Report on the Status of Sand Flax

Linum arenicola

In the Florida Keys

Photo by K. Bradley

Submitted by

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to the Florida Native Plant Society

and

the Key West Tropical Forest and Botanical Garden

Work is now complete for the surveys of *Linum arenicola* (Small) H.J.P. Winkler, sand flax, in the Florida Keys. The primary purpose of these surveys was to determine population size and distribution after Hurricane Wilma on October 24th, 2005. Wilma had a large impact on the Florida Keys, with storm surges flooding much of the landmass of the Lower and Middle Keys (Goodhue, 2005). While working for the Institute for Regional Conservation, the author conducted surveys for *L. arenicola* along with other federal candidate taxa throughout the Florida Keys during 2005. These surveys generated baseline data for the distribution and population size of sand flax prior to Wilma, and the conservation grant from the Florida Native Plant Society (FNPS) was used to assess the current status of this species. Some significant flux has occurred in the distribution and population of the taxon during the interceding four years (described in detail below) pointing to a continuing need for monitoring and population assessments.

Taxonomy and Summary

The Linaceae has a worldwide distribution, with species diversity concentrated in the temperate and subtropical regions of the world. The family contains approximately 6 (to 33) genera and 220-300 species. *Linum* is by far the largest genus, with more than 200 species. Although Cronquist placed the family in the Linales, recent molecular studies by the Angiosperm Phylogeny Group have placed the family within an expanded Malpighiales (Smith *et al*., 2004).

Linum arenicola is a small; almost grass like herb, endemic to southern Florida in Miami-Dade and Monroe counties. John Kunkle Small originally described the species in 1907 as *Cathartolinum arenicola* from plants he collected in Miami-Dade County in 1904. This treatment was consistently followed by Small in (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). In the Florida Keys, the taxon is known from four populations, described below. *L. arenicola* is a candidate for the federal endangered species list (S.R. Hodges and Bradley, 2006).

Surveys in the Keys, and specimen searches conducted at the herbarium of Fairchild Tropical Botanic Garden (FTG) indicates that sand flax is in bloom in the Florida Keys between the months of February and September. Peak flowering time seems to be around March and April. Little is known about the life history of this species, including pollination biology, seed predation and potential seed dispersal. Longevity is equally not known. Due to its diminutive size and grass like appearance, and considering its habitat constraints, flowering time is of great importance in considering survey times for this species.

Habitat

Linum arenicola occupies a very specific habitat niche in the Keys. With the exception of individuals on Big Pine Key, it occurs exclusively on the roadside, between the area being mowed and the intact habitat immediately adjacent. It occasionally extends into the intact habitat adjacent to the roadside, although it was not observed during these surveys extending more than two feet into intact habitat. The most robust populations occur in areas adjacent to pine rockland or rockland hammock where the roadside is not being mowed.

L. arenicola has been found to occur with the following associated species *Abildgaardia ovata, Andropogon ternarius, Angadenia berteroi, Bletia purpurea, Buchnera americana, Byrsonima lucida, Cenchrus incertus, Chamaecrista lineate 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.*

Methodology

Background information on *L. arenicola* was based on the Hodges and Bradley report prepared for the U.S. Fish and Wildlife Service in 2005 (S.R. Hodges and Bradley, 2006). This data in turn reflected the combined information contained in the Institute for Regional Conservation's Floristic Inventory of South Florida (FISF) online database (Gann *et al.,* 2002; Gann *et al.,* 2006). This database includes a compilation of all available plant inventories for conservation areas as well as herbarium specimens of rare plant taxa from most herbaria in Florida and important national herbaria. Of particular relevance among these sources is "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). This report contained a significant amount of background population and distribution about *L. arenicola*. Finally, surveys conducted by the late George Avery, who was one of the most prolific botanists in Florida history, as well as the wealth of information provided by surveys conducted by Keith Bradley, George Gann and Steve Woodmansee were compiled for use in determining potential distribution.

Surveys were conducted for sites obtained during the Hodges and Bradley surveys of 2005. Additional surveys were conducted of sites where access could be obtained based on extirpated occurrences contained in the Austin report. Roadside surveys were conducted for identified colonies, and colony perimeters or positions of individual plants were recorded with a handheld Garmin GPS unit. Maps were then projected using Google Earth™. For the prior surveys, populations had been recorded on a log scale i.e. one, tens, hundreds etc. However,

during these surveys every attempt was made to count all individuals as to provide the most accurate population counts possible. Population counts remain estimates however, and it is entirely possible, indeed likely, that some individuals have been missed due to their small size. Individual counts were made however so that more subtle shifts in population size can be assessed in the future. Surveys were made on Big Pine Key, which likely contains the highest population of *L. arenicola.* However, Big Pine Key contains a large amount of potential habitat, and can be extremely time consuming to survey. Keith Bradley and other IRC staff members have re-monitored these populations post Wilma to determine shifts in population size. As such, in the interest of obtaining as much information as possible, population estimates for Big Pine Key are based primarily on their data, while information gleaned from these surveys was shared with them to increase their data set as well.

Results

Four populations were located, along with three historical populations and one population that is possibly extirpated. Additional surveys were conducted to account for other potential populations. These surveys were typically conducted while driving roads from Little Torch to Boca Chica Key. These data are summarized in Table 1. Extant populations include Big Pine Key, Big Torch Key, Lower Sugarloaf Key and Upper Sugarloaf Key. A former population was found on Middle Torch Key in 2005, however could not be relocated despite repeated surveys. Furthermore, the population on Big Torch Key, which had been known from two sites had shrunk drastically, with only one individual located. Both these areas were heavily affected by storm surges during Hurricane Wilma. However, personal observation leads the author to believe that in addition to storm surge damage, roadside maintenance is a likely culprit for the diminished populations. These populations have been seen to be frequently mowed, which if conducted while populations are in flower or fruit might have devastating effects. Furthermore, what appeared to be herbicide damage was present at one of the sites where plants had been observed prior to Wilma. The author has surveyed these locations multiple times over the last three years, often informally. Plants had never been relocated, until the one plant was found on March 21st, 2010.

On a brighter note, the population on Upper Sugarloaf had not been recorded in the 2005 surveys, although this area had been thoroughly surveyed. Steve Woodmansee first located plants here in 2009 (S. Woodmansee pers. comm.). These surveys located 73 plants, which seemed to be thriving, along the roadside in the Key Deer National Wildlife Refuge. A voucher specimen needs to be collected for this population. The Fairchild Botanic Garden herbarium currently contains 12 specimens from Monroe County, all of which, except for Bradley #2037, were collected on Big Pine Key. The Bradley specimen was collected on Lower Sugarloaf Key.

Discussion

It is hard to quantify and interpret the impact of natural disturbance events when coupled with sea level rise, increased salinity levels, hydrological change, fire management and roadside

maintenance on poorly understood rare plant populations. What has become apparent to many researchers, faced with the task of trying to interpret these effects, is that a lack of baseline information on populations prior to other major disturbance events makes this task even more challenging. Researchers from several different institutions are attempting to understand the effects of Hurricane Wilma, and to aid in making recommendations for the continued protection and well being of rare plant populations. What is clear, is that were we to have a repeat of a storm surge at the level of Hurricane Wilma, which affected much of the Florida Keys, we would be better prepared to interpret these effects the next time. In other words, having not known what changes in distribution and population particular plant species have undergone in the past in response to these events, we struggle to interpret the effects of one event. Having now come to terms with the fact that baseline information is necessary in order to track changes in the wake of natural disturbance, this survey, and others like it, will aid in understanding these effects in the future.

In the case of *L. arenicola* the data are inconclusive as to the exact impacts of the storm surge. What is clear from these surveys is that these populations are in flux, with some impacts possibly coming from Wilma, but being exacerbated by, or accelerated through the impacts of other maintenance decisions. It is the recommendation of the author that an attempt be made, perhaps through the combined efforts of researchers, academic and botanic institutions, as well as state and federal agencies concerned, to get both county and the Florida Department of Transportation to cease mowing in the particular locations where sand flax occurs on the roadside. “No Mow” signs have been placed in other locations in the state, and the impacts felt by residents in this case would be minimal at most. This is particularly relevant on Middle Torch and Big Torch, where populations might rebound if undisturbed for some time, and where they occur in unobtrusive, distinct locations.

It is also clear that continued monitoring of these populations is necessary, as changes can occur quite quickly. While *L. arenicola* appears to have bounced back from Wilma, it has still been shrinking in distribution and population for some time. Additionally, it is important for surveys of this species to take into account flowering time, and to concentrate our surveys in the spring and early summer months. Although it is conceivable that the species will be up at other times of the year, a direct pulse of flowering was noted during March and early April, turning up plants that had previously been unseen.

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Figure 1: Linum arenicola in the Lower Keys

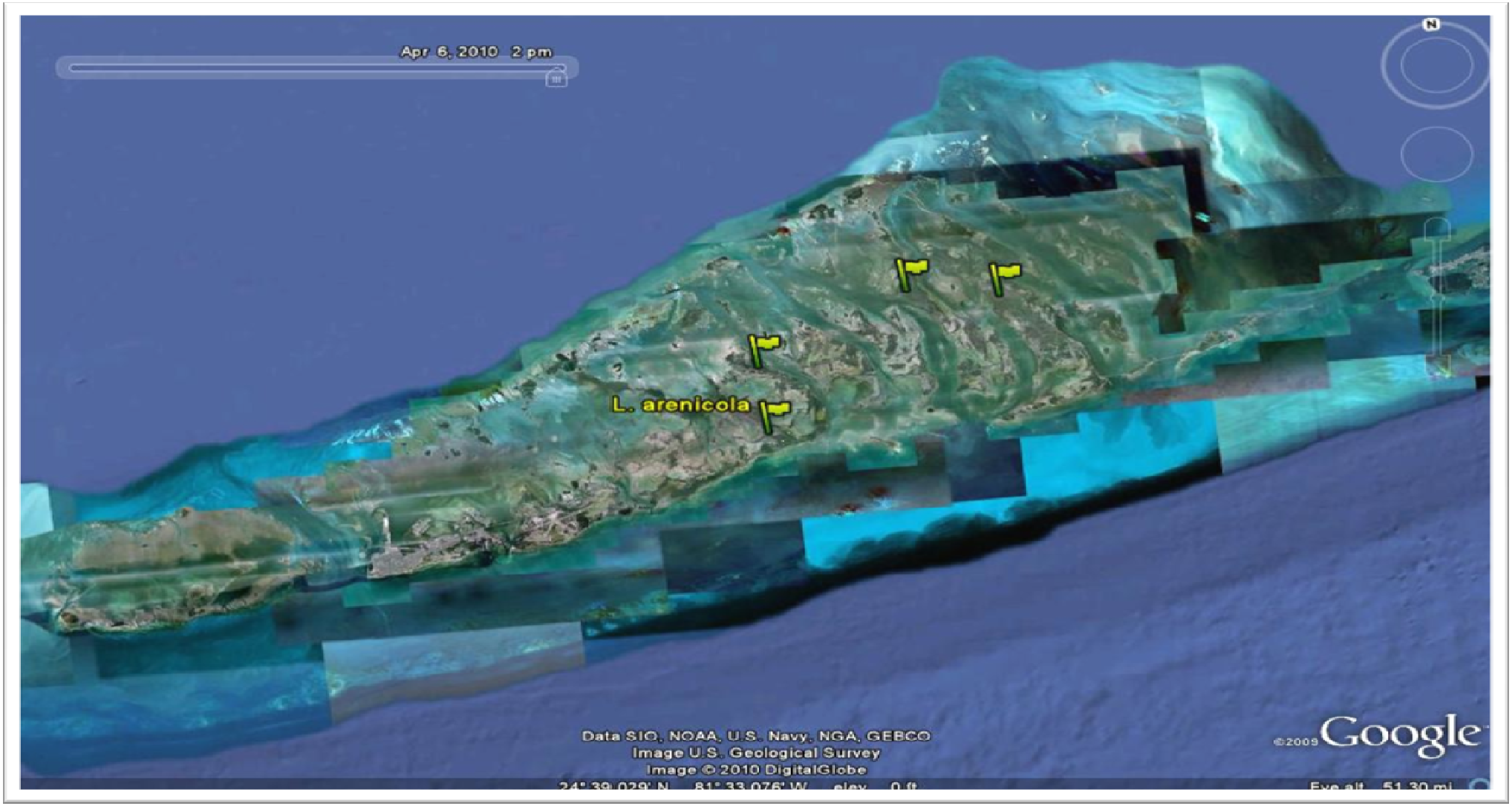

Figure 2: L. arenicola on Big Pine Key, Overview

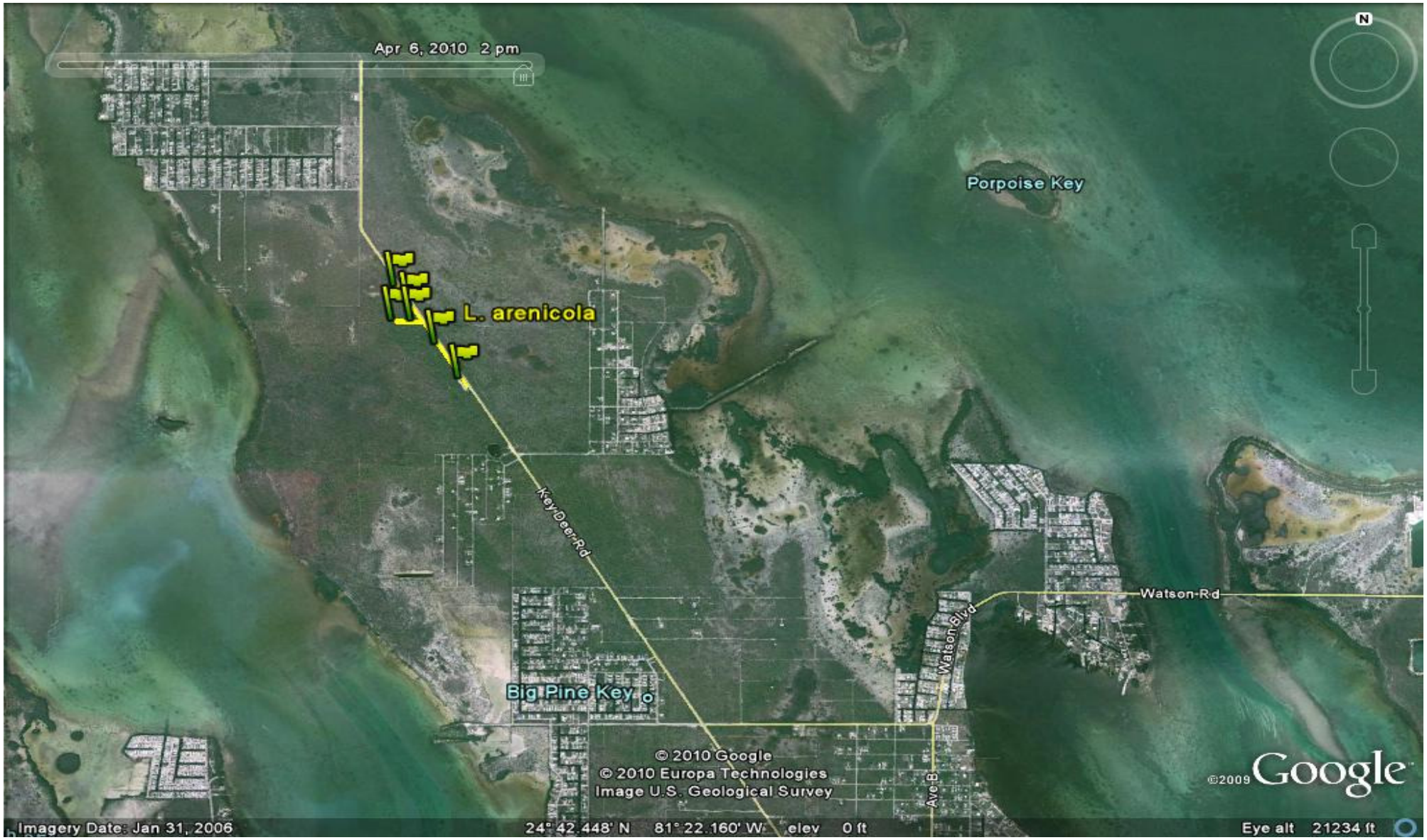

Figure 3: L. arenicola on Big Pine Key, detail

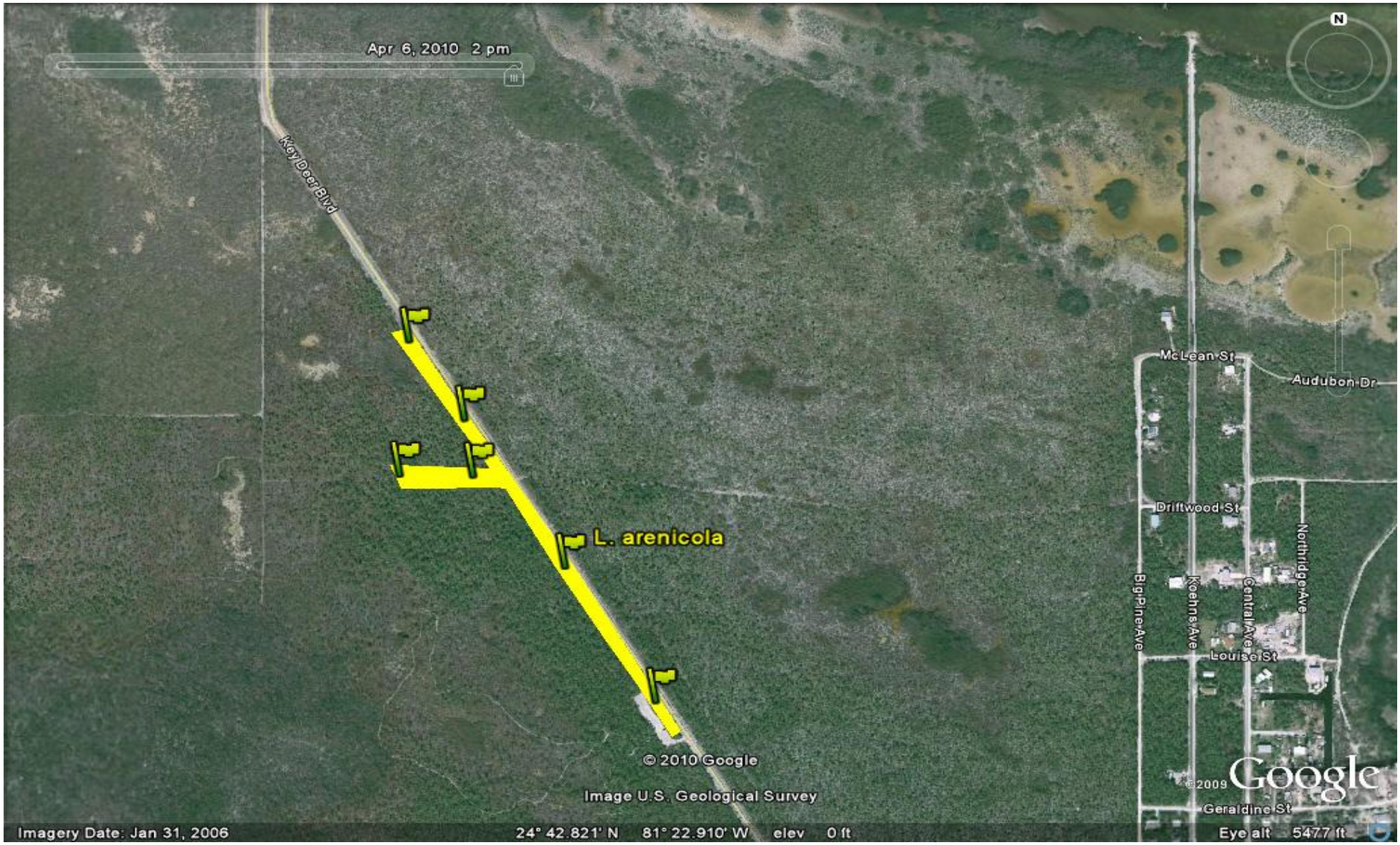

Figure 4: L. arenicola on Big Torch Key

Figure 5: Linum arenicola on Lower Sugarloaf Overview

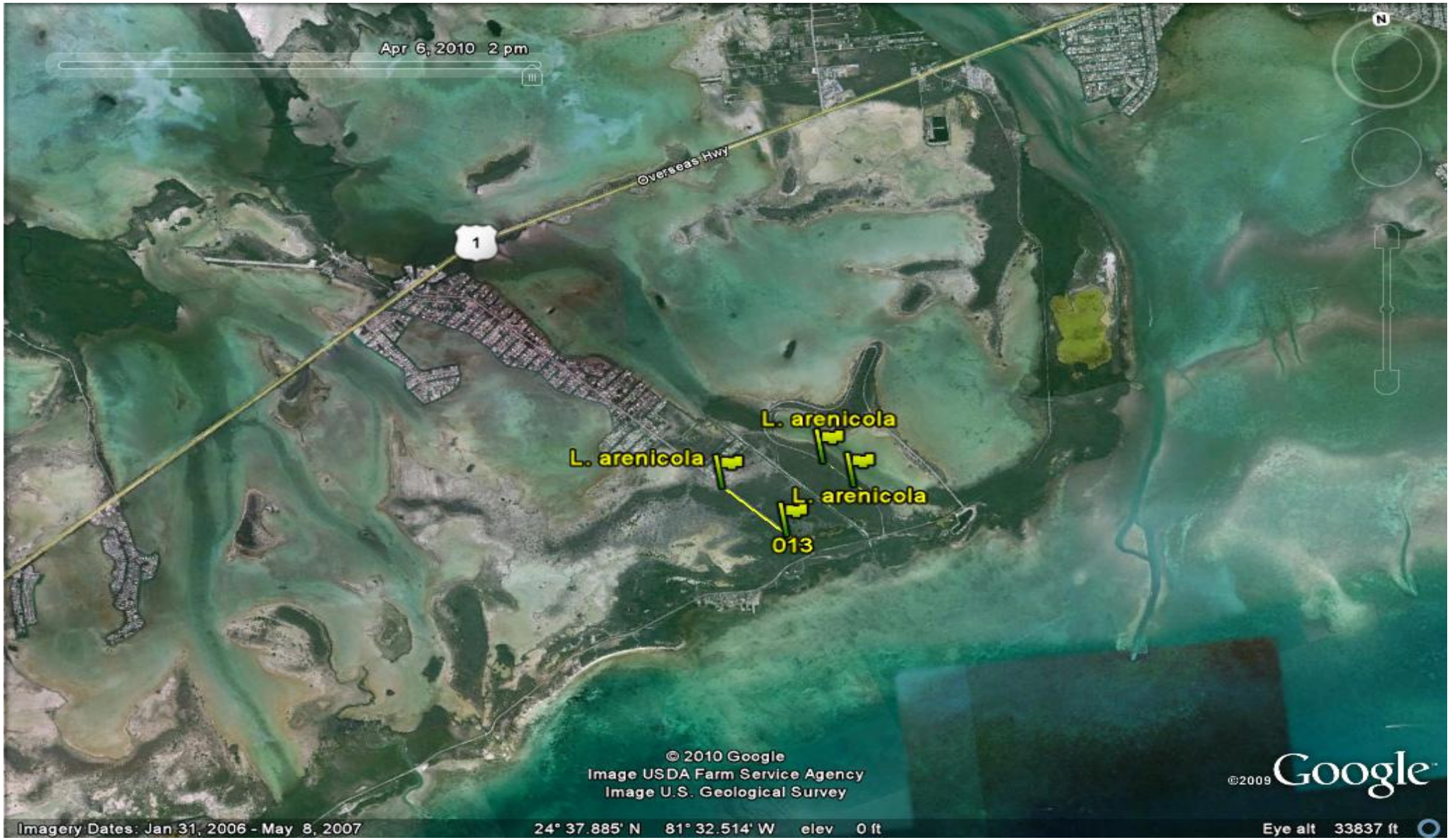

Figure 6: Linum arenicola on Lower Sugarloaf, closeup

Figure 7: Linum arenicola on Upper Sugarloaf, Key Deer Refuge

Figure 8: Linum arenicola on Big Torch Key

Table 1: Linum Arenicola Distribution and Populations Before and After Hurricane Wilma

Extant Occurences

Site	Owner	Population Before Wilma (2005)	Population after Wilma (2009-2010)	Threats	Habitat
Big Pine Key	public	1,001 - 10,000	1,001 - 10,000	Development, Fire suppression	Pine Rockland/Roadside
Big Torch Key	public	11-100	1	Roadclearing or other maintenance	Roadside
Lower Sugarloaf	public	101-1,000	101-1,000 (531 counted)	Roadclearing or other maintenance	Roadside
Middle Torch Key	public	2--10	0	Roadclearing or other maintenance	Roadside
Upper Sugarloaf	public	0	11-100 (73 counted)	Fire suppression, Roadclearing	Pine Rockland/Roadside

Extirpated Occurrences	Owner	Last Known Observation	Cause	
Boca Chica Key	D.O.D.	1912	unknown, probably development	unknown
Park Key	public	1961	unknown, probably maintenance	Roadside
Ramrod Key	public	1979	unknown	Roadside