

**Status Survey of the Federally Threatened *Chamaesyce garberi* in  
South Florida**

Final Report  
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## Introduction

Garber's spurge (*Chamaesyce garberi* (Engelmann ex Chapman) Small) is a small perennial herb belonging to the spurge family (Euphorbiaceae). It is endemic to Collier, Miami-Dade and Monroe counties where it is found in a variety of plant communities including beach dune, coastal grassland, coastal rock barren, pine rockland, and disturbed uplands dominated by native plants. Garber's spurge was listed as threatened under the Federal Endangered Species Act in 1985. The last status survey of Garber's spurge was in 1980 (Austin and Nauman 1908), and the current status was not well known.

Over time, due to habitat destruction, fire suppression, and other human modifications, Garber's spurge appeared to be increasingly rare (U.S. Fish and Wildlife Service 2000). Human induced habitat destruction and alteration are continuing threats for populations of Garber's spurge. The ecological damage to habitats caused by exotic pest plant invasions has been well documented. For this species in South Florida the largest threats are introduced species such as Brazilian-pepper (*Schinus terebinthifolius*), Australian-pine (*Casuarina equisetifolia*), and beach naupaka (*Scaevola sericea*). Further human modifications include fire suppression in coastal grassland and pine rockland habitats, threatening this species by overcrowding of other plant species. There is also a likelihood that populations of Garber's spurge located on non-conservation lands may be subject to outright destruction due to human development. Long term habitat modifications such as sea-level rise and beach erosion are also threats to Garber's spurge as they will likely reduce necessary habitat.

Currently, only one population is known to be monitored irregularly at the Miami-Dade County park Deering Estate at Cutler (Jennifer Possley, personal communication January 2006). Eleven other distinct populations were thought to exist due to surveys within the last ten years. Prior to this report, the status of additional older stations was unknown. It is possible that additional populations may exist within its historic range in South Florida.

South Florida and the Florida Keys were impacted by three hurricanes in 2005 - Katrina on August 26th, Rita on September 20th, and Wilma on October 24th. Wilma had the largest impact, with storm surges flooding much of the landmass of the Keys (Goodhue 2005), in addition to Cape Sable (Pasch et al 2006). Large areas containing Garber's spurge habitat were flooded on several of the islands on which it occurs. Vegetation in many areas was top-killed due to salt water inundation. The long term impact of storm surge on vegetation, especially rare plant populations, was poorly known. It is possible that Garber's spurge responds positively to hurricane disturbance (George Gann, personal communication, May 2007). The outcomes of hurricanes are the opening up of tree and shrub canopy by wind storm damage as well as the reduction of the competitive herb layer by tidal surge, thereby possibly increasing habitat for Garber's spurge.

This study was conducted to determine the status of Garber's spurge throughout its historic range. This included surveys of previously reported populations, and surveys of habitats where the species could occur. In addition to the surveys, the study was

conducted to determine appropriate habitats for the species along with short-term and long term threats.

## Methods

Taxonomy for Garber's spurge followed Herndon (1993). This includes all plants in the *C. garberi* / *C. porteriana* complex with hairy capsules. Other characteristics include cyathia solitary in leaf axils, leaves with thick, entire margins, and equal sized gland appendages. Synonyms include *Chamaesyce brachypoda* Small, *Chamaesyce mosieri* Small, *Chamaesyce keyensis* Small, and *Chamaesyce porteriana* Small var. *keyensis* (Small) D.G. Burch.

Existing plant data in Gann et al. (2007) and other in-house data records collected by IRC staff were used to determine locations of extant and historical populations. Herbarium records from Everglades National Park Herbarium (ENP), Fairchild Tropical Botanic Garden Herbarium (FTG), Florida Atlantis University Herbarium (FAU), New York Botanical Garden (NY), University of Florida Herbarium (FLAS), and the University of South Florida Herbarium (USF) were checked. In addition, previous status surveys and recovery plans were consulted and land managers and biologists were sought for specific, local, and up to date information.

Written permission from landowners was obtained before site visits were made. In addition, we obtained a Research and Collecting Permit from the Florida Department of Environmental Protection for research conducted in Florida State Parks, and a Special Use Permit from the U.S. Department of Interior, for research conducted in the Florida Keys National Wildlife Refuge System. Surveys within Everglades National Park (ENP) were conducted in cooperation with ENP botanists.

Surveys for Garber's spurge began with extant stations, then historic locations. Survey crews of one or two people, with at least one experienced botanist, conducted status surveys at stations where the status of Garber's spurge was extant or unknown. Since Garber's spurge is currently monitored at the Deering Estate at Cutler, that population was excluded from this survey. Areas recently impacted by hurricanes were visited after the rainy season began (when plants were expected to be healthiest) to maximize the possibility of rediscovering Garber's spurge in locations for which its status is unknown. In some areas only accessible by watercraft, IRC has collaborated with local or other agencies for transportation to these regions.

Aerial photos of all survey stations were created to facilitate field surveys. When surveying for new populations, 2004 aerial photographs, habitats, and associated plant taxa were compared with extant stations and IRC databases.

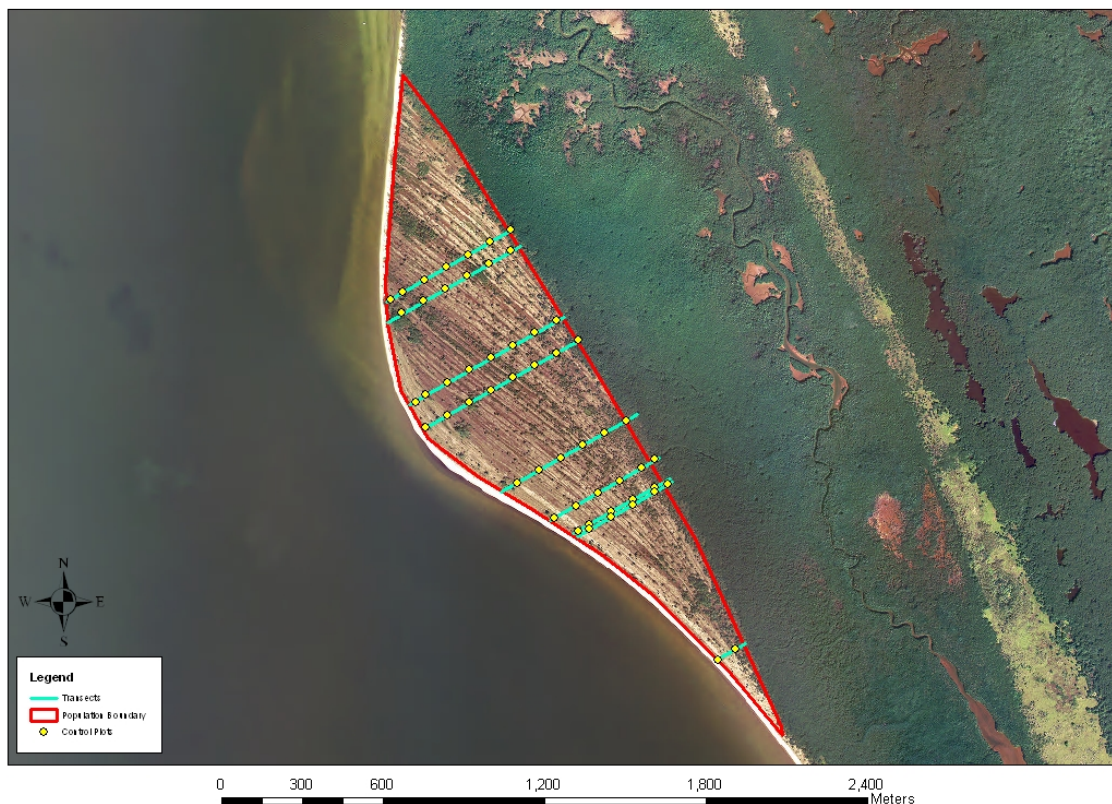
Populations were considered to be extant if plants were found, and historical if no plants were found, but have been observed within the past ten years. A population was considered extirpated if no plants were observed during surveys, and have not been

observed in over 20 years. Additionally, a population was considered extirpated if there was reason to believe that habitat at the station had been destroyed.

When a population was found to be extant, suitable habitat at the site was traversed, plants were counted, and plant populations were mapped. Mapping devices included either a Garmin GPSMap 76 with an accuracy to within three meters, or a Thales MobileMapper CE with ArcPad software for sub-meter accuracy. A centroid of each population was taken. For larger populations, polygon boundaries were recorded using the same device and population sizes were estimated. For populations containing ten or fewer individuals, exact numbers were recorded. For populations containing fewer than 100 individuals, plants were recorded in increments of ten (e.g. 11-20). For populations possessing fewer than 1,000 individuals, plants were recorded in increments of 100 (e.g. 101-200). For efficiency, if a population's density measured greater than 1,000 plants, more systematic methods of estimating population size were used.

Because of the high population density on Northwest Cape Sable, a more systematic approach to sampling was needed. Nine sampling transect lines were randomly generated using ArcGIS. These transects ran perpendicular to the coastline, across the estimated population boundary, and varied in length from just over 200 m to 1 km. The total length of all transects was 4,412 m. Predetermined transect locations were loaded into a Garmin GPSMap 76 and located in the field. Transects were run using a 60 m tape. Garber's spurge intersecting the transect was counted, and the distance along the transect was recorded. A five m diameter plot was set up around every 50<sup>th</sup> Garber's spurge (51 plots) and data was collected on the number of plants in the plot, associated plant species, habitat, substrate, and topography. In addition to these experimental plots, 53 five m diameter control plots were set up at 93 m intervals along the transects and the same data was recorded. See Figure 1 for an overview of the study area on Northwest Cape Sable, Everglades National Park, Monroe County.

**Figure 1: Study Area on Northwest Cape Sable, Everglades National Park, Monroe County**



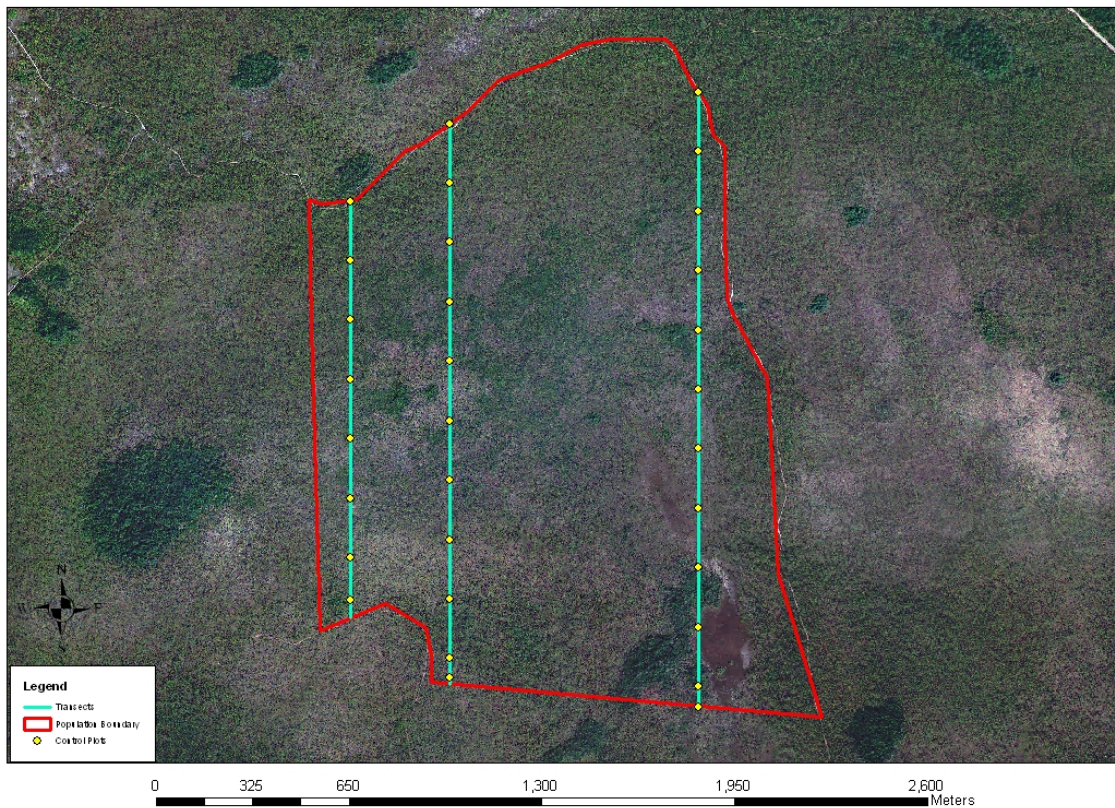
On Long Pine Key, Pine Block B, Everglades National Park, where Garber's spurge occurred across a large area at low densities, a series of modified belt transects was used. Three random easting UTM coordinates that fall within the population boundaries were generated. Three north to south transect lines intersecting the random easting coordinates, were drawn in ArcGIS and loaded into a Thales MobileMapper CE running ArcPad. The transect lines were traversed using a Thales MobileMapper GPS. Observers traversed the transect lines looking for Garber's spurge, on or off the transect line. When Garber's spurge was detected, a GPS position was recorded to indicate the position along the transect lines. The distance from the detected plant to the transect line (detection distance) was recorded as a positive or negative number depending upon whether the plant was on the east or west side of the transect line respectively. All plants that fell within a detectable distance<sup>1</sup> from the detected plant and other detectable plants were counted and considered a cluster. The north and south boundaries of the cluster were then determined by measuring the distance from a center line to the furthest north and south individuals in the cluster. Similarly, the distances from the transect line, to furthest east and west individuals within the cluster were measured as positive and negative numbers

<sup>1</sup> The detection distance is the distance at which observers are reasonably able to identify plants as Garber's spurge (e.g. pubescence evident), and was generally around 1 m.

respectively, to facilitate with statistical computation. See Figure 2 for an overview of the study area on Long Pine Key, Pine Block B, Everglades National Park.

Analysis of these data averaged the east and west boundaries of every cluster to obtain an average width to be used as a belt transect. The total number of plants counted in all clusters was then divided by the total areas of the belt transects to obtain a density estimate.

**Figure 2: Study Area on Long Pine Key, Pine Block B, Everglades National Park, Miami-Dade County**



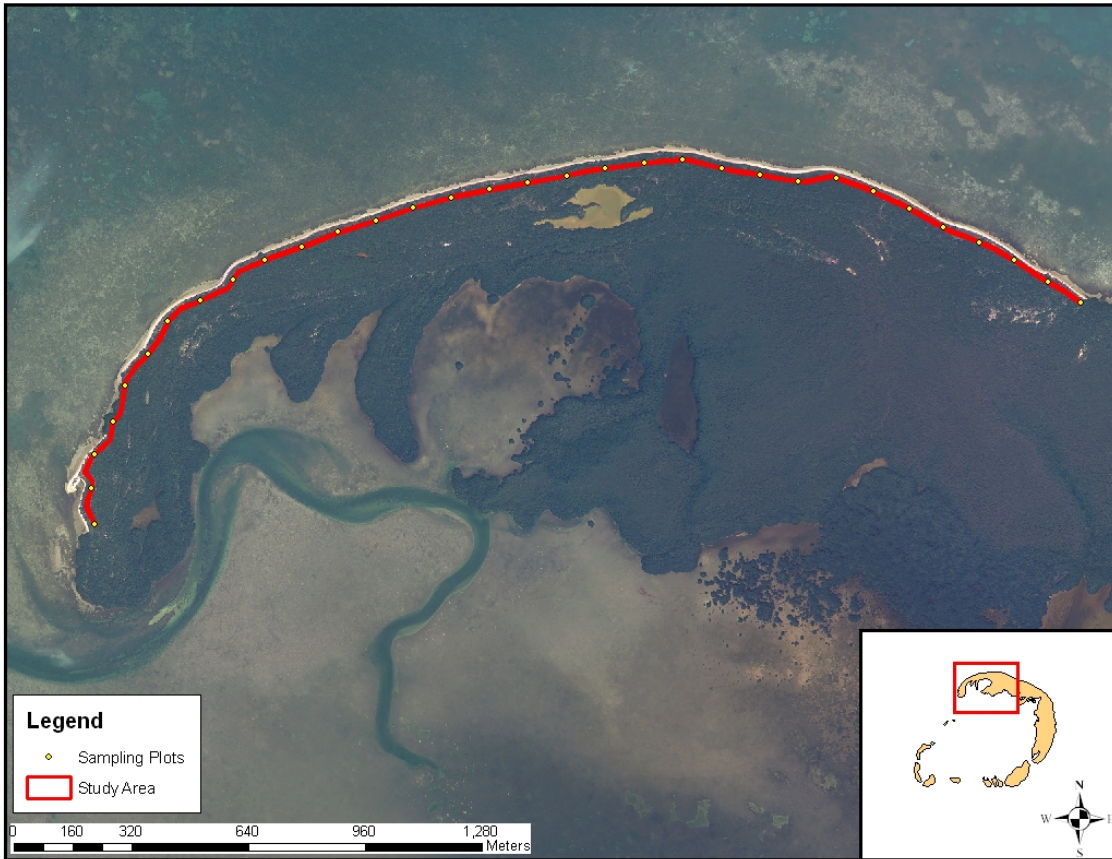
On Snook Beach in the Key West National Wildlife Refuge (KWNWR), the area covered by the Garber's spurge habitat was small enough to effectively employ standard random sampling techniques. Fifty random points within the population boundaries were generated using ArcGIS. These points were then loaded into a Garmin GPSMap 76. A survey team consisting of two people then set up a 5 m diameter plot around each point and recorded the number of Garber's spurge in each plot, associated plant taxa and percent cover of the plot for each plant taxa. See Figure 3 for an overview of the study area on Snook Beach, KWNWR.

**Figure 3: Study Area on Snook Beach, KWNR, Marquesas Keys**



On Long Beach in KWNWR, 5 m radius sampling plots were set up at 107 m intervals (32 plots total) along the ecotone between beach dunes and coastal berm. Counts of Garber's spurge, associated plant taxa, and percent cover of each species were recorded. Garber's spurge was also recorded if it was observed outside of sampling plots. A population estimate was obtained by averaging the Garber's spurge densities across all sampling plots, and applying this density to the total area of suitable habitat. See Figure 4 for an overview of the study area on Long Beach, KWNWR.

**Figure 4: Study Area on Long Beach, KWNWR, Marquesas Keys**



At all populations, habitat, following FNAI (1990), and associated plant species were recorded. In addition, the condition and phenology of plants were also documented, as well as threats to each location of Garber's spurge.

## **Results**

Searches of literature, herbarium specimens and other sources showed that there were 43 locations where Garber's spurge was formerly documented. These stations occurred in Collier, Miami-Dade, and Monroe Counties. Field surveys showed that Garber's spurge is extant at 26 stations, historical at three stations, and extirpated from 15 stations (Table 1).



**Table 1: All Documented Localities of Garber's spurge (1892-2007), Including Results from Surveys**

Site Name	Results	Estimated Population Size
<b>Miami-Dade County</b>		
Deering Estate at Cutler <sup>2</sup>	Extant	30-40
Everglades National Park -Pine Block A (Deer Hammock)	Extant	600-700
Everglades National Park -Pine Blocks B through C	Extant	1,250,277
Miami	Extirpated	N/A
South of Miami	Extirpated	N/A
<b>Monroe County: Florida Keys</b>		
<i>Bahia Honda Key</i>		
Bahia Honda Key – Roadside	Extirpated	0
Bahia Honda State Park	Extant	700-800
<i>Big Pine Key</i>		
Cactus Hammock	Extirpated	0
Coupon Bight - North Shore	Extant	7
Coupon Bight State Buffer Preserve - Roadside*	Extant	20-30
Koehns Avenue	Extirpated	0
Northeast of Watson Hammock	Extirpated	0
Long Beach	Extirpated	0
<i>Big Torch Key</i>		
Big Torch Key, north end, Sect 2 roadside	Extant	300-400
Big Torch Key Parcels 884 and 885, Florida Keys Wildlife and Environmental Area	Extant	3
Boca Chica Key – U.S. Naval Air Station	Extant	10-20
Boca Grande Key – Key West National Wildlife Refuge	Extant	100-200
Boot Key	Extant	40-50
<i>Cudjoe Key</i>		
Cudjoe Key – North End of Cutthroat Drive	Extant	1
Cudjoe Key - Fire Lanes	Extirpated	0

<sup>2</sup> Results from Jennifer Possley of Fairchild Tropical Botanic Garden.

\* Previously undocumented population

Site Name	Results	Estimated Population Size
Fiesta Key (Greyhound Key)	Extirpated	N/A
Key Largo - Crocodile Lake National Wildlife Refuge	Extant	10-20
Key West – Edge of Airport	Extirpated	0
Little Duck Key	Extirpated	0
<i>Long Key</i>		
Beach Ridge	Extirpated	0
Long Key State Park Coastal Rock Barren	Extant	8
Layton Coastal Rock Barren	Historical	0
Lower Matecumbe Key - Klopp Tract, Lignumvitae Key Botanical State Park	Extant	10-20
<i>Marquesas Keys – Key West National Wildlife Refuge</i>		
Long Beach	Extant	300-400
Short Beach	Historical	0
Snook Beach	Extant	6,050
No Name Key	Extant	50-60
Ohio Key	Extant	20-30
Ramrod Key	Extant	100-200
Sugarloaf Key	Extirpated	0
Summerland Key	Extant	40-50
Upper Matecumbe Key	Extirpated	N/A
<i>Vaca Keys<sup>3</sup></i>		
Vaca Keys Bike Path	Extant	400-500
Valhalla Rock Barren - Crawl Key	Extant	4
Woman Key - Key West National Wildlife Refuge	Extant	400-500
<b>Monroe County Mainland</b>		
East Cape Sable	Historical	0
Middle Cape Sable	Extant	400-500
Northwest Cape Sable	Extant	1,000,000
<b>Collier County</b>		
Cape Romano Area	Extirpated	0

<sup>3</sup> The term “Vaca Keys” refers to Crawl Key, Fat Deer Key, Grassy Key and Long Point Key. These once separate islands are now joined by fill and Overseas Highway (US-1)

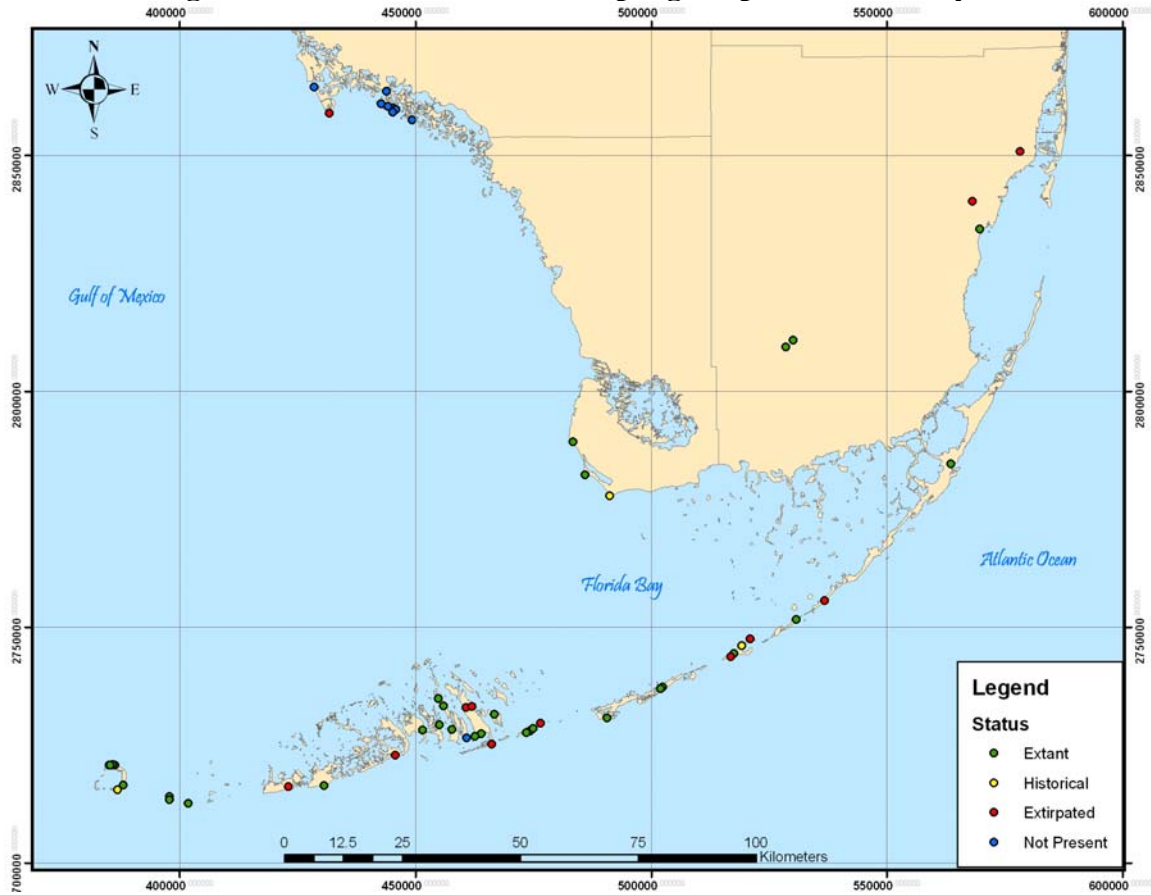
From June, 2006 to November, 2007, surveys were conducted at 40 stations where Garber's spurge is either known to be present or considered historical. Of these 40 stations, Garber's spurge was found to be present at 26 stations (see Table 1). The three sites where Garber's spurge was known to be extirpated were not surveyed. A total of seven new stations were surveyed in an attempt to locate undocumented populations of Garber's spurge. Garber's spurge was found only at one of these stations: along the shoulder of Big Pine Avenue, adjacent to Coupon Bight State Buffer Preserve (CBSBP). See Table 2 for a complete list of these stations.

**Table 2: New Stations Surveyed**

Site Name	Status	Estimated Population Size
<b>Collier County</b>		
<i>Rookery Bay National Estuarine Research Reserve</i>		
Dickman's Point	Not Present	0
<i>Ten Thousand Islands Nation Wildlife Refuge</i>		
Dismal Key	Not Present	0
Hog Key	Not Present	0
Panther Key	Not Present	0
Whitehorse Key	Not Present	0
<b>Monroe County Keys</b>		
<i>Big Pine Key</i>		
Coupon Bight State Buffer Preserve - Roadside	Extant	20-30
<i>Little Torch Key</i>		
Torchwood Preserve	Not Present	0

Population sizes of the 26 stations containing Garber's spurge varied from a single plant to 1,250,277 plants. To date, we estimate there to be roughly 1,910,417 plants extant at 25 stations. The mean population size is 76,417 individuals; however, this is not indicative of the typical population size. The median population size is 60-70 individuals, while the mode is 20-30 individuals. See Table 1 for a list of stations surveyed to date and population estimates. See Figure 5 for Locations of these populations. See Appendix A for detailed maps of these stations, and Appendix B for associated plant taxa recorded at these stations.

**Figure 5: Locations of Garber's Spurge Populations Surveyed**



Garber's spurge was found to be growing in six distinct habitats including beach dunes, coastal berm, coastal grassland, coastal rock barren, disturbed upland, and pine rockland. In addition, Garber's spurge was also observed growing along ecotones between coastal grassland and beach dune, coastal grassland and coastal berm, beach dunes and coastal berm, and pine rockland and rockland hammock. In coastal grassland and beach dune communities, Garber's spurge was observed growing in a crushed shell and sand substrate. In pine rockland and coastal rock barren communities, Garber's spurge was observed growing in soil pockets in exposed limestone. Garber's spurge was observed growing on top of hurricane storm-surge debris in coastal berm habitat and in disturbed upland habitat, Garber's spurge was observed growing out of crushed limestone soil.

Three main threats to Garber's spurge were observed during surveys. Most notably, exotic pest plants were found to be present at every station surveyed. Brazilian-pepper (*Schinus terebinthifolius*) and crows-foot grass (*Dactyloctenium aegyptium*) were especially abundant at many sites. Several populations of Garber's spurge including those on Big Torch Key, Boot Key, Cudjoe Key, adjacent to CBSBP on Big Pine Key, Ohio Key, Ramrod Key, Summerland Key, the Vaca Keys Bike Path, and Valhalla Rock Barren on Crawl Key, are not contained within a conservation area and may be particularly susceptible to habitat destruction either from development or accidental

destruction. Furthermore, with the exception of the populations on Long Pine Key in Everglades National Park, all of the populations are threatened by sea-level rise.

With the results of our surveys, we have created a personal geodatabase containing the geographic distributions of populations in addition to population estimates, associated plant taxa, phenology and threats to the populations.

### *Population Accounts*

#### Miami-Dade County

##### *Deering Estate at Cutler*

**Status:** Extant

**Historical Account:** Garber's spurge was first collected around the Cutler area in Miami-Dade County in 1949 by Roy O. Woodbury (Woodbury s.n, USF). There are no other reports for this occurrence until 1990 when Carol Lippincott vouchered a population of approximately 100 plants growing in pine rockland at the Deering Estate at Cutler (Lippincott 65055., FTG). Duvall and Bradley conducted a survey of this station in 1992 and found 250-500 plants (DERM 1993). Bradley also vouchered this population in 1992 (Bradley s.n., FTG).

**Survey Results:** This population is monitored irregularly by Jennifer Possley of Fairchild Topical Garden's Center for Tropical Plant Conservation. The most recent survey in June, 2007 yielded less than 40 plants (Jennifer Possley, personal communication, June 2007).

**Threats:** Possley notes that the plants are covered in pine duff and the population may be in decline due to fire suppression. Exotic plant invasions are also a threat to this station.

**Management Recommendations:** Burn pine rockland habitat at the Deering Estate at Cutler every three to seven years. Continue management of exotic pest plants at the Deering Estate at Cutler.

##### *Everglades National Park, Long Pine Key*

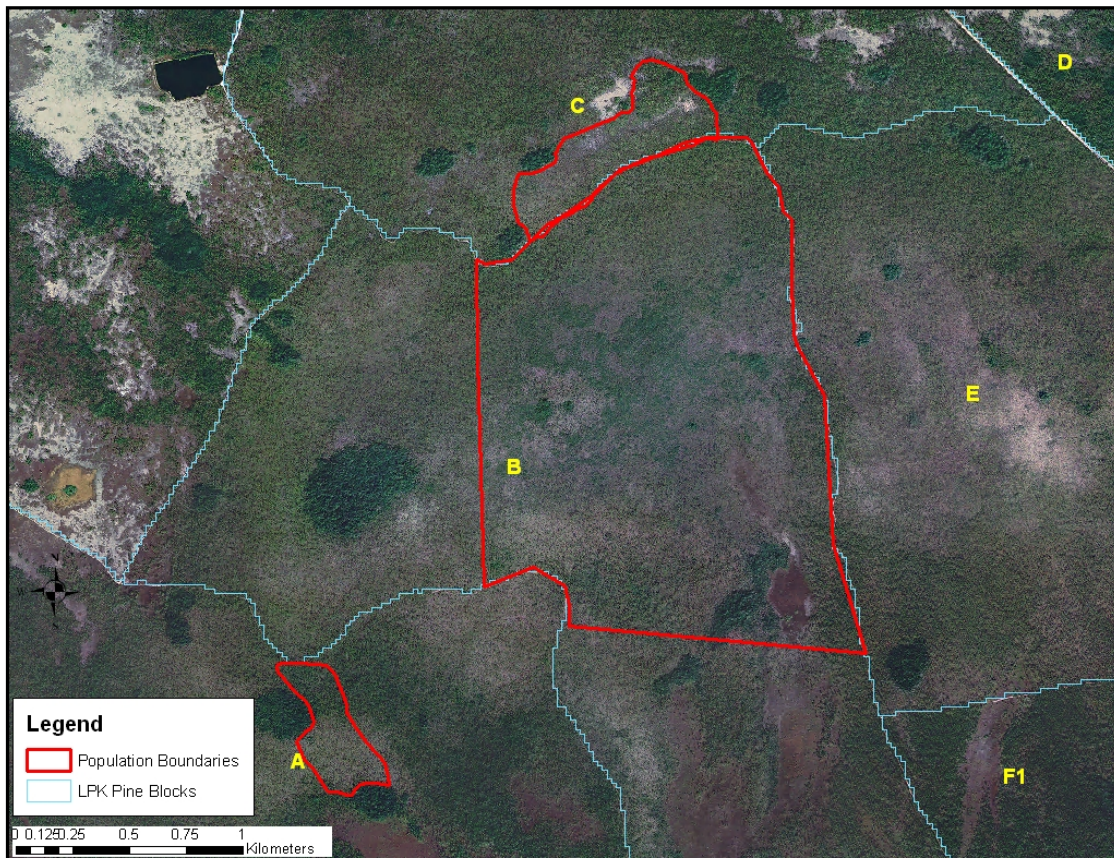
**Status:** Extant

**Historical Account:** Garber's spurge was first reported for the Long Pine Key Region of Everglades National Park in 1956 by Frank C. Craighead. Craighead collected a specimen simply labeled Long Pine Key (Craighead, s.n. ENP). In 1977 George N. Avery collected plants from south of Deer Hammock in Pine Block A (Avery, 1748 FTG). Austin and Nauman document this population in 1981 (Austin and Nauman, 1981). In 1978 Alan Herndon collected plants along an old logging road three and a half miles from gate 5 (Herndon, 61 FTG), placing this occurrence in between Pine Block B and

Pine Block C; roughly 4 km north of Deer Hammock. Duvall and Bradley surveyed this station in 1992 and found over 100 plants in a 50 by 100 m plot, east and southeast of Deer Hammock. In 2005, Everglades National Park biologist Hillary Cooley found Garber's spurge in Pine Block B and later in 2007, Pine Block C (Hillary Cooley, personal communication, June 2007). None of these observations suggested a very large population.

**Survey Results:** Garber's spurge is currently known from three stations on Long Pine Key, although the population is continuous from Pine Block B into the southern portion of Pine Block C. The population in Pine Block A is disjunct from the Pine Block B population by roughly 1000 m. See Figure 6 for locations of these three populations.

**Figure 6: Population Boundaries on Long Pine Key, Everglades National Park, Miami-Dade County**



During surveys conducted in June 2006, Garber's spurge within Pine Block A, in the vicinity of Deer Hammock, was found to be growing in soil pockets in crevices of oolitic limestone in pine rockland habitat and along the ecotone on the south side of Deer Hammock. We estimate 500 to 600 plants to be extant here. Individual plants varied in height, although large plants with woody stems were fairly abundant. Seedling recruitment was also observed, and the vast majority of adult plants did have fruit and flower.

The study area in Pine Block B (not including pine block C) on Long Pine Key, Everglades National Park covers approximately 400 ha and thus presented a challenge for field personnel conducting surveys. Modified belt transect data were used to estimate the population size of this station. Over 4,800 plants were counted along transects using the modified belt transect sampling methodology, and these data yielded a density of .29 plants per square meter. This gives an estimate of 1,250,277 plants present in Pine Block B and Pine Block C.

Most plants at the Pine Block B station are fairly large with woody stems and much branching, and are presumably the same age. Smaller plants and seedlings are also present, but are far less abundant. Nearly all of the plants observed were in fruit and flower.

Plants of Garber's spurge at the Pine Block B station were primarily growing in pine rockland habitat, riddled with solution holes. The composition of this pine rockland habitat varied from open with abundant grasses to dense with shrubs. Many portions of this habitat were relatively low and wet. These variances depended upon elevation, hydrology, and fire history.

Plants were primarily found growing out of soil pockets in cracks of oolitic limestone. Garber's spurge was also found growing in a marl prairie running through the south end of Pine Block B. Everglades National Park suffers from an altered hydrological scheme and most parts of the park are drier than they historically were (Light et al. 1997). Thus, it is likely that Garber's spurge may have colonized drier portions of this marl prairie after the hydrology was altered.

**Threats:** Due to their close proximity, the threats to these populations are the same. Both populations are susceptible to exotic pest plant invasions, especially Brazilian-pepper. These populations are located approximately five km northwest of the "Hole in the Donut" area of Everglades National Park; an old agricultural area with an extremely dense Brazilian-pepper infestation. This infestation is in the process of being removed. However, Everglades National Park fire crews burn pine blocks regularly, thus exotic pest plant invasions in pine rockland habitat are kept in check.

**Management Recommendations:** Continue current fire regime on Long Pine Key. Continue exotic plant removal in the "Hole in the Donut" area of Everglades National Park. Monitor populations of Garber's spurge every other year, or shortly after disturbance events such as fire or hurricanes.

### *Miami Area*

**Status:** Extirpated

**Historical Account:** Garber's spurge was first collected in the Miami Area by J. H. Simpson in 1892 (Simpson, J.H. 575, GH). Charles Pollard and G.N. Collins later

collected Garber's spurge in the Miami Area in 1898 (Charles L. Pollard and G.N. Collins 244, US) No further specific locality data was given on either of these specimens. John Kunkel Small collected Garber's spurge in the Miami Area in 1912 and most recently in 1913 (Small, J.K. 3865 and 4752, NY). Both of these specimens are from south of the Miami River, presumably near present day Downtown Miami. Small's collection in 1913 represents the last report of Garber's spurge at this locality.

**Survey Results:** The Miami Area is highly developed; the only remnant natural communities in the area are fragments of Brickell Hammock. However, no pine rockland communities exist at this location. It is likely that Garber's spurge is extirpated from the Miami Area.

### *South of Miami*

**Status:** Extirpated

**Historical Account:** Garber's spurge was first collected South of Miami in 1906 by John Kunkel Small and Joel J. Carter. In that year, Small and Carter collected Garber's spurge between Miami and Kendall Station, (Small, J.K and Carter 2508, NY) and between Homestead and Camp Jackson<sup>4</sup>, (Small, J.K. and J.J. Carter 2517, NY). Small later collected Garber's spurge in 1915, in the vicinity of Brogdon Hammock, near present day Warwick Hammock in the Pinecrest area. Garber's spurge was most recently collected South of Miami in 1949 by Roy O. Woodbury. Woodbury's specimen comes from the Perrine area (Woodbury s.n. USF).

**Survey Results:** Few pine rocklands remain in the South Miami region, and recent surveys of remaining pine rocklands in Miami Dade County (both public and private) by IRC show that they do not contain Garber's spurge (Gann et al 2007). It is likely that populations of Garber's spurge South of Miami have been destroyed by development.

### Monroe County Mainland

#### *East Cape Sable, Everglades National Park*

**Status:** Historical

**Historical Account:** There are three reports of Garber's spurge from East Cape Sable. Garber's spurge was first collected on East Cape Sable in 1916 by John Kunkel Small (Small 8031). The most recent report of Garber's spurge from East Cape Sable is from a collection made by George N. Avery. Avery collected Garber's spurge on East Cape Sable in 1967 (Avery s.n., FLAS). Avery's notes from 1967 indicate that this species was common in open areas along the beach dune (Avery 1983).

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<sup>4</sup> Some disambiguation about Small's collection locations; Kendall Station refers to an old Florida East Coast Railroad station in the vicinity of present day South Miami, and Camp Jackson was located just to the east of the main entrance to Everglades National Park (see Austin et al 1987).



**Survey Results:** During a reconnaissance trip to Cape Sable in September of 2006, Garber's spurge was not observed on East Cape Sable. Of all three Capes, East Cape Sable seemed to be the most severely impacted by recent hurricanes. Much of the vegetation on East Cape Sable was severely damaged, and very little suitable habitat was observed. Most notably, the beach dunes were essentially destroyed. Garber's spurge is likely extirpated from East Cape Sable, but may reappear.

**Management Recommendations:** Resurvey East Cape Sable for Garber's spurge. If no Garber's spurge is found, consider reintroducing plants from Middle Cape Sable or Northwest Cape Sable. Initiate an exotic plant control program on Cape Sable.

### *Middle Cape Sable, Everglades National Park*

**Status:** Extant

**Historical Account:** Garber's spurge was first collected on Middle Cape Sable in 1916 by John Kunkel Small (Small 7687, NY). Garber's spurge was collected by numerous botanists on Middle Cape Sable in the 1950's and 1960's, most recently by Olga Lakela and Robert W. Long in 1965 (Lakela and Long 28579, GH).

**Survey Results:** Garber's spurge was found on Middle Cape Sable growing in a thin ecotonal strip between coastal berm and beach dunes. We estimate there to be 400 to 500 plants here. Large clusters of plants were mapped. Plants on Middle Cape Sable appeared to be all the same age. This is presumably because of the disturbance caused by Hurricane Wilma's storm surge. For the most part, plants were medium-sized with little branching, and most had fruit and flower. Very little seedling recruitment was observed.

Additionally, ENP Botanist Jimi Sadle observed several hundred plants on Middle Cape Sable in December of 2007. Sadle observed these plants in the same area that we had mapped. However, he also reports Garber's spurge to be abundant in the coastal grassland inland from this location, where there were too many plants to count (Jimi Sadle, personal communication, 2007). This grassland was overlooked during our reconnaissance surveys in September of 2006, and it is likely that there are nearly as many plants here as there are on Northwest Cape Sable.

**Threats:** Threats to these plants appear to be severe stochastic events and long term sea-level rise. In addition, scattered exotic plant species were observed including Brazilian-pepper, crows-foot grass (*Dactyloctenium aegyptium*) and shrubverbena (*Lantana camara*).

**Management Recommendations:** Initiate an exotic plant management program on Cape Sable. Monitor populations of Garber's spurge every other year, or shortly after stochastic events such as fires and hurricanes. Survey coastal grassland on Middle Cape Sable and gather population data.

### *Northwest Cape Sable, Everglades National Park*

**Status:** Extant

**Historical Account:** There are two known reports of Garber’s spurge from Northwest Cape Sable. The earliest report of Garber’s spurge on Northwest Cape Sable is from a collection made by Derek Burch in 1964 (Burch 328, FLAS). Most recently, Avery collected Garber’s spurge on Northwest Cape Sable in 1978. Avery also notes Garber’s spurge growing at this location on the edge of a small hammock in calcareous sand (Avery 1983). Neither of these reports indicates a large population.

**Survey Results:** From February 6 through 8 2007, IRC staff conducted surveys for Garber’s spurge in appropriate habitat on Northwest Cape Sable. Northwest Cape Sable covers an approximate area of 104 ha. Garber’s spurge was found to be present in control plots at an average density of 12.01 plants per plot with a standard deviation of 20.03. This results in a density of 0.61 plants per square meter and a mean estimate of 636,366.81 Garber’s spurge present on Northwest Cape Sable. Calculating 95% confidence intervals gives an estimated range of this mean from a low of 343,983 plants to a high of 928,226.

Garber’s spurge was found in 30 of the 53 control plots (56.6%). Of the 30 control plots with Garber’s spurge, 21 (70.1%) contained Garber’s spurge at a density covering less than 1% of the plot. Seven (23.3%) of these 30 plots contained Garber’s spurge at densities covering 1% to 5% of the plot, and two (6.7%) of the plots had Garber’s spurge at densities that covered 6% to 25% of the plot.

A total of 54 plant species were recorded growing in association with Garber’s spurge in experimental plots. The most frequently recorded species in control plots was the exotic crow’s-foot grass (*Dactyloctenium aegyptium*), which was present in 43 (81.1%) of the control plots, most often covering 6% to 25% of the plot area. See Table 3 for the ten most frequently observed associate plant species. Of the 51 experimental plots, 49 (96%) were represented by coastal grassland habitat. Only two other distinct habitats were found to be associated with Garber’s spurge. These are coastal grassland ecotone with coastal hammock (2%), and coastal grassland ecotone with back dunes (2%). However, Garber’s spurge was also observed in control plots growing in disturbed coastal berm habitat and secondary back dunes. All 51 of the experimental plots contained a crushed shell and sand substrate. Twenty two (43.1%) of the 51 experimental plots had a level topography, while 17 (33.3%) of the plots were on top of a remnant dune ridge. Another 9 (17.7%) of the plots were on the slope of a remnant dune ridge, and only three (5.9%) of the plots were at the bottom of an inter-dune swale.

**Table 3: Top Ten Associated Plant Species for Garber’s Spurge on Northwest Cape Sable**

Scientific Name	Common Name	Number of Plots Observed	Frequency of Observation (n=51)
<i>Bidens alba</i> var. <i>radiata</i>	Spanish-needles	45	88.2%

Scientific Name	Common Name	Number of Plots Observed	Frequency of Observation (n=51)
<i>Eustachys petraea</i>	Common fingergrass	42	82.4%
<i>Fimbristylis spadicea</i>	Marsh fimbry	38	74.5%
<i>Dactyloctenium aegyptium</i> *	Crow's-foot grass	37	72.6%
<i>Spermacoce tetraquetra</i>	Pineland false buttonweed	31	60.8%
<i>Physalis walteri</i>	Walter's groundcherry	31	60.8%
<i>Crotalaria rotundifolia</i>	Rabbitbells	29	56.9%
<i>Croton glandulosus</i>	Vente conmigo	27	52.9%
<i>Melanthera nivea</i>	Snow squarestem	24	47.1%
<i>Alternanthera flavescens</i>	Yellow joyweed	24	47.1%

\* Exotic

**Threats:** Threats to these plants appear to be beach erosion caused by severe hurricanes and long term sea-level rise. In addition, scattered exotic plant species were observed including Brazilian-pepper, crows-foot grass, and shrubverbena

**Management Recommendations:** Initiate an exotic plant management program on Cape Sable. Monitor populations of Garber's spurge every other year, or shortly after stochastic events such as fires and hurricanes.

### Monroe County Keys

#### ***Bahia Honda Key***

**Status:** Extant

**Historical Account:** Garber's spurge was first collected on Bahia Honda Key in 1919 by John Kunkel Small and Matthaus Cuthbert (Small, J.K. and Cuthbert, Matthaus 9139, FLAS). George N. Avery's notes from 1965 report Garber's spurge on the edge of a hammock on the northwest quadrant of the island (Avery 1983). Bradley most recently collected Garber's spurge on Bahia Honda Key in 1995 (Bradley 221 FTG).

**Survey Results:** Surveys were conducted at this station in December of 2006. Bahia Honda State Park harbors a substantial population of Garber's spurge. Plants at this station are found primarily in clearings and disturbed sand substrate along a nature trail behind Sandspur Beach. This trail runs through a variety of habitats including beach dunes, coastal grassland and coastal berm. In addition, Garber's spurge was also found to be growing in disturbed soil along the park road to Sandspur Beach. We estimate there to be 700 to 800 plants extant at Bahia Honda State Park. Large clusters of plants were mapped with a Thales MobileMapper CE. Plants in this population varied in size and age, although most plants appeared to be medium sized individuals, presumably post

Hurricane Wilma recruits. Few very large plants were observed, and even fewer seedlings were observed. Almost all of the plants observed had both fruit and flower.

**Threats:** Threats to this population are limited, as this preserve is very well protected and well managed. Crows-foot grass was observed invading Garber's spurge habitat, although these infestations appeared to be minor and patchy. No other exotic pest plants were observed. Other threats include severe stochastic events and long term sea-level rise.

**Management Recommendations:** Monitor Garber's spurge populations at Bahia Honda State Park every other year or shortly after stochastic events such as hurricanes.

### ***Big Pine Key***

**Status:** Extant

**Historical Account:** The first record of Garber's spurge on Big Pine Key is a collection made by John Kunkel Small and Joel J. Carter in 1911 (Small and Carter 3568, NY). Small and DeWinkeler later collected Garber's spurge on Big Pine Key in 1921, (Small and DeWinkeler s.n., NY). Garber's spurge was collected several more times by numerous botanists on Big Pine Key during the mid to late 20<sup>th</sup> century, without locality data. The most recent collection of Garber's spurge on Big Pine Key is a collection made by Daniel F. Austin and George N. Avery in 1979 (Austin and Avery 6893, FAU). This collection is from a locality on a shell ridge along the north shore of Coupon Bight, presently within the National Key Deer Refuge.

There are several known reports of Garber's spurge with specific locality information. In 1964, Avery reported Garber's spurge for the Cactus Hammock and Long Beach areas on the southeast portion of the island. Also in 1964, Avery reported Garber's spurge growing along the roadside in the Koehns Avenue subdivision on the northeast part of the island (Avery 1983). Mike Ross of Florida International University, recently observed Garber's spurge growing along a hammock edge (probably Watson Hammock), adjacent to Pine Channel, on the west side of the island (Mike Ross, Personal Communication, 2006).

**Survey Results:** Surveys for Garber's spurge on Big Pine Key were conducted in Cactus Hammock, along Koehn's Avenue, Long Beach, and the north shore of Coupon Bight. In addition, we also surveyed trails through Coupon Bight State Buffer Preserve (CBSBP), and adjacent roadsides in an attempt to locate undocumented populations of Garber's spurge. Cactus Hammock and Long Beach were surveyed twice, first in September of 2006 and later in June of 2007. No plants were found during either of these surveys, despite the abundance of suitable habitat at both stations. Similarly, no plants were found at the Koehns Avenue station. The area northeast of Watson Hammock was not surveyed due to recent surveys of the area not yielding any Garber's spurge (Bradley 2006). Seven plants were found to be extant at the station located on the north shore of Coupon Bight. Most of these plants were seedlings. An additional 20-30 plants were found along Big Pine Avenue adjacent to CBSBP. These plants appeared to be mowed frequently.

On the north shore of Coupon Bight, one large individual, nearly prostrate with much branching, was found with fruit and flower, along with six smaller plants. This station was last observed in 1979 by Austin and Nauman who report roughly 100 plants (Austin and Nauman, 1981). Plants were found growing on a narrow sand and shell ridge, roughly 5 m from the high tide rack line, surrounded by mangroves and growing under light shade of seven-year-apple (*Genipa clusiifolia*).

**Threats:** Threats to the population on the north shore of Coupon Bight include invasion by Australian-pine (*Casuarina equisetifolia*), and sea-level rise. Threats to the Big Pine Avenue station include disturbance and extirpation from road maintenance and traffic. In addition, the genus *Chamaesyce*, including Garber's spurge, is known to be in the top one percent of the Key Deer (*Odocoileus virginianus clavium*) diet (Dooley 1975). The plants on the north shore of Coupon Bight appear to be frequently browsed by Key Deer which may also offer an explanation to the marked decrease in the population size, and the extirpation of other populations on Big Pine Key. (Barret and Stiling, 2006).

**Management Recommendations:** Monitor population every other year or shortly after stochastic events such as hurricanes. Inform Monroe County of the Big Pine Avenue population's existence. Protect plants from Key Deer browsing with fencing. Continue management of exotic plant species in the National Key Deer Refuge. Consider collecting and maintaining germplasm from plants on Big Pine Key.

### ***Big Torch Key***

**Status:** Extant

**Historical Account:** Garber's spurge was first documented without date for Big Torch Key (probably in 1979 based on collection numbers) by Clifford E. Nauman, Daniel F. Austin and Tatje (Nauman, Austin and Tatje 844, FTG). This specimen comes from a roadside on the northern part of the island. In 2001, Bradley reported Garber's spurge for the Florida Keys Wildlife and Environmental Area on Big Torch Key (Bradley et al. 2001).

**Survey Results:** Surveys for Garber's spurge on Big Torch Key were conducted along the road shoulders of Dorn Road, owned by the Florida Department of Transportation (FDOT), on the northern portion of Big Torch Key, and in the Florida Keys Wildlife and Environmental Area, Parcel numbers 884 and 885. The roadside station on the northern part of the island was found to contain 300 to 400 plants, growing in a crushed marl substrate along the road shoulders for roughly 1 km. Three plants were found to be extant within the Florida Keys Wildlife and Environmental area growing along the edge of a hammock, adjacent to the road shoulder.

**Threats:** Threats to these populations include potential habitat destruction from road maintenance activities, and sea-level rise.

**Management Recommendations:** Inform FDOT of population's location, so they can plan road maintenance accordingly. Monitor populations every other year or shortly after stochastic events such as hurricanes.

***Boca Chica Key, Key West Naval Air Station***

**Status:** Extant

**Historical Account:** The only report of Garber's spurge on Boca Chica Key is from a recent survey of the Key West Naval Air Station by Florida Natural Areas Inventory (Henize and Hipes 2005). This report provides specific location data for Garber's spurge on Boca Chica Key.

**Survey Results:** Surveys were conducted at this station in June of 2007. Garber's spurge on Boca Chica Key was found to be growing in a low coastal rock barren surrounded by salt marsh. Ten to 20 plants were observed at this station, the majority of which had fruit and flower.

**Threats:** Threats to this population include exotic plant invasions, especially latherleaf (*Colubrina asiatica*), habitat disturbance from recreational use, and sea-level rise.

**Management Recommendations:** Monitor population every other year or shortly after stochastic events such as hurricanes. Consider securing rock barren area of Boca Chica Key to prevent disturbance from recreational use. Initiate exotic plant management program at the U.S. Naval Air Station on Boca Chica Key.

***Boca Grande Key, Key West National Wildlife Refuge***

**Status:** Extant

**Historical Account:** The first known report of Garber's spurge for Boca Grande Key is a collection made by Lansing in 1904 (Lansing 2271, NY). In 1907, Charles Millspaugh also reported Garber's spurge for Boca Grande Key (Millspaugh 1907). The only other report of Garber's spurge on Boca Grande Key is a collection made by George Gann and Keith Bradley in 1996 (Gann and Bradley 410, FTG), who reported Garber's spurge to be rare on the beach dunes.

**Survey Results:** Two small, disjunct patches of Garber's spurge were located on Boca Grande Key during our surveys. We counted 100-200 plants growing along the ecotone of dunes and coastal berm on the northwest side of the island. These plants were medium to large and were in fruit and flower. An additional 40 to 50 plants were counted growing on severely eroded fore dunes on the southwest side of the island. Mortality from saltwater exposure was observed at this location. These plants were small to medium and nearly prostrate. Most of these plants were sterile. In total, we estimate there to be 200 to 300 plants on Boca Grande Key.

**Threats:** Threats to this population include habitat disturbance from human recreational use, beach erosion, and sea-level rise.

**Management Recommendations:** Monitor population every other year or shortly after stochastic events such as hurricanes. Continue exotic plant management program within Key West National Wildlife Refuge. Enforce beach closures within Key West National Wildlife Refuge, especially during high use periods.

### *Boot Key*

**Status:** Extant

**Historical Account:** The only report of Garber's spurge on Boot Key is a by George N. Avery in 1963. Avery gives little information, stating only that the plants were in fruit and flower (Avery 1983).

**Survey Results:** Much of Boot Key is privately owned, and we could not obtain permission to survey most of the island. However, Garber's spurge was found to be growing on FDOT right-of way along old State Road 931 on the southeast portion of the island. Forty to 50 plants were observed growing in crushed marl substrate. Plants at this station were all mature, and exceptionally large, some just less than 1 m high. All of the plants observed at this station were in fruit and flower.

**Threats:** Threats to this population include exotic pest plant invasions, especially Brazilian-pepper and Australian-pine, sea-level rise, and potential habitat loss to development.

**Management Recommendations:** Complete acquisition of Boot Key<sup>5</sup>. Monitor population every other year or shortly after stochastic events such as hurricanes.

### *Cudjoe Key*

**Status:** Extant

**Historical Account:** Garber's spurge was first collected on Cudjoe Key in 1964 by Derek Burch (Burch 555, FLAS). Another collection by Burch made on Ramrod Key may also be attributable to Cudjoe Key. This specimen states Garber's spurge was growing in cracks of oolitic limestone in fire lane through pine woods (Burch 553A, GH). Pine rockland habitat is not known to occur on Ramrod Key, while Cudjoe Key has both pine rockland habitat and fire lanes (Roca 1997). The most recent report of Garber's spurge on Cudjoe Key is by Tina Henize. Henize reports plants on the southeast part of the island, at the north end of Cutthroat Drive (Tina Henize, Personal Communication, 2006).

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<sup>5</sup> Boot Key is included in Florida's land acquisition program (Florida Forever) as part of the Florida Keys Ecosystem Project (FDEP 2007).

**Survey Results:** Surveys on Cudjoe Key were conducted along the fire breaks through the pine rockland, and along Cutthroat Drive. One plant was found to be extant at the north end of Cutthroat Drive. This habitat was presumably once pine rockland, however, due to development and fire suppression, it is now a mixed hardwood forest and disturbed upland. This plant was found growing in crushed limestone substrate on the west shoulder of the road. The plant was not fertile at the time of the observation. No plants were found during surveys of the fire lanes on Cudjoe Key.

**Threats:** Primary threats to this population include human disturbance such as, illegal dumping and automobile activity, encroachment of hardwood species, turf grasses and Brazilian-pepper into the habitat, and long term sea-level rise.

**Management Recommendations:** Monitor population every other year or shortly after stochastic events such as hurricanes. Inform Monroe County of this population's location so they can plan road and infrastructure maintenance accordingly. Keep habitat free of turf grasses, hardwood species and exotic plant species. Consider augmenting this population with germplasm from Ramrod Key or Summerland Key.

### ***Fiesta Key***

**Status:** Extirpated

**Historical Account:** The only report of Garber's spurge on Fiesta Key is a collection made by Derek Burch in 1964 (Burch 562, FTG). This specimen has detailed location information, and reports that the plants occur frequently on the gulf side of the island.

**Survey Results:** Fiesta Key is now occupied by a KOA campground and is devoid of natural habitat; aerial photography shows that it is completely developed and bare of vegetation aside from a few patches of mangroves. Thus, this island was not surveyed.

### ***Key Largo, Crocodile Lake National Wildlife Refuge***

**Status:** Extant

**Historical Account:** Garber's spurge was first observed at Crocodile Lake National Wildlife Refuge on Key Largo by Keith Bradley in 1999 (Gann et al. 2007). This is the only known occurrence of Garber's spurge on Key Largo.

**Survey Results:** Surveys at this station were conducted in December 2006. Garber's spurge at Crocodile Lake National Wildlife Refuge was found to be growing along an open disturbed area with a crushed limestone substrate, between a boat basin and a rockland hammock on the southern portion of the preserve. Plants varied in size and phenological state, but most were large to medium plants with woody stems. Most of the plants in this population had both fruit and flower. No recruitment was observed. We estimate there to be 11 to 20 plants in this population. The preserve manager, Steve Klett,



was present at the time of the surveys. The plants were shown to him and the threats were noted.

**Threats:** Primary threats to this population are an infestation of rose natalgrass (*Rhynchelytrum repens*), and encroachment of hardwood species into the Garber's spurge habitat. Sea-level rise may also impact this population in the future.

**Management Recommendations:** Remove rose natalgrass infestation from area surrounding the Garber's spurge population. Maintain a light gap in the canopy so plants can persist. Monitor population every other year or shortly after stochastic events such as hurricanes.

### *Key West Airport*

**Status:** Extirpated

**Historical Accounts:** The only report of Garber's spurge from Key West is by George N. Avery in 1965. Avery's notes report that he had collected plants along the northern edge of the Key West Airport, and showed the plant specimens to Derek Burch (Avery 1983).

**Survey Results:** Surveys for Garber's spurge were conducted at several City of Key West owned parcels on the northern edge of the airport, including Little Hamaca Park in August 2007. We also obtained access to the Key West Airport and conducted surveys in suitable upland habitat along the northern edge of the property. No plants were found during our surveys, although there is suitable habitat for Garber's spurge at all of the parcels surveyed. It is possible that the population of Garber's spurge along the northern edge of the airport was destroyed during an expansion of the property.

### *Little Duck Key*

**Status:** Extirpated

**Historical Account:** The only report of Garber's spurge on Little Duck Key is a collection made by C.P. Sreemadhavan in 1971 (Sreemadhavan 5142, USF). No specific locality information was given on the specimen label.

**Survey Results:** Searches in September of 2006 were conducted in the vicinity of Veterans Memorial Park, and no plants were located. In June of 2007, both shoulders of Overseas Highway were searched, as well as a narrow coastal berm on the northwest portion of the island. No plants were found, and it is likely that Garber's spurge is now extirpated here.

### *Little Torch Key*

**Status:** Extirpated

**Historical Account:** There are no reports of Garber's spurge from Little Torch Key. However, this island represents a gap between populations on Big Pine Key and Big Torch Key.

**Survey Results:** Surveys were conducted in December of 2007 at The Nature Conservancy's Torchwood Preserve. Neither Garber's spurge nor suitable habitat was found at this site.

### *Long Key*

**Status:** Extant

**Historical Account:** Garber's spurge was first collected on Long Key by John Kunkel Small in 1903 (Small and Wilson 1975, NY). Garber's spurge was subsequently collected on Long Key by F. W. Hunewell in 1921 (Hunewell 7316, GH) and in 1949 by Roy O. Woodbury (Woodbury s.n., FTG). George N. Avery's notes from 1965 report Garber's spurge for an ocean-side beach ridge under Australian-pine (*Casuarina equisetifolia*) and along the shoulders of US-1 (Avery 1983). In 1986, Alan Herndon collected Garber's spurge on the bay side of Long Key in an open grassy field (Herndon 1405, FTG) in Long Key State Park. Garber's spurge was collected in a coastal rock barren on the bay side of Long Key, in Long Key State Park, in 1991 by Carol Lippincott (Lippincott s.n., FTG). Bradley also vouchered this station in 1995 (Bradley 256, FTG). In 1998, Keith Bradley collected plants at the Layton Coastal Rock Barren, just to the east of Long Key State Park.

**Survey Results:** Surveys for Garber's spurge on Long Key were conducted at the Layton Coastal Rock Barren, the Long Key State Park Coastal Rock Barren, and along the beach ridge on the ocean side of Long Key State Park. Both the Layton Coastal Rock Barren and coastal rock barren at Long Key State Park were surveyed in June of 2006. These habitats were found to be severely damaged by Hurricane Wilma in 2005, and no plants were found. In surveys conducted in June of 2007, no plants were found to be extant at the Layton Coastal Rock Barren, nor along the beach ridge at Long Key State Park. However, eight plants were found to be extant at the coastal rock barren at Long Key State Park. Plants at this station were found to be growing out of soil pockets in exposed limestone, under light shade of buttonwood (*Conocarpus erectus*). Three of the plants at this station were medium sized individuals with fruit and flower, and the other five plants were small seedlings.

**Threats:** Threats to this population include severe stochastic events and sea-level rise.

**Management Recommendations:** Monitor population every other year or shortly after stochastic events such as hurricanes. Consider collecting and maintaining germplasm from this population. Consider re-introduction to the beach ridge at Long Key State Park. It is likely that plants may re-appear at the Layton Coastal Rock Barren, and this location should be monitored annually.

### *Lower Matecumbe Key*

**Status:** Extant

**Historical Account:** Garber's spurge was first observed on Lower Matecumbe Key in 2000 by George Gann and Janice Dusquenel (Gann et al. 2007). Plants were discovered on the Klopp Tract; part of Lignumvitae Key Botanical State Park. This is the only report of Garber's spurge on Lower Matecumbe Key.

Plants at the Klopp Tract on Lower Matecumbe Key were found to be growing in a disturbed area along a bike path and in soil pockets in remnant coastal rock barren fragments. Plants were medium to large, some with woody stems and all plants had fruit and flower. Ten to 20 plants are estimated to be extant at this station. No seedling recruitment was observed.

Another coastal rock barren fragment, owned by FDOT, located across Overseas Highway (US-1) from the Klopp Tract was also surveyed. This habitat was fairly disturbed and extremely dry. No plants were found to be extant here.

**Threats:** Threats to this population include exotic pest plant invasions by Brazilian-pepper, lead tree (*Leucaena leucocephala*) and crow's-foot grass. In addition, hardwood species are encroaching into the Garber's spurge habitat. Additional threats to this population include accidental destruction by road maintenance. This population may also be affected in the future by sea-level rise.

**Management Recommendations:** Monitor population every other year or shortly after stochastic events such as hurricanes. Inform FDOT of the population's location so road maintenance can be conducted accordingly. Initiate an exotic plant management program along FDOT right-of-way. Prune hardwood species annually to maintain sunlight in Garber's spurge habitat.

### *Lower Sugarloaf Key*

**Status:** Extirpated

**Historical Account:** The only report of Garber's spurge on Lower Sugarloaf Key is from George N. Avery in 1967. Avery reports plants "in open areas on sendero (trail), near T of road" (Avery, 1983). This station is presumably located near the intersection of Sugarloaf Boulevard and old state road 4A.

**Survey Results:** This general location on Lower Sugarloaf Key was surveyed in June of 2007. During our surveys, only one trail like that described by Avery was located. This trail led to a low elevation salt marsh, and no plants were seen. Surveys of the adjacent Florida Fish and Wildlife Conservation Commission Lower Sugarloaf Hammocks properties were conducted in 2000 by IRC (see Bradley et al. 2000) and also yielded no Garber's spurge. Since this species was only known from trails through hammocks on

Sugarloaf Key, it is possible that Garber's spurge was never well established at this location and may be extirpated on Lower Sugarloaf Key.

***Marquesas Keys, KWNWR***

**Status:** Extant

**Historical Account:** George Gann and Keith Bradley first reported Garber's spurge for the Marquesas Keys in 1996. Gann and Bradley vouchered plants at three distinct locations on the Marquesas Keys; Long Beach, Short Beach and Snook Beach (Gann and Bradley 472, 519 and 439, FTG respectively, and Gann et al. 2007). These were the only known reports of Garber's spurge on the Marquesas Keys.

**Survey Results:** Surveys for Garber's spurge were conducted at all three of the beaches on the Marquesas Keys mentioned above. All three locations appeared to have suffered immense damage from recent Hurricanes in 2004 and 2005, especially to beach dune habitat (See Figure 7). On Short Beach no plants were found, and this location appeared to have taken the brunt of the damage from storm surge. In addition, Gann and Bradley's specimen for this location reports only one small colony. Garber's spurge may be extirpated at this location.

**Figure 7: Eroded Beach Dunes on the Marquesas Keys, KWNWR**



On Long Beach, three widely scattered colonies of Garber’s spurge were located along the entire three km length of the transition zone between beach dunes and coastal berm. Only two of the 33 plots sampled contained Garber’s spurge. The average density of Garber’s spurge in sampling plots was .02 plants per square m. This results in a mean estimate of 55.6 Garber’s spurge present on Long Beach. Calculating 95% confidence intervals gives an estimated range of this mean from a low of 0 plants to a high of 157 plants.

Garber’s spurge was found to be abundant on Snook Beach growing on beach dunes that covered roughly 1 ha. Of the 50 randomly generated sampling plots, 22 (44.0%) were found to contain Garber’s spurge. For more suitable confidence intervals for the mean population size, an outlier containing 375 plants was dropped from the data set. Garber’s spurge was found to be present in the remaining 21 plots at an average density of 12.16 plants per plot with a standard deviation of 24.31. This results in a density of 0.62 plants per square meter and a mean estimate of 6,052.16 Garber’s spurge present on Snook Beach. Calculating 95% confidence intervals gives an estimated range of this mean from a low of 2,576 plants to a high of 9,523.

The most frequently recorded plant species growing in association with Garber’s spurge on Snook Beach was beach ragweed (*Ambrosia hispida*). This species was recorded growing in 20 (90.9%) of the 22 plots that also contained Garber’s spurge. See Table 4 for additional associated species.

**Table 4: Top Ten Associated Plant Species for Garber’s Spurge on Snook Beach, Key West National Wildlife Refuge**

Scientific Name	Common Name	Number of Plots Observed	Frequency of Observation (n=22)
<i>Ambrosia hispida</i>	Beach ragweed, Coastal ragweed	20	90.9%
<i>Erithalis fruticosa</i>	Blacktorch	16	72.7%
<i>Paspalum vaginatum</i>	Seashore paspalum	16	72.7%
<i>Lantana involucrata</i>	Wild-sage, Buttonsage	14	63.6%
<i>Spartina patens</i>	Marshhay cordgrass, Saltmeadow cordgrass	14	63.6%
<i>Cyperus planifolius</i>	Flatleaf flatsedge	13	59.1%
<i>Waltheria indica</i>	Sleepy morning	11	50.0%
<i>Canavalia rosea</i>	Beach-bean, Baybean, Seaside jackbean	11	50.0%
<i>Uniola paniculata</i>	Sea-oats	10	45.5%
<i>Chamaesyce mesembrianthemifolia</i>	Seaside spurge, Coastal beach sandmat	10	45.5%
<i>Eustachys petraea</i>	Common fingergrass, Pinewoods fingergrass	10	45.5%

**Threats:** Threats to the populations on the Marquesas Keys include severe stochastic events, sea-level rise, and disturbance from recreational use.

**Management Recommendations:** Monitor population every other year or shortly after stochastic events such as hurricanes. Continue exotic plant management program within Key West National Wildlife Refuge. Enforce beach closures within Key West National Wildlife Refuge, especially during high use periods.

### *No Name Key*

**Status:** Extant

**Historical Account:** Garber's spurge was first collected on No Name Key by A.H. Curtiss in 1893 (Curtiss 5511, GH). Curtiss's specimen simply states "Door Yard". There are no other reports of Garber's spurge on No Name Key until 1952, when Dickson collected it there (Dickson s.n., FTG). The last known report of Garber's spurge on No Name Key is by Avery in 1979. Avery reports Garber's spurge growing along a roadside on the west shore of the island near an old home site (Avery 1983).

**Survey Results:** Surveys on No Name Key were conducted along old State Road 4A, in addition to old roads, trails, and fire breaks running through the island. If suitable upland habitat was observed along these roads and trails, that habitat was also surveyed. The areas surrounding two abandoned home sites on the west shore of the island were also thoroughly surveyed. Garber's spurge was found along the north and south shoulders of old State Road 4a, adjacent to the National Key Deer Refuge. This population is next to pine rockland habitat. We estimate that there are 50 to 60 plants extant at this station. No other colonies of Garber's spurge were located during our surveys of No Name Key.

**Threats:** Threats to this population include disturbance from automobiles and road maintenance activities, browsing by Key Deer, and sea-level rise.

**Management Recommendations:** Monitor population every other year or shortly after stochastic events such as hurricanes. Protect plants from Key Deer browsing with an exclosure. Continue management of exotic plant species within in the National Key Deer Refuge. Inform Monroe County of population's location, so they can plan road maintenance accordingly.

### *Ohio Key*

**Status:** Extant

**Historical Account:** There are two reports of Garber's spurge from Ohio Key, both by George N. Avery. Avery first reported Garber's spurge on Ohio Key in 1963. He notes that plants are present along the roadside on the southwest quadrant of the island, as well as on sand behind mangroves (Avery 1983). The latter location is probably within present-day Great White Heron National Wildlife Refuge. In 1964, Avery refers to a plant that Derek Burch had collected on the southwest quadrant of the island (Avery 1983). No other specific locality data was given for this report.

**Survey Results:** Surveys of this station were conducted in June of 2007. During these surveys, 20 to 30 plants were observed growing on the south road shoulder, just east of the Ohio-Bahia Honda Channel on FDOT Right-of-Way. In addition, a narrow belt of sand was surveyed behind mangroves on the southwest quadrant of the island. However, this habitat appeared to be too low in elevation to support Garber's spurge, and no plants were found there.

**Threats:** Threats to this population include potential habitat destruction by road maintenance activities and sea-level rise.

**Management Recommendations:** Monitor population every other year or shortly after stochastic events such as hurricanes. Inform FDOT of population's location, so they can plan road maintenance accordingly.

### *Ramrod Key*

**Status:** Extant

**Historical Account:** Garber's spurge was first reported on Ramrod Key by George N. Avery in 1963 (Avery 1983). Avery also reported Garber's spurge for Ramrod Key in 1964 (Avery 1983). Derek Burch collected plants on Ramrod Key in 1964 (Burch 553, FLAS). Burch reports Garber's spurge as frequent in cracks of oolitic limestone in a fire lane through pine woods. However, pine rocklands are not known to occur on Ramrod Key (Roca 1997). Thus, this specimen may be attributable to nearby Cudjoe Key, and was mislabeled. Avery again reported Garber's spurge for Ramrod Key in 1979, on the west shore of the island (Avery 1983). In May of 2007, Steve Woodmansee collected plants just off of Bay Shore Drive (Woodmansee 1984, FTG).

**Survey Results:** Surveys for Garber's spurge on Ramrod Key were conducted in June of 2007, and were concentrated on the northwest portion of the island. We were able to locate a population of 100 to 200 plants growing along both shoulders of Bay Shore Drive, as well as gravel roads east of Bay Shore Drive. The majority of plants were medium sized, and had fruit and flower.

**Threats:** Threats to this population include turf grasses invading suitable habitat, habitat destruction due to road maintenance, and sea-level rise.

**Management Recommendations:** Monitor population every other year or shortly after stochastic events such as hurricanes. Inform Monroe County of population's location, so they can plan road maintenance accordingly.

### *Summerland Key*

**Status:** Extant

**Historical Account:** Garber's spurge was first collected on Summerland Key by John Kunkel Small and Joel J. Carter in 1911 (Small 3591, NY). No further locality data was given. FNAI provided specific element occurrence data for Garber's spurge on Summerland Key (FNAI, Undated). This data shows Garber's spurge to be present on the northeast quadrant of the island along Niles Road. Woodmansee most recently collected Garber's spurge on Summerland Key in April of 2007 (Woodmansee 1980, FTG). This is the same population referenced by the FNAI data.

**Survey Results:** Surveys of this station were conducted in June of 2007 along Niles road on the east side of the island. During these surveys, Garber's spurge was found to be growing on both shoulders of Niles Road on the east side of the island. We observed 70 to 80 plants growing in a crushed limestone substrate along the edge of a buttonwood forest.

**Threats:** Threats to this population include habitat destruction due to road maintenance and sea-level rise.

**Management Recommendations:** Monitor population every other year or shortly after stochastic events such as hurricanes. Inform Monroe County of population's location, so they can plan road maintenance accordingly.

### *Upper Matecumbe Key*

**Status:** Extirpated

**Historical Account:** The only report of Garber's spurge on Upper Matecumbe Key is a collection made by John Kunkel Small in 1912 (Small 3900, NY). No further specific locality data is included on this specimen.

**Survey Results:** Present day Upper Matecumbe Key is highly urbanized with few remaining natural communities. The largest remaining natural area left on Upper Matecumbe Key is Teatable Hammock which was recently acquired by the State of Florida through its Florida Forever Program. This site is currently managed by the Florida Department of Environmental Protection as part of Lignumvitae Key Botanical State Park. Recent surveys of this site by IRC (see Bradley and Gann 2004) did not yield any Garber's spurge. Furthermore, there does not appear to be much suitable habitat for Garber's spurge at this site. It is likely that Garber's spurge is extirpated on Upper Matecumbe Key.

### *Vaca Keys*<sup>6</sup>

**Status:** Extant

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<sup>6</sup> Vaca Keys refers to four, once separate islands. These islands are Crawl Key, Fat Deer Key, Grassy Key, and Long Point Key. These keys were once separated by narrow channels, but are now joined by fill.



**Historical Account:** Garber's spurge was first collected in the Vaca Keys area in 1909 by John Kunkel Small and Joel J. Carter (Small 3145, NY). Small and Carter also collected Garber's spurge on Grassy Key that same year. George N. Avery reports Garber's spurge in the Valhalla Coastal Rock Barren on Crawl Key in 1966 (Avery 1983). A 1999 report issued by FDOT thoroughly documents a population of Garber's spurge along an existing gravel road stretching approximately three and a half miles across all four Vaca Keys (Anonymous 1999). Soon after that report was issued, a paved bike path was constructed along this corridor, and subsequent post construction monitoring reports were issued by FDOT (Anonymous 2003 and 2005).

**Survey Results:** Surveys for Garber's spurge were conducted in the Valhalla Coastal Rock Barren, and along the bike path corridor in June of 2007. The bike path corridor was surveyed using information referenced in reports issued by FDOT in 1999 and 2003 (Anonymous 1999, 2003). Three and a half miles of the bike path on Grassy Key were walked and Garber's spurge was counted on both sides of the bike path. We estimate there to be 400 to 500 plants extant along the bike bath shoulders growing in crushed limestone soil. It is notable that the FDOT reports indicated over 1,000 plants in 1999, twice as many as our estimate, and a slight decrease in the number of patches of Garber's spurge in 2003. The plants varied in size and age, ranging from seedlings to medium sized plants. However, no exceptionally large plants were seen. Most individual plants had fruit and flower.

Four large plants of Garber's spurge were found to be extant at the Valhalla Coastal Rock Barren, along with other associated coastal rock barren taxa. All of these plants were mapped with a hand held GPS unit. Plants at this station are extremely large, measuring up to 60 cm, and have woody stems. All of these plants were fertile at the time of the survey. Plants at this station were evidently burned by saltwater inundation during Hurricane Wilma, but appeared to be responding by re-sprouting from various nodes along the primary stem. The plants were observed growing in soil accumulations on top of limestone rock.

**Threats:** Threats to the bike path population include habitat encroachment by hardwood species and the exotic crows-foot grass, mismanagement or under management of bike path shoulders, and long term sea-level rise. A lack of mowing and not trimming back hardwood species may be leading to habitat loss at this station. Threats to the plants at the Valhalla Coastal Rock Barren include invasion by exotic plant species such as Brazilian-pepper, crows-foot grass, and lead tree (*Leucaena leucocephala*), habitat loss and destruction, stochastic events and long term sea-level rise.

**Management Recommendations:** Monitor populations every other year or shortly after stochastic events such as hurricanes. Acquire Valhalla Coastal Rock Barren. Initiate an exotic plant management program along FDOT right-of-way. Keep shoulders of the Vaca Keys Bike Path free of hardwood species and turf grasses.

## ***Woman Key, Key West National Wildlife Refuge***

**Status:** Extant

**Historical Account:** The only report of Garber's spurge on Woman Key is in *The Flora of the Sand Keys*, a paper by Charles Fredrick Millspaugh from 1907 (Millspaugh 1907). Millspaugh provides detailed vegetation maps of various islands from west of Key West to the Dry Tortugas, including Garber's spurge colonies on Woman Key.

**Survey Results:** Surveys of this station were conducted in July of 2007. During these surveys, Garber's spurge was found to be growing in open areas of beach dunes, in a crushed sand and shell substrate, on the south side of the island. We estimate there to be 400 to 500 plants present on the island.

**Threats:** Threats to this population include habitat disturbance from illegal recreational use, and sea-level rise.

**Management Recommendations:** Monitor population every other year or shortly after stochastic events such as hurricanes. Continue exotic plant management program within Key West National Wildlife Refuge. Enforce beach closures within Key West National Wildlife Refuge, especially during high use periods.

## Collier County

### ***Cape Romano Area***

**Status:** Extirpated

**Historical Account:** A review of herbarium specimens at the Fairchild Tropical Garden Herbarium yielded a specimen from Cape Romano in Collier County from 1967, collected by Olga Lakela, labeled with the synonym *Chamaesyce porteriana* var. *keyensis*.

**Survey Results:** Aerial images of Cape Romano showed what appeared to be coastal grassland and a dune-swale system similar to that of Northwest Cape Sable. This station was surveyed by IRC Senior Biologist Mike Barry in April of 2007. Neither plants nor suitable habitat were found to be present. The portion of Cape Romano Surveyed consisted mostly of remnant, low-lying dunes with *Batis maritima*, *Sesuvium portulacastrum*, dead *Conocarpus erectus* and mangrove shrubs.

In October of 2007, Cape Romano and nearby islands within the Ten Thousand Islands National Wildlife Refuge (TTINWR) were surveyed in an attempt to locate plants in Collier County. An extensive coastal grassland system was located on the southeastern portion of Cape Romano, along with several species associated with Garber's spurge. However, no plants were found on Cape Romano.

Several islands within the TTINWR that appeared to have suitable habitat for Garber's spurge on aerial photographs were also surveyed. These islands were Dismal Key, Hog Key, Panther Key, and Whitehorse Key. We were able to locate potential habitat for Garber's spurge such as small patches of coastal grassland, beach dunes and disturbed upland. However, no plants were found within the TTINWR.

## Discussion

Surveys were conducted at 39 stations where Garber's spurge is either known to be present or considered historical. Of these 39 stations, Garber's spurge was found to be present at 23 stations (see Table 1). A total of seven new stations were surveyed in an attempt to locate undocumented populations of Garber's spurge. Garber's spurge was only found at one of these stations: along the shoulder of Big Pine Avenue, adjacent to CBSBP. See Table 2 for a complete list of these stations. In all, 46 distinct locations were surveyed, and Garber's spurge was found on 24 of these sites.

The size of a preserve may play an important factor in the conservation of this species. The widely varying sizes of these populations are relative to the amount of available habitat at each site, and the distance from human population centers. The largest populations of Garber's spurge (Northwest Cape Sable, Middle Cape Sable, Long Pine Key, and Snook Beach) are all in remote areas on large, federally managed conservation lands; ENP and KWNWR. These conservation lands contain extensive amounts of contiguous beach dunes, coastal grassland and pine rockland habitat. These habitats are dependent upon stochastic events such as wildfires and storm surge from hurricanes, and are hence dynamic. The ruderal nature of this species allows it to exploit and colonize habitat turned over by disturbance. The fact that these habitats within ENP and KWNWR remain un-fragmented makes natural stochastic events even more likely to affect populations of Garber's spurge, in addition to giving the plants more opportunity to respond to these environmental changes.

Although the NKDR on Big Pine Key, Cudjoe Key and No Name Key, contains relatively un-fragmented expanses of pine rockland, there are no large populations of Garber's spurge within these habitats on these islands. This is likely due to the marked increase in the Key Deer populations on these islands over the past 50 years. Garber's spurge is a known food of the Key Deer, and *Chamaesyce* as a genus is in the top one percent of their diet (Dooley 1975). The increase in the Key Deer population may offer an explanation to the marked decrease in the Garber's spurge population along the North Shore of Coupon Bight, and the extirpation of other populations on Big Pine Key. (Barret and Stiling 2006).

Ten of the 24 stations where Garber's spurge was found were road rights-of-way owned by FDOT or Monroe County. The largest of these populations occurred on the Vaca Keys bike path, which stretches over three miles, across four islands. This is significant because, much like the aforementioned habitats, these roadsides also represent a dynamic environment. The difference is that these roadsides provide relatively small, fragmented

pieces of habitat, exposed to more frequent, but less intense disturbances such as mowing.

These roadsides play an important role in the conservation of Garber's spurge, in the sense that they are providing an opportunity for the species to persist. However, many of these roadside populations were either undocumented, or had no prior population estimate so it is hard to infer whether or not Garber's spurge is doing more than merely persisting. In the one instance that we do have data on abundance estimates, results show that the population is in decline. Previous surveys by FDOT (Anonymous 1999, 2003 and 2005), suggest that Garber's spurge is persisting along the bike path corridor, after the initial destruction of several hundred plants in 1999. Although the difference between survey methods do not allow for direct comparison of results, our data show that Garber's spurge is now less abundant than it was during the final post-construction monitoring in 2005. Roadside habitats likely require an intensive amount of strategic human manipulation for Garber's spurge populations to thrive.

Coastal rock barrens also play an important role in the conservation of Garber's spurge. The ecology of these habitats is poorly understood, but we do know that they occur infrequently throughout the Florida Keys, and provide important habitat for many rare plants including Garber's spurge. Despite harboring relatively small populations of Garber's spurge, the overall conservation value of these habitats is immense. The Valhalla Coastal Rock Barren site on Crawl Key should be acquired and managed.

This data can serve as a baseline for future studies of Garber's spurge. Questions such as "How is this species affected by Hurricanes?" and "Are roadside populations of Garber's spurge in decline?" require additional monitoring and surveys over time to be adequately addressed. Additional unanswered questions about this species remain. A cladistic analysis to determine the genetic relatedness among these populations and other species of *Chamaesyce* could provide revealing information and serve as a tool in the conservation of Garber's spurge.

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# Appendix A: Detailed Locations of Garber's Spurge

## Figure A1: Miami-Dade County to Key Largo



Figure A2: Cape Sable



Figure A3: Middle Keys

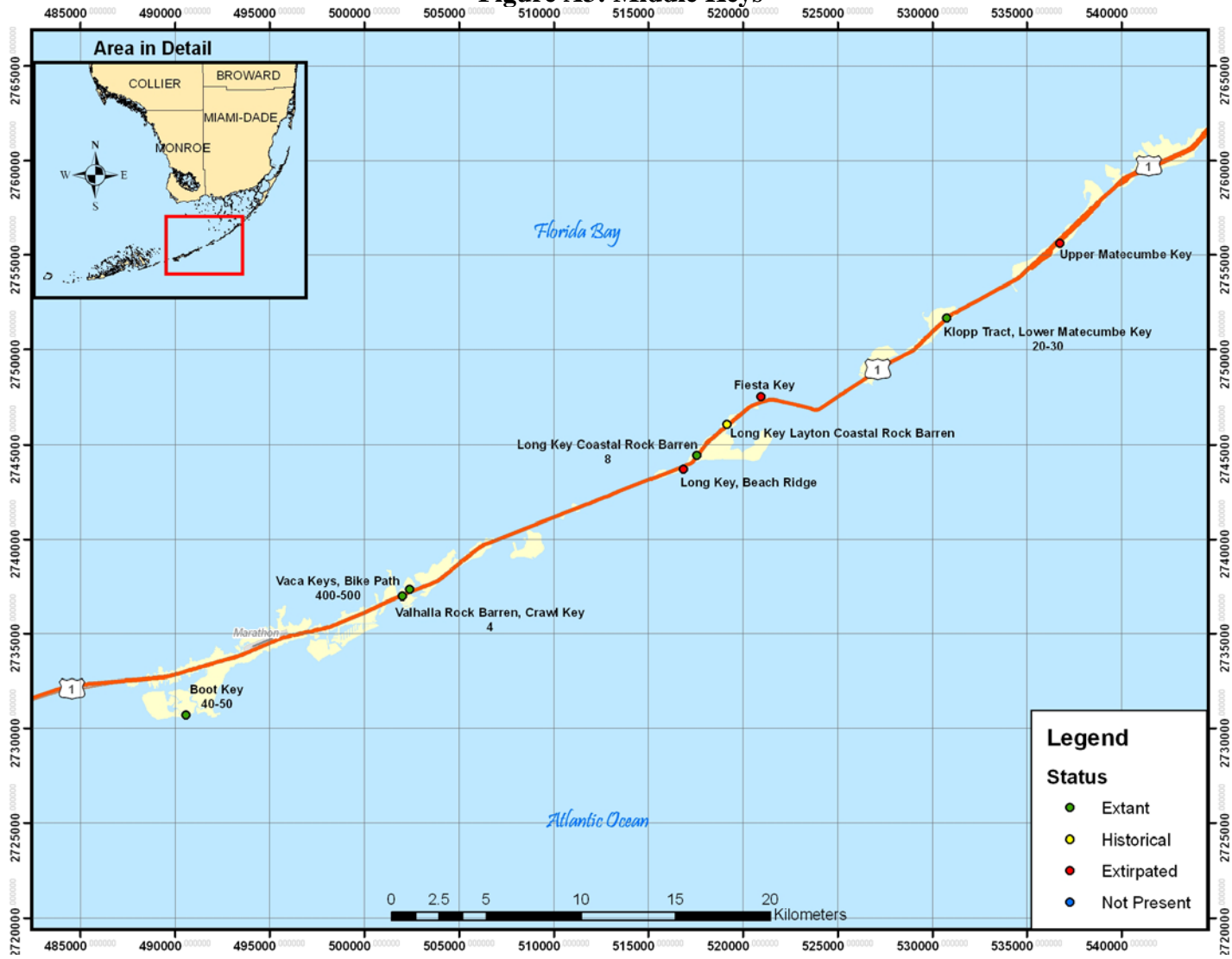


Figure A4: Little Duck Key to Cudjoe Key

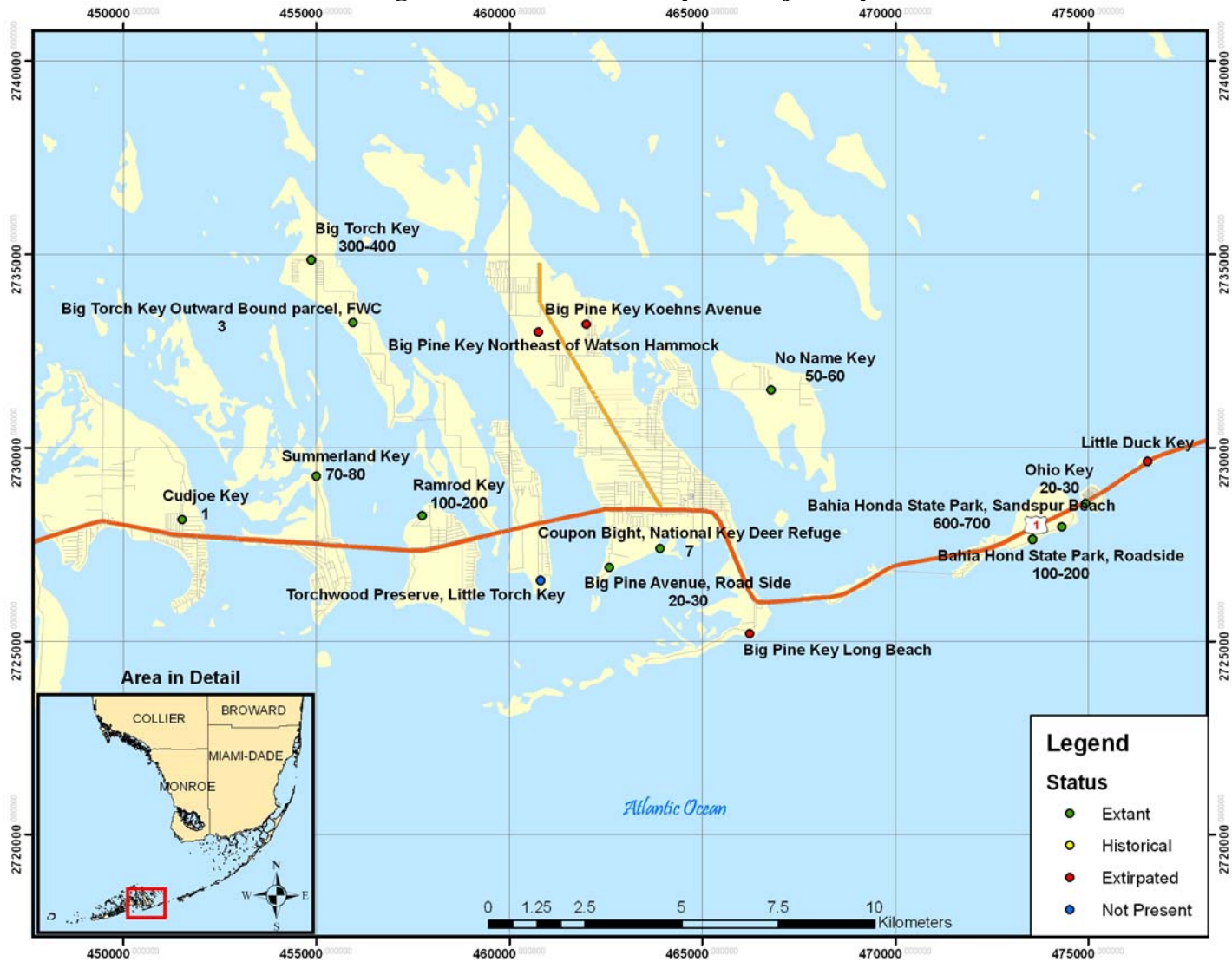


Figure A5: Sugarloaf Key to Key West

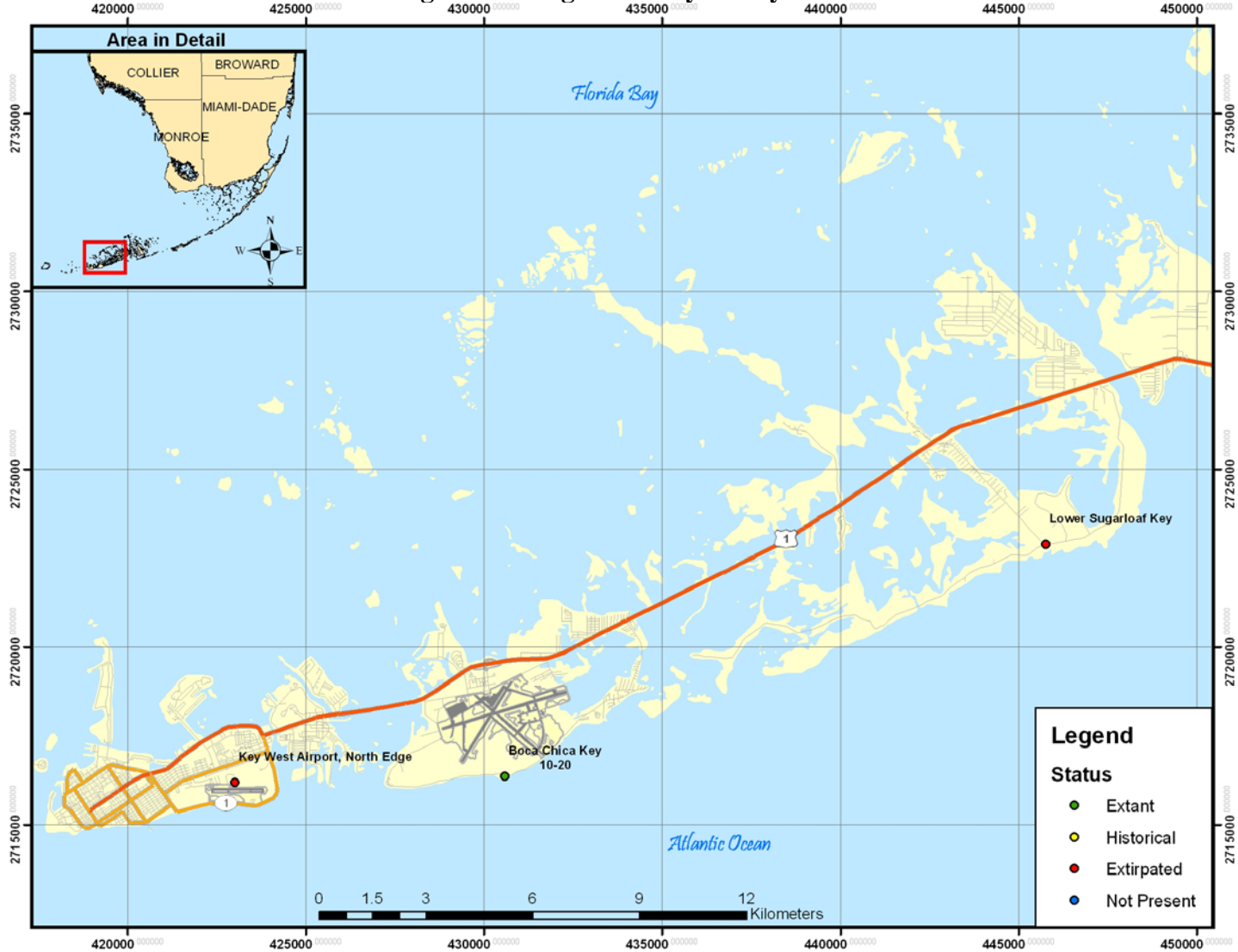


Figure A6: KWNWR

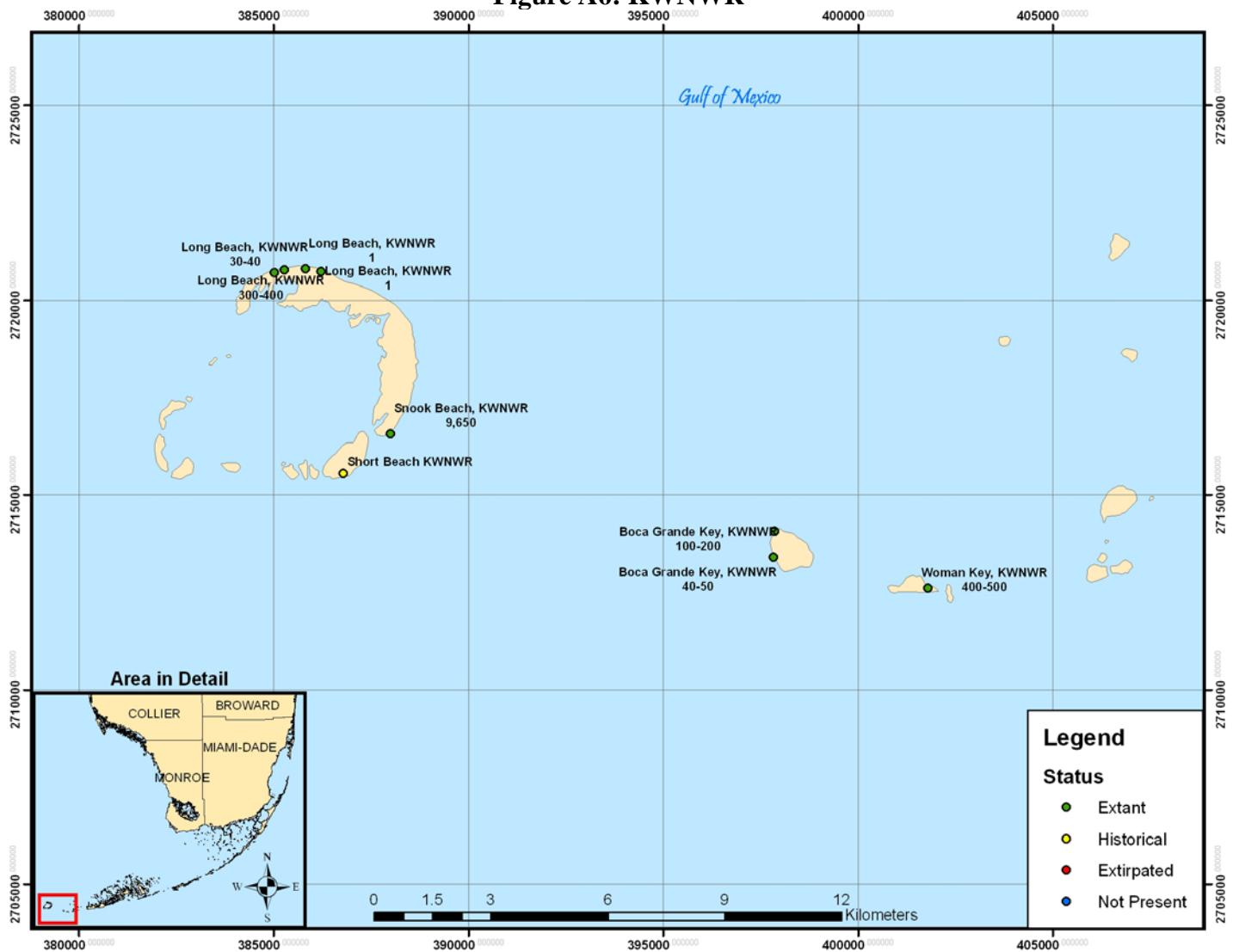
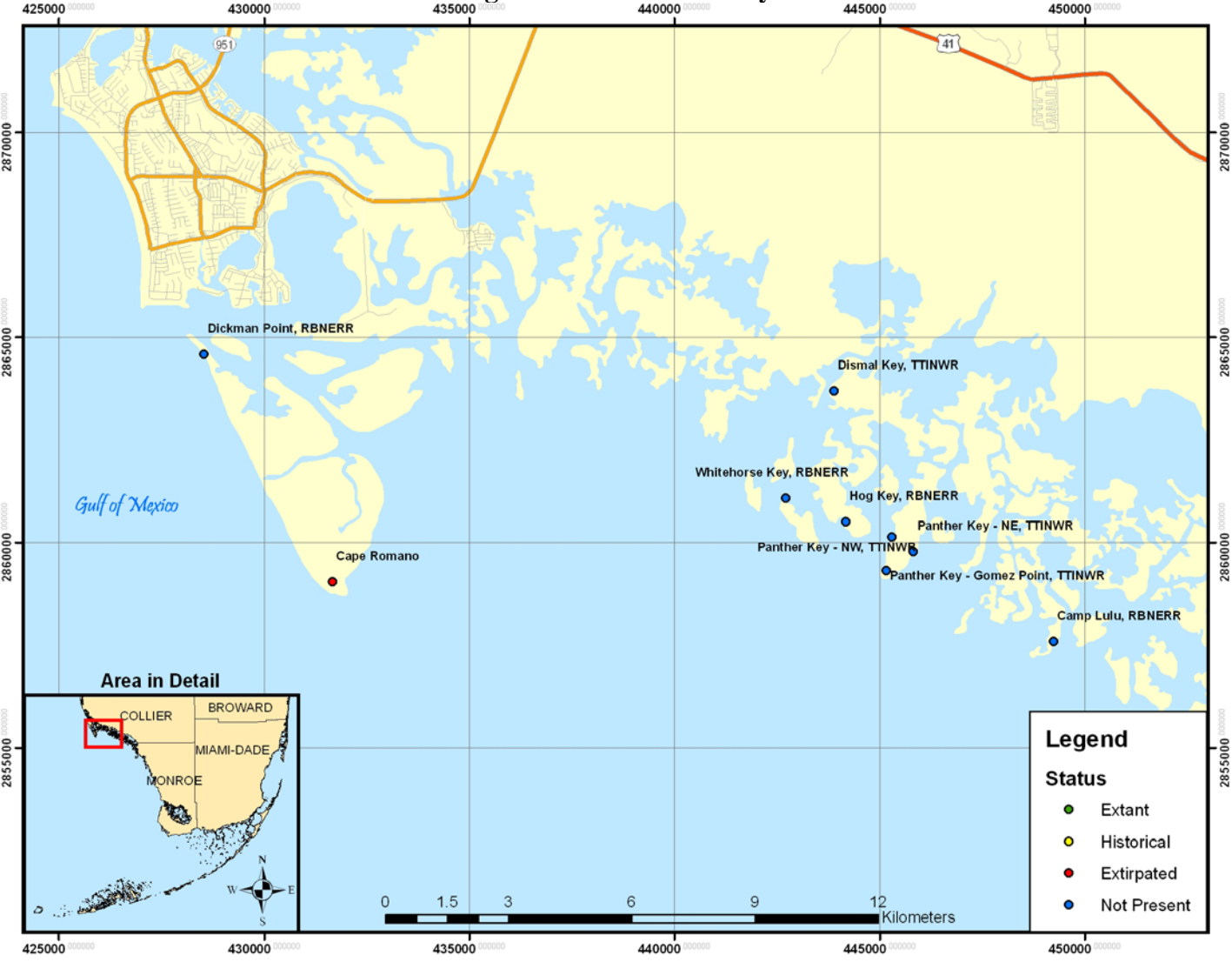


Figure A7: Collier County



**Appendix B: Associated Plat Taxa by Site Name**

Site Name	Latin Name	Common Names	Native Status (N=Native, E=Exotic)
<b>Bahia Honda State Park</b>			
	<i>Abildgaardia ovata</i>	Flatspike sedge	N
	<i>Aristida purpurascens</i>	Arrowfeather threeawn	N
	<i>Catesbaea parviflora</i>	Smallflower lilythorn	N
	<i>Cenchrus incertus</i>	Coastal sandbur	N
	<i>Coccoloba uvifera</i>	Seagrape	N
	<i>Coccothrinax argentata</i>	Florida silver palm	N
	<i>Dactyloctenium aegyptium</i>	Crow's-foot grass, Durban crowfootgrass	E
	<i>Eragrostis elliotii</i>	Elliott's love grass	N
	<i>Ernodea littoralis</i>	Beach-creeper, Golden-creeper, Coughbush	N
	<i>Eustachys petraea</i>	Common fingergrass, Pinewoods fingergrass	N
	<i>Flaveria linearis</i>	Narrowleaf yellowtops	N
	<i>Guapira discolor</i>	Blolly, Beeftree	N
	<i>Ipomoea pes-caprae subsp. brasiliensis</i>	Railroadvine, Bayhops	N
	<i>Jacquemontia havanensis</i>	Havana clustervine	N
	<i>Lantana involucreta</i>	Wild-sage, Buttonsage	N
	<i>Paspalum blodgettii</i>	Coral paspalum, Blodgett's crowngrass	N
	<i>Pithecellobium keyense</i>	Florida Keys blackbead	N
	<i>Polygala grandiflora</i>	Candyweed, Showy milkwort	N
	<i>Randia aculeata</i>	White indigoberry	N
	<i>Schizachyrium sanguineum</i>	Crimson bluestem	N
	<i>Smilax bona-nox</i>	Saw greenbrier	N
	<i>Smilax havanensis</i>	Havana greenbrier, Everglades greenbrier	N
	<i>Uniola paniculata</i>	Sea-oats	N
	<i>Waltheria indica</i>	Sleepy morning	N



Site Name	Latin Name	Common Names	Native Status (N=Native, E=Exotic)
<b>Big Pine Key – Big Pine Avenue</b>			
	<i>Paspalum setaceum</i>	Thin paspalum	N
	<i>Dactyloctenium aegyptium</i>	Crow's-foot grass, Durban crowfootgrass	E
	<i>Phyla nodiflora</i>	Fogfruit, Capeweed	N
	<i>Chamaesyce blodgettii</i>	Limestone sandmat	N
<b>Big Pine Key - National Key Deer Refuge, Coupon Bight, North Shore</b>			
	<i>Genipa clusifolia</i>	Sevenyear apple	N
	<i>Sporobolus indicus var. pyramidalis</i>	West Indian dropseed	E
	<i>Suriana maritima</i>	Baycedar	N
<b>Big Torch Key – Florida Keys Wildlife and Environmental Area, Parcels 884 and 885</b>			
	<i>Aster bracei</i>	Brace's aster	N
	<i>Fimbristylis cymosa</i>	Hurricane sedge, Hurricanegrass	E
	<i>Flaveria linearis</i>	Coastal Plain yellowtops	N
	<i>Paspalum setaceum</i>	Thin paspalum	N
	<i>Psidium longipes</i>	Long-stalked stopper	N
	<i>Setaria parviflora</i>	Yellow bristlegrass	N
<b>Big Torch Key - Roadside</b>			
	<i>Abildgaardia ovata</i>	Flatspike sedge	N
	<i>Eragrostis elliotii</i>	Elliott's love grass	N
	<i>Fimbristylis cymosa</i>	Hurricane sedge, Hurricanegrass	E
	<i>Paspalum setaceum</i>	Thin paspalum	N

Site Name	Latin Name	Common Names	Native Status (N=Native, E=Exotic)
	<i>Sporobolus indicus</i>	Smut grass	E
<b>Boca Chica Key</b>			
	<i>Acanthocereus tetragonus</i>	Barbwire cactus, Dildoe cactus	N
	<i>Atriplex pentandra</i>	Beach orach, Crested saltbush	N
	<i>Borrchia frutescens</i>	Silver sea-oxeye-daisy, Bushy seaside oxeye	N
	<i>Chamaesyce mesembrianthemifolia</i>	Seaside spurge, Coastal beach sandmat	N
	<i>Heliotropium angiospermum</i>	Scorpionstail	N
	<i>Ipomoea violacea</i>	Coastal morningglory	N
	<i>Passiflora suberosa</i>	Corkystem passionflower	N
	<i>Pithecellobium keyense</i>	Florida Keys blackbead	N
	<i>Suaeda linearis</i>	Sea-blite, Annual seepweed	N
<b>Boca Grande Key, Key West National Wildlife Refuge</b>			
	<i>Atriplex pentandra</i>	Beach orach, Crested saltbush	N
	<i>Canavalia rosea</i>	Beach-bean, Baybean, Seaside jackbean	N
	<i>Dactyloctenium aegyptium</i>	Crow's-foot grass, Durban crowfootgrass	E
	<i>Melanthera nivea</i>	Snow squarestem	N
	<i>Paspalum dissectum</i>	Mudbank crowngrass	N
	<i>Sporobolus virginicus</i>	Seashore dropseed	N
	<i>Uniola paniculata</i>	Sea-oats	N
	<i>Waltheria indica</i>	Sleepy morning	N
<b>Boot Key</b>			
	<i>Chamaesyce blodgettii</i>	Limestone sandmat	N
	<i>Flaveria linearis</i>	Narrowleaf yellowtops	N
	<i>Melanthera nivea</i>	Snow squarestem	N

Site Name	Latin Name	Common Names	Native Status (N=Native, E=Exotic)
	<i>Pithecellobium keyense</i>	Florida Keys blackbead	N
	<i>Stenotaphrum secundatum</i>	St. Augustine grass	E
<b>Cudjoe Key - Roadside</b>			
	<i>Chamaesyce blodgettii</i>	Limestone sandmat	N
	<i>Conocarpus erectus</i>	Buttonwood	N
	<i>Metopium toxiferum</i>	Poisonwood, Florida poisontree	N
	<i>Pithecellobium keyense</i>	Florida Keys blackbead	N
	<i>Polygala grandiflora</i>	Candyweed, Showy milkwort	N
	<i>Randia aculeata</i>	White indigoberry	N
	<i>Rapanea punctata</i>	Myrsine, Colicwood	N
	<i>Rhynchosia minima</i>	Least snoutbean	N
	<i>Sporobolus virginicus</i>	Seashore dropseed	N
<b>Everglades National Park, Long Pine Key, Pine Block A</b>			
	<i>Alvaradoa amorphoides</i>	Mexican alvaradoa	N
	<i>Andropogon ternarius</i>	Splitbeard bluestem	N
	<i>Anemia adiantifolia</i>	Pine fern, Maidenhair pineland fern	N
	<i>Angadenia berteroi</i>	Pineland-allamanda, Pineland golden trumpet	N
	<i>Argythamnia blodgettii</i>	Blodgett's wild mercury, Blodgett's silverbush	N
	<i>Chamaecrista deeringiana</i>	Deering partridge pea	N
	<i>Chamaecrista fasciculata</i>	Partridge pea	N
	<i>Chamaesyce deltoidea</i> subsp. <i>pinetorum</i>	Pineland deltoid spurge, Pineland sandmat	N
	<i>Cnidoscolus stimulosus</i>	Tread-softly, Finger-rot, 7-minute-itch	N
	<i>Coccothrinax argentata</i>	Florida silver palm	N
	<i>Colubrina cubensis</i> var. <i>floridana</i>	Florida snake-bark, Cuban nakedwood	N

Site Name	Latin Name	Common Names	Native Status (N=Native, E=Exotic)
	<i>Crotalaria pumila</i>	Low rattlebox	N
	<i>Crotalaria rotundifolia</i>	Rabbitbells	N
	<i>Croton linearis</i>	Pineland croton, Grannybush	N
	<i>Cynanchum blodgettii</i>	Blodgett's swallowwort	N
	<i>Dyschoriste angusta</i>	Rockland twinflower, Pineland snakeherb	N
	<i>Echites umbellata</i>	Devil's-potato, Rubbervine	N
	<i>Ficus citrifolia</i>	Short-leaf fig, Wild banyan tree	N
	<i>Galactia pinetorum</i>	Pineland milkpea	N
	<i>Galactia volubilis</i>	Downy milkpea	N
	<i>Muhlenbergia capillaris</i>	Muhlygrass, Hairawnmuhly	N
	<i>Pinus elliottii</i> var. <i>densa</i>	South Florida slash pine	N
	<i>Piriqueta caroliniana</i>	Pitted stripeeed	N
	<i>Poinsettia pinetorum</i>	Pineland poinsettia, Pineland spurge	N
	<i>Polygala grandiflora</i>	Candyweed, Showy milkwort	N
	<i>Pteris bahamensis</i>	Bahama ladder brake	N
	<i>Quercus virginiana</i>	Virginia live oak	N
	<i>Rapanea punctata</i>	Myrsine, Colicwood	N
	<i>Rhus copallinum</i>	Winged sumac	N
	<i>Rhynchospora floridensis</i>	Florida whitetop	N
	<i>Ruellia succulenta</i>	Thickleaf wild petunia	N
	<i>Schizachyrium rhizomatum</i>	Rhizomatous bluestem	N
	<i>Serenoa repens</i>	Saw palmetto	N
	<i>Smilax bona-nox</i>	Saw greenbrier	N
	<i>Solidago stricta</i>	Narrow-leaved goldenrod, Wand goldenrod	N
	<i>Zamia integrifolia</i>	Coontie, Florida arrowroot	N
<b>Everglades National Park, Long Pine Key, Pine Block B</b>			

Site Name	Latin Name	Common Names	Native Status (N=Native, E=Exotic)
	<i>Andropogon glomeratus</i> var. <i>pumilus</i>	Common bushy bluestem	N
	<i>Ayenia euphrasiifolia</i>	Eyebright ayenia	N
	<i>Boltonia diffusa</i>	Smallhead Doll's-daisy	N
	<i>Cassythra filiformis</i>	Lovevine, Devil's gut	N
	<i>Cirsium horridulum</i>	Purple thistle	N
	<i>Cladium jamaicense</i>	Saw-grass, Jamaica swamp sawgrass	N
	<i>Dyschoriste angusta</i>	Rockland twinflower, Pineland snakeherb	N
	<i>Guettarda elliptica</i>	Everglades velvetseed, Hammock velvetseed	N
	<i>Jacquemontia curtisii</i>	Pineland clustervine	N
	<i>Mikania scandens</i>	Climbing hempweed, Climbing hempvine	N
	<i>Morinda royoc</i>	Yellowroot, Redgal, Mouse's pineapple	N
	<i>Muhlenbergia capillaris</i>	Muhlygrass, Hairawnmuhly	N
	<i>Myrica cerifera</i>	Wax myrtle, Southern Bayberry	N
	<i>Phyllanthus pentaphyllus</i> var. <i>floridanus</i>	Florida five-petalled leafflower	N
	<i>Pinus elliotii</i> var. <i>densa</i>	South Florida slash pine	N
	<i>Polygala grandiflora</i>	Candyweed, Showy milkwort	N
	<i>Randia aculeata</i>	White indigoberry	N
	<i>Rapanea punctata</i>	Myrsine, Colicwood	N
	<i>Sabal palmetto</i>	Cabbage palm	N
	<i>Schizachyrium rhizomatum</i>	Rhizomatous bluestem	N
	<i>Serenoa repens</i>	Saw palmetto	N
	<i>Sida elliotii</i>	Elliott's fanpetals	N
	<i>Sideroxylon reclinatum</i> subsp. <i>austrofloridense</i>	Everglades bully	N
	<i>Sideroxylon salicifolium</i>	Willow-bustic, White bully	N
	<i>Spermacoce terminalis</i>	Everglades Keys false buttonweed	N

Site Name	Latin Name	Common Names	Native Status (N=Native, E=Exotic)
<b>Key Largo - Crocodile Lake National Wildlife Refuge</b>			
	<i>Chamaesyce blodgettii</i>	Limestone sandmat	N
	<i>Chamaesyce hyssopifolia</i>	Eyebane, Hyssopleaf sandmat	N
	<i>Galactia elliotii</i>	Elliott's milkpea	N
	<i>Guettarda elliptica</i>	Everglades velvetseed, Hammock velvetseed	N
	<i>Passiflora suberosa</i>	Corkystem passionflower	N
	<i>Piscidia piscipula</i>	Jamaica-dogwood, Florida fishpoison tree	N
	<i>Rhynchelytrum repens</i>	Rose Natalgrass	E
	<i>Schizachyrium sanguineum</i>	Crimson bluestem	N
	<i>Spermacoce verticillata</i>	Shrubby false buttonweed	N
<b>Long Key Coastal Rock Barren, Long Key State Park</b>			
	<i>Conocarpus erectus</i>	Buttonwood	N
	<i>Evolvulus convolvuloides</i>	Bindweed dwarf morningglory	N
	<i>Jacquemontia pentanthos</i>	Skyblue clustervine	N
	<i>Paspalum setaceum</i>	Thin paspalum	N
<b>Lower Matecumbe Key - Klopp Tract, Lignumvitae Key Botanical State Park</b>			
	<i>Cienfuegosia yucatanensis</i>	Yucatan flymallow	N
	<i>Eugenia foetida</i>	Spanish stopper, Boxleaf stopper	N
	<i>Jacquemontia pentanthos</i>	Skyblue clustervine	N
	<i>Pithecellobium keyense</i>	Florida Keys blackbead	N
	<i>Sporobolus domingensis</i>	Coral dropseed	N

Site Name	Latin Name	Common Names	Native Status (N=Native, E=Exotic)
<b>Marquesas Keys - Long Beach, Key West National Wildlife Refuge</b>			
	<i>Ambrosia hispida</i>	Beach ragweed, Coastal ragweed	N
	<i>Chamaesyce mesembrianthemifolia</i>	Seaside spurge, Coastal beach sandmat	N
	<i>Coccothrinax argentata</i>	Florida silver palm	N
	<i>Eustachys petraea</i>	Common fingergrass, Pinewoods fingergrass	N
	<i>Ipomoea indica var. acuminata</i>	Ocean-blue morningglory	N
	<i>Ipomoea violacea</i>	Coastal morningglory	N
	<i>Jacquinia keyensis</i>	Joewood	N
	<i>Melanthera nivea</i>	Snow squarestem	N
	<i>Metopium toxiferum</i>	Poisonwood, Florida poisontree	N
	<i>Pithecellobium keyense</i>	Florida Keys blackbead	N
	<i>Setaria macrosperma</i>	Coastal foxtail, Coral bristlegrass	N
<i>Waltheria indica</i>	Sleepy morning	N	
<b>Marquesas Keys - Snook Beach, Key West National Wildlife Refuge</b>			
	<i>Ambrosia hispida</i>	Beach ragweed, Coastal ragweed	N
	<i>Argusia gnaphalodes</i>	Sea-lavender, Sea-rosemary	N
	<i>Borrichia arborescens</i>	Green sea-oxeye-daisy, Tree seaside oxeye	N
	<i>Borrichia frutescens</i>	Silver sea-oxeye-daisy, Bushy seaside oxeye	N
	<i>Canavalia rosea</i>	Beach-bean, Baybean, Seaside jackbean	N
	<i>Cenchrus echinatus</i>	Southern sandbur	N
	<i>Chamaesyce mesembrianthemifolia</i>	Seaside spurge, Coastal beach sandmat	N
	<i>Cyperus planifolius</i>	Flatleaf flatsedge	N
	<i>Erithalis fruticosa</i>	Blacktorch	N
	<i>Ernodea littoralis</i>	Beach-creeper, Golden-creeper, Coughbush	N

Site Name	Latin Name	Common Names	Native Status (N=Native, E=Exotic)
	<i>Eustachys petraea</i>	Common fingergrass, Pinewoods fingergrass	N
	<i>Flaveria linearis</i>	Narrowleaf yellowtops	N
	<i>Galactia striata</i>	Florida hammock milkpea	N
	<i>Ipomoea pes-caprae</i> subsp. <i>brasiliensis</i>	Railroadvine, Bayhops	N
	<i>Jacquinia keyensis</i>	Joewood	N
	<i>Lantana involucrata</i>	Wild-sage, Buttonsage	N
	<i>Melanthera nivea</i>	Snow squarestem	N
	<i>Metopium toxiferum</i>	Poisonwood, Florida poisontree	N
	<i>Panicum amarum</i>	Beachgrass, Bitter panicgrass	N
	<i>Paspalum vaginatum</i>	Seashore paspalum	N
	<i>Pithecellobium keyense</i>	Florida Keys blackbead	N
	<i>Portulaca oleracea</i>	Purslane, Little hogweed	E
	<i>Rhizophora mangle</i>	Red mangrove	N
	<i>Scaevola plumieri</i>	Inkberry, Beachberry, Gullfeed	N
	<i>Sesuvium portulacastrum</i>	Perennial sea-purslane, Shoreline seapurslane	N
	<i>Solanum bahamense</i>	Bahama nightshade	N
	<i>Spartina patens</i>	Marshhay cordgrass, Saltmeadow cordgrass	N
	<i>Suaeda linearis</i>	Sea-blite, Annual seepweed	N
	<i>Suriana maritima</i>	Baycedar	N
	<i>Uniola paniculata</i>	Sea-oats	N
	<i>Waltheria indica</i>	Sleepy morning	N
<b>Middle Cape Sable, Everglades National Park</b>			
	<i>Chamaecrista nictitans</i> var. <i>aspera</i>	Hairy sensitive-pea, Hairy partridge-pea	N
	<i>Conocarpus erectus</i>	Buttonwood	N
	<i>Crotalaria rotundifolia</i>	Rabbitbells	N
	<i>Dactyloctenium aegyptium</i>	Crow's-foot grass, Durban crowfootgrass	E



Site Name	Latin Name	Common Names	Native Status (N=Native, E=Exotic)
	<i>Eustachys petraea</i>	Common fingergrass, Pinewoods fingergrass	N
	<i>Ipomoea pes-caprae</i> subsp. <i>brasiliensis</i>	Railroadvine, Bayhops	N
	<i>Opuntia stricta</i>	Erect pricklypear	N
	<i>Rhynchosia parvifolia</i>	Small-leaf snoutbean	N
	<i>Uniola paniculata</i>	Sea-oats	N
<b>No Name Key</b>			
	<i>Chamaesyce blodgettii</i>	Limestone sandmat	N
	<i>Crossopetalum ilicifolium</i>	Quailberry, Christmasberry	N
	<i>Eragrostis elliotii</i>	Elliott's love grass	N
	<i>Paspalum blodgettii</i>	Coral paspalum, Blodgett's crowngrass	N
	<i>Polypremum procumbens</i>	Rustweed, Juniperleaf	N
<b>Northwest Cape Sable, Everglades National Park</b>			
	<i>Abildgaardia ovata</i>	Flatspike sedge	N
	<i>Agave decipiens</i>	False-sisal	N
	<i>Alternanthera flavescens</i>	Yellow joyweed	N
	<i>Ambrosia artemisiifolia</i>	Common ragweed	N
	<i>Bidens alba</i> var. <i>radiata</i>	Spanish-needles	N
	<i>Boerhavia diffusa</i>	Red spiderling, wineflower	N
	<i>Buchnera americana</i>	American bluehearts	N
	<i>Bursera simaruba</i>	Gumbo-limbo	N
	<i>Canavalia rosea</i>	Beach-bean, Baybean, Seaside jackbean	N
	<i>Chamaecrista nictitans</i> var. <i>aspera</i>	Hairy sensitive-pea, Hairy partridge-pea	N
	<i>Chamaesyce mesembrianthemifolia</i>	Seaside spurge, Coastal beach sandmat	N
	<i>Cirsium horridulum</i>	Purple thistle	N
	<i>Commelina erecta</i>	Whitemouth dayflower	N

Site Name	Latin Name	Common Names	Native Status (N=Native, E=Exotic)
	<i>Conyza canadensis</i> var. <i>pusilla</i>	Dwarf Canadian horseweed	N
	<i>Crotalaria rotundifolia</i>	Rabbitbells	N
	<i>Croton glandulosus</i>	Vente conmigo	N
	<i>Dactyloctenium aegyptium</i>	Crow's-foot grass, Durban crowfootgrass	E
	<i>Dichantherium dichotomum</i>	Cypress witchgrass	N
	<i>Digitaria filiformis</i> var. <i>filiformis</i>	Shaggy crabgrass	N
	<i>Echites umbellata</i>	Devil's-potato, Rubbervine	N
	<i>Eustachys petraea</i>	Common fingergrass, Pinewoods fingergrass	N
	<i>Galactia volubilis</i>	Downy milkpea	N
	<i>Gaura angustifolia</i>	Southern gaura, Southern beeblossum	N
	<i>Ipomoea pes-caprae</i> subsp. <i>brasiliensis</i>	Railroadvine, Bayhops	N
	<i>Iresine diffusa</i>	Bloodleaf, Juba's bush	N
	<i>Juncus roemerianus</i>	Black needle rush, Needle rush, Black rush	N
	<i>Lantana camara</i>	Shrubverbena	E
	<i>Leptochloa dubia</i>	Green spangletop, Green sprangletop	N
	<i>Melanthera nivea</i>	Snow squarestem	N
	<i>Mentzelia floridana</i>	Poorman's-patch, Stickleaf	N
	<i>Morinda royoc</i>	Yellowroot, Redgal, Mouse's pineapple	N
	<i>Panicum amarum</i>	Beachgrass, Bitter panicgrass	N
	<i>Panicum virgatum</i>	Switchgrass	N
	<i>Parthenocissus quinquefolia</i>	Virginia-creeper, Woodbine	N
	<i>Paspalum vaginatum</i>	Seashore paspalum	N
	<i>Passiflora suberosa</i>	Corkystem passionflower	N
	<i>Pectis glaucescens</i>	Tea-blinkum, Sanddune cinchweed	N
	<i>Physalis walteri</i>	Walter's groundcherry	N
	<i>Piscidia piscipula</i>	Jamaica-dogwood, Florida fishpoison tree	N
	<i>Poinsettia heterophylla</i>	Fiddler's spurge, Mexican fireplant	N
	<i>Polygala grandiflora</i>	Candyweed, Showy milkwort	N

Site Name	Latin Name	Common Names	Native Status (N=Native, E=Exotic)
	<i>Portulaca oleracea</i>	Purslane, Little hogweed	E
	<i>Portulaca rubricaulis</i>	Stalked purslane, Redstem purslane	N
	<i>Randia aculeata</i>	White indigoberry	N
	<i>Rhabdadenia biflora</i>	Mangrove rubbervine, Mangrovevine	N
	<i>Sabal palmetto</i>	Cabbage palm	N
	<i>Schizachyrium sanguineum</i>	Crimson bluestem	N
	<i>Sida acuta</i>	Common wireweed, Common fanpetals	N
	<i>Solidago sempervirens</i>	Seaside goldenrod	N
	<i>Spartina bakeri</i>	Sand cordgrass	N
	<i>Spermacoce tetraquetra</i>	Pineland false buttonweed	N
	<i>Uniola paniculata</i>	Sea-oats	N
	<i>Verbesina virginica</i>	Frostweed, White crownbeard	N
	<i>Waltheria indica</i>	Sleepy morning	N
<b>Ohio Key</b>			
	<i>Chamaesyce conferta</i>	Everglades key sandmat	N
	<i>Eragrostis elliotii</i>	Elliott's love grass	N
	<i>Sporobolus indicus var. pyramidalis</i>	West Indian dropseed	E
	<i>Stylosanthes calcicola</i>	Everglades key pencilflower	N
<b>Ramrod Key</b>			
	<i>Agalinis fasciculata</i>	Beach false foxglove	N
	<i>Bidens alba var. radiata</i>	Spanish-needles	N
	<i>Chamaecrista nictitans var. aspera</i>	Hairy sensitive-pea, Hairy partridge-pea	N
	<i>Conocarpus erectus</i>	Buttonwood	N
	<i>Eustoma exaltatum</i>	Seaside gentian, Marshgentian	N
	<i>Fimbristylis cymosa</i>	Hurricane sedge, Hurricanegrass	E
	<i>Flaveria linearis</i>	Narrowleaf yellowtops	N
	<i>Paspalum setaceum</i>	Thin paspalum	N

Site Name	Latin Name	Common Names	Native Status (N=Native, E=Exotic)
	<i>Sporobolus indicus</i> var. <i>pyramidalis</i>	West Indian dropseed	E
	<i>Waltheria indica</i>	Sleepy morning	N
	<i>Zoysia tenuifolia</i>	Mascarene templegrass	E
<b>Summerland Key</b>			
	<i>Conocarpus erectus</i>	Buttonwood	N
	<i>Eragrostis elliottii</i>	Elliott's love grass	N
	<i>Eustachys petraea</i>	Common fingergrass, Pinewoods fingergrass	N
	<i>Fimbristylis cymosa</i>	Hurricane sedge, Hurricanegrass	E
	<i>Flaveria linearis</i>	Narrowleaf yellowtops	N
	<i>Paspalum setaceum</i>	Thin paspalum	N
	<i>Sporobolus indicus</i> var. <i>pyramidalis</i>	West Indian dropseed	E
	<i>Stylosanthes hamata</i>	Pencilflower, Cheesytoes	N
<b>Vaca Keys</b>			
	<i>Bidens alba</i> var. <i>radiata</i>	Spanish-needles	N
	<i>Cenchrus incertus</i>	Coastal sandbur	N
	<i>Chamaesyce blodgettii</i>	Limestone sandmat	N
	<i>Chamaesyce hyssopifolia</i>	Eyebane, Hyssopleaf sandmat	N
	<i>Coccoloba uvifera</i>	Seagrape	N
	<i>Conocarpus erectus</i>	Buttonwood	N
	<i>Dactyloctenium aegyptium</i>	Crow's-foot grass, Durban crowfootgrass	E
	<i>Eragrostis elliottii</i>	Elliott's love grass	N
	<i>Ernodea littoralis</i>	Beach-creeper, Golden-creeper, Coughbush	N
	<i>Eustachys petraea</i>	Common fingergrass, Pinewoods fingergrass	N
	<i>Flaveria linearis</i>	Narrowleaf yellowtops	N
	<i>Mimosa quadrivalvis</i> var. <i>angustata</i>	Sensitive brier	N
	<i>Paspalum setaceum</i>	Thin paspalum	N
	<i>Pithecellobium keyense</i>	Florida Keys blackbead	N

Site Name	Latin Name	Common Names	Native Status (N=Native, E=Exotic)
	<i>Polygala grandiflora</i>	Candyweed, Showy milkwort	N
	<i>Spermacoce verticillata</i>	Shrubby false buttonweed	E
	<i>Sporobolus indicus var. pyramidalis</i>	West Indian dropseed	E
	<i>Stylosanthes hamata</i>	Pencilflower, Cheesytoes	N
	<i>Thrinax morrisii</i>	Silver thatch palm, Brittle thatch palm	N
	<i>Vigna luteola</i>	Cow-pea, Hairypod cowpea	N
<b>Valhalla Rock Barren, Crawl Key</b>			
	<i>Alternanthera flavescens</i>	Yellow joyweed	N
	<i>Cyperus squarrosus</i>	Bearded flatsedge	N
	<i>Indigofera mucronata var. keyensis</i>	Florida Keys indigo	N
	<i>Jacquemontia pentanthos</i>	Skyblue clustervine	N
	<i>Opuntia stricta</i>	Erect pricklypear	N
	<i>Opuntia triacanthos</i>	Jumping cactus	N
	<i>Pithecellobium keyense</i>	Florida Keys blackbead	N
	<i>Portulaca pilosa</i>	Pink purslane, Kiss-me-quick	N
	<i>Sporobolus domingensis</i>	Coral dropseed	N
<b>Woman Key, Key West National Wildlife Refuge</b>			
	<i>Alternanthera flavescens</i>	Yellow joyweed	N
	<i>Canavalia rosea</i>	Beach-bean, Baybean, Seaside jackbean	N
	<i>Cenchrus echinatus</i>	Southern sandbur	N
	<i>Chamaesyce mesembrianthemifolia</i>	Seaside spurge, Coastal beach sandmat	N
	<i>Cyperus planifolius</i>	Flatleaf flatsedge	N
	<i>Lantana involucrata</i>	Wild-sage, Buttonsage	N
	<i>Melanthera nivea</i>	Snow squarestem	N
	<i>Panicum amarum</i>	Beachgrass, Bitter panicgrass	N

Site Name	Latin Name	Common Names	Native Status (N=Native, E=Exotic)
	<i>Poinsettia cyathophora</i>	Paintedleaf, Fire-on-the-mountain	N
	<i>Spartina patens</i>	Marshhay cordgrass, Saltmeadow cordgrass	N
	<i>Sporobolus virginicus</i>	Seashore dropseed	N