a negative impact on covered species habitat, and b) to limit the increase in human-related mortality of Key deer and Lower Keys marsh rabbit to a level that would make quasi-extinction over a 50-year period unlikely. Additionally, the Plan aims at keeping secondary impacts to Lower Keys marsh rabbit to current levels or below.

5.1.1 Habitat Protection

The following measures will ensure habitat protection:

- The HCP restricts the loss of native habitat: Native habitat loss caused by development activities over the permit period will be limited to no more than 7 acres in current privately-owned native habitat areas.
- Land development regulations will direct development activities to areas of low habitat quality. No more than two percent of the total H impact over 20 years will be allowed in vacant (privately owned) Tier 1 areas (H = 0.022).
- Monroe County will continue to acquire land to protect habitat areas in perpetuity.
- Monroe County will ensure the management of acquired lands by transferring ownership to state and Federal entities, as appropriate. Lands that remain in county ownership will be managed by the county. Management will include a domestic predator education program.

5.1.2 Minimize the Increase of Human-Related Mortality of Key Deer

The number of human-related deaths for Key deer varies year to year and is significantly correlated with a measure of deer density (Figure 5.1). A goal of this HCP is to ensure that development activities do not result in a significant increase in the relative occurrence of human-related mortality of Key deer.

The PVA model predicts an average of 4.2 additional human-related Key deer deaths per year. The number of human-related Key deer deaths varies from year to year, but is strongly correlated with a measure of deer density (Figure 5.1). Therefore, the ratio "deaths/deer seen" provides an indicator of the potential effects of development on the relative occurrence of human-related deaths. If development impacts are small, and other factors remain the same, future development should not significantly increase the ratio. For the last 13 years (1988-2000), the mean ratio of human-related Key deer deaths to average deer seen in censuses is:

deaths/average deer seen = 1.38
Standard deviation = 0.28
95% confidence interval = (1.23 – 1.53)

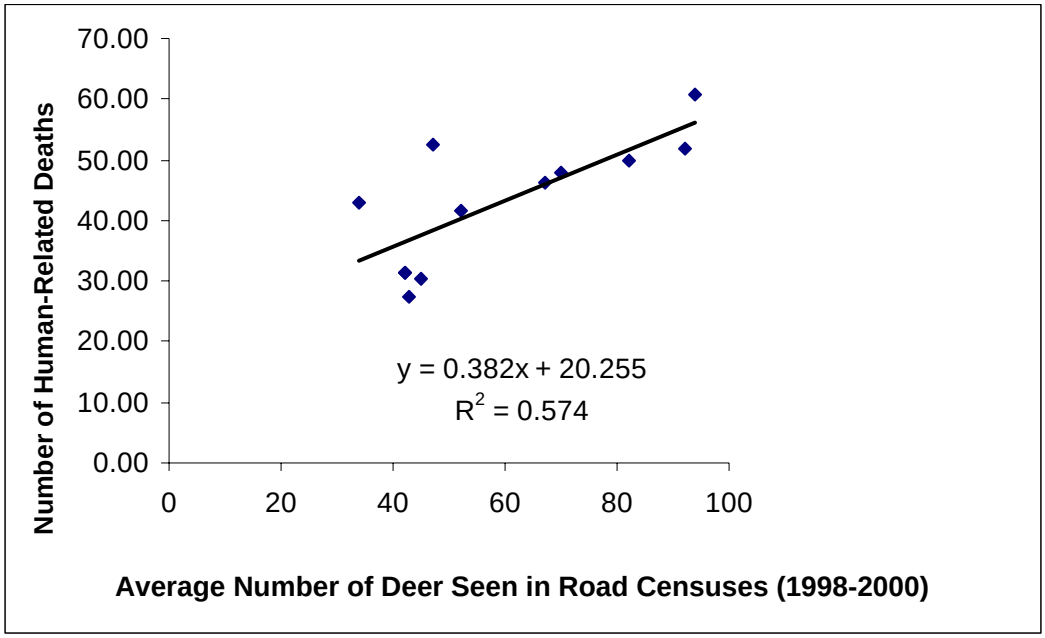


Figure 5.1. Relationship between human-related Key deer mortality and deer density. Data from the Service, and Roel Lopez (pers. comm.)

The predicted average increase in human-related mortality (4.2 deer) would fall within the 95 percent confidence interval, suggesting that no significant increase in the ratio should occur as a consequence of the proposed level of take. For example, an increase of four deer deaths in each of the last 11 years would have produced a mean ratio of 1.48, which is well within the 95 percent confidence interval. The overall effect of the proposed level of development over 20 years is expected to fall within the existing yearly variability.

5.2 Summary of Take and Its Effects on the Covered Species

5.2.1 Florida Key Deer

Under this HCP, the Applicants will carry out covered activities progressively over the permit period. All development activities combined over the permit period will have a maximum total impact of H = 1.1. For H = 1.1, the resulting probability that the population fall below 50 females at least once in 50 years and the average additional total annual human-related mortality are, respectively:

$$\text{Percent Risk}_{(50)} = 2.2e^{0.58*1.1} = 4.2\%$$

$$\text{Additional Annual Human-Related Mortality} = -0.65*1.1^2 + 4.85*1.1 - 0.34 = 4.2 \text{ deer/year}$$

Thus, the PVA model predicts that the combined effect of 20 years of development for a total H = 1.1 would raise the probability that the population will fall under 50 females at least once in 50 years by 2.0 percent over the risk under current conditions (from 2.2 to 4.2 percent) and increase human-related Key deer mortality by 4.2 deer a year. Additionally, the probability of extinction in 100 years is less than 0.1 percent, nearly indistinguishable from current conditions.

The effect of three-laning US-1 was estimated using H and, therefore, based on the spatial model. The Service (1999, 2001) estimated take of Key deer for the underpasses and intersection improvement projects on US-1 and both projects have been constructed. Using the same methodology, the Applicants estimate that the three-laning project may result in the additional death of 1 to 3 deer per year (this estimate is included in the model results).

The Applicants estimate that development activities over 20 years may occur on parcels totaling 168 acres (2.4 percent of the covered area). The total area affected will likely be lower, because development activities in developed parcels will affect only a portion of the parcel. The Applicants estimate that no more than 7 acres of native vegetation will be cleared over 20 years. This represents a loss of about 0.05 percent of native habitat in the HCP covered area and a minor direct effect or take on the covered species.

Construction activities will cause temporary and localized indirect impacts in the vicinity of the construction areas. After construction, other indirect effects may remain, such as edge effects. Given that the majority of the activities contemplated in the 20-year development plan will occur in areas of low habitat quality or on already disturbed lands, indirect and secondary effects are expected to be minimal.

5.2.2 Lower Keys Marsh Rabbit

The Applicants anticipate no direct loss of Lower Keys marsh rabbit habitat as a result of covered activities. No impacts to identified marsh rabbit habitat will be permitted. Indirect effects to marsh rabbit habitat may result if development occurs near marsh rabbit habitat patches. For example, new development near marsh rabbit habitat may bring about stray domestic cats, which are a known cause of mortality for the marsh rabbit. The potential effect of free-roaming domestic cats is reduced with distance to the habitat patch (a 500-meter buffer is generally recommended based on recent research) or if there are barriers to the cats' movements, such as canals. For analysis purposes, the Applicants estimated a "worst-case scenario" for the potential increase of domestic predators in the vicinity of marsh rabbit habitat. For example, assume that the 200 residential units to be permitted over 20 years were located within 500 meters of marsh rabbit habitat. Under this scenario, the number of residential units within 500 meters of marsh rabbit habitat would increase, over 20 years, by 11.6 percent, from 1,723 to 1,923 (Table 5.1). The potential effect of this level of development is ameliorated because the majority of available lots within 500 meters of marsh rabbit habitat are adjacent to canals, in subdivisions already heavily developed (see Figure 2.2). Another indirect effect of additional development in the vicinity of marsh rabbit habitat patches is the potential for road kills. The Applicants anticipate incidental take will be difficult to detect for the following reasons: (1) marsh rabbits are small, therefore, finding a dead or impaired specimen is unlikely, (2) losses may be masked by seasonal fluctuations in numbers or other causes, and (3) the species occurs in

wetland habitat, which makes access and detection of carcasses difficult. Therefore, the Applicants will estimate the level of take of this species by evaluating the acreage of overlap of development in or adjacent to the 500-meter wetland habitat buffers.

Table 5.1. Status of vacant residential lots within 500 meters of Lower Keys marsh rabbit habitat in Big Pine Key

Status	Tier	Total Parcels	Total Acres
Developed	N/A	1,723	416.7
Undeveloped	Combined	2,214	674.1
	1	1,535	542.9
	2	510	86.5
	3	167	32.6

5.2.3 Eastern Indigo Snake

Take of eastern indigo snake habitat is expected in the covered area of the HCP. Take of indigo snakes may occur when lots are cleared for development. The county will ensure that standard protection measures for the eastern indigo snake will be implemented during all construction activities to minimize take of indigo snakes.

A total of 1,351 acres of undeveloped land is in private ownership on Big Pine and No Name Key. A small portion of that may be developed over the next 20 years. The Applicants are requesting coverage for take of eastern indigo snakes resulting from an estimated 168 acres of development in possible indigo snake habitat (see Section 3.4). Monroe County will provide an annual report documenting yearly and cumulative acreages of impacts in all habitat types on Big Pine Key and No Name Key.

5.3 Conservation Strategy - Mitigation Measures and Procedures

The conservation program is focused primarily on strict avoidance and minimization measures, habitat mitigation based on replacing lost habitat value, and the protection and management in perpetuity of acquired habitat. The main goal of the Plan is to mitigate for the anticipated incidental take of covered species in accordance with the requirements for issuance of a Section 10(a)(1)(B) ITP.

5.3.1 Conservative Assumptions and Level of Take

The requested level of take, H = 1.1, is used in this HCP to measure the maximum amount of impacts over 20 years and to establish the level of impact to be mitigated. The model assumes that the entire net impact of H = 1.1 is incurred at the outset of the model run. In practice, H = 1.1 will be accrued over 20 years. The progressive increase in impact levels will allow the Key deer to adapt to changing circumstances, whereas the assumption that all impacts occur at once increases the impact estimates in the model runs.

The model assumed total habitat loss for newly developed parcels. The Key deer uses all available open areas, including developed areas. However, the PVA model assumes that any development on vacant parcels results in the loss of the entire parcel. For example, 200 developed residential lots in Pine Channel Estates contribute 1.8 Key deer to the carrying capacity of the study area (i.e., K = 1.8). However, the model assumes that 200 new houses will contribute nothing to the carrying capacity. Therefore, the model overestimates the impact of development and provides a conservative support to planning for development activities.

The Applicants chose to evaluate a more stringent population viability measure. Recent PVA and conservation literature recommends that conservation planners evaluate shorter-term risks to make management decisions (Akcakaya 2000, Akcakaya and Sjogren-Gulve 2000). The Key deer PVA model can estimate a variety of risk timeframes. For example, extinction risk may be expressed as the probability of extinction of the Key deer in 100 years. Historically, the Key deer population dwindled to less than 50 individuals, but rebounded with the implementation of protection measures (see Section 1.2.1). The Applicants chose to use the risk that the population falls below 50 females at least once in 50 years as a more conservative and realistic measure of risk in evaluating potential development activities. This more stringent indicator guided subsequent viability and incidental take analyses.

Finally, the estimated level of take omits the potential effects of the recently constructed US-1 projects. According to the Service's Biological Opinion (Service 2001), the combined effect of the underpasses and intersection improvement projects could be nine fewer human-related deer deaths per year. The model suggests that such reduction in mortality would ameliorate a significant portion of the impact of the proposed 20-year development program.

5.3.2 Avoidance and Minimization

Avoidance and minimization measures were applied at every step in the preparation of the HCP. First, the Applicants made key decisions, discussed above, in the development and use of the Key deer PVA model, which resulted in a conservative approach to modeling.

Second, development activities in the project area will occur in accordance with the following guidelines, which ensure avoidance and minimization of impacts to the Key deer and other covered species:

1. The total impact of commercial, institutional, and residential development over 20 years will not exceed H = 1.1.
2. New residential development will be limited to a maximum of 200 dwelling units over 20 years.
3. Clearing of native habitat will be limited to parcels to be developed for residential use or for local road widening. The total amount of clearing over 20 years will be limited to no more than 7 acres. No clearing of native habitat, other than that necessary and authorized for new residential development, local road widening, or fire breaks to protect residential areas will be allowed. All other development will occur on disturbed lands.

4. New residential development in Tier 1 areas will be limited to no more than five percent of all residential units permitted over the 20-year period (i.e., a maximum of 10 units) or a total H = 0.022 (two percent of the total H), whichever results in a lower H.

5. No new development other than single-family residential and accessory uses will be permitted in Tier 1. The total H of all development in Tier 1 will not exceed H = 0.022.

6. No development will be permitted which may result in habitat loss on the Sands corridor, as shown in Figure 5.2. With the completion of the Key deer underpasses and the proposed widening of US-1 along the business segment on Big Pine Key, native habitat in the Sands Subdivision area constitutes the main corridor connecting Key deer habitat south and north of US-1 (Figure 5.2).

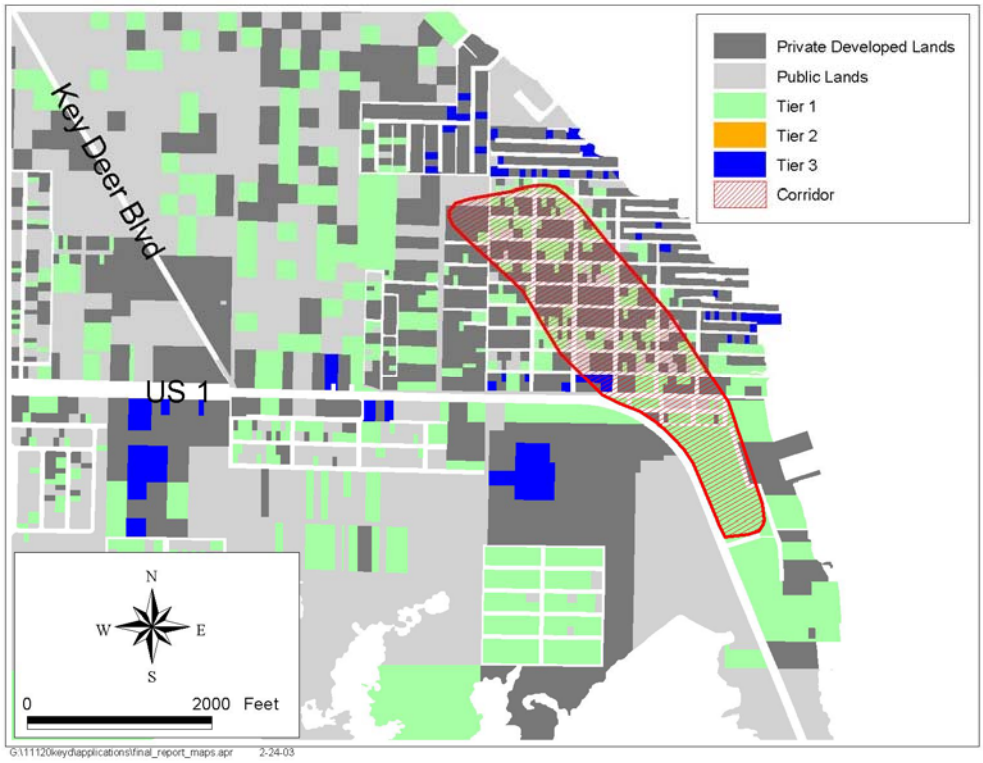


Figure 5.2 Key deer corridor across Sands Subdivision

7. New residential and commercial development will occur progressively over 20 years, thus minimizing the extent of construction impacts that occur at any given time.

8. New commercial development will be limited to infill in existing commercial areas on Tier 2 and Tier 3 lands, mainly along the US-1 corridor on Big Pine Key (Appendix B). This includes all current commercially zoned areas south of Lytton's Way. All new commercial development would be limited to disturbed lands, as defined in the Monroe County Code (9.5-4 [D-14][S-2]). Clearing of pinelands and/or hammock will not be permitted for commercial development activities.

9. Expansion of private non-residential facilities will be restricted primarily to within the US-1 corridor, as described above.

10. The modified ROGO will continue to give new development priority to Tier 3 over Tier 2 and Tier 1 lands.

11. New recreational and community facilities development would be restricted to existing developed areas that are either already publicly owned or acquired for that purpose.

12. Minor recreational and community facilities will be restricted to areas within existing improved subdivisions.

13. Community organizations' development will be restricted to expansions, on existing organization-owned land, up to the buildable area limits per Monroe County Code. No clearing of native habitat will be permitted for these expansions.

14. Speed limits, traffic calming devices, and other measures will be applied to lower the probability of vehicle collisions with Key deer and Lower Keys marsh rabbit on county roads.

15. Public infrastructure development will be restricted to disturbed lands as defined in the Monroe County Code (9.5-4 [D-14][S-2]).

16. No new fences will be allowed in Tier 1 lands, unless they are authorized by the Service. The Service will review applications for fences in Tier 1 for impacts on protected species.

17. No additional fences will be allowed in the US-1 commercial corridor.

18. Fences will be subject to restrictions and guidelines established in agreement with the Service. All fencing will follow the guidelines in Appendix C.

19. No development will be allowed in Lower Keys marsh rabbit habitat. No residential or commercial development will be allowed within 500 meters of marsh rabbit habitat, with the exception of isolated areas (i.e., the green hatched areas on Figure 2.2). Road widening activities along US-1 would occur within existing cleared and filled portions of the FDOT right-of-way.

20. FDOT will avoid impacts to wetlands during US-1 three-laning.

21. Accessory uses will be permitted on lots adjacent to existing developed lots only in Tier 2 and Tier 3 lands. Residential accessory uses would be limited to those listed in the Monroe County Code (Chapter 9.5-4[A-2]).

22. The county will implement an animal control education program to educate the public regarding the potential negative effect of domestic predators on the Lower Keys marsh rabbit. The education program will also request that the public report any Lower Keys marsh rabbit road mortality to the county or to the FWS.

23. The county and Service will annually review and evaluate the need and feasibility of additional regulatory measures to control the spread of domestic predators. If deemed necessary and feasible, measures will be enacted within at a date to be determined through mutual agreement.

24. The county will ensure that standard protection measures for the eastern indigo snake will be implemented during all construction activities to minimize impacts on eastern indigo snakes.

5.3.3 Habitat Mitigation and Habitat Banking

The Applicants propose to mitigate for the incidental take of covered species by acquiring and managing native habitat areas within the HCP project area. The harvest grid used in the PVA (see Section 3) provides a measure of habitat quality and potential indirect effects (i.e., increased human-related mortality) on the Key deer. It also provides a simple currency to compare impacts versus mitigation.

This HCP proposes a level of incidental take not to exceed a total impact area of H equals 1.1. The Applicants will mitigate incidental take impacts by acquiring and managing habitat areas at a 3:1 ratio, using H as the unit of measurement. Therefore, over 20 years, lands with a value totaling an H of 3.3 will be acquired and managed. Land acquisition will occur in advance of or simultaneously with development activities. Should the cumulative $H_{acquired}$ lag the cumulative H_{impact} by 5 percent at any time during the permit period, Monroe County will halt development permit issuance until $H_{acquired}$ is within 5 percent of H_{impact}.

During the building moratorium, Monroe County has continued to acquire lands for conservation. Monroe County issued 29 development permits - during a temporary lifting of the moratorium in 1996 - as well as 266 fencing permits. The Applicants propose to use the H value of acquired parcels, after taking into account permits issued for residential units and fences at a 3:1 ratio, as part of the overall mitigation required under this HCP. The proposed mitigation H, accrued through land acquisition, is H = 0.3390 (Table 5.2).

Table 5.2. Impacts and mitigation in Big Pine Key and No Name Key, 1995 - present

Mitigation (acquisition, credits)		
Properties acquired from 3/15/95 to 11/13/98		H = 0.5211
Properties acquired from 1999 through 2002		H = 0.2646
	Total:	H = 0.7857
Impacts (permits, debits)		
Fences (266 permits)		H = 0.1118
Building permits (29 permits)		H = 0.0371
	Total:	H = 0.1489
Habitat Banking Credit Calculation		
H required to mitigate impacts at 3:1		H = (0.1489*3) = 0.4467
Credit Available ($H_{acquired} - H_{required}$)		H = (0.7857 – 0.4467) = 0.3390

An updated total H value for all development approvals on Big Pine Key and No Name Key from March 13, 1995, to the date of the ITP issuance will be compiled and provided to the Service within one month after permit issuance. This shall be included in the Habitat Mitigation and Habitat Banking calculations at a 3:1 ratio and deducted from the total net H value of the ITP.

Table 5.3 illustrates the annual anticipated mitigation needed based on the implementation schedule presented in Section 6.1.2, for the first five years following issuance of the ITP and associated HCP.

5.3.4 Habitat Management

Monroe County will manage all natural lands acquired under this HCP, either directly or indirectly through agreements with other managing entities. Lands in the project area acquired for the HCP will comprise lands purchased by the Monroe County Land Authority (MCLA) for the Florida Forever Program and lands purchased by the MCLA in accordance with the Monroe County Comprehensive Plan.

Table 5.3. Cumulative increase in H and mitigation needs in the first five years of the permit. By the second year, land acquisition will be necessary to meet mitigation goals.

Project Year	Cumulative Impact (H)	Cumulative Mitigation Debits 3:1	Balance of Credits (initial credit: H = 0.3390)
1*	0.08404	0.25212	0.0878
2	0.16481	0.49443	-0.15543
3	0.18546	0.55638	-0.21738
4	0.20146	0.60438	-0.26538
5	0.21746	0.65238	-0.31338

* Year 1: 10 houses, 15 accessory uses, fire station expansion, 10,000 sq ft institutional expansion, one half of recreational and community facilities and public offices. Year 2: Year 1 plus 10 houses, 15 accessory uses, one half community facilities, and public offices. Year 3: Year 2 plus 10 houses, 15 accessory uses, three-laning US-1; Years 4 and 5: additional 10 houses and 15 accessory uses per year.

Lands acquired through the Florida Forever Program, as part of the Coupon Bight/Key deer CARL project,are owned by the State, but managed by the Service in accordance with existing Refuge practices and State leasing agreement. These lands encompass 3,452 acres of undeveloped land between the Coupon Bight Aquatic Preserve and the Refuge on Big Pine Key.

Other lands acquired by the MCLA either during HCP development or throughout the 20-year life of the ITP that are contiguous with Service lands will be managed by the Refuge through written agreement to be developed with the county. These lands will be managed in conjunction with State agencies and the Lower Keys Wildland Fire Hazard Reduction Initiative. Prescribed burning activities on these lands will be conducted in accordance with the Fire Management Plan for Big Pine Key and No Name Key, which is in preparation.

The Monroe County Land Steward is responsible for managing all other lands acquired by the MCLA in the project area, primarily individual undeveloped lots that cannot be burned due to the proximity of development. Habitat management activities for these lands will vary depending on the habitat quality, presence of rare species, and the character of the adjoining lands. These lands will be maintained free of solid waste and non-native invasive plants and allowed to grow to hammock vegetation. The Land Steward will conduct additional management efforts as needed, including trash removal, invasive exotic plant control and other issues related to natural

resource management. Management of mitigation lands will commence no later than 120 days following acquisition of land in fee title.

5.3.5 Regulatory Actions

Monroe County will enact land development regulations, which will follow the guidelines for a rate of growth and development standards described in this HCP. Since 1992, Monroe County has successfully administered a Rate of Growth Ordinance that directs growth into disturbed lands and protects environmentally sensitive lands. The county has awarded 2,014 Rate of Growth Ordinance (ROGO) allocations since July 1992, of which only about six percent of the total were awarded to parcels with environmentally sensitive characteristics. Nearly half of this six percent was awarded to affordable housing projects.

This HCP limits the proportion of permits in environmentally sensitive areas to five percent of all residential units permitted over 20 years or a total H = 0.022 (two percent of the total H over 20 years), whichever results in a lower total H.

The Master Plan for Future Development of Big Pine Key and No Name Key directs the rate of growth and development standards in the project area. The master plan will follow the avoidance and minimization guidelines described in this HCP.

5.3.6 Other Considerations

With this HCP, the Applicants consolidate their efforts to provide for the protection of the Key deer and other covered species in the project area. For example, ongoing land acquisition has increased the amount of habitat protected in perpetuity. Beginning in 1993, FDOT invested approximately $12 million to study, plan, and execute projects to reduce highway mortality of Key deer and improve safety on US-1 in Big Pine Key.

In addition to co-funding the development of this HCP, the FDOT has also funded the following studies, which are consistent with recovery plans for covered species in the project area:

- Development of a Methodology for Determining Optimum Locations for Wildlife Crossings on State Highways Using a Geographic Information System (GIS) Approach, with Application to Key Deer on Big Pine Key: $18,994.
- Evaluation of Deer Guards for Key Deer, Big Pine Key: $45,000.
- Evaluating Reintroduction as a Conservation Strategy for Lower Keys Marsh Rabbit: $18,000.
- Effectiveness of Fencing, Underpasses, and Deer Guards in Reducing Key Deer Mortality on the US-1 Corridor, Big Pine Key: $170,506.

5.4 Monitoring and Reporting

The Applicants will carry out biological and compliance monitoring to ensure that the biological goals and the commitments made in this HCP are met.

Biological monitoring of the Key deer will focus on assessing the relative occurrence of human-related mortality. The main objective of the biological monitoring is to determine if human-related mortality is increasing beyond the levels observed in recent years. Specifically, the biological monitoring will test the null hypothesis that, as development activities proceed in the project area, there will be no significant increase in the relative incidence of human-related mortality. Based on the statistical relationship between human-related deaths and the mean number of deer seen in standard field censuses (see Sections 5.1 and 5.2), the ratio of human-related deaths to mean number of deer seen should remain below 1.53 during the permit period.

The Service conducts weekly population counts and monthly deer census. The Applicants will conduct a yearly (in April) census to supplement and verify data from the Service (Table 5.4). Census data will provide the "average number of deer seen." Also, the Applicants will request Key deer mortality data the Service collects. Mortality data will provide the "number of human-related deaths." The ratio will then be calculated for the reporting period and compared against the reference value, 1.53.

Table 5.4. Projected budget for monitoring Key deer population for 20-year period

Item/Service	Annual Costs	Costs for 20-Year Plan
Marking supplies	500	10,000
Trapping/surveys	1,000	20,000
Travel costs (2 trips)	3,000	60,000
Data analysis/reporting	500	10,000
Total Costs	**$5,000**	**$100,000**

The Applicants will also review the Service mortality data every year to determine if new spatial patterns emerge, or if any other change in the mortality patterns occur which may be explained by the additional development.

During construction activities of county facilities and road expansion activities, the county biologist will conduct bi-weekly monitoring to ensure that development is occurring in accordance with the conditions of the Plan.

Population surveys of the other covered species will not be conducted because the effects on these species are anticipated to be minimal. Habitat loss data will be compiled for the other covered species. The county will compile habitat impact data for the 500-meter wetland buffer areas identified as important for Lower Keys marsh rabbit. The county will also compile project area impact data (in acres) to document possible impacts to indigo snakes.

Compliance monitoring will include an annual compilation of the amount of development completed and acres converted, number of acres acquired, and a summary of habitat management activities by Monroe County. The total H for development and acquisition will be determined using the spatial model and the appropriate land use H conversion factors.

Documentation of habitat management activities will be conducted by the Monroe County Land Steward for lands acquired under the HCP that are not part of the Coupon Bight/Key deer CARL project. Habitat management activities should parallel land acquisition efforts, that is, the amount of land acquired by the MCLA annually, outside of the Coupon Bight/Key deer CARL project, should be equivalent to that which is managed. The Monroe County Land Steward will submit an annual summary of the number of the county's habitat management activities.

Monroe County is responsible for ensuring that these monitoring activities are funded and implemented. Monitoring activities will be detailed and summarized in an annual report for the life of the ITP.

5.4.1 Annual Reporting

Monroe County will prepare and submit an annual HCP Report to the Service at the end of the reporting year. The reporting period will cover January 1 through December 31 and will be submitted by March 31 following the end of the reporting period. The report will address both the biological monitoring and the compliance monitoring. The report will include the following information:

- Biological Information:
    - Results of the Key deer census, including the calculation of the average number of deer seen.
    - A summary of Key deer mortality information, including the calculation of the number of human-related deaths. Human-related deaths include those due to road kills, entanglement, attacks from domestic predators, and poaching.
    - A discussion and interpretation of mortality data.
    - A summary discussing habitat management activities for county lands.
    - An assessment of whether the ratio of the number of human-related deaths to average deer seen remains below 1.53.
    - For the Lower Keys marsh rabbit and eastern indigo snake:
        - A compilation (in acres) of annual impacts to the 500-meter wetland buffer areas identified as important for Lower Keys marsh rabbit.
        - The cumulative impacts of all development projects affecting buffers since permit issuance.
        - A compilation and report of entire project area impacts (in acres) to document possible effects on indigo snakes.
        - A summary of reported Lower Keys marsh rabbit road mortality (see Section 5.3.2).

- Annual Compliance Information:
  - A list and map of development activities approved and completed.
  - The H value associated with each activity and the total H value of all activities for the year.
  - The cumulative H value of all development since permit issuance.
  - A discussion of observations made during construction monitoring of county facilities and road expansion activities.
  - A list and map of parcels acquired in the reporting year.
  - The H value for each parcel and the total H value of parcels acquired during the reporting period.
  - The cumulative H value of all acquisition since permit issuance including the mitigation credit of H = 0.3999 discussed above.
  - A discussion of management activities conducted during the reporting year.
  - An assessment of the status of all mitigation parcels, addressing the extent of invasion by exotic species, trash disposal, and other potential human-related impacts.
  - A monitoring report documenting compliance with the exotic/nuisance plant control program on county conservation lands demonstrating no more than 20 percent aerial coverage nuisance and 10 percent aerial coverage invasive species identified by Florida Exotic Pest Plant Council.
  - A statement confirming that mitigation has occurred as to maintain a 3H:1H ratio with respect to development activities and demonstrating that acquisition credits represented in H are not greater than 5 percent behind H values for impacts
  - Any other pertinent information relative to the implementation of the HCP.
  - Monroe County will prepare and maintain an updated master list of all development permitted on Big Pine Key and No Name Key with the start date of March 13, 1995, which records the H value for each permit approval and a running total, which is cumulatively subtracted from the total H value. This master list shall be readily available to the public, the Service, and the DCA.

A meeting between the county and Service will be scheduled within 60 days of annual report submittal to review the HCP progress and discuss any problems.

5.5 Adaptive Management

Adaptive management provisions in the HCP aim at reducing risk to the species due to significant data, information gaps, or to circumstances which arise requiring a change in species management or acquisition strategies. The Key deer has been extensively studied (Lopez 2001) and ongoing research programs at Texas A&M University are addressing the Key deer, the silver rice rat and the Lower Keys marsh rabbit. The Key deer PVA model is the state-of-the-art and will likely be fully applicable unless conditions change dramatically. No further studies are proposed as part of this HCP.

The success of the proposed mitigation strategy relies heavily on the willingness of landowners to enter into sales agreements with the Applicants. Should unwilling sellers prevent the county from accomplishing the mitigation goals, Monroe County will halt the issuance of development

permits until willing sellers become available, or practice adaptive management by modifying the acquisition process to one with demonstrated success. Under no circumstance will the county issue permits if mitigation is not assured and, to the extent practicable, land acquisition will occur in advance of incurring impacts.

5.6 Changed Circumstances

Reasonably foreseeable circumstance, which may occur in the project area or to the covered species include hurricanes, flooding, fire, or sudden population decline due to disease or habitat degradation. A steep decline in the populations of the Key deer due to disease, food base change, or catastrophic event will trigger the Service to demonstrate a change in viability of the species. Finally, monitoring the success of this HCP depends on annual data from the Service. Should the Service stop obtaining deer density and mortality data, other options to gather these data should be agreed upon between the Applicants and the Service.

5.7 Unforeseen Circumstances

A catastrophic or other unforeseen event will trigger the Service to demonstrate a change in viability of covered species. The Service will reinitiate consultation on the listed species and resolution of issues should be agreed upon between the Applicants and the Service.

5.8 No Surprises

The “No Surprises” policy establishes a clear commitment from the Federal government to honor its agreements under an approved HCP for which the permittee is in good faith implementing the HCP’s terms and conditions (Service 1996). The HCP handbook (Service 1996) states that the Service will not require the commitment of additional land or financial compensation beyond the level of mitigation provided in the HCP.

6. IMPLEMENTATION AND FINANCING

6.1 Regulatory Actions

Upon approval of the HCP and issuance of the ITP, the county will amend its Comprehensive Development Plan (Comp Plan) and Land Development Regulations (LDR) to codify the development guidelines described in this HCP. The Master Plan for Future Development of Big Pine Key and No Name Key determines the rate of growth and development standards in the project area, in accordance with the guidelines described in this HCP. Pursuant to the 1998 MOU between the Applicants and technical agencies, the DCA and the county may enter into an agreement under Section 380.032, F.S., whereby the county may proceed with development activities in the HCP before amendments to the Comp Plan are completed.

6.1.1 Roles and Responsibilities

Monroe County will act on behalf of the Applicants in conducting the Plan's mitigation program and for all reporting activities under this HCP. In addition, Monroe County will be responsible for the following activities: approving development consistent with the covered activities in the HCP; maintaining a GIS database on the number, habitat type and location of development activities and mitigation actions including acquisition and management activities; funding or providing staff for biological monitoring and annual reporting activities; establishing and maintaining an annual budget and budget amendments for HCP adoption and implementation; and all other duties and responsibilities relating to the execution of the HCP. Moreover, the county will be responsible for ensuring that all mitigation activities are implemented concomitant with development activities. Finally, Monroe County will coordinate with FDOT and DCA to ensure that the provisions of this HCP are met.

6.1.2 Implementation Schedule

Over the life of the ITP, Monroe County will authorize residential development at a steady rate as outlined in the Master Plan. Commercial development and local road improvements would also occur progressively through the plan period at an approximate rate of 2,390 square feet per year and 10,890 square feet per year, respectively. Expansion of the existing fire station and institutions, and approximately half of the community facilities and county offices will be constructed during year one. The remaining community facilities and expansion of county offices will likely be completed in year two of the Plan.

The interim wastewater treatment plants will be constructed in years five, six, and seven of the Plan. FDOT would construct the US-1 three-laning project following completion of the design phase, which is scheduled for 2005. Construction may be completed within the first seven years of the plan period. Issuance of permits for accessory uses and fences will occur at the time of request, for the purposes of the schedule permit issuance was averaged over 20 years. Management of mitigation lands will be commensurate with land acquisition.

6.2 Funding

Monroe County will fund land acquisition and management under this HCP through existing funding mechanisms. Since 1986, the MCLA has been tasked with acquiring lands for the county in accordance with the Monroe County Comprehensive Plan Land Authority Ordinance (Ord. No. 31-1986, 1), and by s. 380.0661-380.0685, F.S., s. 125.0108, F.S. The MCLA was established to conduct land acquisition activities necessary to deal with property rights of small landowners, environmental protection, park and recreational space, affordable housing and public infrastructure should there be an environmental component. The MCLA provides a mechanism to "deal with the challenges of implementing comprehensive land use plans pursuant to the area of critical state concern program, which challenges are often complicated by the environmental sensitivity of such areas (and to provide) a stable funding source and the flexibility to address plan implementation innovatively and by acting as an intermediary between landowners and the governmental entities regulating land use" (Section 1-3, Rule 02-1991, MCLA).

Funding for the MCLA was initially supplied by recurring revenue from a Florida Department of Natural Resources park surcharge and one half cent of tourist impact tax revenue. The State Park surcharge (s. 380.0685, F.S.) is collected at a rate of 50 cents per person per day, or $5 per annual family auto entrance permit, or $2.50 per night per campsite, cabin, or other overnight recreational occupancy unit. Ninety-eight percent of this surcharge is provided to the MCLA for the purpose of land acquisition, ten percent of which may be used for administrative purposes. The tourist impact tax (s. 125.0108, F.S.) is collected as a 0.5-cent bed tax per $1 lodging money on rentals with 6-month term or less, segregated by Area of Critical State Concern. Fifty percent of this tax is provided to the MCLA for the purpose of land acquisition, five percent of which may be used for administrative purposes.

Additional sources of revenue for the MCLA include grants from programs such as Preservation 2000. From 1998 to 2001, contributions to MCLA revenue from the state have been to the amount of $3,000,000 per year, with a total of $14,793,174 provided since 1985 (FDEP 2001). These funds are being used by the MCLA to purchase lands for the Coupon Bight/Key Deer CARL project. Whereas funds generated by grants fluctuate, revenue produced by the state park surcharge is relatively constant. Funds from the tourist impact tax continue to increase with increasing numbers of tourists visiting the Keys. All revenue provided to the MCLA is deposited into an interest-bearing account for the purpose of land acquisition and program administration costs.

Table 6.1 provides a preliminary estimate of the costs for Plan implementation. This cost estimate assumes that management costs for mitigation lands purchased by the MCLA for the Coupon Bight/Key Deer CARL project are not sustained by the county. Mitigation lands to be managed under the HCP include lands acquired in Tier 2 and Tier 3 areas. Administrative costs for land acquisition activities and reporting efforts will primarily constitute staff time and therefore are not shown in the estimate below.

Table 6.1. Estimated cost of the HCP

Item	Unit
Development impact (H)	1.1
Mitigation (H)	3.3
Estimated land value (based on average cost for lands totaling H=3.3)	$6,185,000
Estimated number of acres (based on Tier 1 lands)	270
Annual management costs[1]	$67,950
20-year management	$1,359,000
20-year monitoring ($5,000/year)	$100,000
Total estimated HCP cost (Raw Cost over 20 Years)	$11,685,000

[1] Management cost is estimated at $1,000/acre for the first three years and $100/acre thereafter. The number reported is the 20-year average.

6.3 Permit Amendment Procedures

Modifications to the ITP would need to be made in the event of:

1. Modifications to the boundaries of the project area or the location of development activities;
2. Increases in the acreage of development activities;
3. The listing of a species protected under the Act which is not covered under the HCP and which would likely be taken as a result of covered development activities;
4. A change in the development action or land acquisition mitigation activities that would result in an increased take of one or more of the covered species; and
5. Changes that would result in significant adverse effects to the covered species or new effects to covered species that were not addressed in the HCP.

Amendments to the ITP will require a revised HCP, a permit application and application fee, a National Environmental Policy Act (NEPA) document and a 30-day public comment period. The Service must be consulted and concur on all proposed amendments. There are two types of proposed amendments:

- Minor Amendments. Minor amendments involve routine administrative revisions or changes to the operation and management program, which do not deplete the level or means of mitigation. Such minor amendments do not alter the terms of the Permit. Upon written request of the Applicants, the Service is authorized to approve minor amendments to the HCP, if the amendment does not conflict with the purpose of the HCP as stated in Section 1.2.
- All Other Amendments. All other amendments will be considered an amendment to the ITP, and will be subject to any other procedural requirements of laws or regulations that may be applicable.

6.4 Permit Renewal or Extension

The ITP may be renewed or extended prior to expiration if the biological conditions described in the HCP are not significantly different and no additional take of covered species is requested. In the event that renewal of the ITP is sought, the Applicants will submit a written request to the Service certifying that the provisions within the HCP and all subsequent amendments are valid. The request for renewal will also include a description of the portions of the project to be completed or development activities that would be covered under the ITP renewal period. The request for renewal must be submitted 30 days prior to the ITP's date of expiration.

The Service may renew the ITP if its findings are consistent with those detailed in the Applicant's request. Renewal procedures will be conducted in accordance with 50 CFR 13.22. Renewal of the ITP does not authorize an increase in take levels beyond those stated in the original HCP. All annual reports and reporting requirements must be completed prior to submittal of the request for renewal.

7. REFERENCES

7.1 Agencies and Persons Contacted

Florida Department of Community Affairs
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8. LIST OF PREPARERS

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Ricardo N. Calvo, Ph.D., Project Manager. Dr. Calvo has more than 12 years of experience in ecological research and environmental consulting in the U.S. and abroad. His project experience includes environmental impact assessments for diverse infrastructure projects, threatened and endangered species, preserve design and management, wildlife surveys, mitigation design and environmental planning. He was the Project Director for the PD&E for wildlife underpasses to address Key deer/US-1 motorist conflicts in Big Pine Key. Dr. Calvo also served as the Project Manager for a study to develop feasible alternatives to reduce Key deer mortality along US-1 in Big Pine Key. He received in Ph.D. in Biology in 1990. Dr. Calvo served as project manager and document author for this HCP.

Roel Lopez, Ph.D., Key Deer Expert. Dr. Lopez is a wildlife biologist, published scientific author, and a Key deer expert. He received his Ph.D. in Wildlife and Fisheries Sciences in 2001. Dr. Lopez's specific research interests include Key deer ecology, wildlife population dynamics, habitat management, computer simulation and modeling, use of GIS and databases in resource management. He provided biological expertise on the Florida Key deer including estimating population parameters for the PVA, statistical analysis, and database management.

Barry Lenz, Senior Ecologist. Mr. Lenz is an ecologist with more than 21 years of experience, including 16 years with URS, with a specialization in ecology and threatened and endangered species. He has extensive background in environmental and ecological assessment, environmental permitting, and vegetation community mapping. Mr. Lenz served as a technical researcher and document reviewer.

Amy Lecours, M.S., Environmental Scientist. Ms. Lecours has more than eight years of experience and holds a Master's Degree in Coastal Zone Management and Marine Biology. She has experience in coastal and marine biological investigations for NEPA documents and environmental assessments. Ms. Lecours served as a technical researcher and document author.

Laura Cherney, Environmental Scientist. Ms. Cherney has more than three years of experience in threatened and endangered species surveys, NEPA documentation and wetland delineations. She holds a Bachelor's in Environmental Engineering Sciences. Ms. Cherney served as project coordinator, technical researcher and document author.

8.2 Sub-Consultants

Patricia L. McNeese, M.S., Environmental consultant. Ms. McNeese has 18 years of experience including 14 years working in the Florida Keys environment. She holds Bachelor's and Master's degrees in marine biology. Her Florida Keys experience includes work on such projects as the Monroe County 2010 Comprehensive Plan, the Florida Keys Advance Identification of Wetlands, the Habitat Evaluation Index and the LCP for Big Pine Key and No Name Key. Her latest activities in the Keys have focused on restoration and management of natural habitats. Ms. McNeese has been accepted as an expert witness in environmental planning and Florida Keys biology and ecology. She served as a technical researcher and document author.

Appendix A

Definitions for Terms in the Big Pine Key Habitat Conservation Plan.

For the purpose of this HCP the following definitions are used.

Accessory Uses or Accessory Structures - means a use or structure that is subordinate to and serves a principal use or structure; is subordinate in area, extent and purpose to the principal use or structure served; contributes to the comfort, convenience or necessity of occupants of the principal use or structure served; and is located on the same lot or on contiguous lots under the same ownership and in the same land use district as the principal use or structure. Accessory uses include the utilization of yards for home gardens provided that the produce of the garden is for noncommercial purpose; however, in no event shall an accessory use or structure be construed to authorize a use or structure not otherwise permitted in the district in which the principal use is located, and in no event shall an accessory use or structure be established prior to the principal use to which it is accessory. Accessory uses shall not include guest units or any other potentially habitable structure. Habitable structures are considered to be dwelling units as defined below in this section. [Monroe County Land Development Regulations Sec. 9.5-4, A-2].

Disturbed land - land that manifests signs of environmental disturbance which has had an observable effect on the structure and function of the natural community which existed on the site prior to the disturbance [Monroe County Land Development Regulations Sec. 9.5-4, D-14]. For the purpose of the HCP there is no difference in disturbed and scarified lands.

New Residential Development – any development on a residential property.

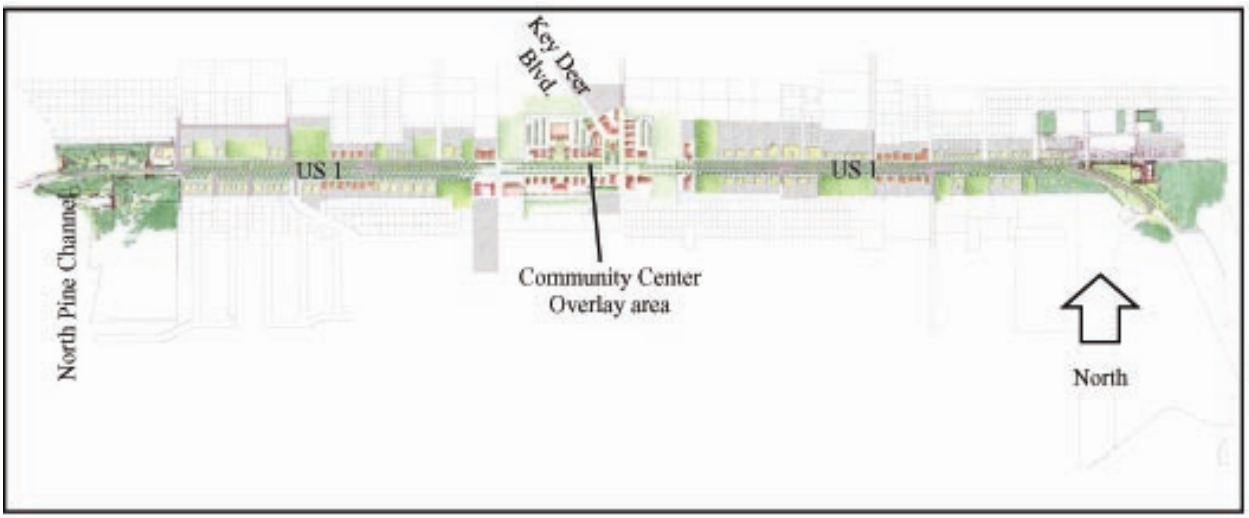
New Commercial Development – any development on a vacant commercial property or any existing commercial use property, or any expansion of the floor area on an existing commercial use property.

Replacement Residential Structures – those structures existing, legally established residential units as of the date this plan are not considered new development nor shall on-site replacement be considered to have any H impact (Monroe County 2004: 39).

Replacement Commercial Structures - those structures that replace legally established structures on the same site that do not increase the footprint size or impact native vegetation.

US-1 corridor – the area along US-1 determined for development in the Big Pine Key and No Name Key Master Plan (Monroe County 2004) (see appendix B for figure).

Appendix B
US-1 Corridor Area



The US-1 corridor area for the purpose of this HCP is the area designated in Figure 4.1 of the Big Pine Key and No Name Key Master Plan (Monroe County 2004) as depicted here.

Appendix C

Summary of Fencing Requirements in the
Big Pine Key and No Name Key Habitat Conservation Plan

No new fences will be allowed in Tier 1 lands, unless they are authorized by the Service. The Service will review applications for fences in Tier 1 for impacts on protected species.

No additional fences will be allowed in the US-1 commercial corridor.

Fencing regulations on Big Pine and No Name Key as set forth in Monroe County Land Development Regulations 9.5-309 (c) as follows are applicable to this HCP.

Big Pine and No Name Key: The purpose of this section is to recognize and provide for the particular habitat needs of the Florida Key Deer (*Odocoileus virginianus clavium*) on Big Pine Key and No Name Key so that deer movement throughout Big Pine Key and No Name Key is not hindered while allowing for reasonable use of minimal fencing for the purposes of safety and protection of property. In addition to all other standards set forth in this section, all fences located on Big Pine Key and No Name Key shall meet the standards of this subsection as listed below:

(1) In the Improved Subdivision (IS) land use district, fences shall be set back as follows:

a. On canal lots, fences shall be set back at least fifteen (15) feet from the edge of abutting street rights-of-way; and built to the edge of all other property lines or as approved through a U.S. Fish and Wildlife Service coordination letter;

b. On all other lots, fences shall be set back at least fifteen (15) feet from the edge of abutting streets rights-of-way, at least five (5) feet from side property lines and at least ten (10) feet from the rear property line, or as approved through a U.S. Fish and Wildlife Service coordination letter;

(2) In all other land use districts, fences may enclose up to a maximum of and not to exceed the net buildable area of the parcel only;

(3) Enclosure of the freshwater wetlands by fences is prohibited;

(4) All fences shall be designed and located such that Key deer access to native habitat, including pinelands, hammocks, beach berms, saltmarshes, buttonwoods and mangroves is maintained wherever possible;

(5) All fences shall be designed and located such that Key deer corridors, as identified by the U.S. Fish and Wildlife Service, shall be maintained;

(6) Fences shall not be permitted without a principal use except where the enclosed area consists of disturbed lands or disturbed land with exotics.