

**Distribution and Population Size of Five Candidate Plant Taxa
in the Florida Keys:**

***Argythamnia blodgettii*, *Chamaecrista lineata* var. *keyensis*,
Indigofera mucronata var. *keyensis*, *Linum arenicola*,
and *Sideroxylon reclinatum* subsp. *austrofloridense***

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Abstract

This study determined population sizes and distribution of Argythamnia blodgettii, Chamaecrista lineata var. keyensis, Indigofera mucronata var. keyensis, Linum arenicola and Sideroxylon reclinatum subsp. austrofloridense in the Florida Keys. These species are all endemic to Monroe and Miami-Dade Counties, and are candidates for federal listing. S. reclinatum subsp. austrofloridense was not found to occur in the Florida Keys, but is extant in Miami-Dade and mainland Monroe counties. A. blodgettii is extant on nine islands, with three others of uncertain status. Its verified range extends from Miami-Dade County to Boca Chica Key. It has an estimated population of between 10,000 and 100,000 plants in the Florida Keys. C. lineata var. keyensis is extant on three islands in the Lower Keys - Big Pine Key, Cudjoe Key and Lower Sugarloaf Key. Lower Sugarloaf Key is a new record for the species. It is restricted to these three islands. It has an estimated population of between 10,000 and 100,000 plants. Indigofera mucronata var. keyensis was found on eight islands, extending from Key Largo to Long Point Key. Several new stations were discovered, as well as the Lignum Vitae Key population, apparently not seen since J.L. Blodgett discovered the taxon in the first half of the 19th century. It has an estimated population of between 1,000 and 10,000 plants. It is extirpated from Miami-Dade and Collier Counties. Linum arenicola is extant on four islands - Big Pine Key, Big Torch Key, Middle Torch Key and Lower Sugarloaf Key. It has an estimated population of between 100 and 1,000 plants in the Florida Keys. It is also extant in Miami-Dade County. Three hurricanes affected these species during our surveys, allowing for data collection and field observations during disturbance events. Our surveys of I. mucronata var. keyensis allowed for many observations of rock barren communities, including new locations for this rare habitat. A parallel study, USFWS agreement #401815G009 by Keith Bradley addresses the rare plants of Big Pine Key.

Cover photos by K. Bradley and S. Hodges: *A. blodgettii*, *C. lineata* var. *keyensis*, *I. mucronata* var. *keyensis* and *L. arenicola*.

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Introduction

This study addresses the population and distribution of five endemic plant taxa in the Florida Keys: *Argythamnia blodgettii*, *Chamaecrista lineata* var. *keyensis*, *Indigofera mucronata* var. *keyensis*, *Linum arenicola* and *Sideroxylon reclinatum* subsp. *austrofloridense*. *A. blodgettii*, *L. arenicola*, and *S. reclinatum* subsp. *austrofloridense* are endemic to Miami-Dade and Monroe counties, while *C. lineata* var. *keyensis* and *I. mucronata* var. *keyensis* are restricted to the Florida Keys area of Monroe County¹. All are candidate species being considered for listing under the Endangered Species Act. It is essential to conservation management planning that adequate distribution and population data exist for these species. No thorough studies had been previously conducted to determine the distribution of these species, and this study fills that void.

The Florida Keys

The Florida Keys is an archipelago of some 1,700 limestone and sand islands forming a 300 km long arc from Soldier Key on the edge of Biscayne Bay in Miami-Dade County, southwest to the Dry Tortugas west of Key West. Their latitudinal position, between 24 and 25 degrees north latitude, is subtropical. The majority of the Keys are part of two discrete limestone formations – Key Largo limestone from Soldier Key to the southeastern corner of Big Pine Key and Miami oolitic limestone on the rest of Big Pine Key and the islands to the west. Elevations are very low, usually less than a meter above sea level, with a maximum elevation of 5.5 m on Windley Key. The climate becomes frost-free in the lower Florida Keys, with only rare frosts in the upper Florida Keys. The mean January temperature is 21°C and the mean July temperature is 28°C. There is a distinct wet season in the summer and dry season in the winter. Rainfall decreases to the south, with an annual average of 140 cm in the north and under 100 cm at Key West. Tropical storms and hurricanes cross the Florida Keys about once every two years. The Keys are situated in close proximity to the Bahamas islands to the east and Cuba to the South.

Because of the subtropical climate and geographic location relative to the Bahamas and Cuba, the Florida Keys have a flora more similar to the Bahamas and parts of Cuba than to most of the Florida mainland. The native flora is comprised almost entirely of Caribbean species, with few temperate species. There are at least four endemic plant taxa in the Florida Keys, and some 21 additional Florida endemics which also occur on the Florida mainland.

The dominant plant communities of the Florida Keys are rockland hammock, pine rockland, and tidal swamp. Rockland hammocks are usually closed canopy forests. Pine rockland is restricted to the lower Florida Keys. It is a woodland/savanna type ecosystem dominated by a single canopy tree, South Florida slash pine (*Pinus elliottii* var. *densa*), an understory of palms and hardwoods, and a diverse herb and grass layer. Tidal swamps are dominated by several mangrove tree species and occur in coastal areas which are

¹ *I. mucronata* var. *keyensis* formerly occurred in Miami-Dade and Collier Counties where it is now thought to be extirpated.

tidally flooded. Many other plant communities also occur in the Keys including beach dunes, coastal berms, rock barrens, tidal marshes, and buttonwood woodlands.

Environmental Changes in the Florida Keys

The Florida Keys, specifically Key West, was the first area of southern Florida to be permanently settled after the Spanish transfer of the Florida territory to the United States in 1821. Since this settlement, most of the ecosystems on the Keys have been impacted by humans, through widespread clearing of rockland hammocks in the 19th century for farming, or building of homes and businesses. Canal and marina construction have altered the hydrology and caused saltwater intrusion into the fresh water lenses of many islands. Extensive areas of rockland hammock, pine rockland, and other ecosystems have been lost. Additionally, disruption of the historic fire regime in pine rockland has probably caused a decrease in the plant diversity on islands with that habitat.

Sea level rise continues to impact the natural areas of the Keys. The approximately 15 cm sea level rise in the Florida Keys area has reduced upland forest coverage (Ross *et al.*, 1994). The pine rockland on Upper Sugarloaf Key has been reduced by approximately 58 ha over the last century (Ross *et al.*, 1994). This trend of upland habitat reduction will no doubt impact all taxa surveyed in this study and will certainly continue to be an important factor in following the populations and distributions of upland species in the Florida Keys.

Rare Plant Species

The extensive modification and destruction of natural areas in the Florida Keys has decreased the ranges and population sizes of many of the Florida Keys' unique plant species. Two plant species are already listed under the U.S. Endangered Species Act (ESA), *Chamaesyce garberi* as Threatened and *Pilosocereus robinii* as Endangered. Other rare plant species that are endemic to the Florida Keys or to the wider southern Florida mainland have also declined and warrant consideration for listing under the ESA. These are *Argythamnia blodgettii*, *Chamaecrista lineata* var. *keyensis*, *Indigofera mucronata* var. *keyensis*, *Linum arenicola*, and *Sideroxylon reclinatum* subsp. *austrofloridense*. Ranges and population sizes of each of these taxa have decreased due to human influences (Bradley & Gann, 1999; Gann *et al.*, 2002) and they are now considered candidates for listing under the ESA by the U.S. Fish and Wildlife Service.

Purpose of this study

Status summaries prepared by Bradley and Gann (1999) for four of these five taxa indicated that there was insufficient information on the distribution, population sizes, habitat requirements, and recovery needs for these 5 taxa. No comprehensive survey had ever been conducted for any of these taxa. The present study was undertaken to determine the current status of each of these taxa in the Florida Keys². In addition, we sought to better define the habitat requirements of each taxon, as well as threats to each population.

² While several of these taxa occur on the Florida mainland, the study was conducted only in the Keys. Other surveys have in part provided data on their distribution outside of the Keys.

Methods

The Floristic Inventory of South Florida

Most of the background research on each of the taxa in this study were collected by IRC during the preparation of the Floristic Inventory of South Florida (FISF) beginning in 1995 (Gann *et al.*, 2002; Gann *et al.*, 2006). The FISF is a relational database (in Microsoft Access) of plant occurrences in a ten county area of South Florida, from the north rim of Lake Okeechobee extending south through the Florida Keys. To build the FISF we incorporated all plant inventories available to us that had been prepared for conservation areas. When a plant inventory was not available IRC staff often prepared one. The database also includes herbarium specimens of rare plant taxa from most herbaria in Florida and important national herbaria. We compiled herbarium label data for each of the taxa in the present study from 11 herbaria. These herbaria include ARCH, F, FLAS, FSU, FTG, GH, MO, NY, PHIL, US, and USF (see Holmgren & Holmgren, 1998 for code definitions).

The FISF database contains extensive data on plant occurrences in the Florida Keys. Because the Florida Keys, Key West in particular, were settled so early, it is one of the first places naturalists began visiting early in the State's history. Consequently the Florida Keys represent some of the best botanical data for South Florida. John Loomis Blodgett was a physician who resided on Key West between 1838 and 1853 and made some of the first herbarium collections from the Florida Keys on Key West, Big Pine Key, and Lignum Vitae Key. He collected each of the three candidate species studied here. On Big Pine Key he made the first known collection of *A. blodgettii*, which was designated as the type specimen and named after him. He also made the first known collections of *C. lineata* var. *keyensis* and *I. mucronata* var. *keyensis*.

Since the Blodgett collections in the first half of the 19th century, the Florida Keys have continued to be well explored by botanists, providing large numbers of herbarium samples, including multiple collections of each taxon in this report. The report "Endangered and Threatened Plant Species Survey in Southern Florida and the National Key Deer and Great White Heron National Wildlife Refuges, Monroe County, Florida" (Austin *et al.*, 1980) contains a great deal of information on population and distribution of each of the targeted species. While this report supplies significant background info, thirty years have now passed since the surveys were conducted.

Art Weiner produced a report "The Hardwood Hammocks of the Florida Keys" in 1980. It gives plant species lists for hammocks located throughout the Florida Keys including notes on their abundance. Curtis Kruer prepared the report "An assessment of Florida's Remaining Coastal Upland Natural Communities: Florida Keys" for the Florida Natural Areas Inventory (FNAI) in 1992. He focused on remaining coastal upland communities in the Keys and recorded rare species based on observation or other sources. Included in this report were some observations of rock barren communities.

The botanical notes of the late botanist George Avery are also included in the FISF. These notes are an outstanding source of information. George Avery seems to have contributed to almost every report published on the rare plants of the Florida Keys

over the last thirty years, either in person or through his botanical legacy. His notes are a critical source of location and population data for rare plant surveys in the Florida Keys. Surveys done by IRC staff are also included, along with information based on observations by Department of Environmental Protection staff, primarily Janice Duquesnel.

In addition to the above collections and references, IRC botanists, especially Keith Bradley, George Gann, and Steven Woodmansee, have spent considerable time botanizing in the Florida Keys. In preparation of the FISF and other IRC projects they have made extensive observations of each of the subject species.

Identification of Survey Locations and Conducting Field Surveys

The FISF database was queried to generate a list of locations where each of the study taxa is or was previously known from. We also conducted a literature search to gather any relevant data, either published or grey, that was not already in the FISF database. Each rare plant occurrence for which we found records was categorized by occurrence status, *i.e.* “Extant,” “Historical,” and “Extirpated.”

All field surveys were conducted by Hodges, usually with one field assistant. Meandering transects were conducted when visiting survey locations in suitable habitat and adjacent locations. Positions of individual plants or perimeters of colonies were recorded with a Garmin GPS unit³. Plants were counted if populations were ten individuals or less. For populations eleven or over, population sizes were estimated on a log₁₀ scale, unless otherwise indicated. Site descriptions were recorded in the field, including habitat descriptions, associated plant species, threats and other management concerns. When new populations or ephemeral populations were discovered, vouchers were collected, assuming that we possessed the appropriate permits and could collect without removing over five percent of the population.

We prioritized field surveys by occurrence status, visiting known (extant) locations first. Visiting these sites first allowed us to develop search images for each taxon, to develop an initial list of associated species, and to learn the typical habitat characteristics of each taxon. Areas surrounding known locations were also searched if suitable habitat was present. Exceptions were made for surveys if we could not obtain permission for privately owned sites, if the sites had been destroyed, or if they had been recently surveyed by other IRC staff. Historical sites – those sites with recorded sightings but which lacked recent surveys or sites with vague locality data, requiring us to search a broad area - were surveyed next.

Following surveys of known and historical locations, we began identifying potential locations for new exploratory surveys. Locality data from the above surveys was incorporated into ArcGIS 9.1. Occurrences were plotted on 2004, 1-meter resolution, true color aerial photographs. Within the range of each taxon, the aerial photographs were reviewed to identify areas with similar aerial signatures to those in areas with known occurrences. Areas that appeared promising were surveyed if site access could be obtained and time was permitting.

³ All positions were recorded in Universal Transverse Mercator projection, WGS84 datum.

Disturbance Events: Hurricanes and Storm Surges

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). The vegetation in many areas was top-killed due to salt water inundation, including that at many of the stations we had just surveyed for rare plants or were planning to survey. We had no choice but to conduct some of our surveys only after Hurricane Wilma in areas with much dead vegetation. These surveys were not as effective in detecting rare plant occurrences as those done before the hurricane. Some populations of rare plants which we had surveyed prior to Hurricane Wilma were resurveyed after the storm to assess the storms' impact.

In addition to this study, Bradley is conducting a parallel study of rare plants on Big Pine Key. This quantitative study will provide a detailed analysis of rare plant taxa in pine rockland on that island, including *A. blodgettii*, *C. lineata* var. *keyensis* and *L. arenicola*. We did not conduct additional surveys on Big Pine Key.

Argythamnia blodgettii

Scientific Name: *Argythamnia blodgettii* (Torr. ex Chapm.) Chapm.

Common Names: Blodgett's wild-mercury, Blodgett's silverbush

Summary: *A. blodgettii* is a small, suffrutescent perennial in the Euphorbiaceae. It is listed as endangered by the state of Florida. On the Miami-Dade County mainland it grows in pine rockland and edges of rockland hammock. In the Florida Keys it grows in pine rockland, rockland hammock, coastal berm and on roadsides, especially in sunny gaps or edges (Bradley & Gann, 1999). There are historical records from Totten Key to Key West. Table 1 summarizes these locations.

Taxonomy: The species was first described by Torrey in Chapman (1884) as *Aphora blodgettii* reporting it for "South Florida," naming it after John Loomis Blodgett, physician and plant collector on Key West from 1838-1853. In an 1896 revision of the genus, Pax placed it in the genus *Ditaxis*. In 1897, Chapman placed it in the genus *Argythamnia* (spelling it *Argyrothamnia*). In 1903 Small placed it in the genus *Ditaxis* writing "In sandy soil, Key West." In 1914 Pax placed it in synonymy under *Ditaxis fendleri*, a plant of Colombia, Venezuela, Curacao, and Trinidad. Small (1933) retained it as *Ditaxis blodgettii*, treating it as a southern Florida endemic. Subsequent authors (Webster, 1967; Long & Lakela, 1971; Wunderlin, 1998; Wunderlin & Hansen, 2003) have retained it as a southern Florida endemic – *Argythamnia blodgettii*.

Synonyms: *Aphora blodgettii* Torr. ex Chapm.; *Ditaxis blodgettii* (Torr. ex Chapm.) Pax; *Argyrothamnia blodgettii* (Torr. ex Chapm.) Chapm.; *Ditaxis fendleri* Pax, not (Müll. Arg.) Pax and K. Hoof.

Field Surveys: We identified 11 known sites and three historical sites for this taxon. We surveyed most of these sites. Sites not surveyed were due to other recent IRC surveys or because we could not obtain permission to these sites. Three sites are of uncertain status due to access or location data issues. We also surveyed 12 potential sites **Table 1** summarizes this data. Florida Keys distribution is shown in **Map #1**.

Results

Extant Populations

Island: Big Munson Island

Owner: The Boy Scouts of America

Current Population: 1,001 – 10,000 plants

Map #2

Location: Big Munson Island is one of the Newfound Harbour Keys south of Big Pine Key. It is accessible only by boat. The island serves as a camp for Boy Scouts with campsites located along a coastal berm which runs along most of the southern edge of the island.

History: *A. blodgettii* was observed and vouchered in 2001 in proximity to populations of the rare species *Chromolaena frustrata* (Bradley & Gann, 2004) which is a candidate for listing under the ESA.

Current Surveys: This population was surveyed on August 24, 2005. *A. blodgettii* was present in large quantities on the island occurring in several different habitats. It is present in small numbers in the small coastal rock barren area, where it occurs with *Opuntia triacanthos*. However, by far the largest numbers of plants occur around the edges of a rockland hammock on the ocean side, towards the western end of the island. Here there are close to ten thousand plants, the majority in clearings winding through the hammock and growing in the understory of the hammock itself. Plants also grow on the nearby coastal berm, where they are in sandy substrate and partial shade. A few plants also occur on the coastal berm at the eastern end of the island. It is worth noting that the Key Deer on the island do not appear to forage on this species, probably because of toxicity.

Threats: Development would pose an obvious threat to this population, however there appears to be little impact with current Boy Scout activity on the island. We will be supplying them with a copy of this report, per request of their organization who graciously supplied us with permission to survey and provided boat transportation. They apparently have a keen interest in preserving the unique characteristics of their beautiful island.

Special Recommendations: Continue to work with the Boy Scouts to aid in awareness of rare and exotic species present on Big Munson to aid in conservation and exotic plant management.

Island: Big Pine Key

Site: Koehn's Subdivision area

Owner: National Key Deer Refuge (in part)

Current Population: 101 – 1,000 plants (ca. 200)

Map #3

Location: Koehn's subdivision area is located in north-eastern Big Pine, east of the Blue Hole.

History: *A. blodgettii* was observed at Koehn's Subdivision by George N. Avery in 1962. He observed plants along a roadside on a low ridge of bulldozer detritus.

Current Surveys: This population was surveyed on December 22, 2005 by Keith Bradley, Stephen Hodges and Josh Mahoney. Most plants occur on the edges of county roads. During the current study we observed plants along the west edge of Koehn's Subdivision on Pine Avenue, just west of there along the edges of Big Pine Street, and a few plants in the pine rockland west of the subdivision. Plants are most common along the road edges and are rare in the intact pine rockland.

Threats: Illegal dumping was observed nearby this population. As with all roadside populations of rare plants, coordination needs to exist with road maintenance crews. Because this population exists on the edge of a dirt road the possibility exists that it will be paved in the future. Other infrastructure projects such as underground cable, sewer and water lines may also impact roadside populations. Herbicide spraying of the roadside

could obviously impact the population as well. Crews need to be made aware of the existence of these populations and to be careful when working nearby.

Special Recommendations: Illegal dumping after Hurricane Wilma is having a large impact on roadside populations of plants throughout Big Pine. Monitor the population after the large amounts of debris have been removed from Big Pine.

Island: Big Pine Key

Site: Cactus Hammock and Long Beach area

Owner: National Key Deer Refuge

Current Population: 1,000 – 10,000 plants (ca. 2,000)

Map #4

Location: This area is on the southeastern corner of Big Pine Key. Long Beach runs from north to south to the west of Cactus Hammock.

History: E.P. Killip vouchered this population in 1936 (Killip 31688, US) and again in 1951 (Killip 40912, US), W.T. Gillis in 1972 (Gillis 11523, FTG), and D.S. Correll in 1977 (Correll & Popenoe 48093, NY). Numerous other observations have been made by botanists and other naturalists over the years.

Current Surveys: IRC biologists surveyed this population on July 6th, 2005. A healthy population occurs along the full extent of coastal berm in this area, possibly extending into private property towards the southwest. Robust plants grow in full sun and completely sandy substrate near the beach. This population extends from the western edge of the public lands to the Big Pine Key Fishing Lodge to the north. *A. blodgettii* also thrives along the clearings and trails extending throughout Cactus Hammock and occurs under shady conditions within the hammock itself. Plants within the hammock occur on both sides of Long Beach Road, however, the majority are on the northern side of the road in the hammock itself. They are abundant along trails and easily seen.

Threats: Storm surges may pose a threat to this population; however they may also ultimately help this species by creating canopy gaps where *A. blodgettii* thrives. The area should be monitored for exotic plant encroachment. There has been discussion in the past of reopening fire breaks through the hammock. This would heavily impact *A. blodgettii*. Fire breaks in Cactus Hammock should remain closed.

Island: Big Pine Key

Site: Watson Hammock area

Owner: National Key Deer Refuge

Population: 2 plants

Map #3

Location: Watson Hammock is located at on the west coast of Big Pine, due west of the Blue Hole. This population is on the northern edge of the hammock.

History: Kruer included this population in his 1992 report (Kruer, 1992), Bradley and Woodmansee observed this population in 2001.

Current Surveys: Two plants were recorded here in the parallel study of rare pine rockland plants by Bradley. Plants were seen on the pine rockland/rockland hammock ecotone.

Threats: Threats to this population may include hot fires and other natural disturbance events.

Special Recommendations: Watson's Hammock was not fully surveyed during this project, additional populations may exist on other hammock edges. This area should be surveyed more thoroughly in the future.

Island: Boca Chica Key

Site: Key West Naval Air Station

Owner: United States Department of Defense

Current population 1,001 – 10,000 plants (ca. 1,200)

Location: The populations are located on the eastern portion of the Key West Naval Air Station.

History: There are no known records of prior observations or collections of *A. blodgettii* in the FISF.

Current Surveys: Tina Henize surveyed this population for Florida Natural Areas Inventory in 2004. She located two distinct populations of *A. blodgettii*. The largest of these is on the eastern portion of Boca Chica just south of Runway 25 where it occurs in disturbed habitat dominated by *Leucaena leucocephala*. She estimated this population at 1,000 – 10,000 plants (ca. 1,000). Another population is located near Weapons Hammock, on the west side of Boca Chica Key, south of Runway 7. This population is estimated at 100 stems (K. Burks personal communication, January 6, 2006; T. Henize personal communication, January 13, 2006).

Threats: Reported threats here include a large population of lead tree (*Leucaena leucocephala*) and maintenance activities. There may be multiple threats to this population including development, periodic clearing, dumping of toxic substances or opening of new roads. NASKW should be made aware of the existence of these populations so that they can avoid impacting them.

Special Recommendations: These populations should be periodically monitored.

Island: Key Largo

Site: Dove Creek Hammocks, Florida Keys Wildlife and Environmental Areas

Owner: Florida Fish and Wildlife Conservation Commission

Current Population: 11 - 100 plants

Map #5

Location: This station, one of several fragments of the State-property known as Dove Creek Hammocks, is on the bay side of Key Largo at the intersection of US1 and Casa Court Dr. at approximately mile marker 94.5.

History: Bradley observed this population in 2000 (Bradley *et al.*, 2000). This population was vouchered by Bradley and Woodmansee that same year (Bradley & Woodmansee 1311, FTG).

Current Surveys: This population was surveyed on July 5, 2005. Plants occur only on the roadside along the edge of the rockland hammock. They grow both in full sun and in partial shade. The population extends from Casa Court Dr. approximately 100m to the east along the Overseas Highway roadside.

Threats: Threats include roadside maintenance activities and exotic plants.

Island: Lignum Vitae Key

Site: Lignumvitae Key Botanical State Park

Owner: Department of Environmental Protection

Current Population: 101 – 1,000 plants

Map #6

Location: Lignum Vitae Key lies to the north-east of Lower Matecumbe Key.

History: There is an anonymous list in IRC's files based off of older plant lists reporting it from 1983. Kruer reported this population in 1992, Roger Hammer reported it in 1995 and Gann and Duquesnel observed the population in 2000.

Current Surveys: Plants here occur around the edges of the park manager residence, as well as in the main lawn. They are primarily along hammock edges, and barely occur in the grassy areas. The population around the main lawn is the primary population here.

Threats: Threats include maintenance activities and encroachment of exotic lawn grasses.

Island: Lower Matecumbe Key

Site: Klopp Tract, Lignumvitae Key Botanical State Park

Owner: Department of Environmental Protection

Current Population: 11 – 100 plants

History: This population was seen by George Gann and Janice Duquesnel in 2000.

Current Surveys: Surveys for this population could not locate this population despite good location data. This area is highly disturbed and plants may have been covered up by other vegetation. Populations of *A. blodgettii* are also ephemeral and this population may not have been currently up. We have treated this population as extant in this study because of its recent observation.

Threats: General disturbance and recruitment of weedy, ruderal species, exotic plants encroachment.

Special Recommendations: Resurvey this population in the future to determine status of this population.

Island: Plantation Key

Site: Snake Creek Hammocks, Florida Keys Wildlife and Environmental Areas

Owner: Florida Fish and Wildlife Conservation Commission

Current Population: 101 – 1,000 plants

Map #7

Location: Snake Creek Hammocks lies just to the east of Snake Creek, on the oceanside, before the drawbridge between Plantation Key and Windley Key. The hammock is adjacent to the FDOT weigh station.

History: Bradley observed this population in 2000.

Current Surveys: This population occurs in disturbed areas with rusting ditching equipment, in areas that were formerly cleared, in small clearings within the hammock, in full shade within the hammock and along the back portion of the weigh station adjacent to the natural area. The largest group seen was directly behind the weigh station occurring on bulldozed piles, and into their small lawn.

Threats: Threats include exotic plants, particularly in formerly disturbed areas, and maintenance activities.

Special Recommendations: Inform restoration crews and FDOT about the presence of this population. Care should be taken with these plants during maintenance activities.

Island: Windley Key

Site: Windley Key State Geological State Park

Owner: Department of Environmental Protection

Current Population: 11 – 100 plants

Map# 8

History: *A. blodgettii* was observed by Kruer in 1992, Bradley in 1994, and Gann and Duquesnel in 1999. Bradley vouchered this population in 1995 (Bradley 284, FTG). This population was vouchered for this survey as well (Hodges 133, FTG).

Current Surveys: Plants here occur in quarry bottoms not being regularly mowed. They also extend up along the edge of the rockland hammock in the eastern portion of the park. Plants were observed in two quarry bottoms. In the first, larger quarry, to the east of the visitor center, plants apparently persist only in natural areas not being mowed. The majority of the plants are in the farthest quarry, which is not mowed. Here the plants extend up the road and into the edges of the rockland hammock.

Threats: Threats include maintenance activities and exotic plant encroachment.

Special Recommendations: Bradley and Gann had observed populations of *A. blodgettii* in other locations within the quarry bottoms. Attention should be paid to movement of these populations. Long term strategies for management of quarry bottoms need to be developed to manage rare plant populations. The quarry immediately adjacent to the entrance and offices was filled with bay mud, this should be avoided in other quarries.

Island: Vaca Key

Site: Blue Heron Hammock, Florida Keys Wildlife and Environmental Areas

Owner: Florida Fish and Wildlife Conservation Commission

Current Population: 11 – 100 plants

Map #9

Location: This hammock is just north of the Marathon Airport, on the other side of Aviation Blvd. near the intersection with Grouper Lane.

History: Small collected *A. blodgettii* on Vaca Key in 1909 (Small & Carter 3192, NY). This population was observed by Bradley and Woodmansee in 2000 (Bradley & Woodmansee, 2000). This location is reported as the Marathon Airport Hammock by Kruer, although he did not locate *A. blodgettii* during his surveys (Kruer, 1992).

Current Surveys: This population was surveyed on June 5, 2005. This population occurs along the roadside on the southern edge of this hammock. Plants grow both in full sun right on the edge of the hammock and also in shady conditions right inside the hammock edge.

Threats: Threats to this population include roadside maintenance activities and exotic plants. As with all roadside populations infrastructure projects such as underground cable, sewer and water lines may impact populations. Herbicide spraying of the roadside could obviously impact the population as well. Crews need to be made aware of the existence of these populations and to be careful when working nearby.

Special Recommendations: This hammock is behind the airport, on the northern side. It is possible that plants are also extant in the remnant hammock inside the airport property just across Aviation Blvd., or along the runway. Except for walking the fence line, we were unable to survey the airport. The Marathon Airport portion of this Hammock should be surveyed to determine if *A. blodgettii* occurs there.

Extirpated Occurrences

Island: Totten Key

Site: Biscayne National Park.

Owner: U.S. National Park Service

Last Observation: 1904

History: *A. blodgettii* was collected here by John Kunkel Small in 1904 (s.n., NY). It has not been seen there again, despite surveys conducted by IRC during a plant inventory of Biscayne National Park (Bradley *et al.*, 2004).

Island: Key West

Site: Key West Cemetery

Owner: City of Key West

Last Observation: 1965

History: *A. blodgettii* was collected on Key West by John Loomis Blodgett sometime between 1838 and 1853 (s.n., NY). Additional collections were made by others in 1874, 1880, 1891, 1896, 1904, 1913, and the last collection was made by E.P. Killip in 1952 (Killip 41891, US). The last observation of the species on Key West was made by George N. Avery in 1965 who observed it in the northeast quadrant of the Key West Cemetery (Avery, n.d.). Bradley has explored the cemetery on several occasions documenting rare plant occurrences and has not been able to find it.

Current Surveys: The cemetery was resurveyed on July 6, 2005 and the species could not be found.

Special Recommendations: It is possible that *A. blodgettii* may still exist on Key West though it has not been recently seen. Little Hamaca Park is the last remaining upland natural area in Key West and other rare species are extant there (e.g. *Bourreria radula*). This area has been botanized in the recent past, but should continue to be resurveyed on occasion, despite the fact that *A. blodgettii* has never been reported from there (Kruer, 1992; Gann *et al.*, 2002). Additional roadside surveys may also eventually locate the species.

Island: Key Largo

Site: Disturbed sites on Northern Key Largo

Owner: Various Private owners, Possibly Dagny Johnson Key Largo Hammocks Botanical State Park or Crocodile Lakes National Wildlife Refuge

Last Observation: 1977

History: *A. blodgettii* was collected here in a weedy field on North Key Largo in 1977. IRC staff have conducted plant inventories of the two parks on North Key Largo, Crocodile Lakes National Wildlife Refuge and Dagny Johnson Key Largo Hammocks

Botanical State Park and have not observed the species. We have seen no other reports from this area.

Status Unknown

Island: Boot Key

Site: Boot Key coastal berm

Owner: Azurite Corp. LTD of Florida

Last Observation: 1998

Current Status: Unknown population size

History: In 1998 plants were observed by Bradley on the coastal berm at the southeast corner of the island. Plants are probably extant at this site. We could not obtain landowner permission to survey this site.

Island: Stock Island

Site: Stock Island Golf Course

Owner: Key West Golf Club Development Inc.

Last Observation: 1981

History: *A. blodgettii* was observed at the Key West Golf Course on Stock Island in 1981 by George N. Avery in a thicket at the southwest corner of the golf course (Avery, n.d.). Only a small portion of the golf course was explored during this survey. The golf course was severely damaged during Hurricane Wilma and we did not finish the survey. It is possible, although unlikely because of heavy maintenance activities at the property in the past 24 years, those plants remain here.

Island: Long Key

Site: Long Key State Park

Owner: Department of Environmental Protection

Last Observation: 1999

History: This population was seen by George Gann and Janice Duquesnel in 1999.

Current Surveys: There was a lack of location data for this species in the park. A portion of the coastal berm was surveyed, however no plants were located. Extensive surveys were done in the coastal rock barren area, where no plants were seen.

Special Recommendations: This area should be resurveyed in the future to look for the presence of this population.

Summary

Florida Keys Current Population Size (excluding Big Pine): 10,001 – 100,000 plants (ca. 11,000). The total known population for *A. blodgettii* based on our surveys, based on a log₁₀ scale is estimated to be in excess of 10,000 plants. By far the largest population surveyed was on Big Munson Island, which is owned by the Boy Scouts of America. Because of the large number of plants located here, it was impossible to give an exact count of the number of plants, however this population is estimated to be 8,000-9,000 plants.

Habitat: *A. blodgettii* is primarily a plant of open sunny areas in pine rockland, edges of rockland hammock, edges of coastal berm, sparsely in coastal rock barren and sometimes disturbed areas in close proximity to a natural area. Plants can be found growing from crevices on oolitic or Key Largo limestone or on sand. The pine rockland habitat where it occurs in Miami-Dade County and the Florida Keys requires periodic fires to maintain an open sunny understory with a minimum amount of hardwoods.

Associated Species by Habitat:

Buttonwood Woodland Edge: *Avicennia germinans*, *Batis maritima*, *Capparis flexuosa*, *Conocarpus erectus*, *Herissantia crispa*, *Laguncularia racemosa*, *Monantheochloe littoralis*, *Pentalinon luteum*, *Sesuvium portulacastrum*, *Sporobolus domingensis*, and *Suriana maritima*

Coastal Berm: Most of the hammock edge species listed above also occur in the Maritime Hammock/Coastal Berm habitat, *C. erectus* is also a dominant component. Additional species include: *Hymenocallis latifolia*, *Solanum bahamense*, *Stachytarpheta jamaicensis*, and *Uniola paniculata*.

Coastal Rock Barren: *A. blodgettii* was only found to occur sparsely in this habitat on Big Munson Island, associated species included: *Chromolaena frustrata*, *Herissantia crispa*, *Heliotropium angiospermum*, *Hibiscus poeppigii*, *Jacquemontia pentanthos*, *Opuntia stricta*, and *Opuntia triacanthos*.

Hammock Edge: *Acanthocereus tetragonus*, *Bouyeria succulenta*, *Bursera simaruba*, *Caesalpinia bonduc*, *Capparis cynophallophora*, *Cissus trifoliata*, *Coccoloba diversifolia*, *Eugenia axillaris*, *Eugenia foetida*, *Exostema caribaeum*, *Exothea paniculata*, *Galactia striata*, *Guapira discolor*, *Gymnanthes lucida*, *Chiococca alba*, *Lantana involucrata*, *Lasiacis divaricata*, *Lysiloma latisiliquum*, *Manilkara jaimiqui* subsp. *emarginata*, *Metopium toxiferum*, *Morinda royoc*, *Myrcianthes fragrans*, *Oeceoclades maculata*, *Passiflora suberosa*, *Piscidia piscipula*, *Pithecellobium keyense*, *Randia aculeata*, *Reynosa septentrionalis*, *Swietenia mahagoni*, *Waltheria indica* and *Zanthoxylum fagara*.

Pine Rockland: Please refer to the Bradley Big Pine Key report.

Roadside and Disturbed Sites: *Catharanthus roseus*, *Capraria biflora*, *Cocos nucifera*, *Dactyloctenium aegyptium*, *Desmodium incanum*, *Heliotropium angiospermum*, *Herissantia crispa*, *Heliotropium angiospermum*, *Leucaena leucocephala*, *Panicum maximum*, *Phoenix dactylifera*, *Rhynchelytrum repens*, *Sansevieria hyacinthoides*, *Senna mexicana* var. *chapmanii*, *Sida acuta*, *Sporobolus indicus* var. *pyramidalis*, *Stylosanthes hamata* and *Tridax procumbens*.

Discussion

Little is known about the reproductive biology or life history of *A. blodgettii*. Studies need to be conducted to examine the details of the biology of all of our endemic species, particularly rare ones. Ephemeral populations present challenges, so we know little about long term continuity of population sizes. Reproductive biology studies would shed additional light on affects of unnatural disturbance and mosquito spraying on pollinators. It is important to note that Key Deer do not appear to feed on this taxon, probably due to toxicity. Grazing by deer can greatly impact other herbaceous species during times of food stress for the deer.

As with all listed species, populations need to be monitored on a regular basis to track trends within the population and changes in management needs. Of particular concern with *A. blodgettii* is roadside maintenance. A coordinated system of informing maintenance crews about rare populations of plants occurring in the right of way is needed. Herbicide spraying of the roadside is obviously of special concern.

Chamaecrista lineata var. *keyensis*

Scientific Name: *Chamaecrista lineata* (Sw.) Greene var. *keyensis* (Pennell) H.S. Irwin & Barneby

Common Names: Big Pine partridge pea, narrowpod sensitive pea

Summary: *C. lineata* var. *keyensis* is a small prostrate to ascending shrub in the Fabaceae. It is endemic to the pine rocklands of the lower keys. Historically, this species was known from several islands, including Ramrod Key, Cudjoe Key, No Name Key and Big Pine Key. The population is sizeable on Big Pine Key, where a large portion of its range is protected in the National Key Deer Refuge. The late botanist George Avery observed the species on Cudjoe Key in 1977, and this station was vouchered in 1979 by Dan Austin (Austin 125961, FTG). John Kunkel Small collected Big Pine partridge pea on Ramrod Key in 1911 and on No Name Key in 1916 (Bradley & Gann, 1999). Ward lists the species as occurring in sparse populations on Cudjoe and No Name Key (Ward, 1978). In a study of Keys endemics Ross and Ruiz (1996) found plants only on Big Pine Key. Several papers have dealt with breeding ecology and effects of fire regimes on *C. lineata* var. *keyensis* (Hessl & Spackman, 1995; Liu *et al.*, 2005; Liu & Koptur, 2003; Rocca, 1997; Ross & Ruiz, 1996).

Taxonomy: John Loomis Blodgett was the first to collect this taxon sometime between 1838 and 1853 on “Pine Key” (Big Pine Key). Pollard (1894) was the first to recognize that this was different than other Florida species of *Chamaecrista*, calling it *C. grammica*, a West Indian plant now called *C. lineata* var. *brachyloba* (Irwin & Barneby, 1982). Small (1903, 1913) followed this usage. In 1917 Pennell recognized it as a distinct endemic species, naming it *Chamaecrista keyensis* (see Irwin & Barneby, 1982). This name was also retained by Small (1933). In 1919, Macbride placed the taxon in the genus *Cassia*, creating the name *Cassia keyensis* (See Isely, 1975). Isely (1975) and Long & Lakela (1971) followed this treatment. In an exhaustive study of *Cassia* and *Chamaecrista* in 1982, Irwin and Barneby noticed the similarity between plants in Florida and other parts of the West Indies. Retaining the plant in the genus *Chamaecrista*, they named the plant *C. lineata* var. *keyensis*, retaining it as endemic with close relatives in the Bahamas and Cuba. Isely (1990), Wunderlin and Hansen (1998), and Wunderlin & Hansen (2003) have followed this treatment.

Synonyms: *Cassia keyensis* (Pennell) J.F. Macbr., *Chamaecrista keyensis* Pennell, *Chamaecrista grammica* Spreng. misapplied, *Cassia grammica* Spreng, misapplied.

Field Surveys: We identified three known sites and two historical sites for this taxon. We surveyed each of these sites. We also surveyed 1 potential site. Discovery of the taxon while surveying for *L. arenicola* on Lower Sugarloaf (included in known sites) was a serendipitous discovery. **Table 2** summarizes this data. Overall Florida Keys distribution is shown in **Map #10**.

Results

Extant Occurrences

Island: Big Pine Key

Site: National Key Deer Refuge and numerous private owners

Location: See Bradley Big Pine Key report

Current Population: 10,000 – 100,000 plants

History: *C. lineata* var. *keyensis* was first collected on Big Pine Key by John Loomis Blodgett between 1838 and 1853 (s.n., NY). It has been collected repeatedly since then, but collections typically have little if any useful habitat or locality data. Recent works have shown the species to be quite common on the island (Ross & Ruiz, 1996; Liu, 2003), but no thorough survey had been conducted to determine its distribution on the island or to quantify its abundance.

Current Surveys: The large area of habitat for this species on Big Pine Key warranted a separate study which has been conducted in parallel with the present study. This report will be issued separately to the US Fish and Wildlife Service. In brief, this taxon is quite common on Big Pine Key, both on roadsides and in intact pine rockland.

Island: Cudjoe Key

Owner: National Key Deer Refuge

Current Population: 101 – 1,000 (ca. 150)

Map #11

Location: The National Key Deer Refuge on Cudjoe is located in the northeastern portion of the island.

History: The late botanist George Avery observed the species on Cudjoe Key in 1977, and this station was vouchered in 1979 by Dan Austin (Austin 125961, FTG). Austin reported 95 individuals found during his surveys (Austin *et al.*, 1980). Monique Rocca, in a work prepared for the Nature Conservancy, found one individual on Cudjoe (Rocca, 1997).

Current Surveys: This population was located during surveys by Stephen R. Hodges and Josh Mahoney on August 23, 2005. This population of approximately 150 plants occurs in the southern portion of the pine rockland area within the refuge. It was observed in a grassy clearing slightly to the northwest of a *Cladium jamaicense* marsh. Although plants were searched for in other locations throughout the pine rockland area, no more plants were located. This population was vouchered (Hodges 117, FTG).

Threats: A major threat to the long term viability of populations of *C. lineata keyensis* is alteration of the fire regime (Liu, 2003). H. Liu's work on fire regimes and the reproductive success of the taxon provides detailed information. In brief she found that reproductive success increased two or three years after prescribed burns. This information needs to be incorporated into prescribed burn schedules for all areas impacting this taxon. Long term lack of fire certainly leads to shady conditions where the taxon will likely disappear. Exotic plants are a constant threat in natural areas of the Florida Keys.

Special Recommendations: Additional surveys should be conducted several months after prescribed burns occur to ascertain whether additional populations exist. This population was not visited after Hurricane Wilma, during which this area of Cudjoe was inundated by a strong storm surge. This population should be surveyed in the next year to determine long term affects of Hurricane Wilma.

Island: Lower Sugarloaf Key
Site: Loop Road Area roadside
Owner: Monroe County
Current Population: 2-3 plants
Map #12

Location: The Loop road area is approximately 500 meters to the east of the intersection between County Road 939 and Old State Highway 4A.

History: We have no knowledge of any collections or observations of this species on Lower Sugarloaf, or any point south-west of Cudjoe.

Current Surveys: These plants were discovered by Stephen R. Hodges and Josh Mahoney on June 2, 2005. This discovery represents a large range extension for the taxon. Plants were located at the same location as *L. arenicola* along the Loop Road area of Lower Sugarloaf. The land adjacent to this road remains private, although the plants occur along the right of way. These are near the western end of the loop (the portion close to the canal and popular swimming hole). This population was not vouchered because of its small size, although a small piece was collected for positive identification by Bradley. *Chamaecrista nictitans* var. *aspera* also occurs in abundance at this site, but these species can be easily distinguished, even in a vegetative state. We attempted to relocate this population in early December after Hurricane Wilma. No living plants were observed, and most of the herbaceous vegetation in the area appeared dead.

Threats: Threats include storm surges, dumping of mulch along the roadside, possible development and exotic plants. Roadside maintenance is also of critical importance to this population. Maintenance activities could completely eliminate this population unless informed and supervised for management of *C. lineata* var. *keyensis* and *L. arenicola*.

Special Recommendations: This population needs to be resurveyed on a regular basis to determine long term effects of storm surges. In addition, long term monitoring will determine whether this population merely represents an ephemeral occurrence, which is likely due to its small population size. Finally, although we were only able to locate the taxon on the roadside, we did not survey along the canal banks because the area is on private property, and land owner information was difficult to obtain. Property across County Road 939 is managed as Florida Keys Wildlife and Environmental Areas. The private parcel on the east side of the road, including the canal and Loop Road areas, should be acquired by the state.

Extirpated Occurrences

Island: No Name Key

Owner: The National Key Deer Refuge owns the majority of suitable habitat

Last Observation: 1916

History: John Kunkel Small collected Big Pine partridge pea on No Name Key in 1916 (Bradley & Gann, 1999). Ward lists the species as occurring very sparingly on No Name Key but does not reference a collection, so this observation remains unclear (Ward, 1978). Bradley also listed the species in his field notes from 1997, but has no recollection of this occasion. To our knowledge the only verifiable observation is the collection by J.K. Small in 1916.

Current Surveys: Hodges and E. Fleites surveyed No Name Key in December, 2005 several times but could not locate the taxon. Surveys were done after Hurricane Wilma, when much of the herbaceous layer was highly impacted by storm surges.

Special Recommendations: This island should be surveyed on an annual basis to determine whether or not *C. lineata* var. *keyensis* maintains ephemeral populations on the island. When populations are located they should be vouchered, even if just a portion of an individual is collected. We had hoped to locate and voucher the taxon during this study; however our surveys were greatly impacted by Hurricane Wilma and should not be considered complete. It seems apparent that this taxon establishes itself periodically on the island, but fails to maintain a steady population there for unknown reasons.

Island: Ramrod

Site: Unknown

Last Observation: 1911

History: John Kunkel Small collected Big Pine partridge pea on Ramrod in 1911. This is the only known observation of this taxon on Ramrod. The taxon was probably extirpated due to development or natural causes.

Current Surveys: All suitable habitat was surveyed including roadsides and natural areas. One large private parcel along the south-western portion of the island was not surveyed because we could not obtain permission to enter the property. Several rare plants are known from that property and it is possible, although unlikely because appropriate habitat does not appear to exist there, that *C. lineata* var. *keyensis* could be found there.

Total Current Population in the Florida Keys (excluding Big Pine Key): 101 – 1,000 plants (ca. 150). Please see the Bradley Big Pine Key Report for population estimates.

Habitat: *C. lineata* var. *keyensis* occurs primarily in intact pine rockland and roadsides on Big Pine Key (Liu, 2003). On Cudjoe Key it occurs in pine rockland and on Lower Sugarloaf Key it occurs on a roadside next to rockland hammock.

Associated Species by Habitat:

Pine Rockland: *Agalinis fasciculata*, *Angadenia berteroi*, *Aristida purpurascens*, *Byrsonima lucida*, *Cassytha filiformis*, *Chiococca parvifolia*, *Cirsium horridulum*,

Coccothrinax argentata, *Dyschoriste angusta*, *Ernodea littoralis*, *Fimbristylis cymosa*, *Galactia volubilis*, *Guapira discolor*, *Guettarda scabra*, *Linum arenicola*, *Metopium toxiferum*, *Manilkara jaimiqui* subsp. *emarginata*, *Myrica cerifera*, *Panicum virgatum*, *Phyla nodiflora*, *Pinus elliotii* var. *densa*, *Pithecellobium keyense*, *Psidium longipes*, *Pteridium aquilinum* var. *caudatum*, *Pteris bahamensis*, *Randia aculeata*, *Rapanea punctata*, *Rhynchospora floridensis*, *Sabal palmetto*, *Schizachyrium gracile*, *Schizachyrium rhizomatum*, *Schizachyrium sanguineum*, *Smilax havanensis*, *Stylosanthes calcicola*, *Sophora tomentosa* var. *truncata* and *Sorghastrum secundum*.

Rockland Hammock Edge/Roadside: *Agalinis fasciculata*, *Angadenia berteroi*, *Aristida purpurascens*, *Buchnera americana*, *Byrsonima lucida*, *Coccoloba uvifera*, *Conocarpus erectus*, *Erithalis fruticosa*, *Fimbristylis spadicea*, *Fimbristylis cymosa*, *Galactia volubilis*, *Linum arenicola*, *Manilkara jaimiqui* subsp. *emarginata*, *Morinda royoc*, *Sabatia stellaris*, *Schizachyrium gracile* and *Waltheria indica*.

Discussion

C. lineata var. *keyensis* is highly dependant on appropriate fire regimes (Liu, 2003). Information about the affects of fire on impacted taxa needs to be incorporated into prescribed burn schedules. It remains unclear what forces restrict populations of this taxon in apparently good habitat (*i.e.* No Name Key). It is possible that large storm surges are responsible for this, however Bradley and Hodges observed *C. lineata* var. *keyensis* resprouting from root stock on northern Big Pine in late December, 2005. This area had also been heavily inundated by a storm surge. This would seem to confirm that this is not a major factor in appropriate habitat.

Sea level rise will continue to impact this taxon by reducing the amount of pine rockland in the Lower Keys (Ross *et al.*, 1994). Other factors that may affect this taxon include mosquito spraying and maintenance activities along roadsides. Additional appropriate habitat, including roadsides, should be surveyed in the future to determine if this taxon is extant in other locations outside of its known range. Finally, populations, particularly those off of Big Pine Key, need to be monitored on an annual basis to track changes in size and management needs.

Indigofera mucronata var. *keyensis*

Scientific Name: *Indigofera mucronata* Spreng. ex DC. var. *keyensis* (Small) Isely

Common Names: Florida Keys indigo

Summary: *Indigofera mucronata* var. *keyensis* is a small, ascending perennial herb in the Fabaceae. The taxon is currently known only from Monroe County in the Florida Keys. The taxon formerly occurred in Collier County where it was collected in the 1800's at "Robert's Key, Caxambas Bay", probably Marco Island, by A.W. Chapman (s.n., US) and in Miami-Dade County in 1877 at "Miami" by A.P. Garber (s.n., US). These two collections represent the only reports we have seen for the taxon outside of the Florida Keys (Gann *et al.*, 2002).

In the Florida Keys, *I. mucronata* var. *keyensis* occurs in coastal rock barren and rockland hammock edges or canopy gaps. The historical range of this species extended from Key Largo to Knights Key, just south of Marathon before the Seven-Mile bridge. In a status summary completed by IRC in 1999, Bradley and Gann found that the taxon had possibly been extirpated from nearly half of the islands it was historically known from. Ross and Ruiz (1996) located a new station for the species on Long Point Key, but only located the species in one other location, Long Key. They also monitored the habitat at Windley Key, but did not locate Florida Keys indigo at the time of their survey. Their study, however, was meant to classify habitat more than to perform an exhaustive search for the species.

Taxonomy: The species was first described by Small (1913) as *I. keyensis* from specimens collected on Lower Matecumbe Key in 1907. Isely (1982) recognized that the plant was similar to the tropical *I. mucronata* of the West Indies, and treated it as a variety of that species – *I. mucronata* var. *keyensis*. In a revision of Southeast Asia *Indigofera*, de Kort and Thijssse (1984) included *I. mucronata* as a synonym of *I. trita* ssp. *scabra*. Kartesz and Gandhi (1990) felt that this taxon did warrant status as a unique variety, but point out that *I. mucronata* DC. was a later homonym of *I. mucronata* Lamark, making Isely's combination illegitimate. They published a new combination *I. trita* L. var. *keyensis* (Small) Kartesz & Gandhi. Isely (see Kartesz & Gandhi, 1990) apparently did not agree with this solution, believing the de Kort and Thijssse study of New World materials to be incomplete. Wunderlin (1998) had continued to use Isely's combination, *I. mucronata* var. *keyensis*, however more recently has adopted the de Kort and Thijssse treatment (Wunderlin & Hansen, 2003).

It is apparent that the nomenclature of this taxon needs further study, but we have continued to use Isely's combination. While we have not studied the taxonomy ourselves, it would be a unique situation to have a taxon whose native range includes tropical America, tropical and South Africa, Madagascar, India, Sri Lanka, Laos, Thailand and New Guinea.

Synonyms: *Indigofera keyensis* Small, *Indigofera trita* L. var. *keyensis* (Small) Kartesz & Gandhi. *Indigofera trita* L. ssp. *scabra* (Roth) de Kort & Thijssse, misapplied.

Field Surveys: We identified known populations of *I. mucronata* var. *keyensis* on seven islands. Four islands had historic occurrences. Potential habitat occurred on 3 islands. Some islands contain multiple stations. Table 3 summarizes these surveys. *I. mucronata* var. *keyensis* was located on two islands where it was thought to be extirpated (Lignum Vitae Key and Upper Matecumbe Key) and discovered in a number of new stations on islands where the species was known to be extant in other locations (Crawl Key, Long Point Key and Lower Matecumbe). **Map #13** shows the overall distribution of this taxon.

Results

Extant Occurrences

Island: Crawl Key

Site: Crawl Key Rock Barren, Oceanside of US1

Owner: Gulf Stream LP

Map #14

Current Population: 101 – 1,000 plants (ca. 500)

Location: Crawl Key is a small island on US1 between Grassy Key and Long Point Key. US1 crosses the northern tip of a circular coastal rock barren. The occurrence referred to here is in the rock barren on the ocean side of US1. This area has also been called the “Valhalla Rock Barren.” This station is privately owned and is adjacent to Curry Hammock State Park on the ocean side of US1. Much of the ocean side of US1 on Crawl Key has been platted. The rock barren area includes about 24 parcels on just under 11 acres, of only 0.34 to 0.46 acres each, all owned by “Gulf Stream LP.” except for the bayside parcel, which is owned by Monroe County.

History: *I. mucronata* var. *keyensis* was first collected here by W.L. Stern and K.L. Chambers in 1958 (340, NY, US). George N. Avery in 1966 reported that it was common here. It was also reported by Kruer (1992) and observed by Bradley multiple times starting in 1996.

Current Surveys: This population was surveyed on October 11, 2005. *I. mucronata* var. *keyensis* occurs in relative abundance throughout the 4 acre rock barren (Kruer, 1992). It is typically found in patches of 20 or 30 plants, but sometimes up to a hundred. In order to aid in quantifying the large number of plants at this site, five, five meter radius plots were placed within the rock barren. Individual plants were counted within these plots for a mean average of 38 plants per plot. This data was used to help us estimate the population size. When surveyed, the plants were in abundant fruit and flower. This population was revisited after Hurricane Wilma and did not appear to have been impacted.

Threats: Other threats include exotic plant encroachment, illegal dumping and possibly storm surges. It is very important to note, however, that there is no definitive data about the long term effects of storm surges on this species. These surges may actually help preserve coastal rock barrens in the long term, and be an integral part of the natural dynamics of this taxon. See appendix one for further information.

Special Recommendations: This site should be acquired by the state or federal government to prevent development, and to conserve the many rare species present at this

coastal rock barren. This site lies immediately adjacent to Curry Hammocks State Park and contains some of the rarest plant species in the Florida Keys. The Crawl Key Rock Barren area is of critical conservation importance and all of it should be protected within the park. The two highest quality coastal rock barrens, probably the rarest and least known habitat in the Florida Keys, are on Long Key and Crawl Key. They should both be conserved and studied long term.

Island: Crawl Key

Site: Crawl Key Rock Barren, Bayside

Owner: Monroe County

Current Population: 11 – 100 plants

Map #14

Location: This station is immediately across US1 from the above station and is essentially part of the same population.

History: Bradley surveyed this area in the 1990's but did not observe the taxon.

Current Surveys: IRC biologists Stephen Hodges and Eric Fleites discovered this formerly unknown station on October 11, 2005. Here, two small colonies occur in light gaps in the hammock, just north of the bike trail. There are many other small clearings throughout this portion of the hammock that have the appropriate associated species and conditions but where no plants were found. Examination of aerial photographs indicates that this was the northern edge of the rock barren, before US1 dissected it.

Threats: The major threat to these populations is exotic plants, already encroaching. Other threats include development and maintenance activities, and illegal dumping.

Special Recommendations: This population should be monitored on an annual basis. This property is already owned by Monroe County and should be incorporated into Curry Hammocks State Park. Many of the rarest plant species present in the vicinity of the park remain unprotected. The Crawl Key Rock Barren area is of critical conservation importance and all of it should be protected within the park.

Island: Key Largo

Site: Key Largo Narrows, John Pennekamp Coral Reef State Park

Owner: Florida Department of Environmental Protection

Current Population: 11 – 100 plants

Map #15

Location: Key Largo narrows is located on the southwestern end of Key Largo, adjacent to Travel Trailer Town.

History: W. Atwater collected *I. mucronata* var. *keyensis* on Key Largo in 1959 (Atwater M-170, FLAS). A.H. Curtiss also collected this taxon on Key Largo but did not include a date (Curtiss 586, NY). Neither included specific locality data. G. Avery reported it growing thickly in the area in 1964. Gann and Bradley observed the population in 1995, Gann and Duquesnel also observed it in 1998. Gann vouchered this population in 2004 (Gann 1215, FTG).

Current Surveys: This population was surveyed on December 23, 2005. Plants were observed growing near the hammock edge apparently just above the high tide line. Habitat for this population is somewhat distinct, although similar associated species occur here as well. This population is not a true rock barren, but is poorly understood.

Threats: Exotic plants are a major threat to this population. Populations of several species of exotic plant are large in this area and should be eradicated. In addition, illegal dumping, and hurricane debris exist in large quantities around the site. This should be removed and the park boundary abutting the trailer park should be fenced to prevent trespassing.

Special Recommendations: This population should be monitored on an annual basis.

Island: Lignum Vitae Key

Site: Lignumvitae Key Botanical State Park

Owner: Florida Department of Environmental Protection

Current Population: ca. 5 plants

Map #16

Location: Lignum Vitae Key lies to the north-east of Lower Matecumbe Key.

History: *I. mucronata* var. *keyensis* was collected on Lignum Vitae Key between 1838 and 1853 by John Loomis Blodgett. This was also the first collection ever made of the taxon. No other reports were ever made from the island despite repeated botanical exploration during the past few decades.

Current Surveys: IRC biologists Stephen Hodges and Eric Fleites rediscovered this population on October 13, 2005, some 150 years after Blodgett collected it there. This population was vouchered (Hodges 122, FTG). Plants occur near an area once formerly cleared for a landing strip, along the hammock buttonwood ecotone, near the end of the island's stonewall. Several plants were in flower and fruit when surveyed. A thorough count was not possible without disturbing and possibly harming some individuals, therefore the population was estimated from the closest possible vantage point. Multiple surveys have been conducted for this species over the years, including a thorough search of the hammock edge for *Chromolaena frustrata* in 2003 (Bradley & Gann, 2004; G. Gann personal communication, October 16, 2005). This indicates that this population is naturally ephemeral.

Threats: Because of the extreme rarity of the taxon on the island, any disturbance could lead to its permanent extirpation. During trail maintenance, work on the stone wall, exotic plant removal or any other maintenance in the area, it is imperative that substrate in the area not be disturbed.

Special Recommendations: It will be important to monitor this population after hurricanes to determine if disturbance events predicate its appearance.

Island: Long Key

Site: Long Key State Park

Owner: Florida Department of Environmental Protection

Current Population: 101 – 1,000 plants

Map #17

Location: Within Long Key State Park on the western portion of the island, this population is scattered throughout the coastal rock barren on the Bay side of US1, southwest of the landfill.

History: George Avery observed *I. mucronata* var. *keyensis* in what is now Long Key State Park in 1966. It was later collected there by Carol Lippincott in 1991 (s.n., FTG) and observed there by a number of botanists, including IRC staff, since then.

Current Surveys: This population is scattered throughout the coastal rock barren on the Bay side of US1, southwest of the landfill. This rock barren is very patchy, with small areas of rock barren habitat divided by areas of dense rockland hammock hardwoods. Most plants occur along the edge of the hardwoods occur in partial shade, along with *Chromolaena frustrata*. Bradley, with Janice Duquesnel, has observed plants along the edge of Florida Bay in the same general vicinity; however storm surges made this area impractical to survey during this study.

Threats: Apparently secure. However exotic plant encroachment and shading out by hardwoods remain long term threats.

Special recommendations: This population was severely impacted by storm surges from Hurricane Wilma. Additional surveys should be conducted in the next year and subsequent years to ascertain the longer-term effects upon the population.

Island: Long Point Key

Site: Curry Hammock State Park

Owner: Florida Department of Environmental Protection

Current Population: 11 – 100 plants

Map #14

Location: Long Point Key is a small island on US1 between Crawl Key and Fat Deer Key.

History: *I. mucronata* var. *keyensis* was discovered on the island by Ross & Ruiz (1996). Ross' station was on private property on Burnt Point at the northern end of the island.

Current Surveys: Stephen Hodges and Eric Fleites discovered a new colony on October 11, 2005 to the south of Ross' station. They are found north of US1, approximately 500 meters from the northern property line of the state park, to the west of the north-south park road. We could not obtain permission from the landowner to survey the Ross station and so those plants were not surveyed. These plants occur under buttonwood, on rocky substrate with *Cyperus squarrosus* (Hodges 125, FTG), *Opuntia stricta*, *Jacquemontia pentanthos* and other species. Plants were observed in two distinct locations, approximately 150 feet apart. Rock barren areas are scarce in the area and these areas should be periodically monitored.

Threats: Threats include planned restoration activities (J. Duquesnel personal communication, October 12, 2005) and other maintenance. Substantial debris was dumped on the site prior to it being added to Curry Hammock State Park. Exotic plants are a major problem in that area and could easily move north towards the *I. mucronata* var. *keyensis* population.

Special Recommendations: Planned efforts to restore this site to a salt marsh should be coordinated around the existence of these rare plant populations.

Island: Lower Matecumbe Key

Site: Lignumvitae Key Botanical State Park, Klopp Tract

Owner: Florida Department of Environmental Protection

Current Population: 11 – 100 plants

Map #18

Location: The Klopp Tract is at approximately mile marker 77 on the bayside of the Overseas Highway.

History: John Kunkel Small first collected *I. mucronata* var. *keyensis* on Lower Matecumbe Key in 1907 (s.n., NY). Small designated this as the type collection of *I. keyensis* Small (Small, 1913). It was also collected on Lower Matecumbe by Small in 1917 (8390, NY) and 1925 (11595, NY), by H.N. Moldenke in 1930 (625, NY), and S. Mori and C. Gracie in 1988 (18790, NY). S. Mori did not recall where he made the collection (S. Mori, personal communication, January 16, 2006). None of these collections have any specific locality data.

George D. Gann and Janice Duquesnel found the taxon at the Klopp Tract in 2000, an out parcel of Lignumvitae Key Botanical State Park. Plants were growing in a disturbed coastal rock barren. After this discovery, a road was constructed through the population by the State of Florida for access to new park headquarters and maintenance facilities.

Current Surveys: This station was resurveyed on October 13, 2005. It was also vouchered (Hodges 126, FTG). This population occurs in scraped ground that was formerly a coastal rock barren. Plants are scattered in full sun slightly to the north of the road leading into park headquarters. Unfortunately, further development is planned for the site. Some trees have been planted in the area which may ultimately shade out some of the plants.

Threats: Major threats include development (already planned), exotic plants, maintenance activities and landscaping.

Special Recommendations: Other locations should be considered for the development planned for the site. Coastal rock barren restoration should be attempted for the already disturbed site. If this area must be developed by FDEP, then options for conservation of the plants should be considered (germplasm collection, relocation of individuals, etc.). Other state listed species occur in the same vicinity.

Island: Lower Matecumbe Key

Site: Florida Department of Transportation Property

Owner: Florida Department of Transportation

Current Population: 101 – 1,000 plants

Map #18

Location: This occurrence is located on the Oceanside, in a vacant lot directly across the Overseas highway from the entrance to the Klopp Tract, Lignumvitae Botanical State Park headquarters. At approximately mile marker 77.

History: See the Lower Matecumbe Klopp Tract description for the history on Lower Matecumbe. We have no record of any site-specific observations or collections.

Current Surveys: Stephen R. Hodges found this station on November 6, 2005. The population was vouchered. The property lies directly across from the Klopp Tract, on the Oceanside of US1. The property is ringed by *Schinus terebinthifolius*, but contains an intact coastal rock barren within the exotics. *I. mucronata* var. *keyensis* occurs along the *S. terebinthifolius* edge, throughout the western portion of the property, where it appears quite healthy. Several plants were even seen growing on the roadside. The population occurs with a large population of *Cienfuegosia yucatanensis* (Hodges 131, FTG), which grows in thick patches throughout the property.

Threats: Threats include exotic plants, development and maintenance activities. Because of the large amount of *S. terebinthifolius* present on the property, special care should be taken to inform any exotic removal crews about the importance of this area. If exotics are removed and the site becomes open, fencing should be considered to prevent trespassing and illegal dumping.

Special recommendations: This area should be monitored for the continued health of rare plant populations on the property. Exotic removal needs to occur here, however with a great deal of care and study since *I. mucronata* var. *keyensis* needs partial shade for optimal health. IRC consulted with FDOT about the importance of this site, and they are reviewing possibilities for the conservation of this area. The property should be donated to the Florida Fish and Wildlife Conservation Commission. An additional oceanside, possible rock barren site occurs on private property approximately half a mile south on Overseas Highway. This site is visible on aerial images. From the roadside it appears highly disturbed and to not contain suitable habitat. However, further effort should be made to contact the landowner for permission to thoroughly survey this site.

Island: Plantation Key

Site: Snake Creek Hammocks, Florida Keys Wildlife and Environmental Areas

Owner: Florida Fish and Wildlife Conservation Commission

Current Population: 101 – 1,000 plants (ca. 1,000)

Map #19

Location: Snake Creek Hammocks lies on the southwestern end of the island, on the oceanside right before the drawbridge over Snake Creek.

History: Bradley discovered this population in 1999. Bradley and Woodmansee observed plants there again in 2000 (Bradley *et al.*, 2000). Bradley surveyed this site in 2002 and only observed a few small and desiccated plants.

Current Surveys: This population was surveyed on June 23, 2005. Along with Crawl Key and Long Key, this site represents one of the healthiest known populations of *I. mucronata* var. *keyensis*. Plants grow along the ecotone between buttonwood woodland and rockland hammock, and in small clearings within the hammock for much of the ecotonal edge. The largest individual observed was almost eight feet high, well beyond described limits for the taxon; most populations had individuals in fruit and flower. When this site was revisited after Wilma, the plants were dropping their leaves, but stems appeared to still be green.

Threats: Major threats include exotic plant encroachment and maintenance activities.

Special Recommendations: This population should be resurveyed in the near future to ascertain long term effects of storm surges on this population.

Island: Upper Matecumbe Key

Site: Teatable Hammock, Lignumvitae Key Botanical State Park

Owner: Florida Department of Environmental Protection

Current Population: 11 -100 plants

Map #20

Location: Teatable Hammock is a rockland hammock on the ocean side of the southwestern tip of the island.

History: Frank C. Craighead collected *I. mucronata* var. *keyensis* on Upper Matecumbe Key in 1962 (s.n., USF) with no specifics on location or habitat. The next observation of the taxon on the island was made by Karen Achor in 1982 (Weiner, 1980 and later appendices) who recorded it for Teatable Hammock. Bradley did not see the taxon at that station in several surveys between 1996 and 2003, including during a survey for *Chromolaena frustrata* (Bradley & Gann, 2004).

Current Surveys: This population was surveyed by Hodges and Fleites on October 11, 2005. FDEP park biologist Janice Duquesnel also observed this population just prior to IRC surveys (J. Duquesnel, personal communication, October 12, 2005). This population was vouchered (Hodges 124, FTG). Plants were found growing along *Schinus terebinthifolius* edges, in clearings, and under *Conocarpus erectus*, including along a small trail traveled by Bradley at least 3 times in recent years. These populations are located on the southeast and northwest edges of the small lagoon area at the end of the canal. The area has apparently been cleared before. This is the extreme western portion of the hammock. Exotic plant control has occurred at the site recently, which was probably beneficial to the population. The rediscovery at this station in an area previously surveyed, like that on Lignum Vitae Key, indicates that populations can go through large changes in population size, at least on a year-to-year basis.

Threats: Additional exotic removal may take place at this site, and care will need to be taken to not impact this population during maintenance in the future. Threats are continued exotic plants, and illegal dumping. An additional threat at this site is access by locals fishing in the canal. Plants occur immediately adjacent to the trail and several areas adjacent to the small man made lagoon. Consideration should be given on how best to manage this area.

Island: Windley Key

Site: Windley Key Fossil Reef Geological State Park

Owner: Florida Department of Environmental Protection

Current Population: 2 plants

Map #21

Location: Windley Key Fossil Reef Geological State Park is located just to the south of Snake Creek and Plantation Key, on the bayside. It is the highest point in the Florida Keys. *I. mucronata* var. *keyensis* was first collected at this station by Conrad Byrd in 1968 (s.n., FTG). Plants were later recorded here by Kruer (1992) and seen by Bradley in 1998, and George Gann, Janice Duquesnel, and Bradley in 1999. Only a few plants were known to exist.

Current Surveys: Hodges and Fleites surveyed this population on June 23, 2005. These plants occur in a small coastal rock barren site, on the extreme western portion of the park, near the ocean, slightly above tidal marsh habitat with dominant *Spartina spartinae*. These plants were growing right on the hammock edge near a *Cordia globosa* individual. What is now known as the single island Windley Key was once two islands known as the Umbrella Keys. The islands were joined by fill during the construction of the FEC Railway around 1906-1907. The small rock barren where *I. mucronata* var. *keyensis* now grows was once at the western edge of the uppermost of the two Umbrella Keys, immediately adjacent to a narrow channel that once ran between the islands. It is possible that a larger rock barren existed here, or that much more ecotonal rock barren

habitat existed and was destroyed by a combination of railway construction and other development activities.

Threats: Exotic plant removal has taken place at this site in the past, and care should be taken whenever maintenance activities occur near the area. Other threats include shading by hardwoods and exotic plant invasion.

Special Recommendations: This population should be monitored on an annual basis.

*Extirpated Occurrences*⁴

Island: Craig Key

Site: Roadside

Owner: Florida Department of Transportation

Last Observation: 1965

History: This is a small island on US1 between Lower Matecumbe Key and Fiesta Key. The portions of the island along US1 are mostly fill, placed there during construction of the former FEC railroad. The entire island was built during the construction of the railway and in subsequent development projects. George N. Avery and Conrad D. Byrd recorded *I. mucronata* var. *keyensis* at the “bridgehead” on the oceanside in 1965. No other reports from the island have been made, and a search during this study found no plants or suitable habitat. This was probably a waif occurrence, possibly a recruit from Lignum Vitae Key or Knight’s Key.

Island: Knight’s Key

Last Observation: 1908

History: This island is at the eastern terminus of the 7-mile Bridge, immediately west of Vaca Key (the City of Marathon). This island was the location of a major seaport early in the 19th century and for a time was the terminus of the FEC Railway. The island has been almost completely developed, with only mangrove forest and some small cleared lots remaining amongst a marina, homes, and RV campground. *I. mucronata* var. *keyensis* was collected here by Britton in 1908 (Britton 552, NY). We have seen herbarium collections from Knight’s Key of species typical of rock barrens, including *Chromolaena frustrata*, *Evolvulus convolvuloides*, and *Hibiscus poeppigii*. It is likely that a rock barren was here prior to construction of the seaport and FEC Railway in the beginning of the 19th century. Railroad service was initiated to Knight’s Key in 1909, the year before Britton’s collection, and the station may have been extirpated soon after that.

Island: Vaca Key

Site: Unknown

Last Observation: 1964

History: Vaca Key is the location of most of the City of Marathon. *I. mucronata* var. *keyensis* was collected on Vaca Key by J.H Simpson in 1892 (466, NY, US). In 1964

⁴ To be thorough, we have included the two collections made outside of the Florida Keys in the 19th century.

George N. Avery recorded the taxon at a place he referred to only as “Williams.” We do not know what location he was referring to, possibly a person’s home. No other reports have been made for the island since. Vaca Key has been almost completely developed, with few natural areas remaining. During this study we surveyed Blue Heron Hammocks (Bradley *et al.*, 2000; Kruer, 1992; Weiner, 1980), owned by the State of Florida, the Crane Point Nature Center and the Florida Keys Wildlife and Environmental Lands property in the northeast corner of the island. The taxon was not found at these locations.

Mainland: Miami-Dade County

Location: Brickell Hammock area, Miami

Last Observation: 1877

History: Only a single collection of *I. mucronata* var. *keyensis* has been made in Miami-Dade County. In 1877 A.P. Garber collected the taxon at “Miami” (s.n., NY; s.n., US). Garber’s collection was probably made at or close to Brickell Hammock south of the Miami River. Only fragments of natural areas remain in this area, all dense canopy rockland hammock unsuitable for growth of *I. mucronata* var. *keyensis*.

Mainland: Collier County

Location: Marco Island

Last Observation: 19th Century

History: Only a single collection of *I. mucronata* var. *keyensis* has been made in Collier County. Sometime in the 19th century A.W. Chapman collected the taxon at “Robert’s Key, Caxambas Bay” (s.n., US). Caxambas Bay is just south of Marco Island and Roberts Bay enters into the south edge of Marco Island from Caxambas Bay. We can’t be sure of Chapman’s collecting location, but since the grass *Aristida gyrans*, a plant of scrub and scrubby flatwoods, was also collected by him at the same location it was most likely Marco Island. This was an area with many shell mounds, the possible habitat of *I. mucronata* var. *keyensis* on Marco Island. The taxon has never been recorded for Marco again, nor any other area on Florida’s southwest coast. Marco Island has been intensely developed, however located in this area is Otter Mound Park which was recently acquired as conservation land and should be surveyed.

Total Current Population in the Florida Keys: 1,000 – 10,000 plants (ca. 1500)

Habitat: *I. mucronata* var. *keyensis* occurs in coastal rock barren, ecotone rock barren areas and scraped areas mimicking rock barren habitat. Because these areas contain many of the same species we have not split them by habitat here.

Associated Species: Species found occurring with *I. mucronata* var. *keyensis* included *Acacia farnesiana*, *Acanthocereus tetragonus*, *Agave decipiens*, *Alternanthera flavescens*, *Alternanthera maritima*, *Amyris elemifera*, *Batis maritima*, *Blutaparon vermiculare*, *Borrchia arborescens*, *Bursera simaruba*, *Capparis flexuosa*, *Capraria biflora*, *Cassytha filiformis*, *Chamaesyce garberi*, *Chamaesyce porteriana*, *Chromolaena frustrata*, *Cienfuegosia yucatanensis*, *Cissus trifoliata*, *Cladium jamaicense*, *Commelina erecta*, *Conocarpus erectus*, *Cordia globosa*, *Cynanchum angustifolium*, *Cyperus elegans*, *Cyperus fuliginus*, *Cyperus squarrosus*, *Dactyloctenium aegyptium*,

Desmodium incanum, *Dicliptera sexangularis*, *Evolvulus convolvuloides*, *Eugenia axillaris*, *Eugenia foetida*, *Galactia striata*, *Hibiscus poeppigii*, *Fimbristylis cymosa*, *Flaveria linearis*, *Gymnanthes lucida*, *Gossypium hirsutum*, *Guapira discolor*, *Heliotropium angiospermum*, *Herissantia crispa*, *Jacquemontia pentanthos*, *Leptochloa dubia*, *Melanthera nivea*, *Morinda royoc*, *Opuntia stricta*, *Opuntia triacanthos*, *Pentalinon luteum*, *Piscidia piscipula*, *Pithecellobium keyense*, *Pithecellobium unguis-cati*, *Polygala grandiflora*, *Portulaca oleracea*, *Portulaca rubricaulis*, *Randia aculeata*, *Rhynchosia minima*, *Rhynchelytrum repens*, *Schinus terebinthifolius*, *Sesuvium portulacastrum*, *Sida abutifolia*, *Sida ciliaris*, *Sideroxylon celastrinum*, *Stachytarpheta jamaicensis*, *Stylosanthes hamata*, *Tillandsia paucifolia*, *Tillandsia utricularia*, *Tillandsia usneoides*, *Waltheria indica*, *Vigna luteola* and *Zanthoxylum fagara*

Discussion

Our study represents a substantial increase in the known, extant locations and population size for this species. Besides merely conducting thorough surveys, there are several reasons why this study might have located populations not seen prior, or not observed in many years. One of these is the frequency of hurricanes during the study and in the past decade. Many species react to natural disturbance, including the federally threatened taxon *Chamaesyce garberi* (J. Duquesnel and G. Gann personal communication, September 2006). The proliferation of *I. mucronata* var. *keyensis* leads us to believe that this may be another species that responds positively to hurricanes or other forms of natural disturbance.

As surveys for this species progressed, it became increasingly clear both through observation and conversations with other biologists, such as Janice Duquesnel of FDEP service, that the coastal rock barren habitat was poorly understood, and that essentially no information had been published on the topic. Surveys of rock barrens also led to the discovery of new populations of several other rare taxa including *Cyperus squarrosus*, bearded flatsedge, in Curry Hammocks State Park. Previously this taxon was known to have two occurrences in the National Key Deer Refuge, and one in the privately owned Crawl Key rock barren (Gann *et al.*, 2002).

The second was discovery of a population of the state listed endangered species *Cienfuegosia yucatanensis* Millsp., Yucatan flymallow, on the DOT owned Lower Matecumbe property. This population is estimated by IRC to be the second largest extant population in the continental U.S. (Gann *et al.*, 2002). Both the expanded range of *I. mucronata* var. *keyensis* and the discovery of these other rare taxa point to the need for a more concerted effort to locate and monitor coastal rock barrens. Conservation strategies for these species will be impossible to design without a better understanding of the ecological dynamics that shape and maintain them.

Taxonomic work is desperately needed on this taxon. The adoption of a name which lumps species from all portions of the tropical world is suspect. A revision of the genus is needed again, which examines in detail new world material. In addition, we know almost nothing about the reproductive and pollination biology of this taxon, or its life history. Nothing is known about how long individuals live. Because of the lack of information, it is impossible to gauge the affects of mosquito spraying, or other potentially harmful activities.

This study brought to light the highly ephemeral nature of these populations. They may vary widely even year-to-year and annual monitoring is needed to begin to understand these trends. Other populations may be discovered in the future. Our understanding of the dynamics of these populations will remain shallow until long term monitoring and in depth biological studies of the taxon are completed.

Linum arenicola

Scientific Name: *Linum arenicola* (Small) H.J.P. Winkler

Common Names: sand flax

Summary: *L. arenicola* is a wiry, yellow flowered herb in the Linaceae. It is endemic to southern Florida in Miami-Dade and Monroe counties. It is found in pine rockland, disturbed pine rockland, marl prairie, and roadsides on rocky soils. It is currently known from only about five populations in Miami-Dade County and the four occurrences described below in the Florida Keys. Development, exotic pest plants, and modifications to fire regime threaten it.

Taxonomy: This species was first described by Small in 1907 as *Cathartolinum arenicola* for plants he collected in Miami-Dade County in 1904. This treatment was consistently followed by Small (1913a, 1913b, 1933). In 1931, Winkler included *Cathartolinum* within the genus *Linum*, renaming the plants *Linum arenicola*. Others have followed this treatment, including Rogers (1963), Long and Lakela (1971), Robertson (1971), Wunderlin (1998), and Wunderlin & Hansen (2003).

Synonyms: *Cathartolinum arenicola* Small

Field Surveys: We located 4 known populations of this taxon and 3 historical populations. Additional surveys were conducted along roadsides ranging from Little Torch to Lower Sugarloaf. **Table 4** summarizes this data. During these surveys we concentrated on areas adjacent to pine rockland or rockland hammock. Surveys were conducted with a driver and one observer by driving slowly, approximately 5mph, along the road shoulder. Areas that seemed particularly promising were surveyed on foot. The large area of potential habitat, scarcity and diminutive size of *L. arenicola* make thorough surveys for this species difficult. In total 94 km of roadsides were surveyed. **Map #22** shows overall distribution in the Florida Keys. **Map #23** shows roads surveyed.

Results

Extant Occurrences

Island: Big Pine Key

Site: National Key Deer Refuge

Owner: National Key Deer Refuge

Map #24

Location: Please see the Bradley Big Pine Key report for detailed location data.

History: *L. arenicola* was first collected on Big Pine Key by John Kunkel Small in 1911 (s.n., NY; s.n. PHIL). It has been collected repeatedly since then but collections typically have little if any useful habitat or locality data. It has also been recorded at the Boss Tract (O'Brien, 1991) and at Terrestris Preserve (O'Brien, 1991), each located south of Watson Blvd. and west of Key Deer Blvd. It was also collected on the road shoulder along Long Beach Drive at the southwestern corner of the island by S.R. Hill in 1982

(10983, NY). K. Bradley, S. Woodmansee, and G. Gann have surveyed this road shoulder on several occasions and the species was not observed.

Current Surveys: The large area of habitat for this species on Big Pine Key warranted a separate study that has been conducted in parallel with the present study. This report will be issued separately to the US Fish and Wildlife Service. In brief, *L. arenicola* is rare in pine rockland and on road shoulders on the island. In a survey of nearly 600 plots (radius of 2.5 m) placed throughout the pine rockland on the island, the species was found in only 7 plots where a total of 33 plants were counted.

Island: Big Torch Key

Site: Roadsides

Owner: Monroe County Department of Transportation

Current Population: 11 – 100 plants

Map #25

Locations:

History: Bradley and Woodmansee observed this population in 2001.

Current Surveys: Hodges and Mahoney surveyed two roadside populations on June 2, 2005. One of these lies adjacent to a *Cladium jamaicense* marsh with scattered hardwoods near the northern portion of the island. All plants found were on the western side of the road. The other population lies adjacent to private property, near a housing development on the southern end of the island. The northern population had individuals in fruit and flower, while only sterile individuals were observed in the southern population.

Threats: Threats to this species include roadside maintenance and exotic plants. Range wide threats include sea level rise, habitat loss, and changes to the fire regime. Additionally, because of the small and fragmented nature of the current population in the Florida Keys, stochastic events, disease or genetic bottlenecks may strongly affect this species.

Island: Lower Sugarloaf Key

Site: Roadside

Owner: Florida Department of Transportation

Current Population: 101 – 1,000 plants

Map #26

Location: Approximately two km south along

History: *L. arenicola* was collected here by R. Marvin in 1959 (Rogers 12148, NY), G. Avery also collected it in 1978 (Avery 2011, FLAS). K. Bradley vouchered this population in 1999 (Bradley 2037, FTG). B. Tatje observed the population in 1979 (Austin *et al.*, 1980) and K. Bradley observed this station again in 2000.

Current Surveys: Hodges and Mahoney surveyed this population was surveyed on June 2nd, 2005. Plants occur in an almost continuous band along the roadside County Rd. 939 from existing homes on the southern end of the island to the stop sign at SR 939A. Two additional stations were discovered along the Loop Road on June 2, 2005. These are also along the roadside, but are adjacent to private property. Loop Road extends north from the old US1, just to the east of a canal, bridge and popular swimming hole. The plants

are along maritime hammock, in grassy clearings. All populations were revisited after Hurricane Wilma, and no living plants could be found.

Threats: Threats include illegal dumping, roadside maintenance and exotic plants. Several piles of dumped mulch were seen along the roadside, which has *L. arenicola* and *C. lineata* var. *keyensis*. This should be monitored and stopped.

Special Recommendations: This entire area should be acquired as conservation lands to the adjoining Florida Fish and Wildlife Conservation Commission property. These stations should be surveyed over the next year to determine long-term effects of storm surges on these populations.

Island: Middle Torch Key

Site: Roadside

Owner: Monroe County Department of Transportation

Current Population: 3 plants

Map #27

Location: These plants are located 0.15 km south of the turnoff for Big Torch Key.

History: C.E. Nauman collected *L. arenicola* here in 1979 (Nauman 853, US) and (Nauman 854, FAU). Most of these collections are now held at Fairchild Tropical Botanic Garden. Dan Austin observed populations in the area (Austin *et al.*, 1980). When surveyed by Austin and colleagues, several hundred plants were observed.

Current Surveys: Hodges, Mahoney and Woodmansee surveyed this population on June 1, 2005. We could only locate three individuals. This population occurs about 75 m to the south of the intersection with the turn off to Big Torch Key.

Threats: Threats include roadside maintenance and exotic plants.

Special Recommendations: Resurvey this population in the next year to determine long term effects of storm surge and to monitor population size.

Extirpated Occurrences

Island: Boca Chica

Site: Unknown

Last Observation: 1912

History: *L. arenicola* was collected on Boca Chica Key by John Kunkel Small in 1912 (s.n., NY). No specific locality data was recorded by Small. We did not survey the majority to this island, but in a survey of the Naval Air Station by Tina Henize, the species was not found (T. Henize, personal communication, January 16, 2006). It was also not seen during a 2001 survey of county land on the south edge of the island by K. Bradley and S. Woodmansee in 2001 (Gann *et al.*, 2001). The species is probably extirpated on the island.

Current Surveys: Hodges and Fleites also explored roadsides and land on the south edge of the island on July 7, 2005, but no plants were seen.

Island: Park Key

Site: Roadside

Owner: Florida Department of Transportation

Last Observation: 1961

History: *L. arenicola* was collected on Park Key by W.P. Osborne in 1961 (Osborne 64, MO). Park Key is at mile marker 18 between Upper and Lower Sugarloaf Keys and is dominated by US1 and mangrove forest. The collection was probably made on the shoulder of US1.

Current Surveys: The US1 road shoulders were searched by Hodges and Mahoney but no plants were found.

Island: Ramrod Key

Site: Roadside, Unknown

Owner: Probably the Florida Department of Transportation

Last Observation: 1980

History: *L. arenicola* was collected on Ramrod Key in 1911 by John Kunkel Small (s.n., NY, PHIL). Austin *et al.*, 1980 also reported this population, and gave the location as being just north of the Overseas highway near the intersection with Trinidad Lane. It has not been relocated on this island since despite general botanical surveys of portions of the island by Bradley, Woodmansee, and other botanists.

Current Surveys: During this project Hodges and Mahoney surveyed the Austin site, and all road shoulders and could not locate the species. Hodges and Mahoney also surveyed natural areas on the southern end of the island, while Hodges and Fleites surveyed natural areas on the northern end of the island. The species was not located. It is presumed extirpated.

Total Current Population in the Florida Keys (excluding Big Pine Key): 101 – 1,000 plants

Habitat: Outside of Big Pine Key, *L. arenicola* occurs exclusively on roadsides in the Lower Florida Keys. These areas are adjacent to natural areas and have not been planted with sod. They imitate upland herbaceous habitat. Associated species data for Big Pine occurrences is given in Bradley 2006.

Associated Species, Roadsides: Species that were found occurring with *L. arenicola* included *Abildgaardia ovata*, *Angadenia berteroi*, *Bletia purpurea*, *Buchnera americana*, *Byrsonima lucida*, *Cenchrus incertus*, *Chamaecrista lineata* var. *keyensis*, *Chamaesyce blodgettii*, *Cladium jamaicense*, *Coccothrinax argentata*, *Coccoloba uvifera*, *Conocarpus erectus*, *Crotalaria pumila*, *Desmanthus virgatus*, *Eragrostis elliottii*, *Erithalis fruticosa*, *Ernodea littoralis*, *Fimbristylis cymosa*, *Fimbristylis spadicea*, *Flaveria linearis*, *Galactia volubilis*, *Metopium toxiferum*, *Morinda royoc*, *Paspalum caespitosum*, *Paspalum setaceum*, *Phyla nodiflora*, *Pithecellobium keyensis*, *Polygala balduinii*, *Polygala grandiflora*, *Sabatia stellaris*, *Schizachyrium gracilis*, *Schizachyrium sanguineum*, *Sida ciliaris*, *Sideroxylon salicifolium*, *Sophora tomentosa* var. *truncata*, *Spermacoce verticillata*, *Sporobolus pyramidalis*, *Stylosanthes hamata*, *Thrinax radiata* and *Waltheria indica*.

Discussion

L. arenicola occurs on roadsides that are typically composed of native, pine rockland herbaceous species. Sod, such as *Stenotaphrum secundatum*, *Paspalum notatum*, *Zoysia* or *Eremochloa* inhibit the presence of this species. These areas are typically dry and rocky. It seems to only rarely occur within intact pine rockland, but more frequently adjacent to it. This makes developing conservation and management plans for this species exceptionally difficult. Its persistence on roadsides is not fully understood. One possibility is that the species has evolved to occur in this habitat as fire regimes and natural areas were altered and destroyed over the last several hundred years.

Road maintenance activities are critical to the survival of this species in the Lower Keys. As with all roadside populations, infrastructure projects such as underground cable, sewer and water lines may impact populations. Herbicide spraying of the roadside could obviously impact the population as well. Crews need to be made aware of the existence of these populations and to be careful when working nearby. The largest population surveyed, Lower Sugarloaf, had been impacted by repaving of the road recently which dumped asphalt on top of and adjacent to the population.

We know little about the pollination or reproductive biology of this species. Longevity is not known. Studies addressing these topics need to be conducted in order to develop meaningful conservation strategies. Lack of pollinator information makes assessing the affects of mosquito spraying in the Florida Keys impossible. Populations need to be monitored on an annual basis to ultimately determine trends in population size. Finally, the diminutive size and habitat preference of this species make surveys very difficult. It is possible that other populations exist and biologists and other naturalists should constantly be aware of its possible presence in these areas.

Sideroxylon reclinatum subsp. *austrofloridense*

Scientific Name: *Sideroxylon reclinatum* Michx. subsp. *austrofloridense* (Whetstone) Kartesz & Gandhi

Common Names: Everglades bully

Summary: After consulting the historical records, observation information from IRC and other botanists and reviewing available herbarium specimens at Fairchild Tropical Botanic Garden, we have determined that this species does not occur in the Florida Keys. The primary population is known from Everglades National Park, though it also occurs in Big Cypress National Wildlife Preserve and in a few other locations within Miami-Dade County (Gann *et al.*, 2002). It is known from Monroe County, but only on the mainland. If it had occurred in the Florida Keys, the most likely locations would have been pine rocklands on Key Largo, Big Pine Key, Cudjoe Key or Lower Sugarloaf Key, all of which were surveyed for this and other species. Most of the sites on Key Largo have been developed, or are succeeded, and there have been no records of this taxon ever being collected there. No further information is included on this taxon for this status summary.

Table 1: *Argythamnia blodgettii*

Extant Occurrences				
Site	Owner	Population	Threats	Habitat
Big Munson Island	private	1,001-10,000	Invasive exotic plants	Clearings around hammock, hammock edge, hammock understory
Big Pine Key Cactus Hammock and Long Beach Coastal Berm	public	101-1,000	Invasive exotic plants, trail maintenance	Coastal berm and along cleared trails inside Cactus Hammock
Big Pine Key, Koehn's Subdivision	public	101-1,000	Invasive exotic plants, maintenance	Pine rockland roadsides.
Big Pine Key, Watson's Hammock	public	2-10	Exotic plants	Hammock edges
Key West Naval Air Station	D.O.D.	1,001-10,000	Invasive exotic plants, maintenance	Around runways and near old roadways.
Key Largo, Dove Creek Hammocks	public	11-100	Road side construction, mowing	Road side scraped rock on edge of protected hammock.
Lignum Vitae Key	public	101-1,000	Invasive exotic plants, maintenance	Clearings around main house and park manager home.
Lower Matecumbe Key, Klopp Tract	public	unknown		
Plantation Key, Snake Creek Hammock	public	11-100	Exotic plants, maintenance behind	Clearings and disturbed sites inside hammock, also occurring
Windley Key	public	11-100	Invasive exotic plants, maintenance	Around quarries, extending some into hammock understory
Vaca Key, Blue Heron Hammocks	public	11-100	Invasive exotic plants, maintenance	Road side scraped rock on edge of protected hammock.
Indefinite Occurrences				
Site	Owner	Last Known Observation	Comments	
Key West Golf Course	Private	1981	Presumed extant, however due to the storm surge after Hurricane Wilma this location was not fully surveyed.	
Boot Key	Private	1999	Presumed extant, unable to contact owner for permission to survey	
Long Key State Park	Public	1999	Presumed extant, lack location data	
Extirpated Occurrences				
Site	Owner	Last Known Observation	Comments	
Northern Key Largo	various	1977	Unknown	
Key West	unknown	1965	Probably developed	
Key West Cemetary	public	1965	Unknown, area surveyed but no plants seen	
Totten Key, Biscayne National Park	public	1904	Unknown	

Table 1 (cont.)

Locations Surveyed but not found			
Site	Owner	Habitat	Comments
Boca Chica Key, Southern Edge of Island	public	Roadside/Maritime Hammock edge	
Cudjoe Key, National Key Deer Refuge, Roadsides	public	Pine rockland/roadside	
Key West roadsides adjacent to Key West Cemetary	public	roadside	
Plantation Key other sites	public	primarily mangrove and salt flats	
Stock Island, Key West Botanical Garden	private	rockland hammock/disturbed	
Upper Sugarloaf National Key Deer Refuge	public	pine rockland	
Ramrod Coastal Berm	public	coastal berm	Although this property was surveyed, the area was not completely walked and should be surveyed more thoroughly in the future. Several other rare taxa are reported for this area.
Roadsides from Little Torch to Lower Sugarloaf	public	roadsides	
No Name Key, National Key Deer Refuge and roadsides	public	Pine rockland/roadsides	
Ohio Key	public	roadsides	
Vaca Key, Crane Point Nature Center Hammock	private	Palm Hammock	
Vaca Key, Marathon Hammock on 113th and 1st Ave	public	disturbed rockland hammock edge	

Table 2: *Chamaecrista lineata* var. *keyensis*

Table 2: <i>Chamaecrista lineata</i> var. <i>keyensis</i>				
Extant Occurrences				
Site	Owner	Population	Threats	Habitat
Big Pine Key, National Key Deer Refuge	public	10,001 - 100,000	exotic plants, fire suppression	Pine Rockland
Cudjoe Key, National Key Deer Refuge	public	101-1,000	exotic plants, fire suppression, storm surge?	Pine Rockland
Lower Sugarloaf Key, Loop Road Area	public	2-10	exotic plants, road maintenance, storm surge	Scraped road side on edge of protected hammock.
Extirpated Occurrences				
Site	Owner	Last Known Observation	Cause	Habitat
No Name Key	unknown	1916	unknown	Pine rockland
Ramrod Key	unknown	1911	unknown	Pine rockland
Location Surveyed but not found				
Site	Owner	Habitat		
Upper Sugarloaf Key, National Key Deer Refuge	public	Pine Rockland		

Table 3: Indigofera mucronata var. keyensis				
Extant Occurrences				
Site	Owner	Population	Threats	Habitat
Crawl Key Rock Barren	private	101-1,000	Development, exotic plants, shading by hardwoods	Coastal Rock Barren
Crawl Key, North of US1	public	11-100	exotic plants, fire suppression, shading	Coastal Rock Barren
Key Largo, John Pennekamp Coral Reef State Park	public	11-100		
Lignum Vitae Key, Lignumvitae Key Botanical State Park	public	2-10	exotic plants, shading from hammock	Ecotonal Rock Barren
Long Key State Recreation Area	public	101-1,000	Exotic plants, storm surge?	Coastal Rock Barren
Long Point Key, Curry Hammock State Park	public	11-100	Exotic plants, restoration and maintenance activities	Coastal Rock Barren under Buttonwood woodland
Lower Matecumbe Key	public	101-1,000	Exotic plants, development	Coastal Rock Barren
Lower Matecumbe, Klopp Tract, L.V. B.S.P.	public	11-100	Exotic plants, planned development	Former rock barren, now scraped and disturbed
Plantation Key, Snake Creek Hammock	public	101-1,000	Exotic plants	Ecotonal Rock Barren
Upper Matecumbe Key, Tea Table Hammock, L.V.K.B.S.P.	public	11-100	Exotic plants, maintenance activities	Former rock barren, now scraped and disturbed
Windley Key State Recreation Area	public	2-10	Exotic plants, hardwoods, storm surge	Coastal Rock Barren
Extirpated Occurrences				
Site	Owner	Last Known Observation	Cause	Habitat
Craig Key	private	1965	unknown, possibly recorded in error	unknown
Knights Key	private	1909	Development	Rockland hammock or coastal rock barren
Vaca Key	private	1964	Development	Rockland hammock or coastal rock barren
Indefinite Occurrences				
Site	Owner	Last Known Observation	Comments	
Long Point Key	private	1996	Presumed extant, unable to contact owners for permission to survey	
Location Surveyed but not found				
Site	Owner	Habitat	Comments	
Big Munson Island Coastal Rock Barren	private	Coastal Rock Barren	outside of known range	
Big Pine Key, Cactus Hammock Rock Barren	public	Coastal Rock Barren	outside of known range	
Crawl Key, Properties near dump	public	Disturbed/Rockland Hammock Edge	no appropriate habitat	
Fat Deer Key, Curry Hammock State Park	public	Ecotonal Rock Barren		
Other locations on Fat Deer Key	public	Salt Marsh/Palm Hammock Edge	no appropriate habitat	
Vaca Key, Crane Point Nature Center	private	Palm Hammock	no appropriate habitat	

Table 4: Linum arenicola

Table 4: Linum arenicola				
Extant Occurrences				
Site	Owner	Population	Threats	Habitat
Big Pine Key, National Key Deer Refuge in part	public	1,001-10,000	Development, Fire suppression	Pine Rockland
Big Torch Key	public	11-100	Road clearing or other maintenance	Scraped road side
Lower Sugarloaf Key	public	101-1,000	Road clearing or other maintenance	Scraped road side
Middle Torch Key	public	2-10	Road clearing or other maintenance	Scraped road side
Extirpated Occurrences				
Site	Owner	Last Known Observation	Cause	Habitat
Boca Chica Key	D.O.D.	1912	unknown, probably development	unknown
Park Key	public	1961	unknown, probably road maintenance	Roadside
Ramrod Key	public	1979	unknown	Roadside
Location Surveyed but not found				
Site	Owner	Habitat	Comments	
Boca Chica Key, southern edge of island	public	roadside		
No Name Key, Roadsides and Refuge	public	pine rockland		
Ramrod Key, Dan Austin Site	public	roadside		
Roadsides from Little Torch Key - Lower Sugarloaf Key	public	roadside	see map of roads surveyed	
Upper Sugarloaf Key, National Key Deer Refuge	public	pine rockland		

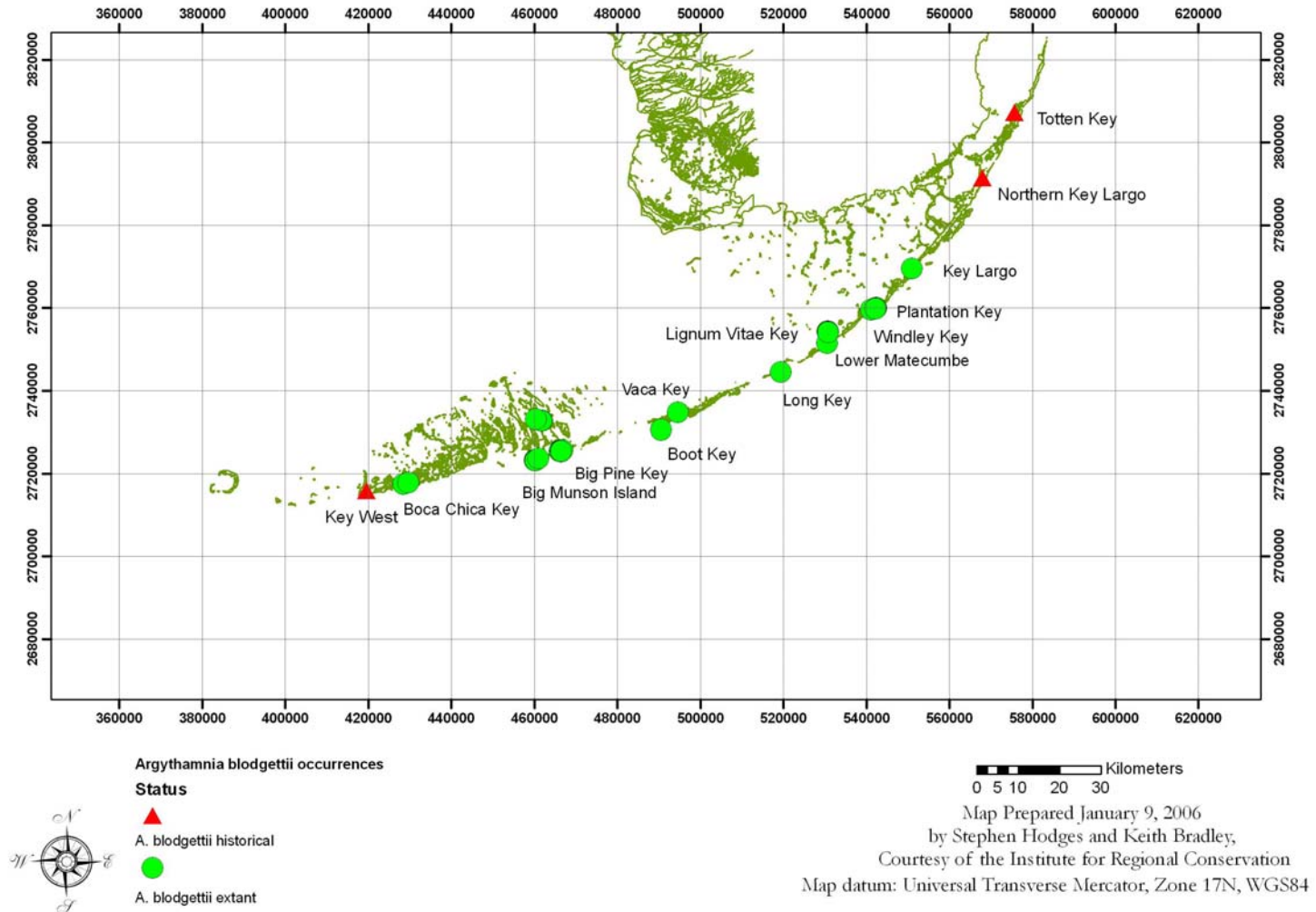
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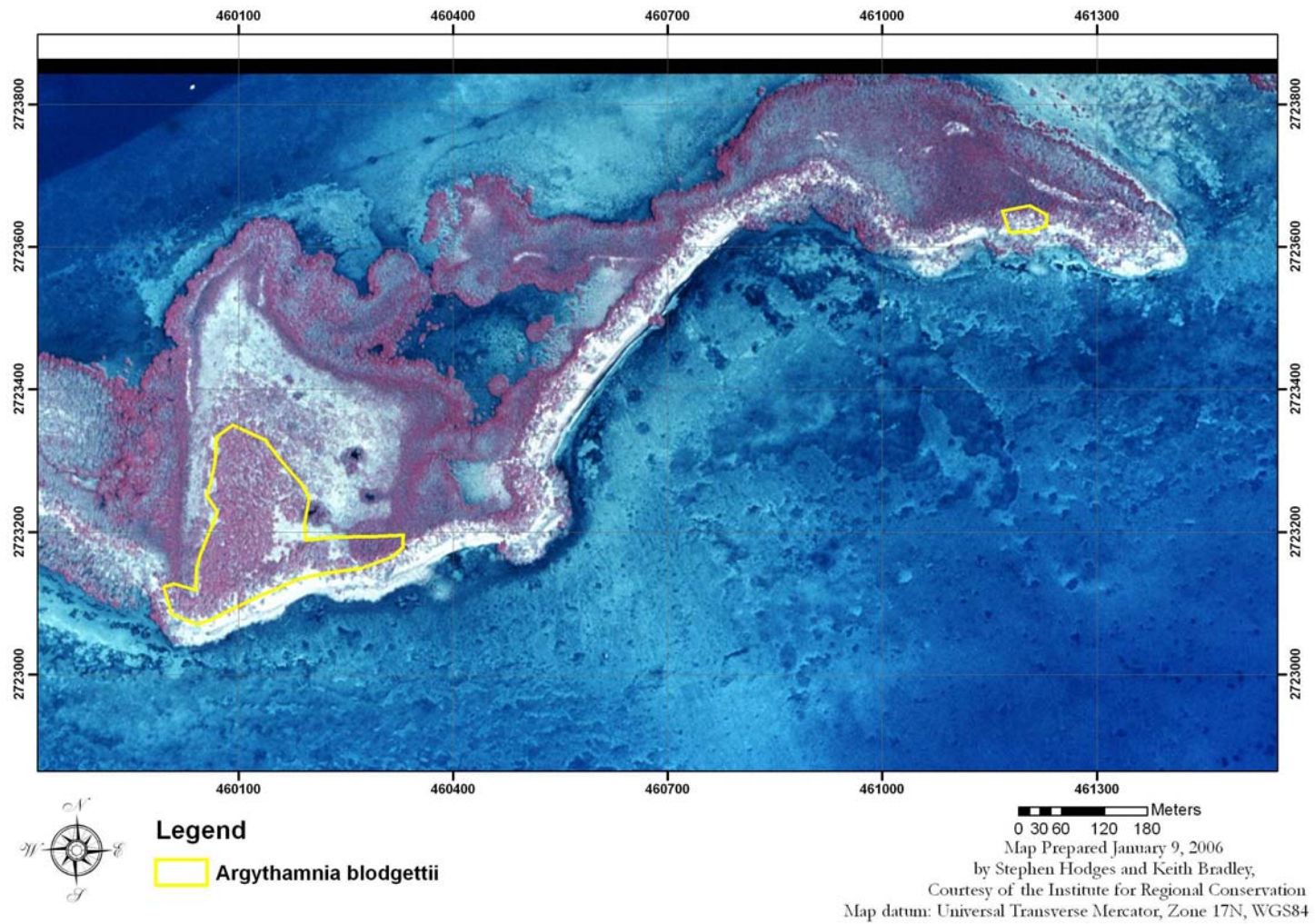
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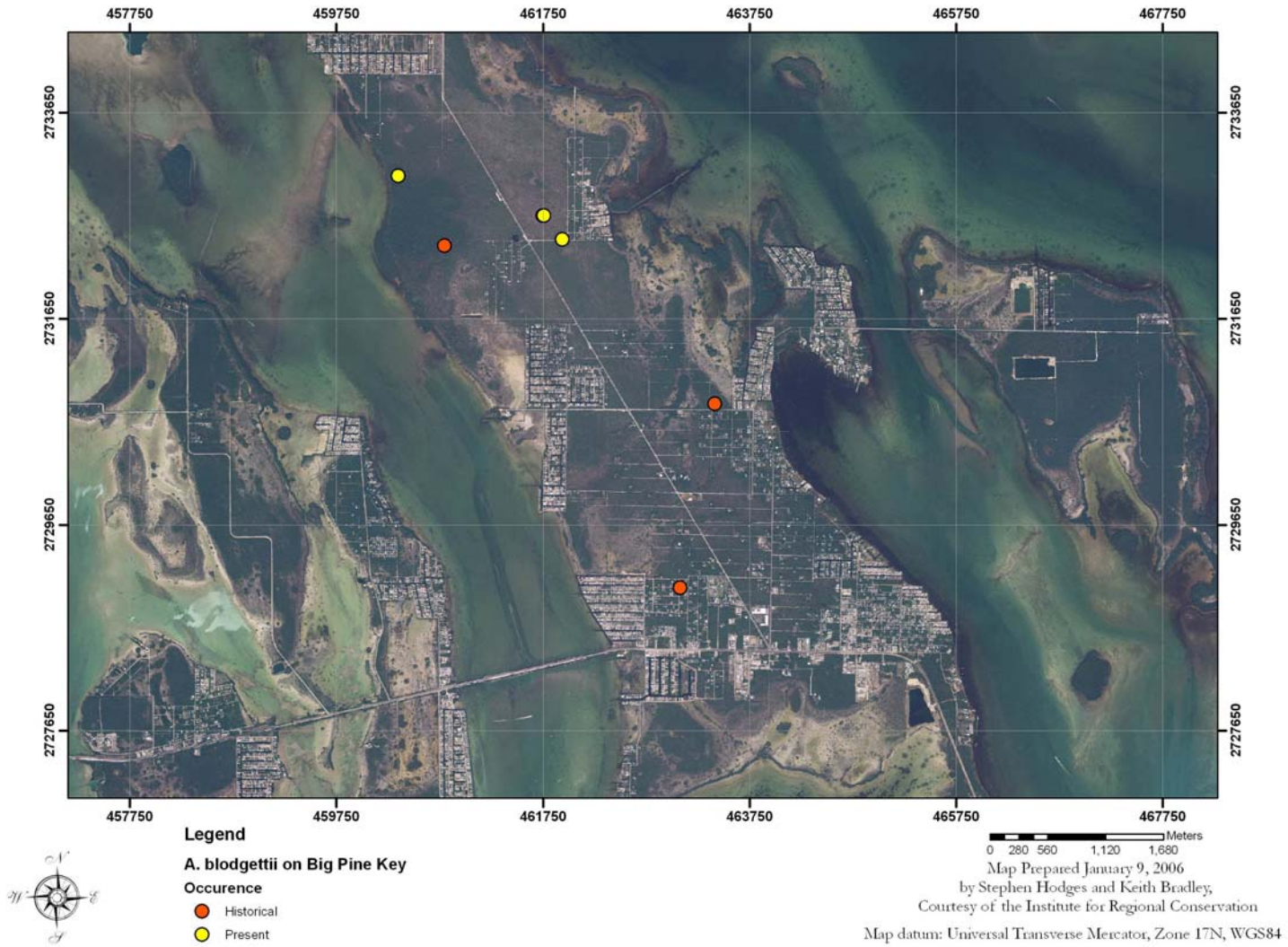
Map #1: Distribution of *Argythamnia blodgettii* in the Florida Keys



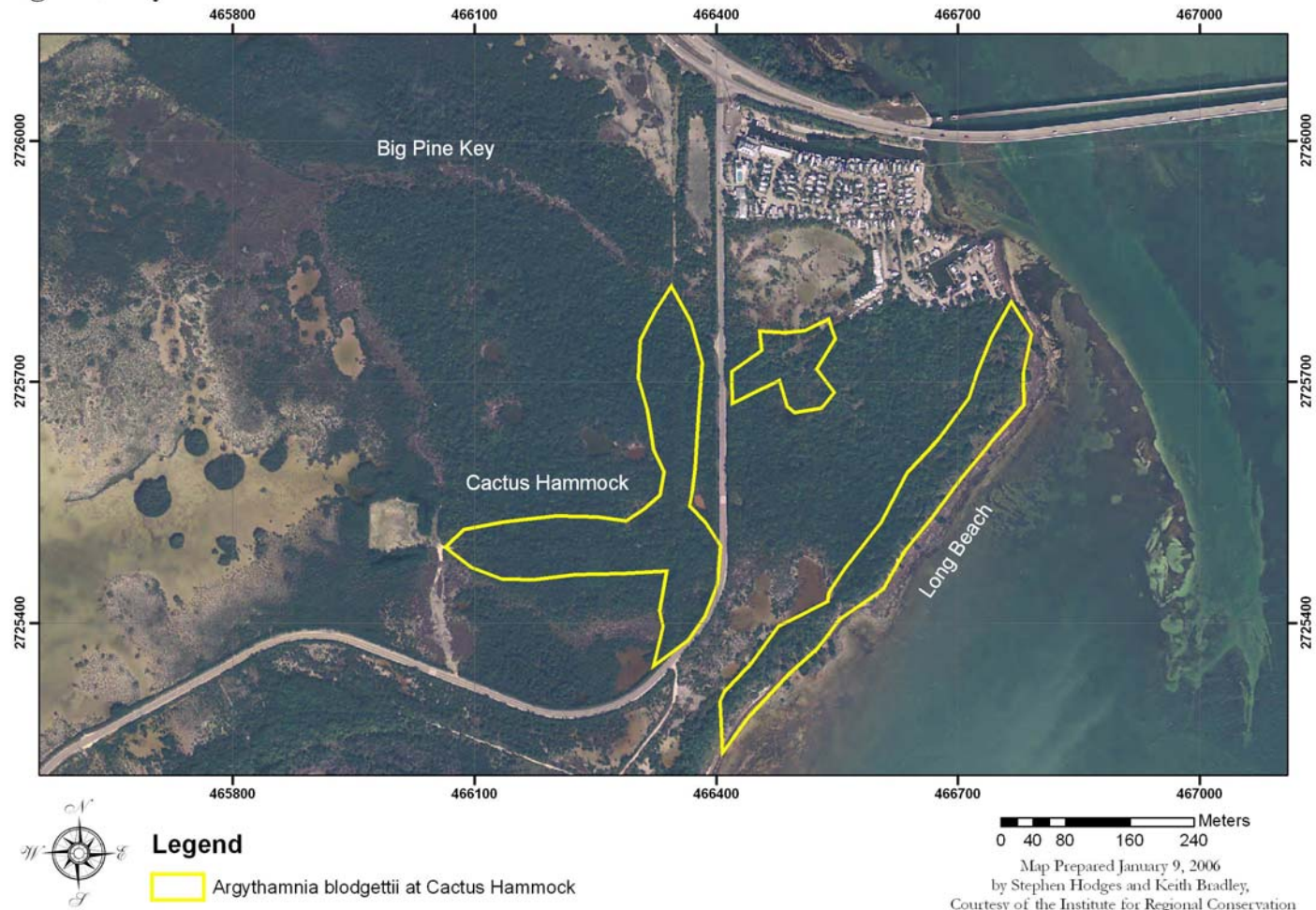
Map #2: Distribution of *Argythamnia blodgettii* on Big Munson Island



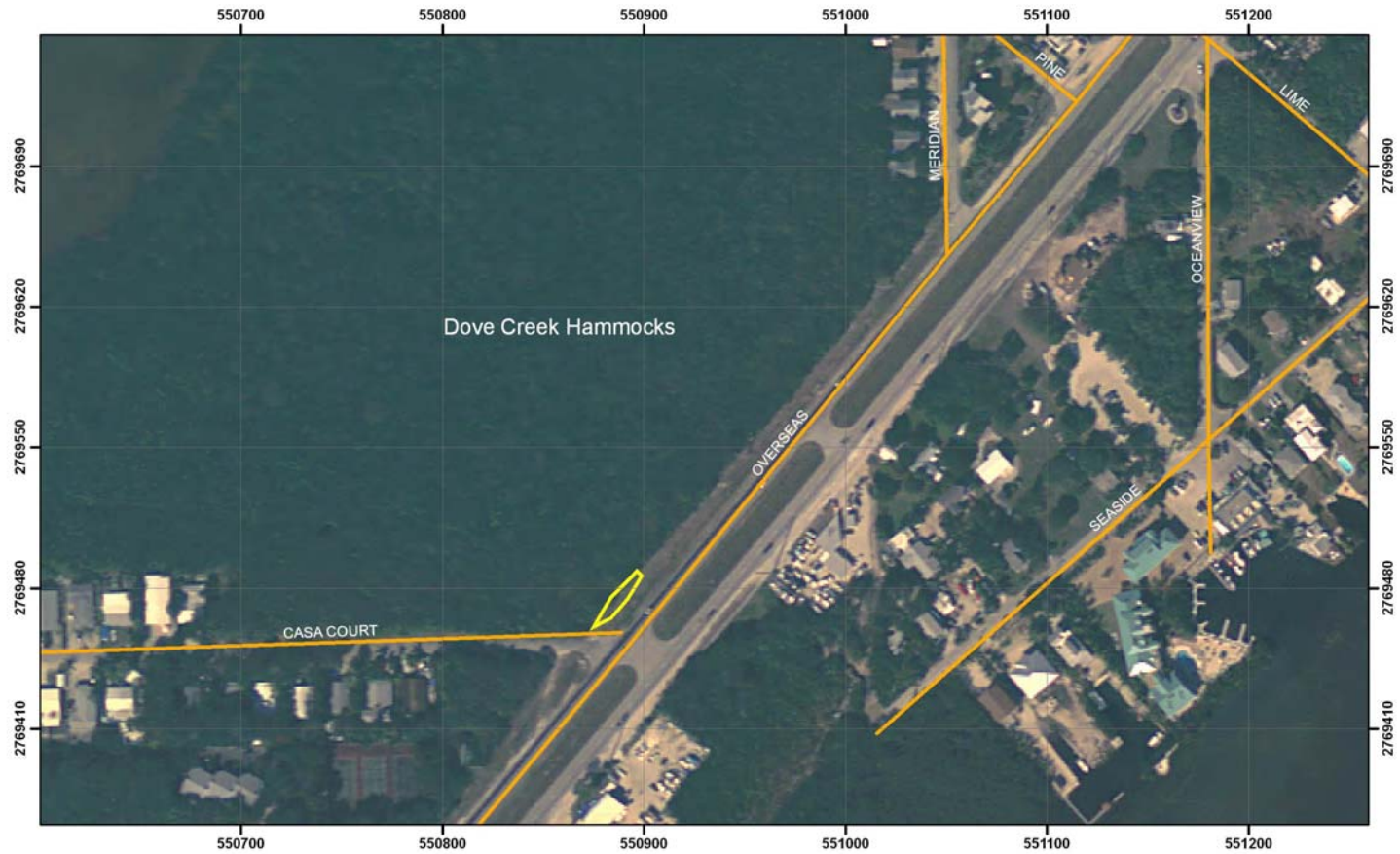
Map #3: *Argythamnia* Locations on Big Pine Key excluding southeast point



Map #4: Distribution of *Argythamnia blodgettii* in the Cactus Hammock area, Big Pine Key

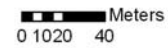


Map #5: Distribution of *Argythamnia blodgettii* at Dove Creek Hammocks



Legend

 *Argythamnia blodgettii* at Dove Creek Hammocks

 Meters
0 10 20 40

Map Prepared January 9, 2006
by Stephen Hodges and Keith Bradley,
Courtesy of the Institute for Regional Conservation
Map datum: Universal Transverse Mercator, Zone 17N, WGS84


Map #6: Distribution of *Argythamnia blodgettii* on Lignum Vitae Key, Lignumvitae Key Botanical State Park



Map #7: Distribution of *Argythamnia blodgettii* at Snake Creek Hammocks, Plantation Key



Legend

 *Argythamnia blodgettii* at Snake Creek Hammocks

0 30 60 120 180 Meters

Map Prepared January 9, 2006
by Stephen Hodges and Keith Bradley,
Courtesy of the Institute for Regional Conservation
Map datum: Universal Transverse Mercator, Zone 17N, WGS84

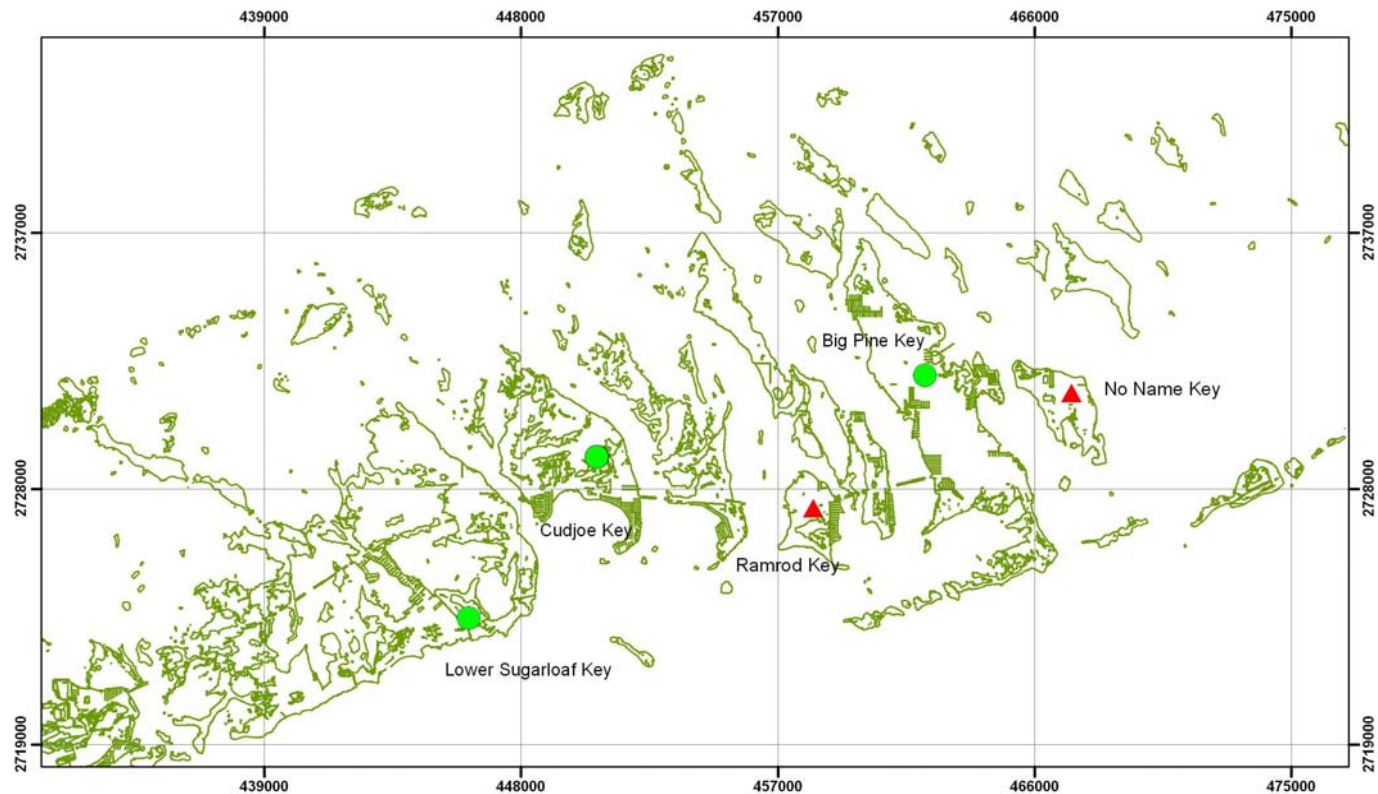
Map #8: Distribution of *Argythamnia blodgettii* at Windley Key Fossil Reef Geological State Park



Map #9: Distribution of *Argythamnia blodgettii* at Blue Heron Hammock



Map #10: Overall Distribution of *Chamaecrista lineata* var. *keyensis* in the Florida Keys.



Legend

C. lineata var. *keyensis*

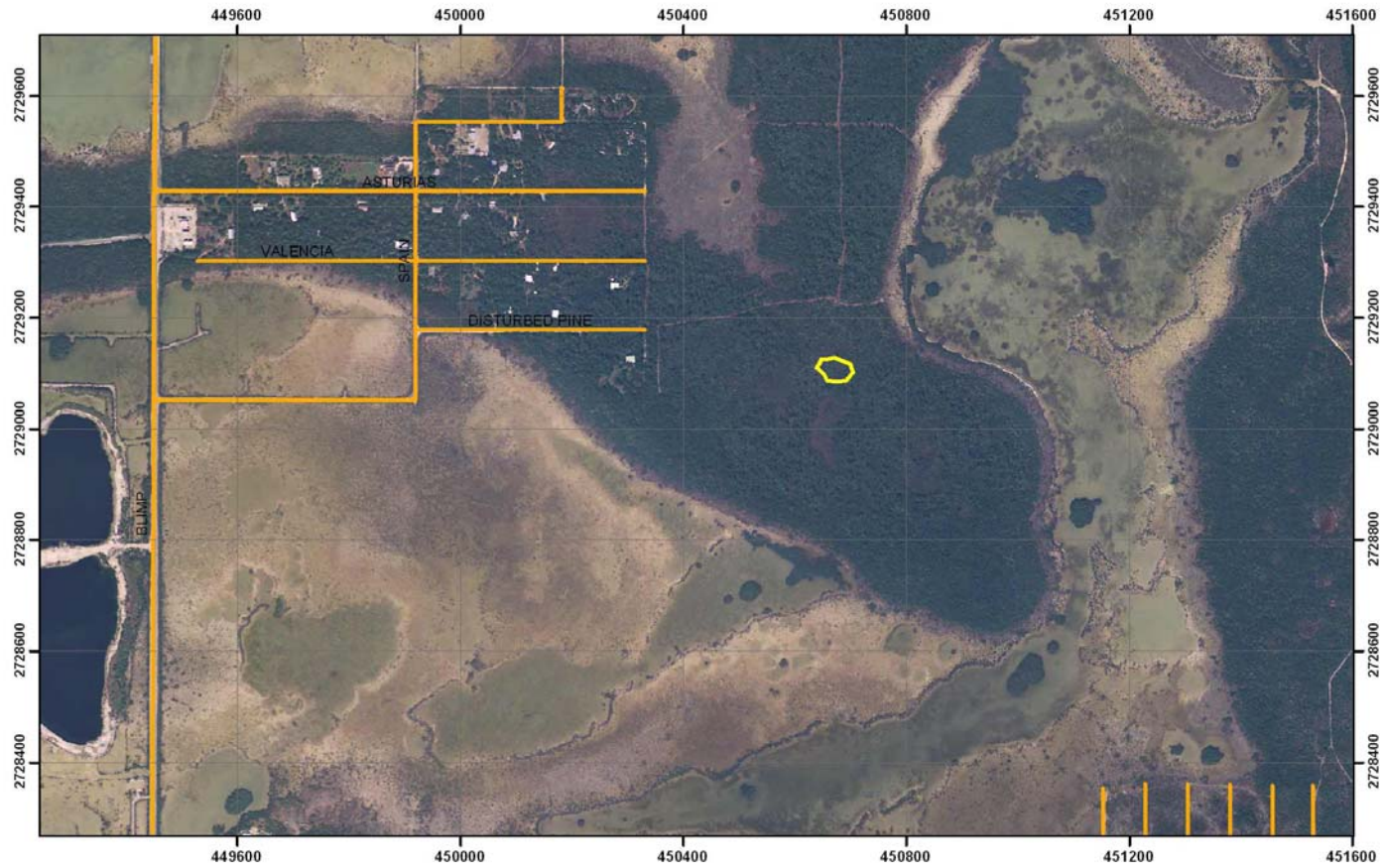
Status

- ▲ *C. lineata* var. *keyensis* Historical
- *C. lineata* var. *keyensis* Extant



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 Map datum: Universal Transverse Mercator, Zone 17N, WGS84

Map #11: *Chamaecrista lineata* var. *keyensis* on Cudjoe Key



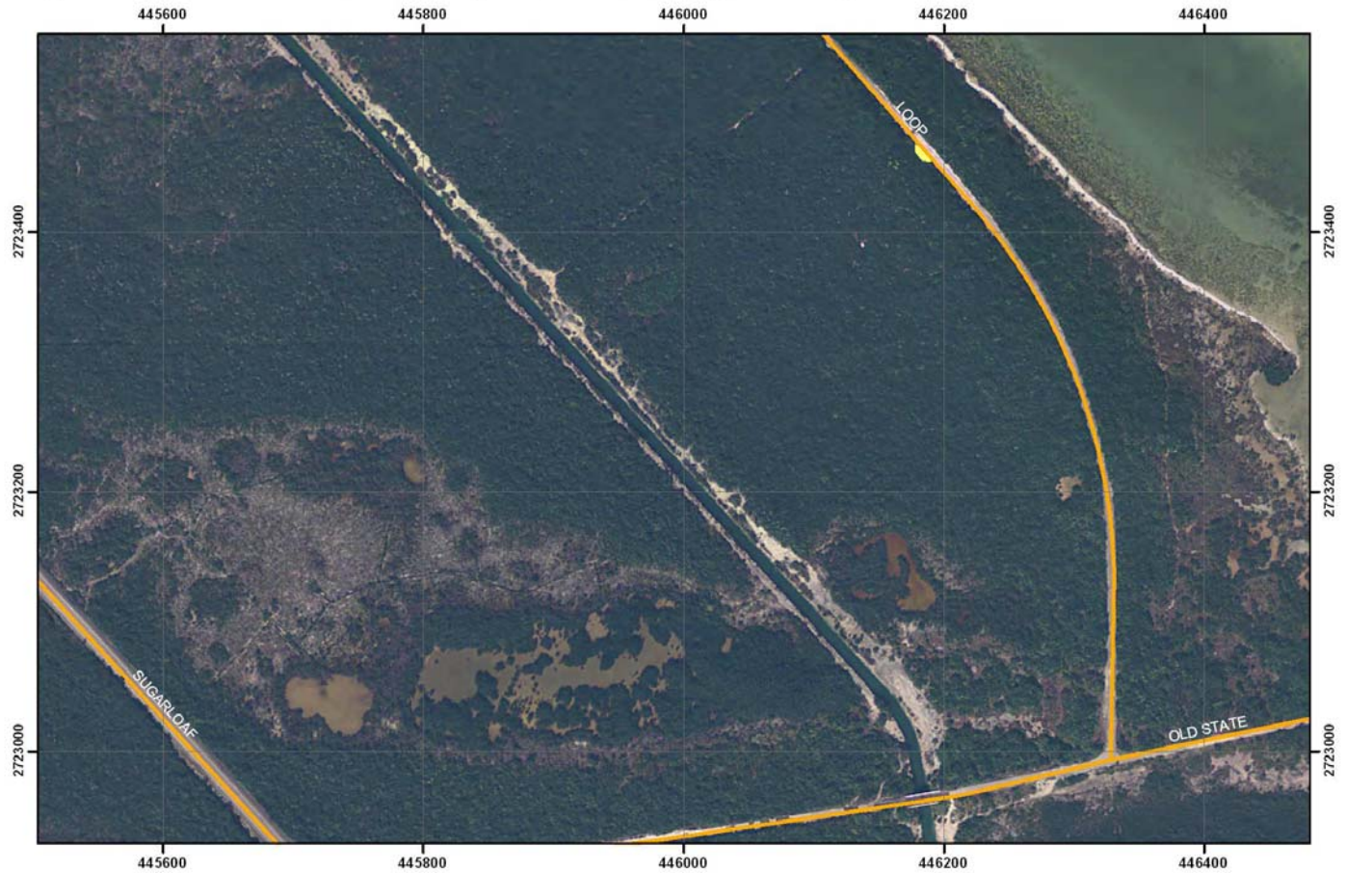
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 *C. lineata* var. *keyensis*

0 90 180 360 540 Meters

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Map #12: *Chamaecrista lineata* var. *keyensis* on Lower Sugarloaf Key



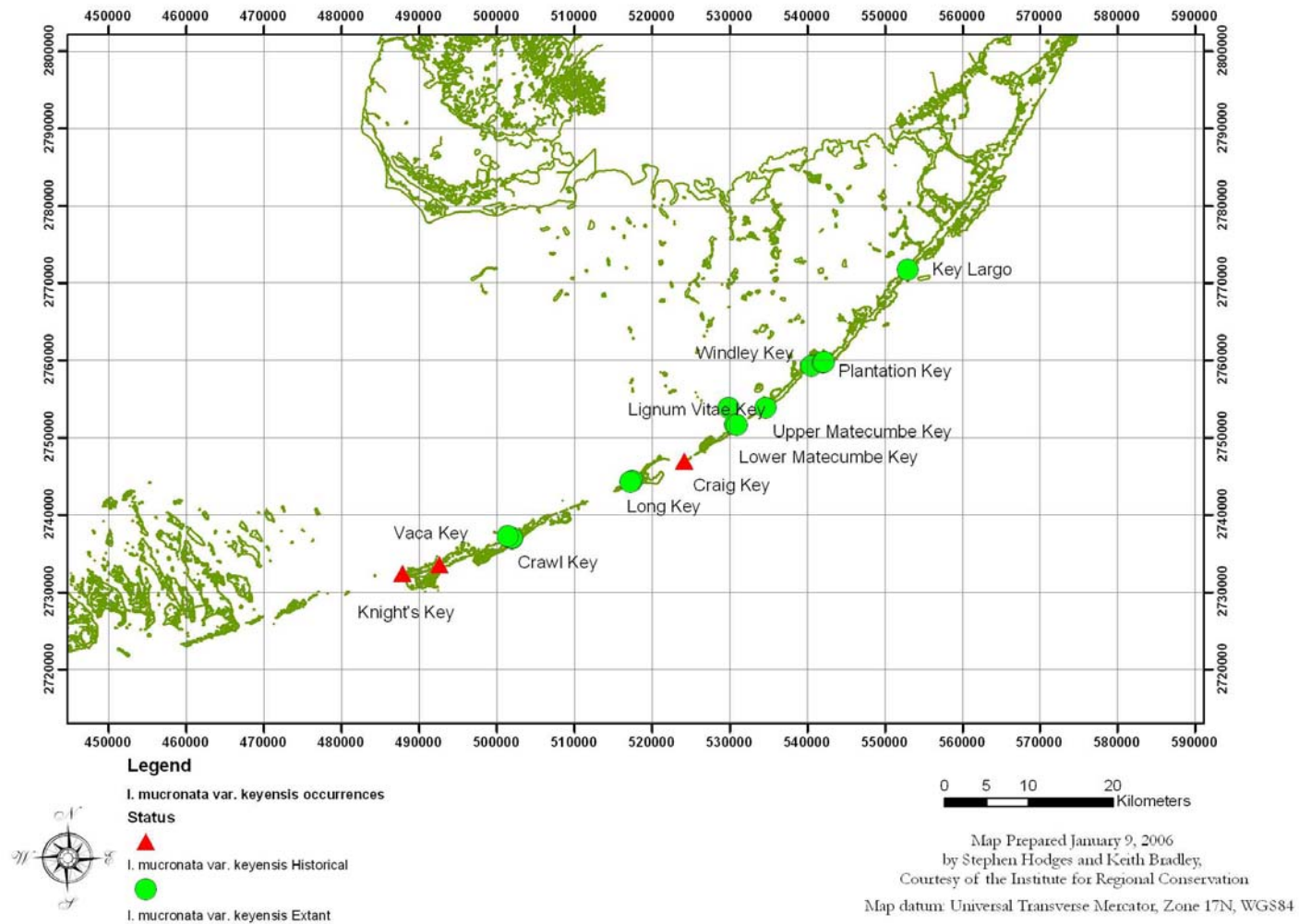
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 Chamlinekeye Lower Sugarloaf

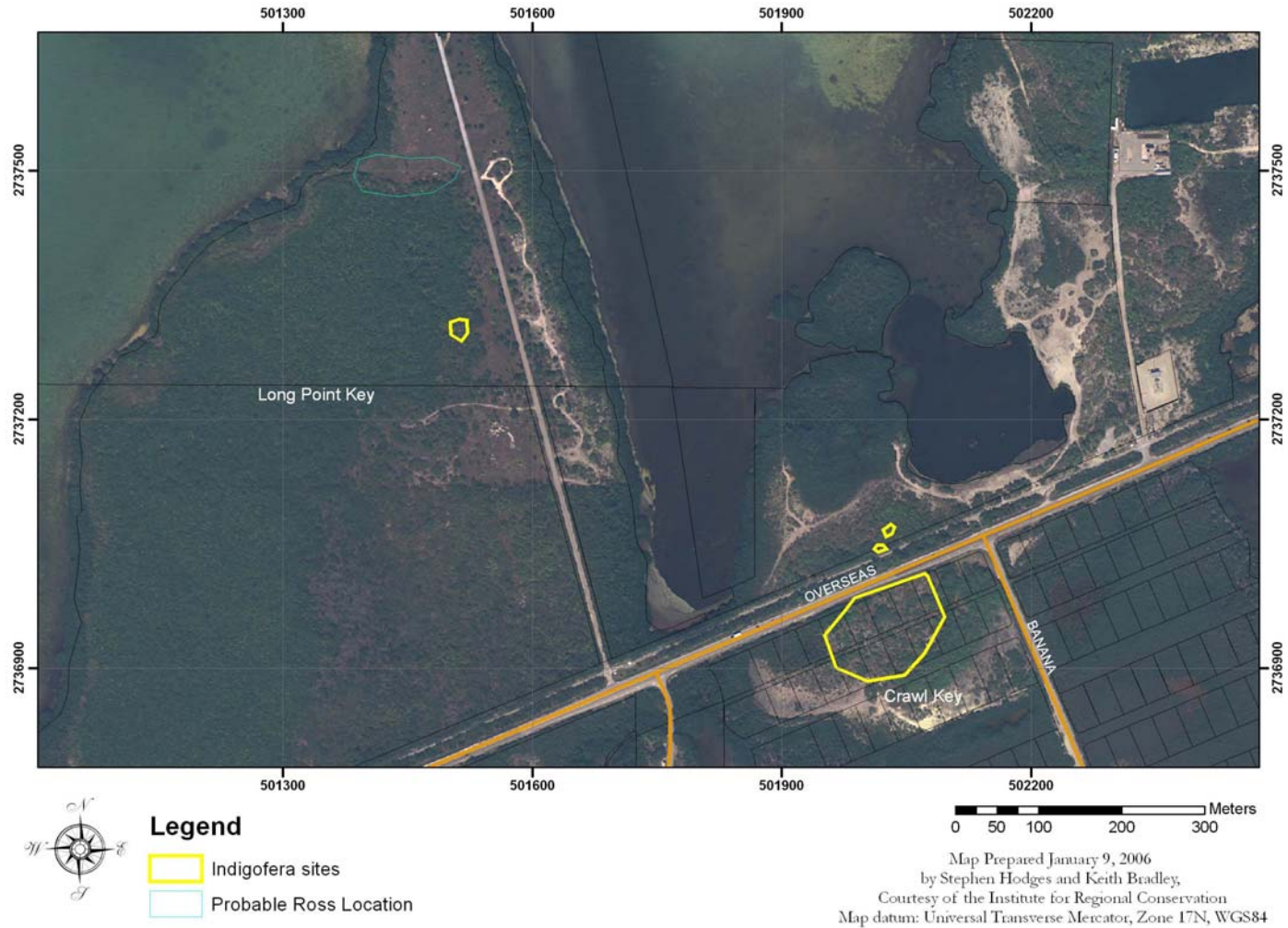


Map Prepared January 9, 2006
by Stephen Hodges and Keith Bradley,
Courtesy of the Institute for Regional Conservation
Map datum: Universal Transverse Mercator, Zone 17N, WGS84

Map #13: Distribution of *Indigofera mucronata* var. *keyensis* in the Florida Keys.



Map #14: Distribution of *Indigofera mucronata* var. *keyensis* near Curry Hammock State Park



Map #15: Distribution of *Indigofera mucronata* var. *keyensis* at Key Largo Narrows,
John Pennekamp Coral Reef State Park



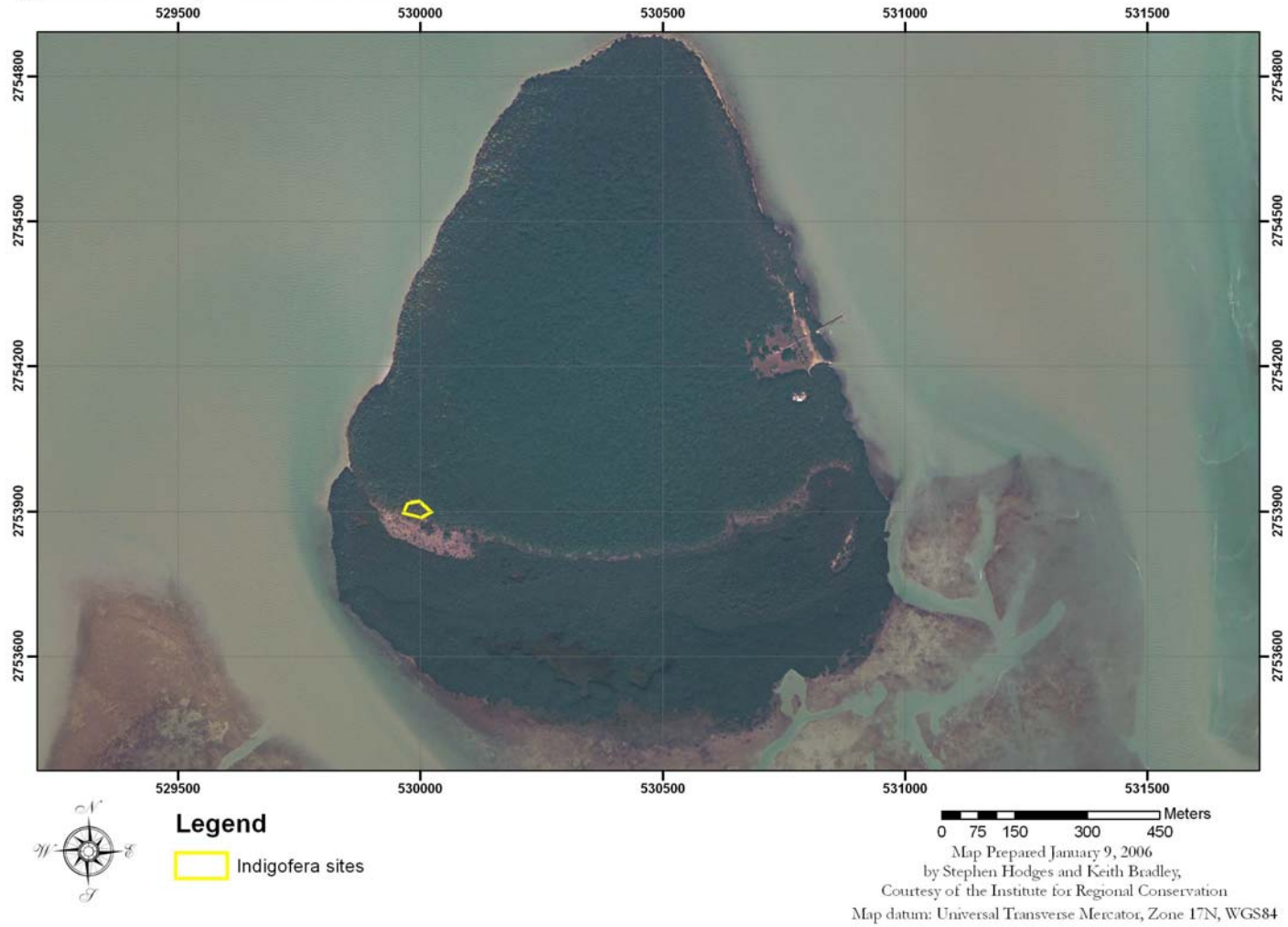
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I. mucronata var. *keyensis*

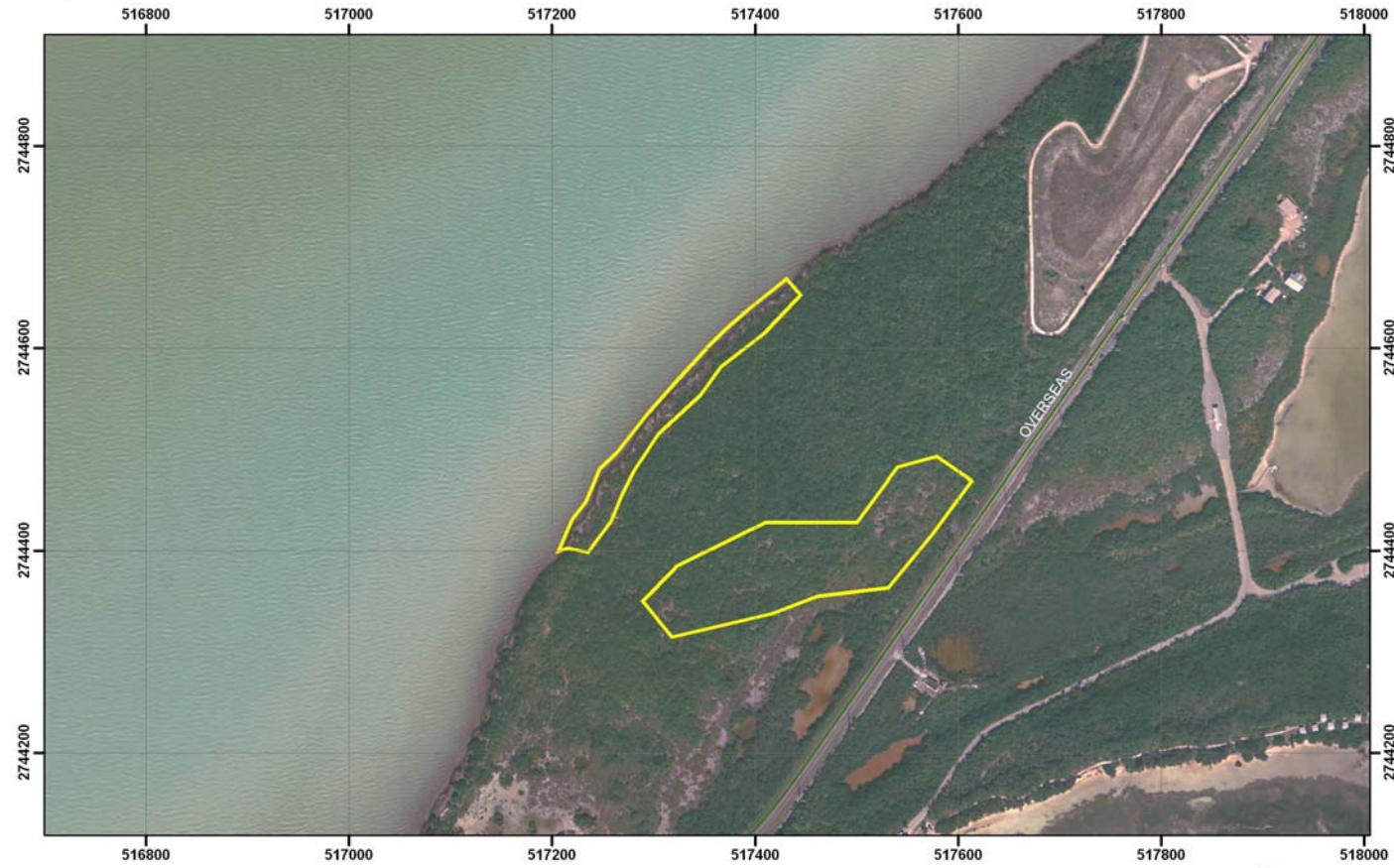
0 15 30 60 Meters

Map Prepared January 9, 2006
by Stephen Hodges and Keith Bradley,
Courtesy of the Institute for Regional Conservation
Map datum: Universal Transverse Mercator, Zone 17N, WGS84

Map #16: Distribution of *Indigofera mucronata* var. *keyensis* on Lignum Vitae Key, Lignumvitae Key Botanical State Park



Map #17: Distribution of *Indigofera mucronata* var. *keyensis*
Long Key State Park



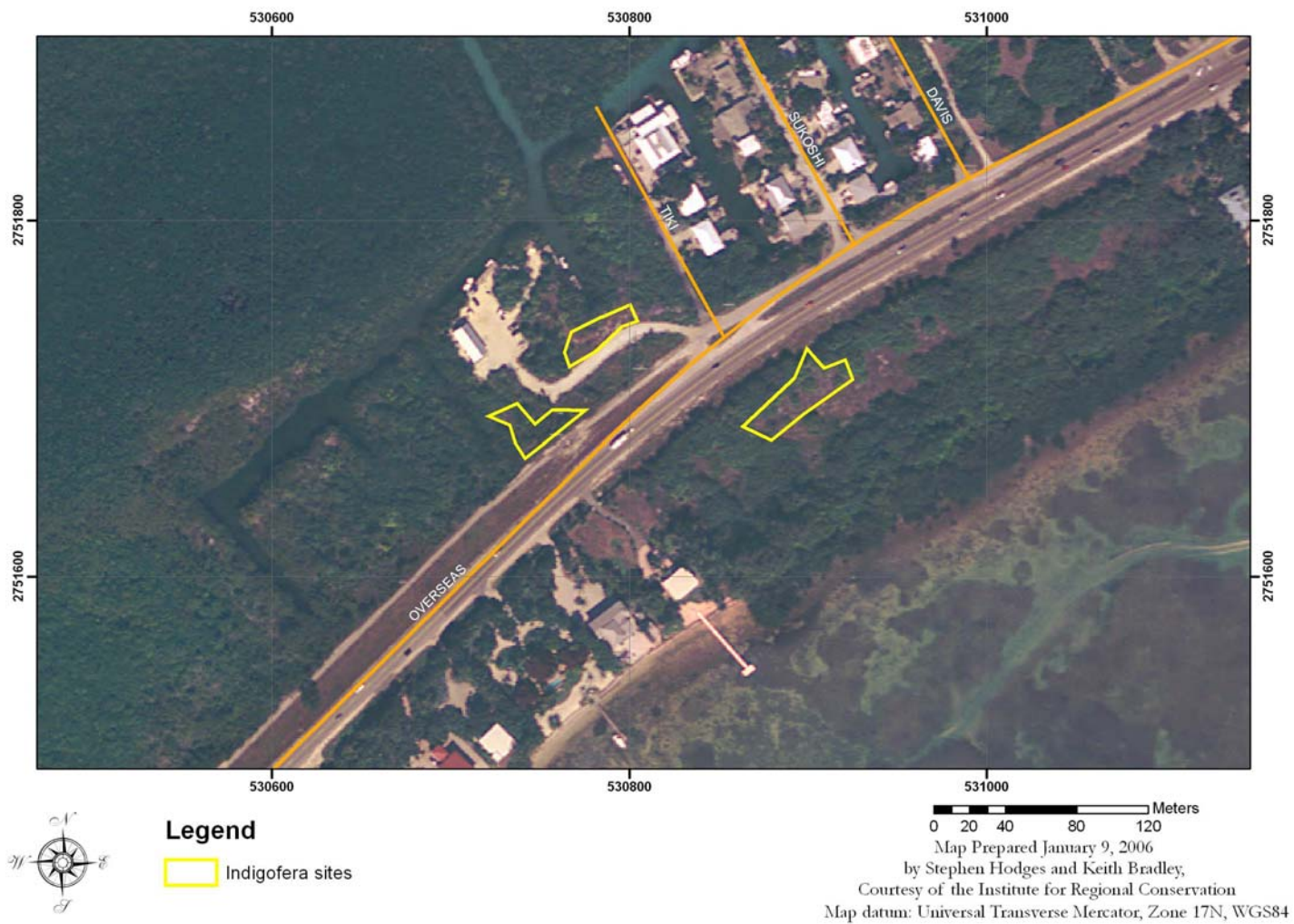
Legend

 Indigofera sites

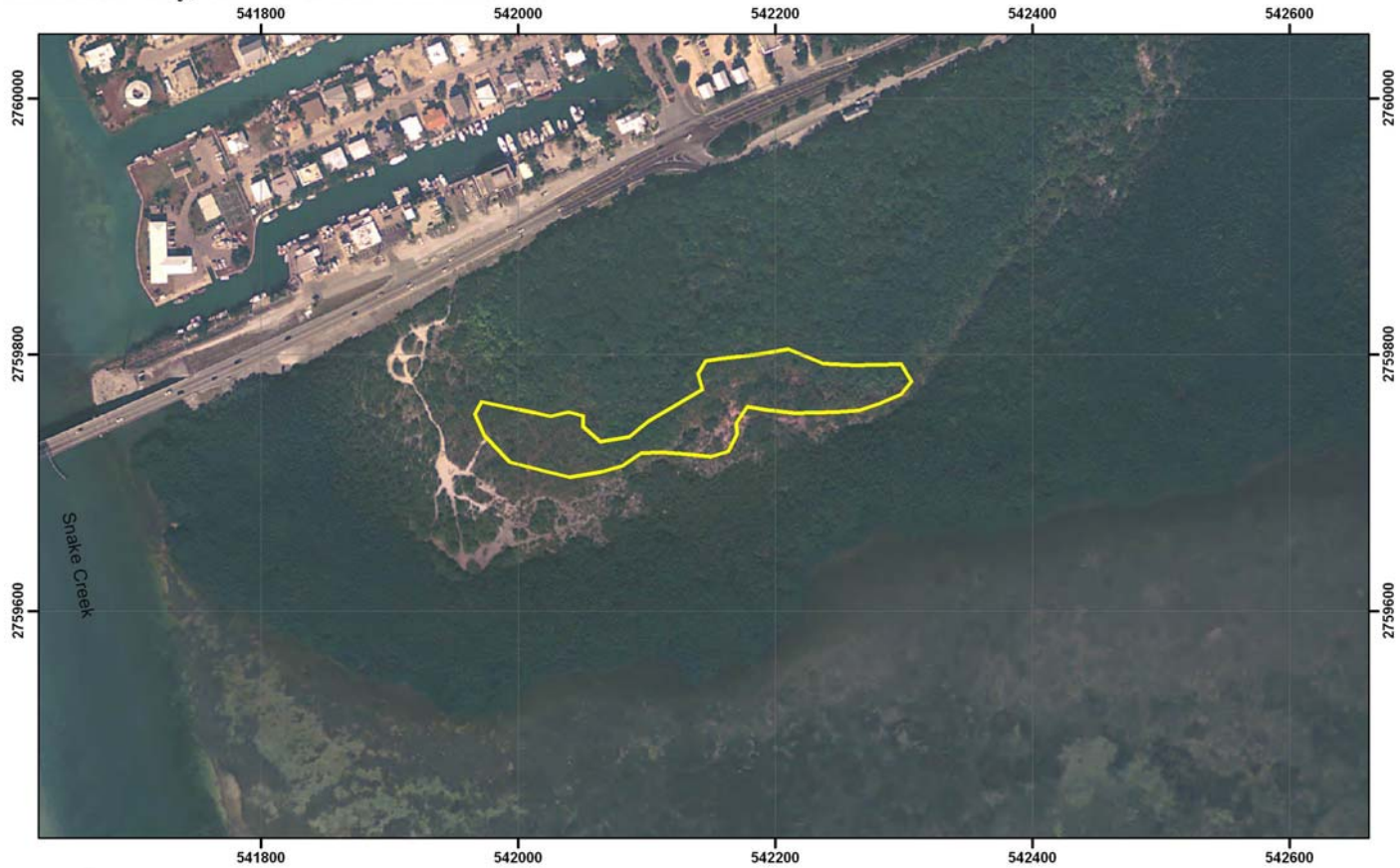
0 40 80 160 240 Meters

Map Prepared January 9, 2006
by Stephen Hodges and Keith Bradley,
Courtesy of the Institute for Regional Conservation
Map datum: Universal Transverse Mercator, Zone 17N, WGS84

Map #18: Distribution of *Indigofera mucronata* var. *keyensis* on Lower Matecumbe Key



**Map #19: Distribution of *Indigofera mucronata* var. *keyensis* on
Plantation Key, Snake Creek Hammocks**



Legend

 *Indigofera* sites

0 30 60 120 180 Meters

Map Prepared January 9, 2006
by Stephen Hodges and Keith Bradley,
Courtesy of the Institute for Regional Conservation
Map datum: Universal Transverse Mercator, Zone 17N, WGS84

Map #20: Distribution of *Indigofera mucronata* var. *keyensis* on Upper Matecumbe Key, Teatable Hammock, Lignum Vitae Key Botanical State Park



Legend

 Indigofera sites

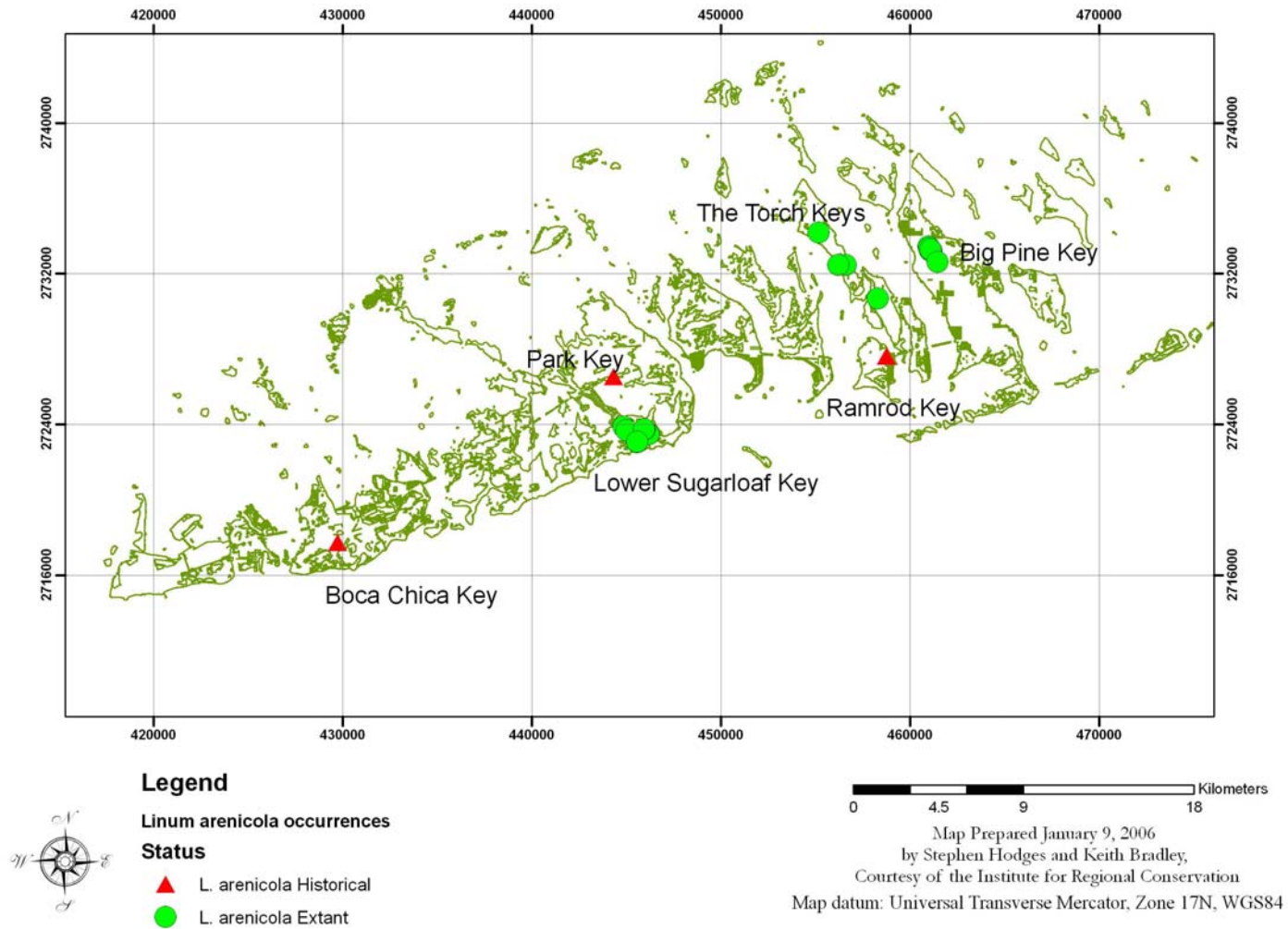
0 20 40 80 120 Meters

Map Prepared January 9, 2006
by Stephen Hodges and Keith Bradley,
Courtesy of the Institute for Regional Conservation
Map datum: Universal Transverse Mercator, Zone 17N, WGS84

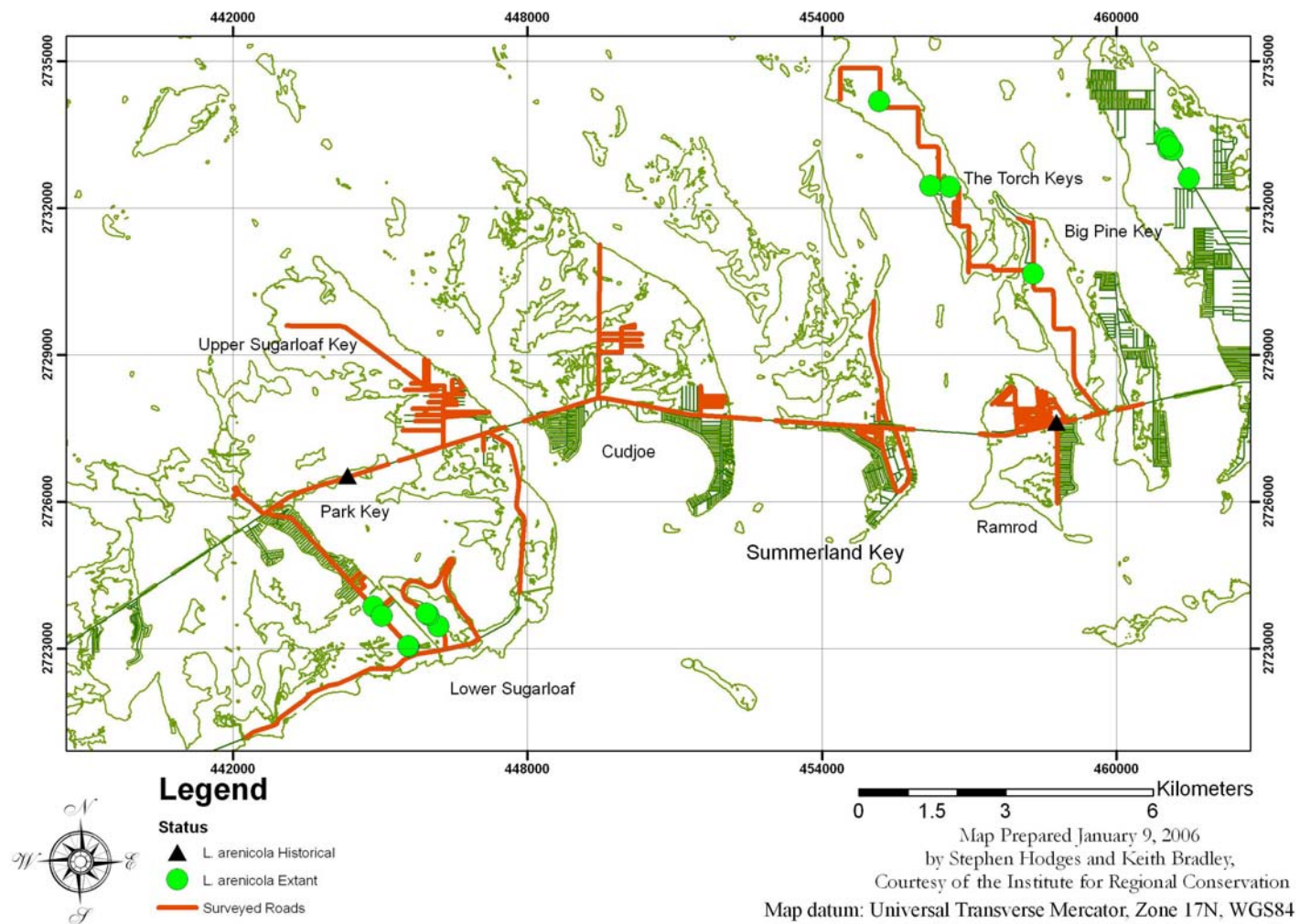
Map #21: Distribution of *Indigofera mucronata* var. *keyensis* at Windley Key State Geological Park



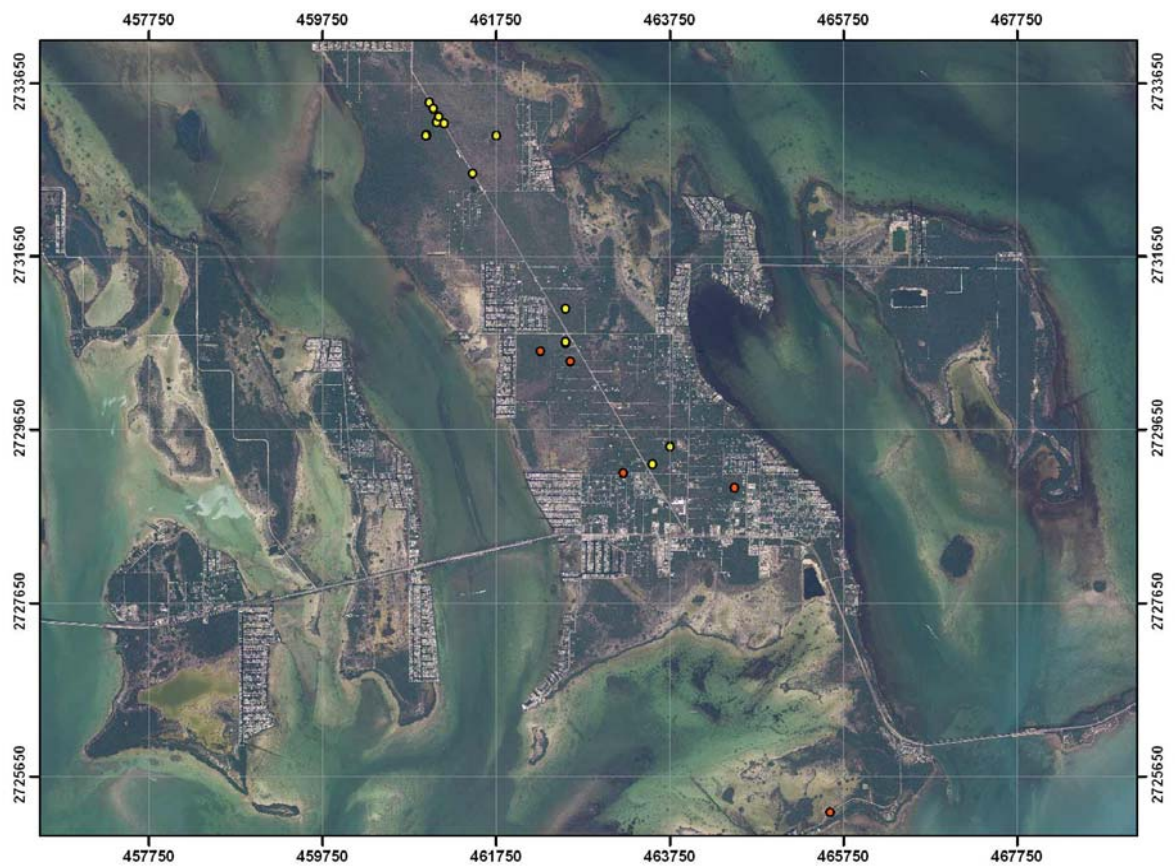
Map #22: Overall Distribution of *Linum arenicola* in the Florida Keys



Map #23: Roads Surveyed for *Linum arenicola* in the Florida Keys



Map #24: *Linum arenicola* on Big Pine Key

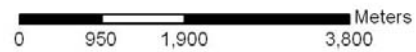


Legend

***Linum arenicola* on Big Pine**

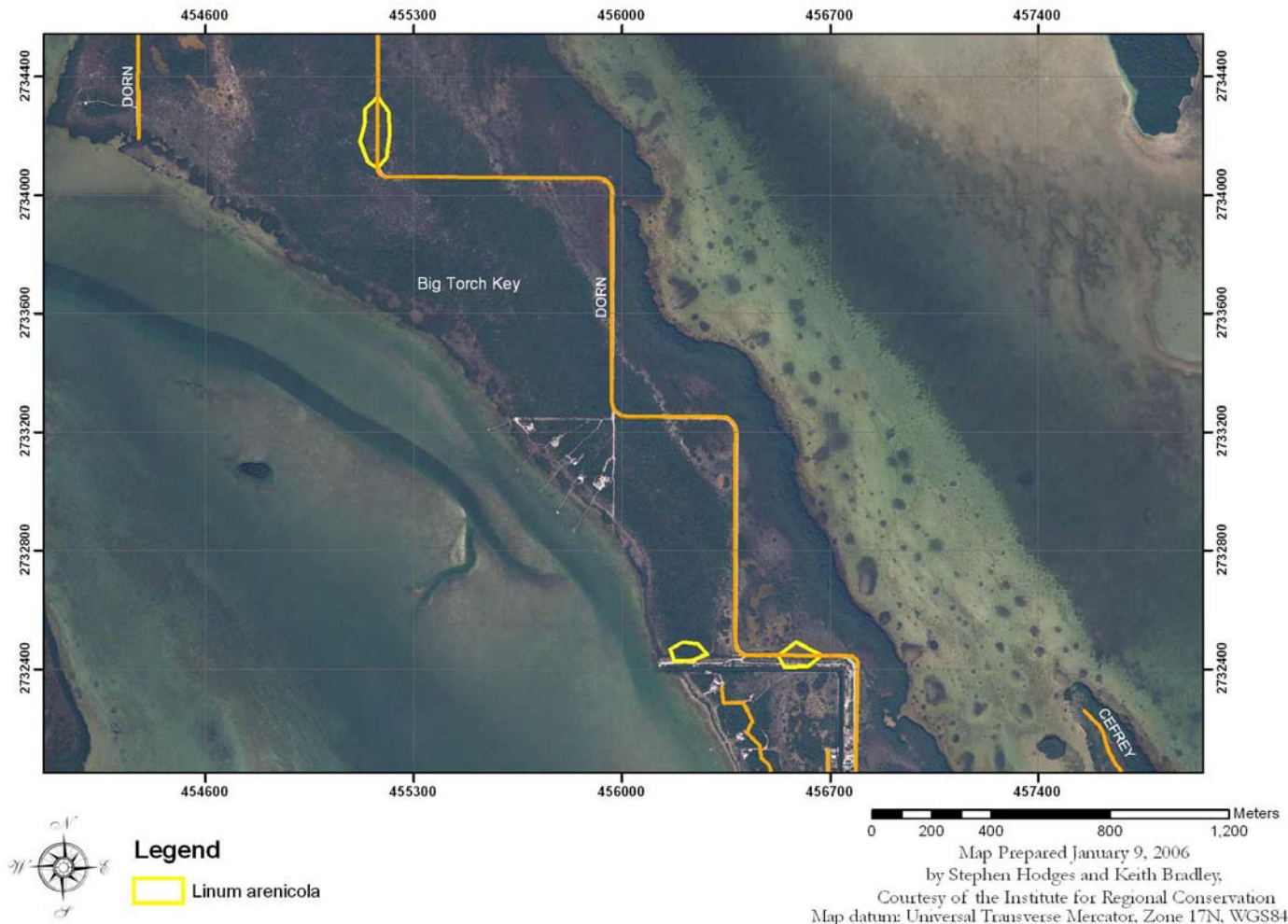
Occurrence

- Historical
- Present



Map Prepared January 9, 2006
by Stephen Hodges and Keith Bradley,
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Map datum: Universal Transverse Mercator, Zone 17N, WGS84


Map #25: *Linum arenicola* on Big Torch Key



Map #26: *Linum arenicola* on Lower Sugarloaf



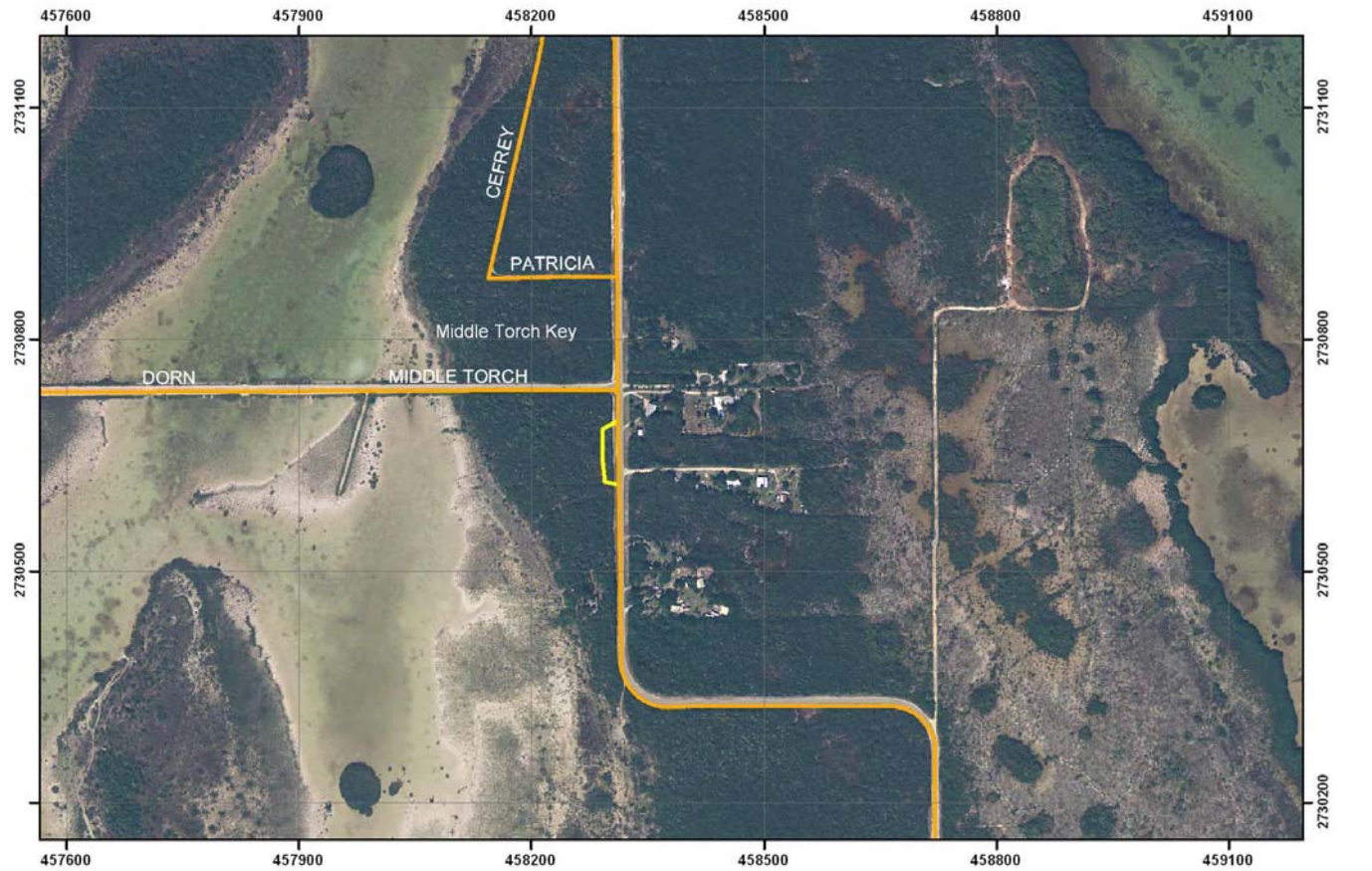
Legend

 *Linum arenicola*


0 85 170 340 510 Meters

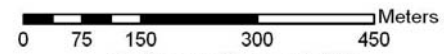
Map Prepared January 9, 2006
by Stephen Hodges and Keith Bradley,
Courtesy of the Institute for Regional Conservation
Map datum: Universal Transverse Mercator, Zone 17N, WGS84

Map #27: *Linum arenicola* on Middle Torch Key



Legend

 *Linum arenicola*



Map Prepared January 9, 2006
by Stephen Hodges and Keith Bradley,
Courtesy of the Institute for Regional Conservation
Map datum: Universal Transverse Mercator, Zone 17N, WGS84

