

# **ENVIRONMENTAL ASSESSMENT**

## **VISITOR CENTER**

**Florida Keys National Wildlife Refuge Complex  
Monroe County, Florida**

**April 26, 2016**

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## **I. Introduction**

The Florida Keys National Wildlife Refuges Complex (Refuge Complex) (Figure 1) is composed of four individual National Wildlife Refuges (NWRs) that include: Crocodile Lake National Wildlife Refuge, which is located at the northern end of the Florida Keys on Key Largo, Florida, and the Lower Florida Keys Refuges which include: National Key Deer Refuge, Key West National Wildlife Refuge, and Great White Heron National Wildlife Refuge, which are situated between the city of Marathon and the Marquesas Keys (west of Key West, Florida). The Refuge Complex is administered by the U.S. Fish and Wildlife Service (Service).

The Service proposes to construct, operate, and maintain approximately 1,840 square feet of building space and 26,400 square feet of parking lot to support a visitor center in the lower Keys for the Florida Keys National Wildlife Refuges Complex (Figure 2). The site of consideration for this proposed action is approximately 1.0 acres of developed land on the National Key Deer Refuge located on U.S. Highway 1 / Overseas Highway, Big Pine Key, Monroe County, FL (Figure 3). The site had been previously developed and used as parking lot and feed store prior to Service ownership. On the neighboring 2.0-acre lot, the Refuge Complex proposes a trail system for visitors to experience some of the native habitats found on the National Key Deer Refuge. Big Pine Key is one of the largest keys in the lower Florida Keys and much of this island is owned and/or managed by Service as part of the National Key Deer Refuge, which is approximately 84,834 acres in size with 8,983 acres in terrestrial habitats and the remainder in coastal marine habitats. Existing and proposed elevations within the proposed project are depicted in Figure 4.

While the Lower Florida Keys Refuges Comprehensive Conservation Plan (CCP) did discuss a new visitor center for the Refuge Complex, the CCP's Environmental Assessment did not fully analyze the proposed site and did not include the details currently proposed. The Refuge Complex developed this document to comply with the National Environmental Policy Act (NEPA) of 1969, following the Council on Environmental Quality counterpart regulations at 40 CFR part 1500.

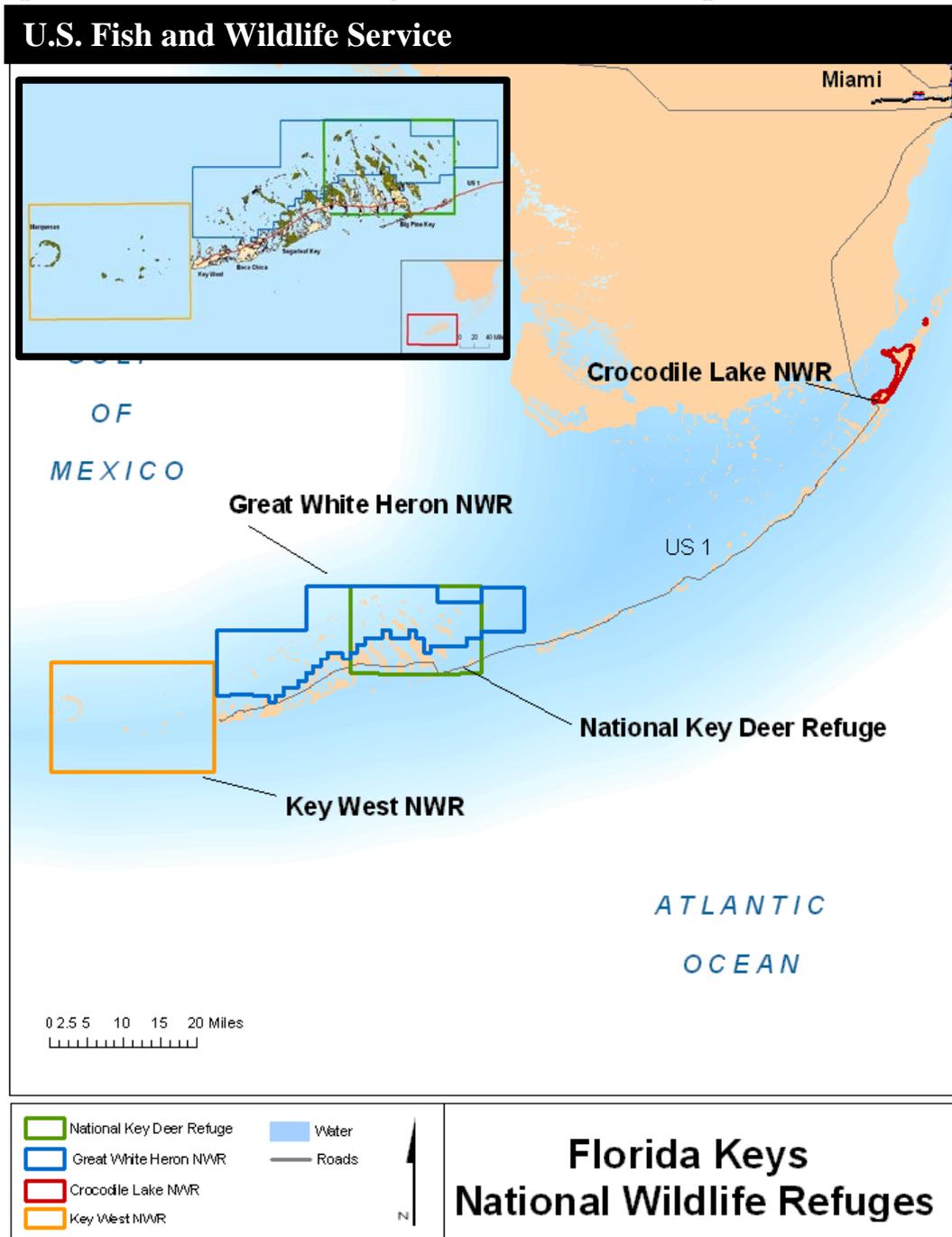
## **II. Purpose of the Proposed Action**

The purpose of the Proposed Action is to serve the existing vision, goals, objectives, and strategies outlined in the Lower Keys Refuges CCP (US Fish and Wildlife Service 2009), while serving the purposes of the Lower Keys NWRs, the mission of the National Wildlife Refuge System (NWRS), and the NWRS Improvement Act.

The purposes for the lower Keys NWRs in the Refuge Complex include protecting and conserving Key deer and other wildlife resources; providing a haven for great white herons, migratory birds, and other wildlife; serving as a preserve and breeding ground for colonial nesting birds and other wildlife; preserving critical habitat for the American crocodile; and providing for compatible public outdoor recreational use and enjoyment. The vision for the Lower Keys NWRs includes working with partners

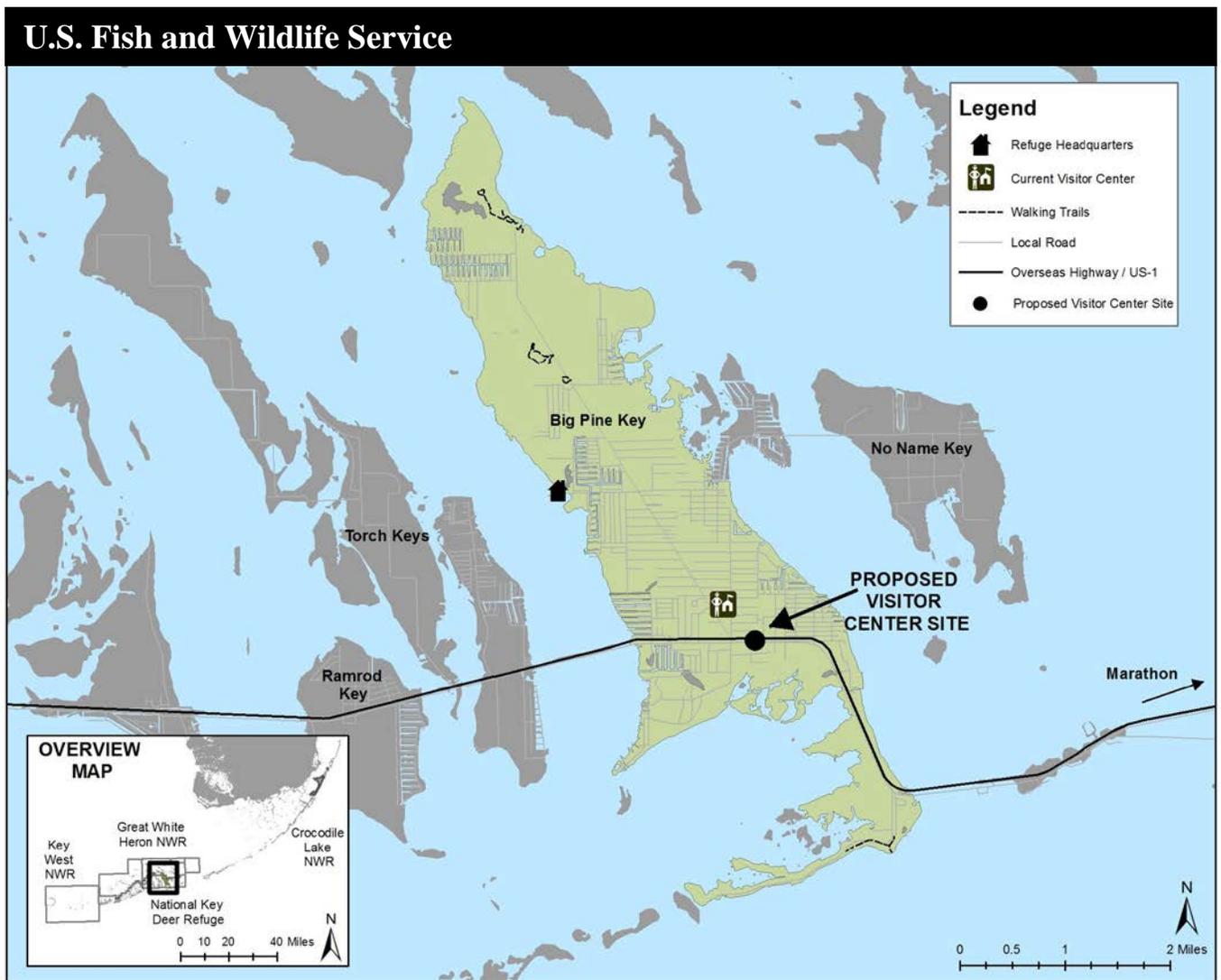
to protect vital habitats; provide a haven for wildlife and habitat diversity; protect, enhance, and restore ecological diversity and integrity; and provide unique opportunities for research and compatible wildlife-dependent recreational uses for present and future generations.

**Figure 1. Location of Florida Keys National Wildlife Refuges**



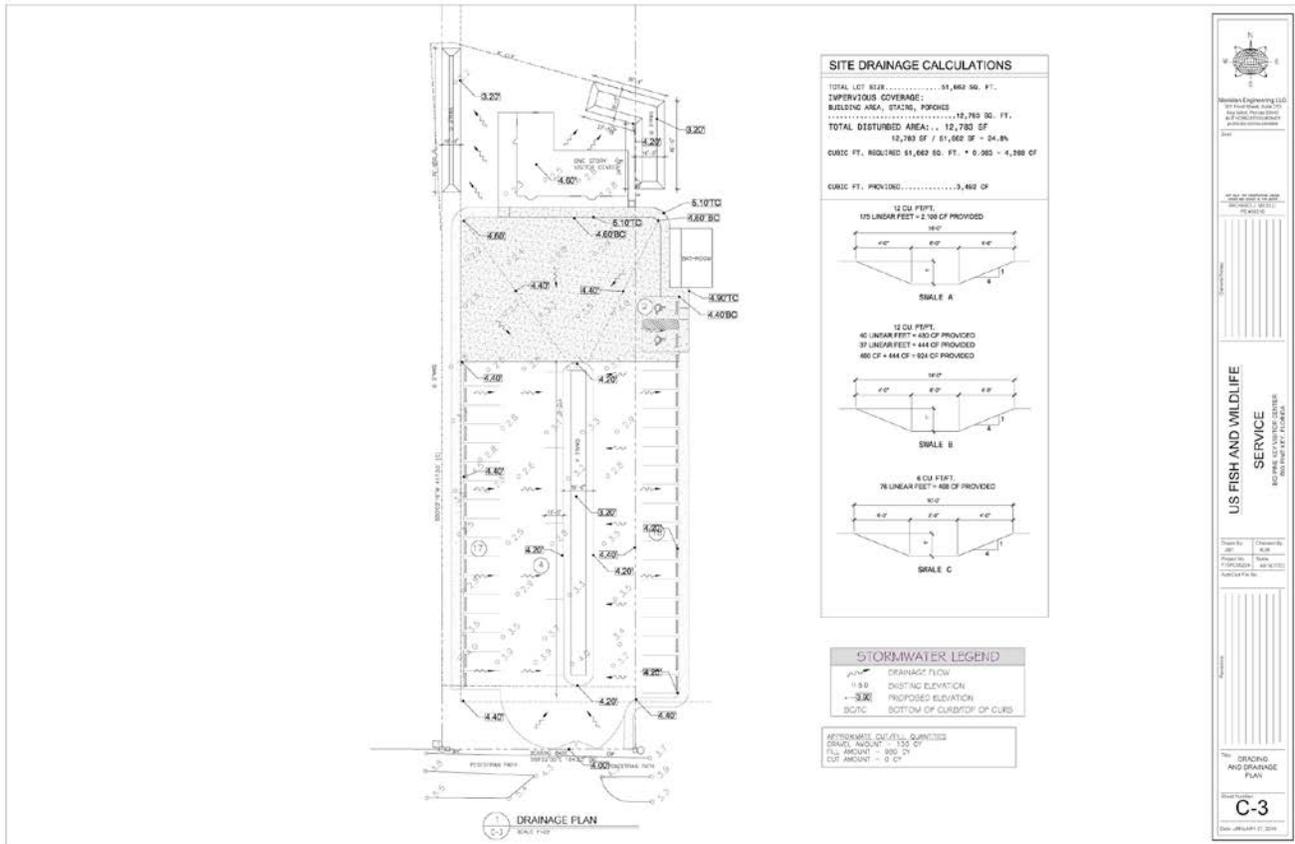
Source: F1 Data Transmission, 2007; U.S. Census Bureau, 2000  
**Yellow box - Key West NWR, Blue Box – Great White Heron NWR, Green Box – National Key Deer Refuge**

**Figure 2. Current and Proposed Locations of Visitor center for the Lower Keys National Wildlife Refuges**





**Figure 4. Existing and proposed elevations and drainage plans for the Florida Keys National Wildlife Refuges Complex Visitor Center**



While serving the vision outlined in the CCP, the NWRS mission, and the NWRS Improvement Act, the Proposed Action would specifically implement and support multiple CCP goals, objectives, and strategies for the Lower Keys NWRs, the most important of which are listed.

CCP Goal 4 Promote an understanding and appreciation of natural and cultural resources and provide visitors with a quality, safe, and enjoyable experience compatible with wildlife and wildland conservation.

CCP Goal 4, Objective 2 Enhance environmental education programs to increase student, teacher, and parent awareness and understanding of the refuge's ecology, native flora and fauna, wildlife and habitat management, and environmental history.

CCP Goal 4, Objective 2, Strategy Establish environmental education at a new (proposed) visitor center and use designated sites at National Key Deer Refuge for environmental education activities.

CCP Goal 4, Objective 3 Enhance environmental interpretation and outreach efforts to increase the public's awareness and understanding of the refuges' ecology, native flora and fauna, wildlife and habitat management, and cultural resources.

CCP Goal 4, Objective 3, Strategy Consider relocating the visitor center operations to a Service-owned facility on U.S. Highway 1 on Big Pine Key.

### **III. Need for Action**

The need for the Proposed Action is to address shortcomings of the existing visitor center, including lease costs, facility condition, inadequate parking, and Service visibility. Fulfilling that need will improve public outreach and environmental education opportunities with an updated facility with dedicated parking and interpretive outdoor opportunities such as a trail system. The Proposed Action includes construction aimed at reducing the cost to the government as compared to constructing a larger, more expensive facility. The Refuge Complex currently operates and staffs a visitor center in a leased storefront on Big Pine Key just north of U.S 1, which includes a gift store operated by the Friends and Volunteers of Refuges (FAVOR), the Refuge Complex's Friends Group. This current leased space consists of 2 small offices, one larger office, a men's and women's restroom, and a larger room that serves as a display area and book store. This space was adequate when visitor use numbers were lower than current and predicted conditions, however; the leased storefront is increasingly inadequate to meet current and future use demands due to the lease cost and the congested location, including a shared parking lot. While we recognize the need for a new, owned visitor center, we also recognize the need to minimize costs associated with the development of a new visitor center. The proposed visitor center would include a cost effective property with a reasonable return on investment that contains a separate area for a bookstore, a location that allows for outdoor activities and interpretation such as a native plant garden and outdoor classroom space, and a parking area sufficient to accommodate the current and

increasing numbers of visitors to the Lower Keys. Current lease costs to the Service for the existing storefront visitor Center are in excess of \$86,600.00 per year.

In 2008, the Service acquired commercial property on Overseas Hwy /U.S. 1 on Big Pine Key to be used for the construction of a new visitor and environmental education center to fulfil the goals and objectives of the CCP. The Refuge Complex would construct a visitor center that would provide on-site offices to support Refuge visitation, education, and outreach, while serving and supporting the purposes of the Refuge Complex as outlined in the CCP. By having the visitor center located in a stand-alone building on Refuge property and on the Overseas Highway, the Refuge Complex would enhance a more independent identity and be in a position to better serve the resident and visiting public. The location on the Overseas Highway/ U.S. 1 is expected to provide increased visitor contacts due to its new high visibility location. Approximately 25,000 people visit the existing storefront Visitor Center annually and that number could triple at the new location. The establishment of the proposed Visitor Center at this new location would result in considerable savings to the government over time and provide an outdoor area for environmental education. The Service estimates that the construction of the new visitor center would cost approximately \$500,000. At this price, the government would see a return on its investment in less than six years.

#### **IV. Public Involvement**

This Environmental Assessment to evaluate the addition of a new visitor center builds upon the public involvement and planning process of the CCP and Environmental Assessment for the Lower Keys NWRs. The Service previously provided information and opportunity for public comment on the proposed visitor center during the CCP process. The CCP was prepared in compliance with the National Environmental Policy Act of 1969. This law requires the Service to include public involvement in environmental planning.

In preparation for the CCP, public scoping meetings for the Lower Florida Keys NWRs were conducted in March 2005. The March 8, 2005 meeting was held on Big Pine Key at the local charter school with approximately 40 people in attendance. The March 9, 2005 meeting was held in Key West at the Board of County Commissioners' meeting room with approximately 20 people in attendance. Meeting notices were published in the local newspapers and flyers were displayed at several locations, such as the post office and supermarkets. The public provided comments on issues that should be addressed in the 15-year CCP.

In June 2006, a core CCP planning team of Service staff started meeting regularly to develop the CCP for the Lower Florida Keys NWRs. The team considered all public and interagency comments. The team prioritized the most important issues to be addressed by the refuges over the 15-year life of the CCP.

The notice that the Draft CCP was available was published in the *Federal Register* on May 23, 2008. Press releases were also issued through local newspapers and radio public service announcements. Over 200 notices were sent to interested parties and stakeholders on the Lower Florida Keys CCP mailing list. The 30-day public review and comment period for the Draft CCP was from May 23 through June 23,

2008. At least 47 persons attended two public meetings during the open comment period. The meetings were held in Big Pine Key on June 9, 2008, and in Key West on June 10, 2008. The Service received 25 comment letters on the Environmental Assessment and Draft CCP.

All comments received during public review and comment were considered in the development of the final CCP. The Service adopted the final CCP on September 14, 2009.

The CCP indicated a future Environmental Assessment would be developed by the Service with respect to the development of a new Visitor Center. This document serves to accomplish that requirement and potentially interested parties of the proposed action were notified to provide comment on the proposed action. Building on the considerable public involvement from the CCP planning process and to provide public input opportunity on this specific proposed action, the Refuge Complex developed notices and information and posted them on the National Key Deer Refuge's website, on the National Key Deer Refuge's Facebook site, at the Refuge Complex's Administrative Office, and at the existing Refuge Complex's Visitor center. The Refuge Complex also emailed and mailed out notices to the CCP mailing list, adjacent property owners, and Native American Tribes. The Refuge Complex provided copies of the documents for review and comment by State agencies through the State Clearinghouse. The Refuge Complex also developed and distributed a press release to the local media announcing the availability of the Environmental Assessment and the deadline for public comments. Copies of the document were also available for public review and comment on the National Key Deer Refuge's website, at the Refuge Complex's administrative office, and at the Refuge Complex's visitor center.

Written comments will be accepted by mail, email, fax, and hand delivery to the Refuge Complex. The Refuge Complex will evaluate all comments received by the stated deadline. Responses to comments will be included in the Service's "Response to Comments" appendix that will be available at the time of the final decision.

## **V. Alternatives Analyzed, Including the Proposed Action**

### **Alternative A – Construct, Operate, and Maintain a New Visitor Center (Proposed Action)**

The Proposed Action would replace the existing leased space with a new visitor center on Service-owned property for the purposes of environmental education and outreach. The building would offer space for educational displays, office space for visitor services personnel, and classroom space for us to allow local schools to use the National Key Deer Refuge to enhance their wildlife education programs. It would also provide an area to be used as bookstore that would be managed by the Refuge Complex's Friend Group. The area outside this building would provide a space for a native plant nursery, a pollinator garden, and adequate parking to meet the current and future demands of ever increasing visitation. This new building would be located at 30587 Oversees Highway (Figure 2). The proposed building (a modular building, Conestoga Cabin "Cropper Island" model, on concrete piers in accordance with local building regulations and fully ADA compliant) has two offices approximately 20 feet by 20 feet (combined) and a display / classroom area approximately 24 feet by 60 feet, providing a total of approximately 1,840 square feet of display and office space. A trail system would also be established on the neighboring 2-acre lot which is also owned by the Service and is part of the National Key Deer

Refuge (Figure 5). Due to the proposed location and enhanced visibility of the Visitor Center to Overseas Highway traffic, an increase in visitation would be expected at the new facility.

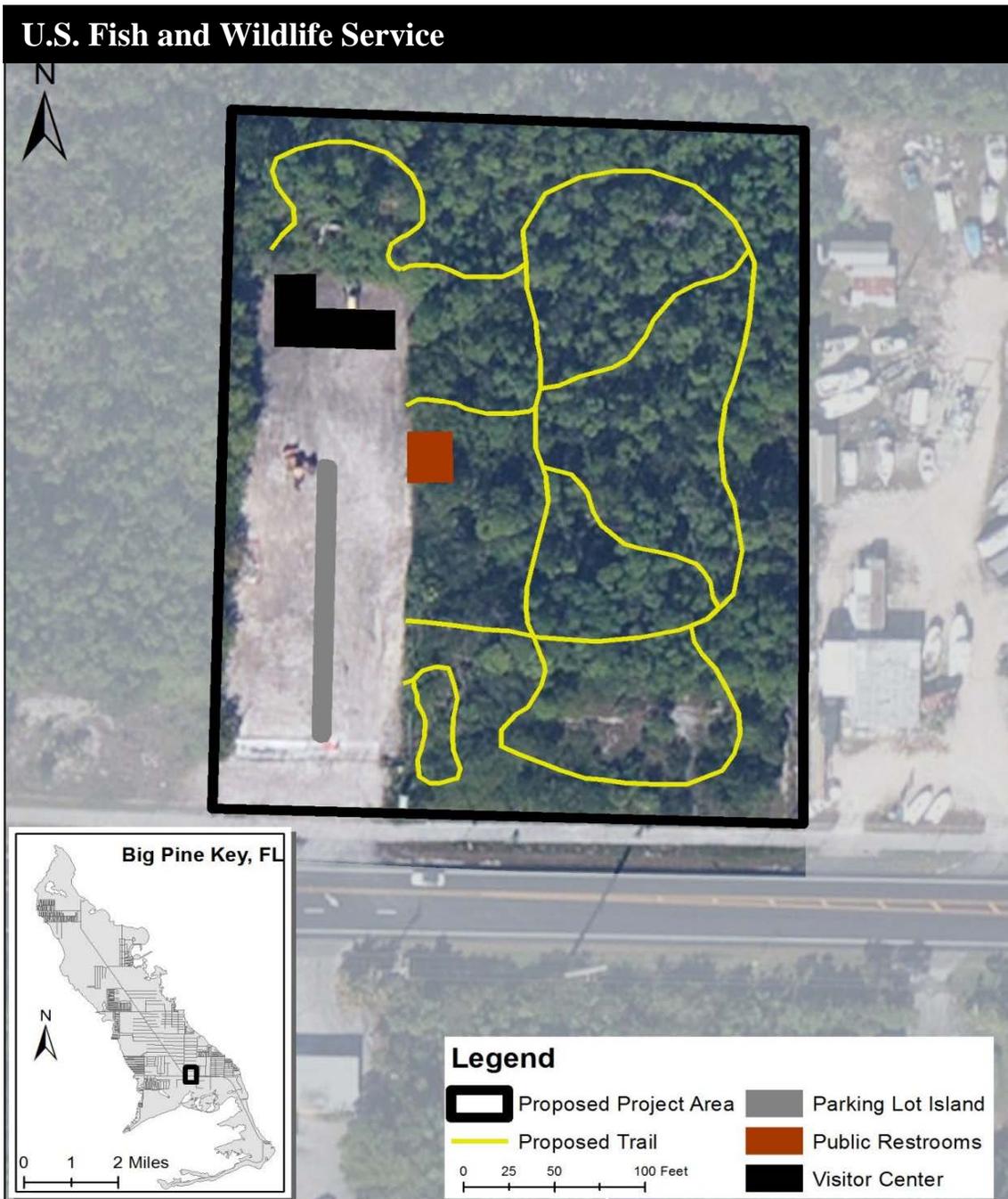
Considerable savings to the government would be expected over time. The lease cost of the current storefront visitor center location is approximately \$86,600 per year, including rent and utilities. The utilities at the proposed visitor center are expected to cost the Service less than \$4,000 annually. With an estimated construction cost of \$500,000, the new building would provide a return on investment in less than six years followed by a savings to the government of approximately \$82,600 per year in lease fees.

On the neighboring 2-acre undeveloped Refuge property, the Service has already selectively improved 0.06 acres through the removal of two buttonwood (*Conocarpus erectus*) trees, four sea grape (*Coccoloba uvifera*) trees, one Florida thatch palm (*Thrinax radiata*), seven poisonwood trees (*Metopium toxiferum*), one strangler fig (*Ficus aurea*) tree, one Spanish stopper (*Eugenia foetida*) shrub, and two Florida Keys blackbead (*Pithecellobium keyense*) shrubs to accommodate a restroom and two handicapped accessible parking spaces. An additional 0.1 acres would potentially also need to be improved and graded for a gravel parking area to accommodate visitors using the Refuge facilities. Approximately 0.25 miles of walking trails and interpretive panels are proposed to be installed within the undeveloped adjacent Refuge property to provide additional environmental education opportunities (Figure 5). Minimal vegetation thinning is proposed during the installation of walking trails, as it would be important to maintain the plant and wildlife species diversity. The site is also suitable for additional education exhibits, should Service funding become available, including a native pollinator garden, a native plant propagation nursery, and an outdoor classroom facility with seating for students. Two small, shallow wetland swales required for stormwater retention pursuant to building code would provide an additional environmental education opportunity and are proposed to be planted with native species.

#### **Alternative B – Continue Current Management (No Action Alternative)**

Refuge staff and visitors would continue use of the existing visitor center in the leased storefront on Big Pine Key. Lease costs to the government would be expected to increase over time and visitation would be expected to increase modestly over time due to the location of the storefront and competition for shared parking space. Visitors to the existing leased space have experienced difficulty locating the visitor center off of the main highway. When driving from the Highway and turning onto Key Deer Blvd, visitors often miss the turn to the current visitor center location and continue down Key Blvd instead. Visitors have indicated the current location can be hard to find since the visitor center is tucked into the back of the strip mall in the corner of the parking lot. Complex visitors and Refuge Complex staff would continue navigating the overcrowded parking lot and continue competing with other business's customers for parking spaces. The current leased space does not provide outside environmental education or interpretation opportunities and does not fully fulfil the goals and objectives of the Refuge Complex CCP.

**Figure 5. Proposed Walking Trail Network within Pine Rockland Habitat adjacent to Proposed Visitor center Site**



**Figure 6. Artist's Rendering of the Proposed Florida Keys National Wildlife Refuge Complex Visitor Center**



## **Other Alternatives Considered, but Discarded**

Two additional action alternatives were analyzed, but discarded.

The first discarded alternative involved a closure of the existing leased storefront Visitor Center with no new construction. This alternative was dismissed since it did not meet the stated purpose and need, specifically it does not support the 2009 Lower Florida Keys Refuges CCP goals and objectives, it does not address the shortcomings of the existing Visitor Center, and it does not further the mission of the NWRS or the Service. Although the cost of the current lease of space to the Service is expected to continue to increase, a visitor contact station for Refuges in the Florida Keys is a principal manner to retain agency relevancy. Environmental outreach and education, as well as dissemination of accurate and up-to-date Refuge Complex information to the public are paramount to attaining Refuge Complex goals and objectives.

The second discarded alternative involved developing a significantly larger, more expensive Visitor Center on the 1-acre parcel on the Overseas Highway currently proposed for development under Alternative A, which would not meet the stated need to minimize costs associated with development of a new Visitor Center. The Refuge Complex has worked diligently since the land acquisition in 2008 to secure external funding to construct a new visitor center pursuant to the goals and objectives of the CCP, which included significant public input. Sufficient external funding has not successfully been appropriated or received to fully develop the site.

## **VI. Affected Environment**

### **Physical Resources**

#### Climate

The climate of the Lower Florida Keys is tropical (Jordan 1991) with a mean annual temperature of about 77 degrees Fahrenheit (F). The coldest average monthly temperature, 70 degrees F, occurs during January. The warmest mean monthly temperature is 84 degrees F and occurs in August (Thomas 1974). Temperatures below 39 degrees F are unusual due to the moderating effects of the warm marine waters and the coastal Gulf Stream. Freezing temperatures and frost have never been recorded. The mean annual rainfall is 39 inches, of which 80 percent falls from May through October (Hanson 1980). Compared to other seasons, winters are usually dryer with most rainfall occurring during passing cold fronts. Prevailing wind direction is east to southeast with an annual average of about 11 knots. Winds are strongest during the winter months (December through March) when cold fronts from the north move through the area. The mean annual sunshine is 3,300 hours, 10 percent more than the Florida Peninsula to the north.

#### Geology

The geology of the Lower Florida Keys (Big Pine Key west to Key West) has been described in detail by Hoffmeister (1974). Marine carbonate sediments nearly 20,000 feet in depth underlie the Keys. Along this submerged platform, coral reefs developed in a band from present day Miami to the Dry

Tortugas. Two limestone formations of marine origin are found in the Lower Florida Keys. Miami oolite, a medium-to-hard limestone, overlies the Key Largo limestone formation. In the Lower Keys, Key Largo limestone is exposed only in a narrow band on the extreme southeast end of Big Pine Key. Elsewhere in the Lower Keys, it is overlain by Miami oolite, formed during the Pleistocene era in a high-energy, shallow-water environment containing an abundance of calcium carbonate. The configuration of limestone strata in the Lower Keys allows for the development of the freshwater lenses found there.

### Soils

Physical and chemical properties of soils in Monroe County have been described by the U.S. Department of Agriculture (1989). Saddlebunch marl is the dominant soil in tropical hardwood hammocks. In some hardwood hammock areas, humus may be present to a depth greater than 3 feet. Key Vaca, a very gravelly loam, is the dominant soil in the pine rocklands. Soil types in the freshwater wetlands are of the Rock-Outcrop-Cudjoe Complex, consisting of 55 percent rock outcrop and 45 percent Cudjoe marl. Soils within the fire-dependent pine rocklands are very thin; burning removes vegetative litter and exposes the bare oolitic caprock. Cracks and crevices in the exposed limestone cap rock form pockets of soil. The relationship between soil productivity and different forest cover types in the Florida Keys was studied by Ross et al. (2003). The location of the proposed activity contains soil physical and chemical properties predominantly of Monroe County hardwood hammock and pine rockland types.

### Water Quality and Quantity

Studies of surface and nearshore water quality have been performed in the Florida Keys (Florida Department of Environmental Regulation 1985; 1987; Kruczynski 1999; Lapointe and Clark 1990). Florida International University's Southeast Environmental Research Center maintains a long-term water quality monitoring network for the marine waters of the Florida Keys National Marine Sanctuary, including several sampling points within the backcountry waters of the refuges. For more information, see: <http://serc.fiu.edu/wqmnetwork>. The Florida Department of Environmental Protection also conducts semi-annual monitoring of water quality in several wells in the Florida Keys. For more information, see: <http://www.dep.state.fl.us/water/monitoring/index.htm>.

Both the surface and subterranean freshwater resources of refuge lands on Big Pine Key are vulnerable to contamination because of sea level rise, runoff of fertilizers, herbicides and pesticides from lawns, and the outflow from septic tanks (Wightman 1990). The latter are a constant source of pollution (Paul et al. 1991) because of the geological characteristics of the Lower Florida Keys (Lapointe and Clark 1992). Septic tank densities in subdivisions adjacent to refuge lands greatly exceed the normally accepted national benchmark of 40 tanks per-square-mile. This benchmark was set for areas unlike Big Pine Key where suitable soils are present (Saarinen 1989). Storm surges, such as that experienced in Hurricane Wilma in 2005, cause a short-term spike in salinity levels of freshwater solution holes, but normal levels are recovered over time.

One third of the proposed development site is previously developed commercial space (1 acre) with no water retention. The remainder is unimproved hardwood hammock and pine rockland with an occasional ephemeral wetland area as a result of rainwater. Water is retained on site in a natural fashion and water quality and quantity on site is commensurate with other previously developed and undeveloped lots along the Overseas Highway on Big Pine Key.

### Refuge Infrastructure

The three Lower Florida Keys NWRs are comprised of islands that are scattered across an expanse of water extending nearly 75 miles from the Seven Mile Bridge west to the Marquesas Keys. The NWRs' approved acquisition boundaries cover vast amounts of land and water. Road access is limited to only a few mainline islands connected by U.S. Highway 1. Boat access to the majority of islands is dependent on weather and tides, and requires local knowledge and planning.

The administrative boundaries of all the Lower Florida Keys NWRs encompass more than 400,000 acres of sovereign submerged lands and waters owned by the State of Florida. In 1992, the Service entered into a Management Agreement with the State of Florida that authorizes certain measures to be implemented within the state-owned waters to minimize wildlife disturbance and habitat destruction from non-wildlife-dependent recreational activities (this Management Agreement is also known as the Backcountry Management Plan). It prohibits personal watercraft, airboats, water skiing, hovercraft, and aircraft landings within the majority of Key West and Great White Heron NWRs. It also established idle speed, no motor, and no access buffer zones near critical wildlife habitats. These zones were subsequently incorporated as Wildlife Management Areas in the FKNMS's General Management Plan. Actions to prevent or minimize the destruction or loss of marine resources are implemented under the State of Florida's sovereign submerged land regulations and the National Marine Sanctuary Act. The Service's Office of Law Enforcement has legal responsibilities under the Endangered Species Act and Migratory Bird Treaty Act to protect federal trust resources, wherever they may occur.

Additionally, within the administrative boundary of National Key Deer Refuge, there is a patchwork of conservation lands owned and managed by multiple agencies and groups. Federally owned parcels range from a couple-hundred acres to less than a half-acre in size, interspersed among vacant private lots within residential subdivisions and commercial zones. In addition to refuge-owned lands, the Service manages through lease agreements about 700 acres of Florida Forever and other State-acquired lands, and about 200 acres of county lands acquired by the Monroe County Land Authority. Additionally, the South Florida Water Management District has contributed substantial funding for wetlands acquisition in central Big Pine Key. Private groups, such as The Nature Conservancy, Trust for Public Land and The Conservation Fund, provide funds and expertise to assist in expedited acquisitions of environmentally sensitive lands that may be imminently threatened by development.

The Refuge Complex currently manages 11 buildings and one storefront. At the Crocodile Lake NWR on Key Largo there is an office building and 1 bunkhouse; at the National Key Deer Refuge on Big Pine Key there is an office building, 2 bunkhouses, 1 maintenance shop, and 5 employee residences.

There is currently no infrastructure located at the proposed development site. One acre was previously developed and is predominantly cleared of vegetation and the substrate leveled. The remaining 2 acres is undeveloped and vegetated.

## **Biological Resources**

### Flora-Plant Communities and Cover Types

The Lower Keys NWRs harbor a very diverse assemblage of plants, with 423 native and 88 non-native species recorded (US Fish and Wildlife Service 2009). Upland vegetation is primarily of West Indian origin (Dickson 1955, Weiner 1979). Native plant diversity is greatest in National Key Deer Refuge (410 species), followed by Key West NWR (182 species), and Great White Heron NWR (128 species) (Gann et al. 2007a, b, c). Federally listed species include the Key tree cactus (endangered) and Garber's spurge (threatened), with six candidate species under consideration for listing. On-line floristic databases maintained by the Atlas of Florida Vascular Plants (<http://www.plantatlas.usf.edu>) and Institute for Regional Conservation (<http://www.regionalconservation.org/>) provide additional information on plant communities and species.

The Florida Keys are a disturbance-based ecosystem, affected periodically by wind and flooding events associated with hurricanes, drought, and fire. Due to the small size of the islands, flat topography, low elevation, depth to groundwater, close proximity to the sea, and geological substrate, very slight differences in elevation yield marked differences in plant communities (Ross et al. 1992). Major cover types described below include pine rockland, tropical hardwood hammock, freshwater wetlands, salt marsh transition, mangrove forest, inland salt ponds, beach ridge hammock, beach and dune, and marine (US Fish and Wildlife Service 2009). Each of these major cover types includes multiple plant communities, providing for a diverse mosaic of habitats across the island landscapes.

The following habitat types are present on the proposed development site which includes a 1-acre previously developed lot where building and parking infrastructure is proposed and an adjacent 2-acre undeveloped lot where a small interpretive educational trail system is proposed.

#### *Pine Rockland*

Pine rockland is a globally endangered plant community found only in the Lower Florida Keys, Everglades National Park, and in scattered parcels in Miami-Dade County, representing less than 3 percent of its original extent due to conversion to other land uses, significant ecological degradation, and outright destruction (Noss et al. 1995). Pine rocklands consist of an open canopy of slash pines with patchy understory and groundcover layers. The south Florida slash pine (*Pinus ellioti* var. *densa*) and palms (*Coccothrinax argentata*, *Thrinax morrisii*, *Thrinax radiata*, and *Serenoa repens*) are fire-adapted and dependent on periodic fires for their long-term persistence (Snyder et al. 1990). Sub-canopy layers include a diverse assemblage of tropical and temperate shrubs, palms, grasses, and herbs (Folk 1991). Pine rocklands occur at an elevation 3 to 8 feet above mean sea level and are usually underlain by a freshwater lens. Pine rocklands have the highest plant diversity of all plant communities in the Florida Keys. A total of 250 species of plants has been identified in the pine rocklands of south Florida and the Lower Keys. This community contains 14 herbs endemic to south Florida, 5 of which occur only in

these Lower Keys settings (Avery and Loope 1980). Common plants associated with pinelands include long-stalked stopper, blackbead, Keys thatch palm, silver palm, locustberry, and poisonwood. Pine rocklands contain significant freshwater resources, including widespread freshwater solution holes and marshes that are important to Key deer.

Pine rocklands are dependent on fire to maintain the diverse assemblage of plants. Radiocarbon dating on soil samples taken from two water holes on Big Pine Key reveal repeated, local fires during the past ca. 450–500 years, documenting the long importance of fire in the Florida Keys' pine rocklands (Horn 2008). Pine rocklands typically burn once or twice every decade (Hofstetter 1974). Fire frequency has been shown to be an important parameter affecting the abundance and diversity of endemic herbs and the vegetation structure of pine rocklands (Lui et al. 2005, Bradley and Saha 2009, others). In the absence of fire, pine rocklands will succeed to hardwood hammock approximately within a 50-year-timeframe (Dickson 1955).

Pine rocklands are intolerant of saltwater. Of all refuge plant communities, flooding events from hurricanes and sea-level rise pose the greatest risks for the pine rocklands (Klimstra 1986). Flooding by sea water occurs only periodically due to storm surges associated with strong tropical storms. In the wakes of hurricanes in 1998 (Georges) and 2005 (Wilma), many slash pines were killed by this form of saltwater intrusion. Ross et al. (1994) reported that a 1/2-foot rise in sea level over a 70-year period reduced the size of the pine rocklands on Upper Sugarloaf Key by 66 percent.

#### *Tropical Hardwood Hammock*

Tropical hardwood hammocks are the climax terrestrial plant community in the Florida Keys. Occurring on uplands 2 to 8 feet above sea level, hammocks are hardwood forests consisting of a wide diversity of evergreen and semi-deciduous trees and shrubs, many of West Indian origin. These include paradise tree, gumbo limbo, Jamaican dogwood, pigeon plum, blolly, and wild dilly. Except during extreme storm events, these areas are not inundated by sea water. Although tropical hardwood hammocks are not fire-maintained communities, fire may periodically enter hammocks from a nearby pineland wildfire, especially during extreme drought conditions (Klimstra 1986).

Tropical hardwood hammocks serve as important stopover areas for neotropical migratory birds, particularly during inclement weather. Human development has severely reduced and fragmented this habitat in the Florida Keys, deleteriously affecting forest nesting birds and fruit foragers, such as the state-listed white-crowned pigeon (Bancroft and Bowman 1994, Bancroft et al. 1995).

#### *Freshwater Wetlands*

Freshwater wetlands are primarily isolated features in the Lower Keys, occurring in shallow basins or lowlands either surrounded by higher upland forests or between upland areas and transition zones. Within this category, there are natural mosaics of subtypes related to depressions, elevations, bedrock surface exposure, soil types, and fire regimes. They have standing freshwater levels that persist for extended periods. The average marsh elevation is 3 to 6.5 feet above mean sea level, with size varying up to 247 acres (Folk 1991). Wetland plant species include sawgrass (*Cladium sp.*), buttonwood, white-top sedge, and leather fern. These wetlands are important to amphibians, reptiles, insects, mammals,

birds, and crustaceans. Freshwater wetlands reach their greatest extent and distribution on Big Pine Key, but refuge lands on Cudjoe, No Name, Upper Sugarloaf, Big Torch, Little Pine, and Howe Keys also contain freshwater wetlands year-round. Freshwater wetlands are absent in Key West NWR; however, ephemeral puddling occurs on a very small scale where limestone caprock is exposed on Boca Grande Key.

### Fauna-Fish and Wildlife

More than 250 bird species have been observed in the refuges (U.S. Fish and Wildlife Service 2009). Avian species that are listed under the provisions of the Endangered Species Act and documented in the refuges include the roseate tern and piping plover. The red knot is a candidate species. State-listed species include the aforementioned species, as well as the least tern, peregrine falcon, snowy plover, bald eagle, and white-crowned pigeon. The Refuges provide important breeding, wintering, and stopover habitat for neotropical migratory birds, including songbirds, shorebirds, and raptors. Through the Partners in Flight Initiative, federal, state, and private agencies are developing and implementing a comprehensive approach for managing selected species of migratory nongame birds (US Fish and Wildlife Service 2009). In an attempt to prevent the listing of most of these birds as threatened or endangered species, these trust species are given high priority in management decisions. Nesting bald eagles, wading birds, white-crowned pigeons, and some terns are also surveyed annually.

#### *Raptors (Hawks and Allies)*

The Lower Florida Keys Refuges are situated along a major migratory pathway for raptors. Sixteen migratory species have been observed in the refuges. Migration begins in late August with the passage of American swallow-tailed kites and ends in November with Swainson's hawks. Broad-winged and sharp-skinned hawks and American kestrels are the most abundant migratory birds. More peregrine falcons pass over the Keys than any other hawk observation sites in North America (Lott 2006). While most of the migratory raptors use the refuges as a resting and feeding stopover en route to the tropics, significant numbers of certain species overwinter, such as the broad-winged and short-tailed hawks. Bald eagle nesting has been monitored annually since 1985 with four to six active nests sighted yearly. Some islands were used for nesting for over 20 years and others for only a few years, with pairs moving elsewhere. Osprey and red-shouldered hawks are also nesters in the refuges.

#### *Resident Landbirds*

Red-bellied woodpeckers, red-winged blackbirds, gray kingbird, black-whiskered vireo, white-crowned pigeon, and mangrove clapper rail are among the more common resident breeding birds. The only warbler species known to breed in the Lower Florida Keys Refuges are Cuban yellow and prairie warblers. Both are common breeders in the backcountry islands. The mangrove cuckoo is a species of concern, but data are lacking on its status and ecology in the Florida Keys.

#### *Neotropical Migratory Birds*

Neotropical migratory birds are species that breed in North America and winter in Mexico, Central America, the Caribbean, and South America. These species are of keen interest to birdwatchers and

conservationists because they migrate remarkable distances in all weather conditions, and they provide a diversity of viewing opportunities during the spring and fall migration, more than doubling the number of species seen in the Florida Keys compared to the nesting season. Many are experiencing range-wide declines due to the destruction and fragmentation of breeding and wintering habitat, poisoning by pesticides, collisions with towers and large buildings, and feral cat predation.

### *Mammals*

As with many island chains, few land-dwelling species occur in the Florida Keys. Most of the native mammals represent sub-species of those found on mainland Florida, but they have become genetically distinct due to thousands of years of geographic isolation. Key deer and raccoons are the most commonly seen native mammals in the Lower Florida Keys Refuges. Marsh rabbits and silver rice rats occur in low numbers and due to their behavioral habits, are rarely seen. Native mammals are absent from Key West NWR. Bottlenose dolphins are the most common sea-dwelling mammal within the refuges' boundaries. The Florida manatee is a rare, transient visitor. Descriptions of Key deer, Lower Keys marsh rabbit, and silver rice rat can be found under the section on Endangered, Threatened, and Candidate Species.

### *Amphibians*

Amphibians require freshwater and therefore are absent in Key West NWR and most of the back country islands in the Great White Heron NWR. They occur on National Key Deer Refuge, most notably in freshwater solution holes, wetland ponds and man-made mosquito ditches on Big Pine Key. At least seven native amphibians occur on this refuge. The most common is the southern leopard frog. Inventories are needed to establish baseline data on the status and distribution of amphibians.

### *Reptiles*

A comprehensive survey of reptilian species in the Lower Florida Keys Refuges is lacking and a precise number of species is not known. Eleven species of lizards, nine species of snakes, and eleven species of turtles have been documented; however, many are non-native. The American alligator, American crocodile, Big Pine ringneck snake, eastern diamondback rattlesnake, and eastern indigo snake (likely extirpated) are among the noteworthy native species. The green, loggerhead, and hawksbill sea turtles are nesting species, while Kemp's ridley forages in waters surrounding the refuges. Box turtles inhabit upland areas of National Key Deer Refuge (Verdon 2004). Inventories are needed to establish baseline data on the status and distribution of reptiles as only sea turtles have been the subject of long-term monitoring. Descriptions of marine turtles and eastern indigo snake can be found under the section on Endangered, Threatened, and Candidate Species.

### *Invertebrates*

No attempt has been made by the Service to catalogue the entire suite of invertebrate species on the Lower Florida Keys Refuges, although other researchers have studied certain species or groups of tree snails, dragonflies, and butterflies. There are a variety of *Liguus* tree snails that inhabit similar hammock communities that merit attention and conservation. Currently, there is little substantively

known about the numbers of the *Liguus* snails on Big Pine Key, which are likely phenotypes of the Florida tree snail (*Liguus fasciatus*) (Close 2000, Hillis et al. 1991). Butterfly assemblages have been studied (Minno and Emmel 1993, Minno et al. 2005). At least eight resident butterflies have disappeared from the Keys since the late 1970s, and another eight species of butterflies found in the lower Keys are highly imperiled (M. Minno pers. comm. 2008). The causes of this widespread decline are likely due to many factors, especially habitat destruction and fragmentation, as well as mosquito control spraying, exotic predatory ants, hurricanes, and poaching. The application of insecticides to control adult mosquitoes is known to deleteriously impact butterfly populations (Emmel 1991, Salvato 2002). The Service must continue to build a cooperative relationship with the Florida Keys Mosquito Control District in an effort to further reduce or eliminate the use of broad-spectrum adulticides on refuge lands. Three federal candidate butterflies that occur in the refuges (Bartram's hairstreak, Florida leafwing, and Miami blue) are described in more detail in the section under Endangered, Threatened, and Candidate Species below.

### Endangered, Threatened, and Candidate Species

While there are numerous threatened, Endangered and Candidate species within the Refuge Complex only a few could occur on the affected area. "Endangered" means a species is in danger of extinction throughout all or a significant portion of its range. "Threatened" means a species is likely to become endangered within the foreseeable future. "Candidate" species are those for which the Service has enough information to warrant proposing them for listing but is precluded from doing so by higher listing priorities; however, the Service carries out priority conservation actions for these species to prevent further decline and possibly preclude the need to list. While there are numerous threatened, Endangered and Candidate species within the Refuge Complex only a few could occur on the affected area.

### Endangered Species

#### *Key Deer*

The Key deer is the smallest subspecies of the North American white-tailed deer. It historically ranged from Key Vaca to Key West, but the current range includes approximately 26 islands from Big Pine Key to Sugarloaf Key, with the center of its population on Big Pine and No-Name Keys. Most lands within its current range, including privately owned lands, lie within the administrative boundaries of National Key Deer Refuge. Key deer use all cover types, including those normally above tidal influence (pine rockland, hardwood hammock, freshwater wetlands), as well as tidally influenced types (mangrove, salt marsh transition). They also use residential areas extensively where they feed on ornamental plants and grasses and seek freshwater. The Key deer remains listed as endangered due to its restricted range, sea level rise, habitat fragmentation, and high human-related mortalities and disturbances.

The Key deer population increased markedly during the 1990s and now likely exceeds habitat carrying capacity in areas of high animal densities on No Name Key and parts of Big Pine Key. The result has been degradation of native plant communities and loss of habitat diversity, with probable but as yet unstudied impacts on other wildlife species. Several once-common plant species that are highly

palatable to deer, such as black torch, have disappeared or been greatly reduced over large areas of Big Pine and No Name Keys. Deer at high densities may exist at a lowered nutritional plane and are more susceptible to epizootic diseases.

For many years, Key deer aggregations have been particularly high near subdivisions, such as Port Pine Heights and Koehn. Their burgeoning numbers are due to the reproductive output of a large number of resident does, the availability of ornamental plants for feeding, and feeding by tourists and residents. Deer roadkill numbers have increased steadily with deer population growth, with annual mortality exceeding 100 animals. Despite this elevated mortality, deer numbers have remained high and are offset by annual population recruitment.

Although deer numbers have increased on Big Pine and No Name Keys, there was a reduction or extirpation in other parts of the deer's range, including Johnson, Cudjoe, and Sugarloaf Keys. More than 30 deer were translocated to suitable habitat on Cudjoe and Sugarloaf Keys in recent years. The fate of these herds must be monitored over time to assess the efficacy of translocation as an effective management strategy to ensure the long-term viability of the species. Deer on backcountry islands also need to be monitored. To date, detailed demographic studies have only been conducted on the core population on Big Pine and No Name Keys.

#### *Lower Keys Marsh Rabbit*

The Lower Keys marsh rabbit is a subspecies of the marsh rabbit, which is more widely distributed in the southeastern United States. This subspecies originally ranged throughout the Lower Florida Keys, including Key West. The current range appears to consist of three separate metapopulations: the Boca Chica area (Boca Chica, Geiger, East Rockland and Saddlehill Keys), the Sugarloaf area (Sugarloaf and Saddlebunch Keys), and the Big Pine area (Big Pine, Annette, East Water, Howe, Johnson, Little Pine, Mayo, Newfound Harbor, Porpoise, and No Name Keys) (Forys and Humphrey 1999a). Lower Keys marsh rabbits are predominantly found in salt marsh transition communities that have dense ground cover created by a clump grass, cordgrass (*Spartina spartinae*). Rabbits are also widely distributed among freshwater wetlands and they travel through all cover types, including pine rockland. Habitat for rabbits provides for forage, nest cover, and predator avoidance. The amount of thick ground cover within a patch of habitat was the single most important variable in predicting whether a patch would be consistently occupied by marsh rabbits (Forys and Humphrey 1999b). Although habitat loss from human development is responsible for the original decline of the Lower Keys marsh rabbit, current threats include predation by cats, encroachment of woody overstory into grassy habitats, and road mortalities caused by vehicles (USFWS 2007).

#### *Miami Blue Butterfly*

The Miami blue is a small, brightly colored butterfly approximately 0.8 to 1.1 inches (1.9 to 2.9 centimeters) in length with a forewing length of 0.3 to 0.5 inches (8.0 to 12.5 millimeters) (Minno and Emmel 1993). Wings of males are blue above (dorsally), with a narrow black outer border and white fringes; females are bright blue dorsally, with black borders and a red and black eyespot near the anal angle of the hindwing. There are two distinct wild metapopulations, with one in Bahia Honda State Park

and the other on several islands within the Key West NWR (Cannon et al. 2009). The Miami blue is a coastal butterfly reported to occur in and around the edges of hardwood hammocks near the coast, including landscapes prone to frequent natural disturbances immediately adjacent to the coast (e.g., coastal berm hammocks, dunes, and scrub), but also tropical pinelands and along trails, using open sunny areas. In the Keys, it was most abundant near disturbed hammocks where weedy flowers provided nectar (Minno and Emmel 1993, 1994).

#### *Bartram's Hairstreak*

The Bartram's hairstreak is a small butterfly approximately 1 in (25 mm) in length with a forewing length of 0.4 to 0.5 in (10 to 12.5 mm) and has an appearance (i.e., color, size, and body shape) characteristic of the hairstreak genus (Minno and Emmel 1993). The Bartram's hairstreak requires pine rockland that retain its host plant, pineland croton. The mainland population is within Long Pine Key in Everglades National Park, with sporadic and localized occurrences within pine rockland fragments on lands owned by Miami-Dade County. In the Florida Keys, the butterfly occurs only on Big Pine Key within National Key Deer Refuge, private, state, and other lands (Salvato and Hennessey 2003; M. Salvato, Service, pers. comm. 2008).

#### *Florida Leafwing*

The Florida leafwing butterfly is a medium-sized butterfly approximately 2.75 to 3 in (76 to 78 mm) in length with a forewing length of 1.3 to 1.5 in (34 to 38 mm) and has an appearance characteristic of its genus (Minno and Emmel 1993). The upper-wing (or open wing) surface color is red to red-brown, the underside (closed wings) is gray to tan, with a tapered outline, cryptically looking like a dead leaf when the butterfly is at rest. As with the Bartram's hairstreak, the Florida leafwing occurs only within pine rocklands that retain its host plant, pineland croton. The Florida leafwing has not been seen on Big Pine Key since 2006 (M. Salvato, Service, pers. comm. 2008).

#### *Key Tree Cactus*

The Key tree cactus is endemic to the Florida Keys, and grows in hardwood hammocks. It was listed as endangered due to severe population declines caused by destruction of upland areas. Historically distributed from Key Largo to Key West, the species presently occurs only on Big Pine Key in the National Key Deer Refuge, Long Key State Park, Dagny Johnson Key Largo Hammock State Botanical Park, and private lands on Upper and Lower Matecumbe Keys. The Key tree cactus population continues to decline even on public conservation lands, attributed to saltwater intrusion from recent hurricanes and maturing hammocks that may be shading out seedlings and young plants. Its ability to persist in light of climate change may be tenuous without direct intervention, such as assisted migration to suitable habitat at higher elevations or captive propagation.

#### *Florida Semaphore Cactus*

The Florida semaphore cactus is an erect, trunk-forming cactus endemic to the Florida Keys. The branches may grow in one or multiple planes from the trunk. The spines are not barbed. There is only one naturally occurring population in the Lower Keys, on The Nature Conservancy's Torchwood

Hammock Preserve on Little Torch Key. There are outplanted populations on north Key Largo, Big Pine Key, and at the Key West Tropical Forest and Botanical Garden. This cactus grows close to saltwater on bare rock with a minimum of humus-soil cover in hammocks near sea level (Small 1933, Benson 1982). It occurs in buttonwood-dominated scrub salt marsh areas between rockland hammocks and mangrove swamps and possibly other habitat such as openings in rockland hammocks (Gann et al. 2002). Like the Key tree cactus and other cactus species in the Lower Keys, its ability to persist in light of climate change may be tenuous without direct intervention.

### *Eastern Indigo Snake*

This large, stout-bodied, shiny black snake can grow up to 8 feet long. It is docile, non-poisonous, and occurs throughout Florida, but is rare in the Lower Keys. It is a habitat generalist inhabiting the pine rocklands, tropical hardwood hammocks and buttonwood-dominated scrub salt marsh. There have been no confirmed sightings within the Keys in more than a decade. So, although its status has not been assessed, it is thought to be extirpated from the Florida Keys.

### Threatened Species

#### *Stock Island Tree Snail*

The Stock Island tree snail is found in hardwood hammocks in the Florida Keys. The snail historically occurred on Stock Island and Key West where it is virtually extirpated. Habitat loss and a major decline in the original Stock Island population led snail collectors to move snails to other hammocks throughout the Keys. The translocation of snails successfully prevented extinction of the species, but several of the few remaining populations are at risk due to continuing habitat loss to development. The National Key Deer Refuge contains one of the last established populations of this snail. Strategies for protecting hardwood hammocks will benefit the Stock Island tree snail.

#### *Garber's Spurge*

Populations of Garber's spurge in the Florida Keys historically occurred on beach dunes, coastal rock barrens, hammock edges and canopy gaps, and to a lesser extent pine rockland. Populations on dunes have the potential to be threatened by trampling from beach goers. Small isolated populations could become extirpated due to a number of factors, including natural events, such as hurricanes and tidal surges, or manmade factors, such as mowing or herbicide application. It probably occurs on less than half of the islands where it once occurred in the Florida Keys.

### Candidate Species

#### *Blodgett's Silverbush*

On the mainland, Blodgett's silverbush grows in pine rockland and edges of rockland hammock (Bradley and Gann 1999). In the Keys, this species grows in pine rockland, rockland hammock, coastal berm, and on roadsides, sometimes disturbed areas in close proximity to a natural area, especially in sunny gaps or edges (Bradley and Gann 1999). The pine rockland habitat where it occurs in Miami-

Dade County and the Florida Keys requires periodic fires to maintain an open sunny understory with limited hardwoods. Occupied sites within the National Key Deer Refuge currently include Cactus hammock, Long Beach coastal berm, Koehn's subdivision, and Watson's hammock.

### *Big Pine Partridge Pea*

The Big Pine partridge pea is a small prostrate to ascending herbaceous shrub with yellow flowers and pinnately compound leaves. Big Pine partridge pea occurs mostly in pine rockland on Big Pine Key and Cudjoe Key, where it is widely but unevenly distributed (Bradley 2006). Plants also occur on conservation lands owned by the State of Florida, Monroe County, and The Nature Conservancy. Additional sites occur on county and state road rights-of-way and private properties. Big Pine partridge pea is fire-adapted, and fire history and time since fire are important parameters that affect the abundance of this species (Lui et al. 2005a). While the storm surge from Hurricane Wilma in 2005 resulted in significant population declines in all areas, post-hurricane recovery has been greater in burned plots, suggesting that fire may have a positive impact on the recovery of candidate species and species richness (Bradley and Saha 2009).

### *Wedge Spurge*

Wedge spurge is a small prostrate perennial herb. The stems are slender and numerous, radiating out from the tap root. Wedge spurge is known only from pine rockland vegetation on Big Pine Key (Small 1933, Long and Lakela 1971, Wunderlin 1998, Ross and Ruiz 1996). Most of the range is encompassed within the National Key Deer Refuge. The remainder occurs on State of Florida, Monroe County, and private lands, including the Terrestris Preserve owned by The Nature Conservancy. A similar relationship between fire and hurricanes exists for wedge spurge as was discussed above for the Big Pine partridge pea (Bradley and Saha 2009).

### *Sand Flax*

Sand flax is a wiry, yellow-flowered herb found in pine rockland, disturbed pine rockland, marl prairie, roadsides on rocky soils, and disturbed areas (Bradley and Gann 1999; Hodges and Bradley 2006). There are 11 extant occurrences in the Florida Keys and extreme south Florida, with only 3 of these sites located on public conservation lands. The largest population in Monroe County is located on Big Pine Key within National Key Deer Refuge and surrounding lands (Gann et al. 2002; Bradley 2006; Hodges and Bradley 2006).

Key deer is the only endangered, threatened or candidate species known to occur within the proposed project area. Bartram's scrub-hairstreak butterfly, Florida leafwing butterfly, Miami blue butterfly, Garber's spurge, Big Pine partridge pea, sand flax, wedge spurge, Blodgett's silverbush, Lower Keys marsh rabbit, Stock Island tree snail, Key tree cactus, Florida semaphore cactus, Eastern indigo snake have not been detected within this project area.

## **Social and Cultural Resources**

### Cultural Resources

At the end of the late Pleistocene, Florida's shoreline extended 100 to 125 miles seaward of its current location (Borremans 1990). Pollen profiles from south Florida indicate that the area supported an arid scrub-shrub habitat between 14,000 to 10,000 years before present (B.P.). Evidence of Florida's earliest inhabitants is very limited. Less than 100 Paleoindian sites are known statewide; none of these are located in the Keys. The Cutler-Fossil Site in Miami-Dade County yielded bones of humans and late Pleistocene fauna, a possible hearth, and stone and bone tools. The hearth yielded a radiocarbon date of about 9,670 B.P. The site is situated on the Atlantic Coastal Ridge and overlooked forested and open savannahs, open marshes, and wetlands. Like for the region's later occupants, potable water was a limiting factor for settlement and population size.

By 4,000 years ago, sea level had risen and formed the modern shorelines, and the Florida Keys were established as a chain of islands off the southern tip of Florida. The establishment and spread of shellfish species, such as conch, whelk, oyster, and clam, began in this period. The Archaic Period (10,000-3,000 B.P.) is denoted by the presence of large coastal shell middens, often containing fiber- and sand-tempered pottery, and interior black earth middens situated on hardwood hammocks or along natural drainages. To date, no archaeological sites dating to the Archaic Period have been identified on uplands in the Keys. The now-submerged landscape holds a higher probability for sites dating to the Paleoindian and Archaic Periods (Borremans 1990; Mathewson 1992).

The best-documented pre-Columbian site in the Keys is the Upper Matecumbe Key Site (Goggin 1944). Decorated pottery recovered from the site shows its occupation during the latter part of the Glades II Period (750 – 1200 A.D.) and the Glades III Period (1200 – 1500 A.D.). The Archaeological and Historical Conservancy, Inc., has conducted large-scale archaeological and historical reconnaissance of the Keys, documenting a number of historic properties or verifying the locations of previously identified sites (Carr, Allerton, and Rodriguez 1987; Carr and Fay 1990; Carr and Rodriguez 1988).

Ethnohistoric accounts dating to the 16th century indicate the Keys were occupied by groups either affiliated with the Tequesta or the Calusa. The Tequesta primarily occupied the area around Biscayne Bay, but they were also present throughout most, if not all, of southeastern Florida (Wheeler 2004). The Calusa was a maritime-based chiefdom centered in the Charlotte Harbor region, but whose reach extended well into the Ten Thousand Islands area. These chiefdoms relied heavily on the rich estuarine and maritime resources of south Florida (Marquardt 1992; Widmer 1988). Fontaneda, a Spanish sailor shipwrecked on the Florida coast in the mid-16th century, listed the caciques or political leaders, as well as the provinces and towns that they controlled. Three caciques listed as being in the "land of the Martines" are Guarungunve, Cuchiyaga, and Matecumbe (Worth 1995). In 1675, Bishop Calderon visited the Viscaynos, the Maticumbeses, the Bayahondos, and the Cuchiagaros. The Viscaynos are thought to have occupied the area around Biscayne Bay; the Maticumbeses occupied either Upper or Lower Matecumbe Key; the Bayahondos occupied Bahia Honda Key or Key Vaca; and the Cuchiagaros occupied Big Pine Key (Griffin, Fryman, and Miller 1979). By the late 18th century, the Keys and much of south Florida appeared to have been abandoned by the Calusa, the Tequesta, and other Indian groups.

The Miccosukees, Seminoles, and their Oconee and Creek ancestors began to move into Florida from Georgia and Alabama during the mid-1700s. It does not appear that they ever occupied the Keys, though the Seminole established the town of Ochupocrassa near Biscayne Bay about 1820 (Leynes and Cullison 1998).

Prior to the Spanish cession of Florida to the United States in 1821, the Keys had no permanent settlements. The Straits of Florida were an important, but treacherous, passage from the Gulf of Mexico to the North Atlantic and Europe. Native American, Spanish, Bahamian, and American “wreckers” established temporary camps to salvage cargo from ships that had run aground and would occasionally refloat seaworthy vessels. The construction of the Florida Reef lighthouses between 1852 and 1878 led to the industry’s decline. Havana, Cuba, was the center of the salvage industry during the period of Spanish dominance in the Caribbean and Florida. By the 17th century, the industry’s efforts shifted to New Providence and Nassau in the Bahamas. The United States Congress passed legislation in 1825 that required any wreck salvaged in American waters be brought to an American port for adjudication. A number of Bahamians moved to the Keys following the establishment of a U.S. Navy base and federal court on Key West (Leynes and Cullison 1998). These early immigrants became known as “Conchs” and made their living primarily by exploiting maritime resources, such as fish, sponges, turtles, and ship wrecks (Griffin, Fryman, and Miller 1979).

Until the late 1870s, the Keys’ economy continued to focus on the sea, although hunting, charcoal production, and small-scale agricultural operations were becoming more important (Table 2). The Watson Homestead, located on Big Pine Key and within the present National Key Deer Refuge, provides a glimpse into this period. Robert B. Watson and his family, who owned a 107-acre tract from 1905 to 1924, grew limes, plantains, guavas, tomatoes, and onions. Bee-keeping and a small grocery store augmented their income (Carr and Fay 1990).

The earliest “plantations” produced fruits and vegetables for the market in Key West. Shortly after 1900, pineapples became a lucrative crop, leading to the deforestation of scrubby woods and mature hardwood hammocks for fields. Aiding the commercial success of pineapple and lime plantations was the extension of Florida East Coast Railway from Miami to Key West. Railroad construction began in 1900 and was completed by 1912. Pineapple production was in decline by 1906. Clearing of the pine rockland and hammocks for fields led to erosion that left “old stony fields.” Limes were introduced by Dr. Henry Perrine from the Yucatan in 1838; the first trees were planted on Indian Key and possibly nearby keys. The Conchs used the limes for seasoning and medicinal purposes. Although wild limes sold for very high prices, the lime industry only took off following the demise of the pineapple plantations, reaching peak production in 1923. A hurricane in 1926 devastated most of the Keys’ lime groves. Competition from West Indies and Mexican growers slowed recovery. Production in 1935 was only a quarter of 1923 yield (Griffin, Fryman, and Miller 1979; Leynes and Cullison 1998; Windhorn and Langley 1974).

The Hurricane of 1935 destroyed the Florida East Coast Railway, but not access to the Keys. Construction of the Overseas Highway began in the early 1920s. By 1928, the highway ran from Miami to within 40 miles of Key West, with the remainder connected by ferry runs between islands. Following the 1935 hurricane, the former railway bridges and landfill islands supported the remaining stretch of the

Overseas Highway to Key West. The Highway opened up the Keys to the emerging saltwater fishing, recreational, and tourist markets (Griffin, Fryman, and Miller 1979; Windhorn and Langley, 1973 and 1974). Residential and commercial development expanded quickly after World War I.

Reviews of the Service's Southeast Region Master Site File, which is based upon the Florida Master Site Files, and the available literature and historic maps did not reveal any historic properties in the project area. Several historic properties are located in the vicinity, but none will be impacted by the proposed construction. Based upon location and the extent of past disturbance, the potential for intact archaeological sites is considered to be quite low to non-existent. An archaeological survey and/or monitoring is not warranted or recommended. This undertaking will have "no effect" as no historic properties are present.

### Demographic and Socioeconomic Information

The 2014 population estimate for Monroe County was 75,208 (U.S. Census Bureau 2015a), which was a 5.5% increase from 2010 (U.S. Census Bureau 2015b); the 2010-2014 population increase was similar for Florida at 5.8% and lower for the United States at 3.3% (U.S. Census Bureau 2015b). Monroe County is a long, skinny county made up of a collection of islands and keys off the southern coast of Florida. The location, amenities/desirability, shape, and configuration of Monroe County resulted in an average of 76.5 people per square mile in 2014 compared to 361 for Florida and 88.9 for the United States (calculated from U.S. Census Bureau 2015a and 2015b).

In 2014 Monroe County continued to be mostly white (89.3%), male, and older with 53.1% male and 46.9% female and with 18.8% of the population 65 or older. Comparatively in 2014, Florida was 76.2% white with 48.9% male and 51.1% female and with a similar 18.2% 65 or older, while the United States was 73.8% white with 49.2% male and 50.8% female and with a lower percentage of 13.7% 65 or older. The median age in Monroe County in 2014 was generally older at 46.7 years compared to 41.2 for Florida and 37.4 for the United States. While 21.7% of the 2014 Monroe County population identified as Hispanic or Latino of any race, over half of that was Cuban (12.2%). The Hispanic or Latino population of any race was similar for Florida at 23.3%, while it was lower for the United States at 16.9%. Of the 2014 Monroe County residents, 80.5% were born in the United States, 28.6% were born in Florida, and 17.8% were foreign born. While these numbers were similar for Florida at 77.1%, 35.7%, and 19.6%, respectively, a higher percentage of residents of the United States were born in the United States and were born in their state of residence and a lower percentage of U.S. residents were foreign born in 2014 (85.5% born in U.S., 58.7% born in state of residence, and 13.1% foreign born). While 76.2% spoke English only in the home in Monroe County in 2014, 18.6% spoke Spanish in the home. These percentages were similar in 2014 for Florida (72.2% and 20.5%) with a slightly higher percent English spoken and lower percent Spanish spoken in the home in the U.S. (79.1% and 13%). (U.S. Census Bureau 2015a)

The median home value in Monroe County was more than double the median home value for Florida and for the U.S. in 2014: \$379,700, \$156,200, and \$175,700, respectively. For Monroe County in 2014 19.2% of homes had a value less than \$200,000 and 10.9% had a value of \$1 million or greater compared to 63.7% and 1.8% for Florida and 56% and 2.1% for the U.S. Median monthly costs in 2014

for houses with mortgages were \$2,238 for Monroe County, which was higher than the \$1,480 for Florida and \$1,522 for the U.S. Approximately 43.7% of Monroe County 2014 rents were \$1,500 or greater, which is much higher than the only 15.3% for Florida and 15.9% for U.S. rents of the same value. Of note, about 75% of the Monroe County housing stock in 2014 was built before 1990; Hurricane Andrew occurred in 1992, which dramatically altered building code requirements. Of the 2014 Monroe County residents, 68.4% moved into their current housing unit in 2000 or later. Average household size for Monroe County in 2014 was similar to Florida and the U.S.: 2.57 people per household, 2.62, and 2.63, respectively. Also similar for 2014 for Monroe County, Florida, and the U.S. was average family size: 3.23 people per family, 3.25, and 3.23, respectively. (U.S. Census Bureau 2015a)

In 2014 Monroe County had lower percentages of unemployed workers than Florida and the U.S.; 4.4% of Monroe County was unemployed in the total labor force and 7.1% in the civilian labor force compared to 6.5% and 10.9% respectively for Florida and 5.8% and 9.2% respectively for the U.S. While 2014 saw 13.9% of people with income below the poverty line in Monroe County, this figure was slightly higher for Florida at 16.7% and 15.6% for the U.S. In 2014 90.4% of Monroe County had a High School degree or higher and 29.7% had a Bachelor's degree or higher compared to 86.5% and 26.8% for Florida and 86.3% and 29.3% for the U.S. Employment in Monroe County in 2014 was skewed towards arts, entertainment, and recreation and accommodation and food services at 24.8% compared to only 12% of Florida and 9.5% of the U.S. Median household income was higher for Monroe County than for Florida and similar to the U.S. in 2014: \$55,449, \$47,212, and \$53,482, respectively. The differences were more noticeable when looking at Monroe County's higher mean household income (\$81,727) and per capita income (\$34,424) compared to Florida (\$67,143 and \$26,499, respectively) and the U.S. (\$74,596 and \$28,555). (U.S. Census Bureau 2015a)

### Visitor Services

The Florida Keys are experiencing a decline of local residents who grew-up with the knowledge of the intrinsic and economic value of the Keys' natural resources and ecosystem functions. This is pertinent to the NWRs in terms of the continuing effort needed to educate new permanent and seasonal residents about natural resources and the needs of endangered and imperiled species, compounded by a large, seasonal influx of visitors.

The National Survey of Fishing, Hunting, and Wildlife-Associated Recreation has been conducted about every 5 years since 1955. It provides information on the number of participants in fishing, hunting, and wildlife watching (observing or photographing wildlife and feeding birds), and the amount of time and money spent on these activities. Over 90 million U.S. residents, aged 16 years old or older, fished, hunted, or watched wildlife in 2011. Nearly 34 million people fished or hunted and more than 71 million participated in at least one type of wildlife-watching activity. Wildlife recreators' enthusiasm was reflected in their spending, which totaled \$144.7 billion in 2011, and amounted to 1 percent of the gross domestic product. Wildlife watchers spent more than \$54.9 billion on trips, equipment, and other related items. (U.S. Department of the Interior, U.S. Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau 2011)

The 2011 survey also found that 6.4 million people 16 and older fished, hunted, or watched wildlife in Florida with 3.1 million fishing, 242,000 hunting, and 4.3 million participating in wildlife watching activities. In 2011 residents and visitors spent \$9 billion on wildlife recreation in Florida, including: \$4.8 billion in trip-related expenditures; \$2.7 billion on equipment expenditures; and \$1.5 billion on licenses, contributions, land ownership and leasing, and other items. (U.S. Department of the Interior, U.S. Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau 2011)

The Service's *Banking on Nature 2013: Economics Benefits to Local Communities of National Wildlife Refuge Visitation* report outlines the economic benefits of NWRs.

Recreational visits to national wildlife refuges generate substantial economic activity. In Fiscal Year 2011, more than 46.5 million people visited refuges. Their spending generated more than \$2.4 billion of sales in regional economies. As this spending flowed through the economy, nearly 35,000 people were employed and \$792.7 million in employment income were generated. About 72 percent of total expenditures were by non-consumptive activities on the refuges.

(Carver and Caudill 2013)

In Florida, six NWRs were specifically analyzed in the *Banking on Nature 2013* report: Arthur R. Marshall Loxahatchee, Crystal River, Egmont Key, Hobe Sound, Merritt Island, and St. Marks NWRs. For these Florida NWRs, total economic effects ranged from \$2.9 million (Hobe Sound NWR) to \$63.7 million (Merritt Island NWR). Further, for every \$1 of budget expenditure, the total economic effects associated with these budget expenditures ranged from \$6.81 (Arthur R. Marshall Loxahatchee NWR) to \$17.61 (Merritt Island NWR). (Carver and Caudill 2013)

According to the Monroe County Tourist Development Council, Key West receives approximately 2 million visits by car annually (Leeworthy 2010). These visitors traverse the extent of the Florida Keys, contributing to the local economy in each region. An important part of the revenue income in the Lower Florida Keys is related wildlife-dependent visitation (Leeworthy and Morris 2010). Over 25,000 visitors visited the Florida Keys NWRs Visitor center in the Big Pine Key Plaza in 2015. The Blue Hole interpretive site at National Key Deer Refuge averages 3 times that many visitors, who often bypass the current visitor center, possibly due to its lack of visibility. Approximately 80,000 visitors have been recorded annually at the Blue Hole interpretive site on Big Pine Key. Although there are no exact visitation numbers for the Great White Heron and Key West NWRs, they receive year-round visitation by the diving, snorkeling, fishing, boating, and kayaking industries, as well as visits by seasonal and permanent residents. Visitor estimates from the industry during the mid-2000s were over 436,000 for Key West NWR and 146,000 for Great White Heron NWR (Lower Florida Keys Refuges CCP, U.S. Fish and Wildlife Service 2009).

The National Wildlife Refuge System Improvement Act of 1997 established six priority wildlife-dependent public uses on national wildlife refuges, assuming that they are appropriate for and compatible with the purpose(s) of each refuge: hunting, fishing, wildlife observation, wildlife photography, and environmental education and interpretation. Hunting is prohibited on all Refuge Complex lands and throughout the Florida Keys. Collectively, the three NWRs provide opportunities

for the other five priority wildlife-dependent activities. Some non-priority recreation uses have been allowed on the NWRs to support the priority public use activities, for example, horseback riding occurs on certain trails in the National Key Deer Refuge and picnicking occurs on NWR beaches that are open to public access. Lower Keys NWRs lands with public access are free of charge and open 7 days a week. Hours are from 1/2-hour before sunrise to 1/2-hour after sunset. Some Lower Keys NWRs lands are closed to public access to protect environmentally sensitive wildlife or habitats.

Most of the National Key Deer Refuge properties are located on the mainline keys (islands that are accessible by vehicles) and open to public access via fire roads and other trails. Many visitors come to the National Key Deer Refuge to observe and photograph the unique, tiny Key deer; most of the deer population is found on Big Pine and No Name keys. The Service provides extensive interpretive information at the Refuge Visitor center on Big Pine Key, the Blue Hole interpretive site, and the 2/3-mile Watson and the 1/8-mile Mannillo nature trails. The Blue Hole is an old quarry with an observation deck and a partial trail that provides for viewing of a variety of turtles, fish, birds, alligators, Key deer, and raccoons. Many other undeveloped trails are open to wildlife-dependent recreational activities on Big Pine, No Name, Cudjoe, and Lower and Upper Sugarloaf keys. Ohio Key also has beach access.

Fishing on any of the three NWRs is not specifically listed as a NWR-regulated activity in the Code of Federal Regulations. Saltwater fishing along the refuges' shorelines and in state-owned marine waters adjacent to the NWRs' lands is regulated by the State of Florida and occurs primarily on Ohio Key. Saltwater fishing activities in the backcountry areas include hook and line for finfish, baitfish netting, crabbing, and lobstering. There is no freshwater fishing allowed on any Keys NWR property.

Key West and Great White Heron NWRs contain over 300,000 acres of marine waters, dozens of mangrove islands, and several islands with pristine undeveloped beaches that are designated as Wilderness. The marine waters are some of the best waters for saltwater sport fishing in North America. Visitors come from all over the world to fish these waters and numerous tournaments are held. The dozens of mangrove islands and shallow waters are home for nesting, feeding, and resting birds, such as pelicans, cormorants, herons, egrets, and plovers, to name a few. Due to an abundance of birds, the NWRs are also havens for birders.

NWR management of the marine waters is limited, as they are State-owned waters. This limited authority is granted by the State of Florida via the Management Agreement with the State of Florida for Submerged Lands within the Boundaries of the Key West and Great White Heron NWRs, authorizing certain measures to be implemented within the State-owned waters to minimize wildlife disturbance and habitat destruction from non-wildlife dependent recreational activities. The Management Agreement specifically allows the Service to regulate access within 300 feet of certain islands, to enforce boating speed zones and no-entry areas, and to prohibit the use of personal water craft (e.g., jet skis), aircraft landings, hovercraft, airboats, and waterskiing within the administrative boundaries of the two NWRs. All other marine activities (e.g., fishing) within the NWRs' administrative boundaries are regulated by the State of Florida and Florida Keys National Marine Sanctuary.

A NWR Park Ranger operates the Lower Keys NWRs Visitor Center and oversees management of

various sites on National Key Deer Refuge. The Service is actively involved in several environmental educational and interpretive organizations and events including, but not limited to, the Florida Keys Wildlife Refuges Outdoor Fest, Rockin' Refuge Rangers, Camp Run A Muk, and Summer Family Friendly evenings, as well as numerous guided nature walk, bike, and kayak excursions. Partner organizations include: Monroe County Environmental Education Advisory Council, the Florida Keys Scenic Highway Initiative, the Florida Keys Overseas Heritage Trail, and the interagency Florida Keys Eco-Discovery Center. Environmental education opportunities provided on National Key Deer Refuge include those for local schools, boy and girl scouts, boys and girls club, master naturalist and master gardener programs, and colleges.

Volunteers continue to be a major contributor to the success of the Refuge System. In 2015, nearly 42,000 volunteers contributed 1.5 million hours on refuges nationwide, a service valued at more than \$34 million. The Lower Florida Keys Refuges depend on a volunteer base of about 70 individuals. Itinerant workers, such as college students doing alternative spring breaks, and other organized programs, such as Student Conservation Association and AmericCorps, also assist. Combined, these volunteers contributed over 11,000 volunteer hours in 2014, which was the equivalent of 5.3 additional full-time staff.

## **VII. Environmental Consequences**

### **Impacts Common to All Alternatives**

No significant adverse environmental impacts are anticipated from implementation of any of the alternatives analyzed. A few potential impacts would be similar under each of the alternatives, including environmental justice, other management, climate change, socioeconomic environment, visitor services, cultural resources, refuge revenue-sharing, and other effects.

#### Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" was signed by President Clinton on February 11, 1994, to focus federal attention on the environmental and human health conditions of minority and low-income populations, with the goal of achieving environmental protection for all communities. The Order directed federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The Order is also intended to promote nondiscrimination in federal programs substantially affecting human health and the environment, and to provide minority and low-income communities with access to public information and opportunities for participation in matters relating to human health or the environment.

None of the management alternatives described in this EA would disproportionately place any adverse environmental, economic, social, or health impacts on minority and low-income populations.

### Other Management

All management activities that could affect the NWRs' natural resources, including subsurface mineral reservations, utility lines and easements, soils, water and air, and historical and archaeological resources would be managed to comply with all laws and regulations. In particular, any existing and future oil and gas exploration, extraction, and transport operations on the NWRs would be managed similarly under each of the alternatives. Thus, the impacts would be similar.

### Climate Change

Neither of the alternatives would impact climate change, sea level rise, or carbon sequestration.

### Socioeconomic Environment

Neither of the management alternatives would negatively impact the socioeconomic environment. Both alternatives would be anticipated to have positive socioeconomic impacts.

### Visitor Services

Visitor Services activities would continue under alternative A and B. Neither alternative would negatively impact current visitor services programs.

### Cultural Resources

None of the alternatives analyzed would negatively impact cultural resources. In the event that a previously undetected cultural resource site were to be uncovered during implementation, activity would stop and the Refuge Complex would coordinate with the Service's Regional Archaeologist and Florida's State Historic Preservation Office, as appropriate.

### Refuge Revenue-Sharing

Neither of the alternatives would impact refuge revenue-sharing.

### Other Effects

The two alternatives would have similar effect or minimal to negligible long term effects on meteorology, air quality, geology, topography, soils, water quality and quantity, noise, transportation, human health and safety, children, hazardous materials, waste management, aesthetics and visual resources, and utilities and public services.

### **Alternative A – Construct, Operate, and Maintain a New Visitor center (Proposed Action)**

The Proposed Action would provide office space for Refuge Complex staff and volunteers, a Visitor center for the purpose of education and outreach, associated parking, and adjacent interpretive trails. The building would also offer space for educational displays; a bookstore that would be managed by FAVOR, the Refuge Complex's Friends Group; and classroom space for us

to allow local schools to use the NWRs to enhance their wildlife education programs. The area outside this building would provide a space for a native plant nursery, a pollinator garden, and adequate parking to meet the current and future demands of the continually increasing visitation. This building would be located at 30587 Overseas Highway/ U.S. 1, Big Pine Key, Monroe County, Florida. Implementation of the Proposed Action would be anticipated to result in easier access for the public than the current location. It would be much more visible to visitors, thus be easier to find. Parking at this facility would be safer due to a decrease in non- NWR related traffic and easier to obtain because the Visitor Center would no longer be competing with the neighboring businesses for those parking resources. After initial construction of the Visitor Center, considerable savings to the government would be expected due to the elimination of monthly rent that is required at the current location. The new higher profile Visitor Center on Overseas Highway/ U.S. 1 would also direct more visitors to that facility as opposed to the admin offices, thereby reducing staff administrative burden in the admin offices. The increase in visibility and enhanced resident and visitor access to the Visitor Center would be expected to positively contribute to the local economy and regional tourism industries. The Refuge Complex visitor services program would be expected to be enhanced and increase in volume. A significant increase in the number of contacts with the proposed new Visitor Center would be expected. Increasing the number of opportunities for high quality wildlife observation and photography and environmental education and interpretation, the new site would offer visitors the ability to visit and experience some of the native habitats available on Big Pine Key by using the new trail system on the neighboring 2-acre lot.

The proposed new Visitor Center would be constructed on concrete piers and comply with the latest local building codes, making the structure safer and more resilient with respect to potential effects of weather as a result of climate change.

The implementation of the Proposed Action and the development of the proposed facility would have negative impacts to the soils located under the building footprint. However, these impacts are considered to be discrete and are not considered significant. The lot that would be used for this action is a former commercial developed site that includes an asphalt covered parking lot. The trail system on the neighboring lot would require the trimming of branches and potentially the removal of small brush. This action could negatively impact some of the vegetation along the trail system. These impacts are considered to be discrete and are not considered significant. Further, the use of the adjacent trails by visitors would increase use of the site and increase the potential for wildlife and habitat disturbance; however, these impacts would be considered discrete and not significant.

The implementation of the Proposed Action and the development of the proposed facility would have negative impacts to wildlife and habitats occurring on the site. The site is incidentally used by limited numbers of species. Those species that use the site to move through the area would be anticipated to continue to do so, avoiding the actual building site. Because the lot was formerly covered in asphalt that needed to be removed to accommodate the Visitor center, the habitat may be improved for some species. Direct impacts would result on the site, since a 0.06-acre area of mixed vegetation was removed in order to facilitate engineering and planning to accommodate a

proposed new public restroom and two handicapped accessible parking spaces. The wildlife and habitat impacts anticipated from implementation of the Proposed Action would be considered to be discrete and are not considered significant.

### **Alternative B – Continue Current Management (No Action Alternative)**

Under Alternative B, no building or parking lot would be constructed. Staff and visitors would continue use of the existing Visitor Center in the leased storefront on Big Pine Key. Visitors would continue to have difficulty locating the Visitor Center and would continue to compete for parking in a very crowded public parking lot. For the foreseeable future, the Refuge Complex would probably continue to see its budget remain the same or decrease annually. As rent continues to increase over time, the Service would have to continue to expend funding for rent, instead of for other projects. If it were to become cost ineffective to continue to use the leased space, the existing Visitor center would be closed and staff would have to move to the administrative building and be placed in offices already occupied by other staff, creating poor work conditions due to overcrowding. The displays would be removed and put into storage until a suitable space became available. Outdoor education classes conducted by volunteers and staff would continue with a diminished quality. The ground-level elevation of the existing Visitor Center makes it more vulnerable to storm surge or other high water events, including from sea level rise and other impacts from climate change. No wildlife and habitat impacts would be associated with implementation of the No Action Alternative.

### **Direct and Indirect Impacts**

Direct impacts are caused by an action and occur at the same time and place as the action. For the Proposed Action, direct impacts could include temporary construction noise, minor and temporary air pollution caused by dust and diesel emissions, and soil disturbance for the building and parking lot footprints. No known nesting birds are within the area that might be affected by construction noise or dust. Temporary construction at this site is not expected to cause nest abandonment. The area around three sides of the construction site may contain endangered Key deer. Temporary construction noise and pollution may have limited, short term impacts to listed species. Construction crews and equipment entering and exiting the lot at 30587 Overseas Hwy may intermittently slow traffic on the Highway. There would be no anticipated road closures associated with the construction. Direct habitat impacts would include the removal 0.06 acres of mixed vegetation. However, given the location and scope of the Proposed Action, none of the direct impacts are anticipated to be significant.

Indirect impacts are those effects that may be reasonably expected later in time and space. Minimal indirect impacts are anticipated. These could include minor siltation into adjacent drainage ditches for Overseas Highway and impacts associated with temporary construction activities. However, given the location and scope of the Proposed Action, none of the indirect impacts are anticipated to be significant.

## **Cumulative Impacts and Climate Change**

A cumulative impact is an impact on the natural or human environment, which results from incremental impact of a Proposed Action, when added to other past, present, and reasonably foreseeable future actions, regardless of which agency or person undertakes such other actions (40 Code of Federal Regulations §1508.7). The Service is not aware of any past, present, or future planned actions that would result in significant cumulative impacts when added to the Proposed Action due to both the scale and location of the proposed facility and the fact that the proposed visitor center site was formerly a commercial business.

Similarly, no significant negative effects related to climate change are anticipated from implementation of the Proposed Action.

## Literature Cited

- Avery, B., & Loope, L. 1980. *Endemic Taxa in the Flora of South Florida*. Homestead: South Florida Center Report.
- Bancroft, G., & Bowman, R. 1994. *Temporal Patterns in diet of nestling white-crowned pigeons: implications for conservation of frugivorous Columbids*. The Auk.
- Bancroft, T. G., et al. 1995. *Deforestation and its Effect on Forest-nesting Birds in the Florida Keys*. Conservation Biology.
- Benson, L. 1982. *The cacti of the United States and Canada*. Stanford: Stanford University Press.
- Borremans, N. 1990. *The Paleoindian Historical Context*. Florida's Archaeological Contexts.
- Bradley, K. 2006. *Distribution and Population Size for Three Pine Rockland Endemic Candidate Plant Taxa on Big Pine Key, Florida*. Vero Beach.
- Bradley, K., & Gann, G. 1999. *The pine rockland forests of southern florida*. The Palmetto.
- Bradley, K., & Saha, S. 2009. *Post-hurricane responses of rare plant species and vegetation of pine rocklands in the Lower Florida Keys*. Miami: The Institute for Regional Conservation.
- Cannon, P. et al. 2009. *Discovery of the Imperiled Miami Blue Butterfly on Islands in the Florida Keys National Wildlife Refuges*. Big Pine Key.
- Carr, & Allerton, R. 1987. *An Archaeological, Historical and Architectural Survey of the Middle Keys*. Miami: The Archaeological and Historical Conservancy.
- Carr, R., & Fay, P. 1990. *An Archaeological Survey of the Lower Keys*. Miami: The Archaeological and Historical Conservancy.
- Carr, R., & Rodriguez, I. 1988. *An Assessment of the Archaeological and Historic Resources of the Florida Keys*. Miami: The Archaeological and Historical Conservancy.
- Close, H. 2000. *The Liguus tree snails of South Florida*. Gainesville: University Press of Florida.
- Dickson, J. 1955. *An Ecological Study of the Key Deer*. Tallahassee: Florida Game and Freshwater Fish Commission.
- Emmel, T. C., & Urich, F. C. 1991. *Life Histories of Neotropical Butterflies from Trinidad*. Gainesville: Tropical Lepidoptera.
- Folk, M., Klimstra, W., & Kruer, C. 1991. *Habitat Evaluation: National Key Deer Range*. Tallahassee: Florida Game and Fresh Water Fish Commission.
- Forys, E., & Humphrey, S. 1999b. *The importance of patch attributes and context to the management and recovery of an endangered lagomorph*. Landscape Ecology.
- Forys, E., & Humphrey, S. 1999a. *Use of population viability analysis to evaluate management options for the endangered Lower Keys marsh rabbit*. Journal of Wildlife Management.
- Gann, G., et al. 2007a. *National Key Deer Refuge in the Floristic Inventory of South Florida Database Online*. Miami: The Institute for Regional Conservation.

- Gann, G., et al. 2007b. *Great White Heron National Wildlife Refuge In the Floristic Inventory of South Florida Database Online*. Miami: The Institute for Regional Conservation.
- Gann, G., et al. 2007c. *Key West National Wildlife Refuge in the Floristic Inventory of South Florida Database Online*. Miami: The Institute for Regional Conservation.
- Goggin, J. 1944. *Archaeological investigations on the Upper Florida Keys*. Tequesta.
- Griffin, Fryman, & Miller. 1979. *Cultural Resource Reconnaissance of the National Key Deer Wildlife Refuge*. Tallahassee: Cultural Resource Management, Inc.
- Hillis, D. E. 1991. *Minimal Genetic Variation in a Morphologically Diverse Species, Florida Tree Snail*. Journal of Heredity.
- Hofstetter, R. 1974. *The effect of fire on the pineland and sawgrass communitites of Southern Florida*. Miami: Environments of South Florida.
- Horn, S. 2008. *Sediment Records of Fire and Vegetation History from Solution Holes in the National Key Deer Refuge*. University of Tennessee.
- Klimstra, W. 1986. *Controlled burning in habitat management: some observations, National Key Deer Refuge*. USFWS.
- Kruczynski, W. L. 2000. *Sources of Water Quality Information for Confined and Nearshore Waters in the Florida Keys*. U.S. Environmental Protection Agency.
- Lapointe, B. C. 1992. *Nutrient inputs from the watershed and coastal eutrophication in the Florida Keys*. Estuaries.
- Leeworthy, V. 2010. *Visitor Profiles: Florida Keys/Key West*. University of Massachusetts Amherst.
- Leeworthy, V., & Morris, F. 2010. *A socioeconomic analysis of the recreation activities of Monroe County residents in the Florida Keys/Key West*. National Marine Sanctuaries.
- Leynes, J., & Cullison, D. 1998. *Biscayne National Park Historic Resource Study*. Atlanta: National Park Service.
- Liu, H., Snyder, J., Koptur, S., & Ross, M. 2005. *Effects of fire intensity on vital rates of an endemic herb of the Florida Keys*. Nat Areas.
- Long, R., & Lakela, O. 1971. *A Flora of Tropical Florida*. Coral Gables: University of Miami Press.
- Lott, C. 2006. *Systemic Monitoring of peregrine falcons and seven other diurnal migrant raptor species in the Florida Keys*. Tallahassee: Florida Fish and Wildlife Conservation Commission.
- Marquardt, W. 1992. *Culture and Environemnt in the Domain of the Calusa*. Gainesville: Institute of Archaeology and Paleoenvironmental Studies.
- Minno, M., & Emmel, T. 1993. *Butterflies of the Florida Keys*. Gainsville: Scientific.
- Minno, M., Butler, J., & Hall, D. 2005. *Florida Butterfly Caterpillars and their Host Plants*. Gainesville: University Press of Florida.
- US Fish and Wildlife Service. 2009. *Lower Florida Keys National Wildlife Refuges Comprehensive Conservation Plan*.

- Noss, R., Edward, L., & Scott, M. 1995. *Endangered Ecosystems of the United States: A Preliminary Assessment of Loss and Degradation*. U.S. Department of the Interior.
- Paul, J., Jiang, S., & Rose, J. 1991. *Concentration of Viruses and Dissolved DNA from aquatic Environments by Vortex Flow Filtration*. Appl Environ Microbiol.
- Plant Atlas*. Undated. Retrieved March 16, 2016, from Plant Atlas: [http:// www.plantatlas.usf.edu](http://www.plantatlas.usf.edu)
- Ross, M., & Ruiz, P. 1996. *A Study of the Distribution of Several South Florida Endemic Plants in the Florida Keys*. Miami: Florida International University Southeastern Environmental Research Program.
- Ross, M., O'brien, J., & Flynn, L. 1992. *Ecological Site Classification for Florida Keys Terrestrial Habitats*. Biotropica.
- Saarinen, A. 1989. *The Use of Septic Systems and Their Effects on the Freshwater Resources on Big Pine Key*. Gainesville: University of Florida.
- Salvato, M., & Hennessey, M. 2003. *Notes on the Historic Range and Natural History of Anaea troglodyta floridalis*. Journal of the Lepidopterists' Society.
- Salvato, M., & Salvato, H. 2002. *A new host record for Automeris io and the re-occurrence of Kricogonia lyside in Florida*. News Lepid.
- Small, J. 1933. *Manual of Southeastern Flora*, . New York.
- The Institute for Regional Conservation*. (2016). Retrieved March 16, 2016, from Conservation of Rare Plants, Animals, and Ecosystems: <http://www.regionalconservation.org/>
- U.S. Census Bureau. 2015a. 2010-2014 American Community Survey 5-Year Estimates. Data Profiles for Monroe County, Florida; Florida; and United States. <https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/2014/>
- U.S. Census Bureau. 2015b. Quick Facts. Quick Facts for Monroe County, Florida; Florida; and United States. <http://www.census.gov/quickfacts/table/PST045215/12087>
- U.S. Department of the Interior, U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. 2011. National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. <https://www.census.gov/prod/2012pubs/fhw11-nat.pdf>
- U.S. Fish and Wildlife Service. 2009. Lower Florida Keys National Wildlife Refuges Comprehensive Conservation Plan. Including National Key Deer, Key West National Wildlife Refuge, and Great White Heron National Wildlife Refuge, October 2009. Atlanta, GA. <http://www.fws.gov/southeast/planning/PDFdocuments/Florida%20Keys%20FINAL/TheKeysFinalCCPFormatted.pdf>
- Verdon, E. 2004. *Activity patterns, habitat use, and movements of the Florida Box Turtle in the Florida Keys*. Miami: Florida International University.
- Weiner, A. 1979. *The Hardwood Hammocks of the Florida Keys: an Ecological Study*. Mimeo.
- Wheeler, R. 2004. *Southern Florida Sites Associated with the Tequesta and their Ancestors*. Tallahassee: Florida Division of Historical Resources.
- Widmer, R. 1988. *The Evolution of the Calusa: A Nonagricultural Chiefdom on the Southwest Florida Coast*. Tuscaloosa: University of Alabama Press.

- Wightman, M. 1990. *Geophysical analysis and Dupuit-Ghyben-Herzberg modeling of freshwater lenses on Big Pine Key, Florida*. Tampa: University of South Florida.
- Worth, J. 1995. *Fontaneda Revisited: Five Descriptions of Sixteenth-Century Florida*. Florida Historical Quarterly.
- Wunderlin, R. 1998. *Guide to the Vascular Plants of Florida*. Gainesville: University Press of Florida.