



CONSERVIAN

FLORIDA KEYS INVASIVE AUSTRALIAN PINE ASSESSMENT & ACTION PLAN



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Conservian/Coastal Bird Conservation, Big Pine Key, Florida.

Cover Photo: Invasive Australian pine in Parmalee Key subdivision in foreground. Photo below: Australian pine invading mangrove wetland habitat in Big Pine Key. All photographs in this document are © Conservian/M. Zdravkovic.



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Introduction

Overview

The Florida Keys comprise a string of more than 1,800 islands that arc southwestward 150 miles (240 km) from the southernmost tip of mainland Florida. Invasive Australian pine (*Casuarina equisetifolia*) is present on the majority of the islands of the Florida Keys. All islands and coastal lands are increasingly vulnerable to the many impacts of global sea level rise, and those threats are exacerbated by Australian pine infestation. Planted by humans beginning in the late 19th century, Australian pine is an aggressive, invasive species that destabilizes coastal lands and is highly destructive to native island habitats and wildlife. It is illegal to buy, sell, or plant anywhere in the state, and is listed as a Category One invasive plant by the Florida Exotic Pest Plant Council (Pernas *et al* 2013). Australian pine is a hazard to infrastructure during and after tropical storms and hurricanes, as fallen trees can impede emergency services, block evacuation routes, and damage power lines, buildings, and vehicles, all of which can

cause significant economic loss and contribute to human fatalities. Eradication of Australian pine is a high priority to increase coastal resiliency and ecological integrity and is critically important in order to protect human landward interests and restore natural, coastal ecosystems.

Australian pine is not currently being consistently targeted in the Florida Keys to prevent proliferation. Recolonization and new propagation of the invasive tree has occurred, and it continues to spread since Hurricane Irma in September 2017. No comprehensive assessments of the quantity and locations of Australian pine had been conducted in the Florida Keys until this project. To document its abundance and distribution in the region, Conservian conducted aerial and ground surveys from 2021-2023, identifying more than 400 sites impacted by Australian pine.

Based on Conservian's new aerial and ground survey data, the Florida Keys have a median count of approximately 18,500 specimens of the invasive tree, impacting an estimated total of 1045 acres. Seventy-four sites were identified with at



least 51-100 Australian pine trees, and approximately one third of those sites are estimated to contain more than 200 trees. By stand density, eighteen percent of the affected acreage is highly impacted with monocultures of Australian pine, 34% are partial monoculture sites at the moderate to high impact level, 44% are moderately impacted with small clusters of trees, and four percent of the sites identified are at the low impact level with individual trees or occasional small clusters (Figure 1).

Forty-two percent of the estimated 18,500 Australian pine trees are located on private commercial land, 29% are on public land (municipal, state, and federal), and 26% are found on private residential land (Figure 2 in the [Summary](#)). The percentages of the impacted 1045 acres are quite similar: 45% is commercially-owned, 31% is publicly owned or managed, and 27% is residential land (Figure 3 in the [Summary](#)).

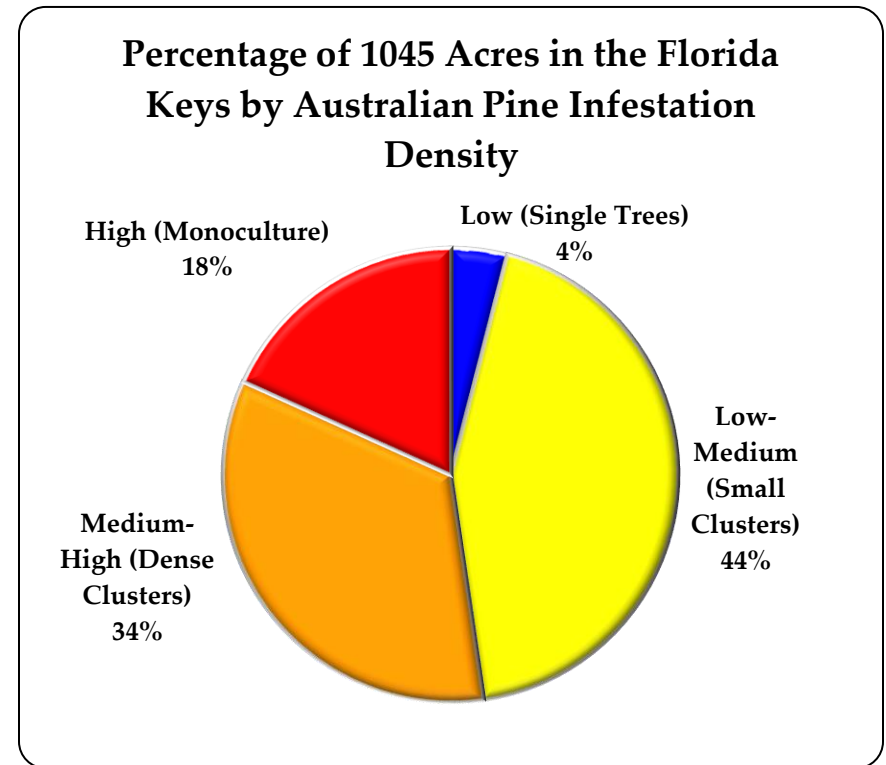


Figure 1: Percentage of acres classified by infestation density.



Conservian's new Australian pine assessment and action plan can serve as a guide for locating and prioritizing areas of need, addressing threat impacts, estimating the resources required for treatment, enacting, and implementing new eradication ordinances, and identifying potential partnerships, especially the public-private collaborations necessary to facilitate the removal of invasive trees located on

private properties. The conservation and legislative actions recommended herein are realistic, feasible, and can be implemented cooperatively at the county, state, and local level. If consistently applied, they should lead to the extirpation of Australian pine from the Florida Keys within the next decade.

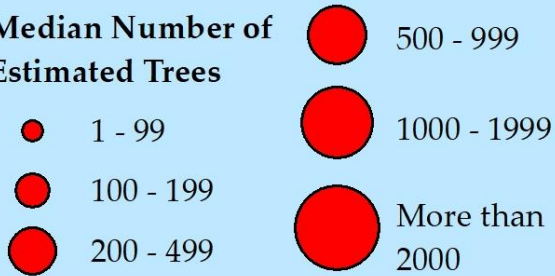
Picture 1: Australian pine monoculture, Crawl Key (see Table 1, pg. 17).



Australian Pine Count per Island Median Estimates



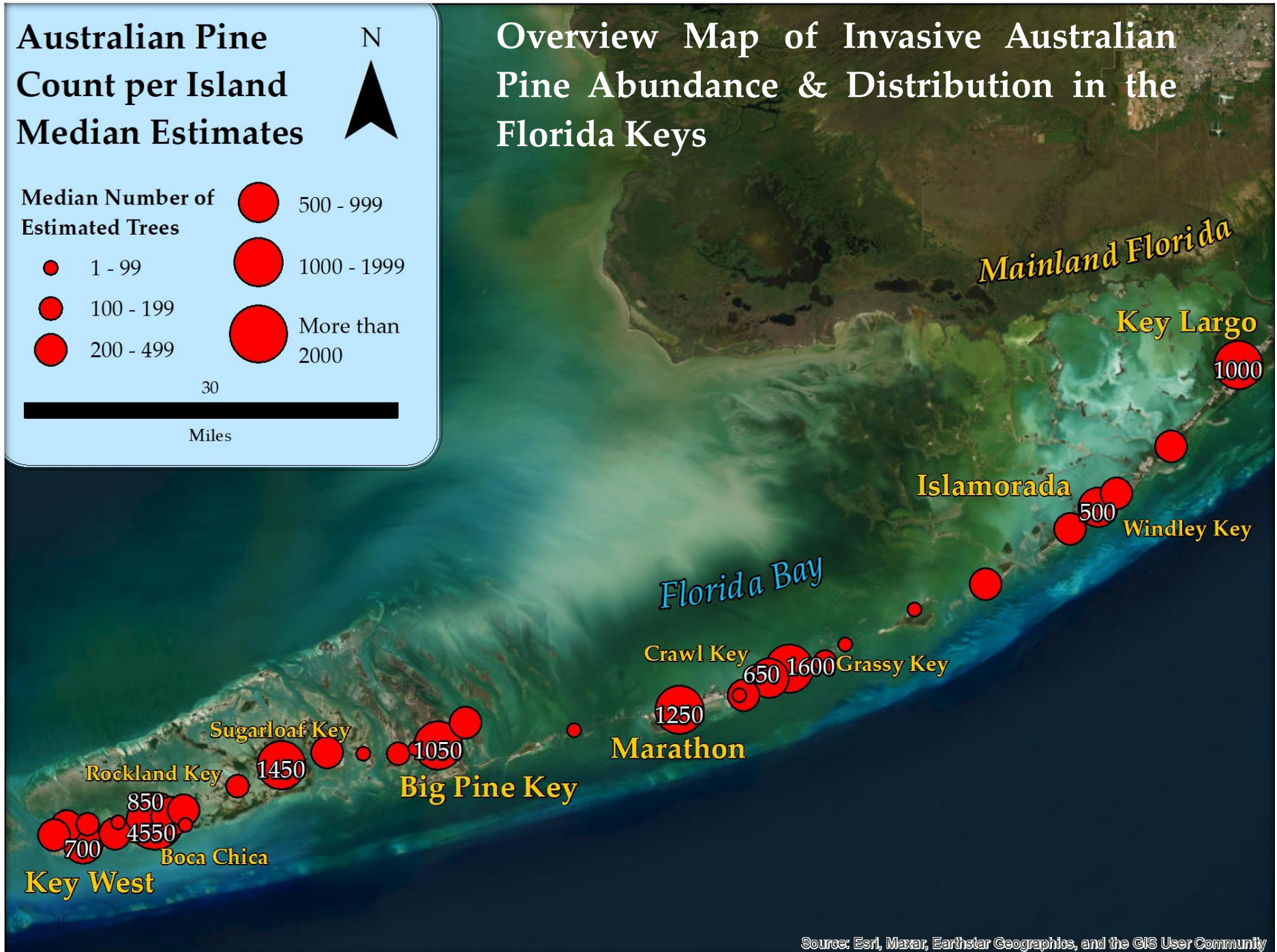
Median Number of
Estimated Trees



30

Miles

Overview Map of Invasive Australian Pine Abundance & Distribution in the Florida Keys



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Species Details

Of all exotics invading coastal areas, Australian pine poses the greatest threat to native beach vegetation (Johnson and Barbour 1990). It is listed as a Category One invasive plant by the Florida Exotic Pest Plant Council (Pernas *et al* 2013) and is listed as a noxious weed by the State of Florida due to its potential to “...pose a threat to agriculture, beneficial organisms, or the environment, or become a public nuisance” (Rule 5B-57.004 F.A.C). It is illegal to introduce, multiply, possess, move, or release *C. equisetifolia* anywhere in the state. Australian pine is also on the *Florida Class 1 Prohibited Aquatic Plants List* (Rule 5B-64.011), which states: “...under no circumstances will these species be permitted for possession, collection, transportation, cultivation, and importation except as provided in Rule 5B-64.004, F.A.C.”

Australian pine destabilizes coastlines and is highly destructive to native coastal habitats and coastally obligate species supported by such ecosystems, causing destruction to shorelines, tidal creeks, wetlands, pinelands, and maritime hammocks in the Florida Keys (Pernas *et al* 2013).

Australian pine was introduced to south Florida by humans in the 1890s for use as wind breaks (Pernas *et al* 2013). The threat posed by the invasive tree to coastal economies and infrastructure is significant. Because of its shallow root system, it is among the weakest trees during storm events; most hurricane damage from fallen trees is caused by Australian pine as it blocks roads and damages structures, vehicles, and utilities. The tree roots also invade and destroy water mains (Pernas *et al* 2013).

In wetland areas, Australian pine displaces mangroves, causing a loss of key foraging and nursery habitats that support economically valuable marine wildlife species (Pernas *et al* 2013). The invasive tree destroys native habitats by extinguishing indigenous vegetation, leading to reduction in plant biodiversity (Pernas *et al* 2013). Australian pine has a rapid growth rate, produces allelopathic (poisonous to plants) needles (branchlets) and seeds that inhibit the propagation of native plant species, and produce thick ground litter that further impedes germination.



Australian pine spreads through wind and waterborne seeds that can remain viable for up to two years. New seedlings can mature in 2-3 years, producing new seeds, and can grow up to 10 feet per year in that time (USDA). The tree does not support native wildlife, but instead creates its own

Picture 3: Australian pine threat to power lines, Rockland Key.



monoculture environment, by destroying the native plant understory necessary to hold and build beach and dune habitat (Pernas *et al* 2013). In addition, Australian pines grow to the water's edge on beaches and have very shallow, wide root systems that provide little support during storm events. The trees topple over easily, taking with them precious beach dunes and sand, causing further beach erosion. The invasive tree changes natural hydrology by replacing mangroves and choking wetlands, weakening the natural system of shoreline buffers and tidal creeks that provide protection from storm surge during hurricanes (Pernas *et al* 2013).

Australian pine obstructs or destroys the nesting habitat of many animals, including sea turtles, American Crocodiles, the rare Swallow-tailed Kite, and numerous species of beach-nesting birds. Loss of mangrove wetlands also harms a wide variety of aquatic species that depend on them, including shrimp, oysters, red drums, snappers, tarpons, jacks, and sheepsheads. The invasive tree provides little or no support for native wildlife (Pernas *et al* 2013).

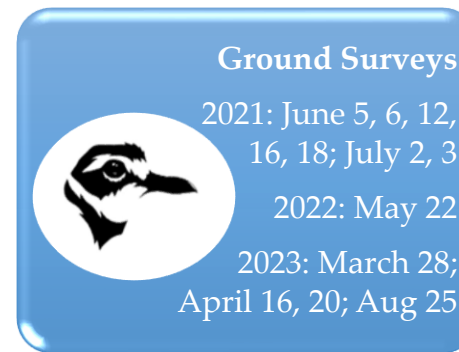


Methodology

Conservian conducted surveys for Australian pines in the Florida Keys from Key Largo to Key West from spring of 2021 to spring of 2023, collecting over 4000 digital geo-referenced aerial and ground photographs, to document the abundance and distribution of the invasive tree. We also collected data on property and habitat type, development level, and threats associated with each site impacted by Australian pine. Surveys were conducted aerially, by vehicle, and on foot. We conducted aerial surveys using a Cessna 172N Skyhawk aircraft with photos taken from the window of the plane. Aerial surveys from Marathon north to Ocean Reef in Key Largo were conducted on May 8, 2021, and aerial surveys from Marathon south to Key West were conducted on May 16, 2021. Both aerial surveys were conducted in excellent weather conditions.

Flying altitude in the U.S. is restricted to 500 ft over water and 1000 ft above populated areas, with additional restrictions over airports, small airfields, cell towers, and U.S.

government surveillance installations, which created challenges in collecting photographic data for such areas. In some instances, we were compelled by additional air space restrictions to take photos at greater than optimal distances, which required additional on-the-ground surveys to collect the necessary photo data.



Multiple ground truth surveys were conducted to confirm the accuracy of aerial survey data and to produce reliable Australian pine estimates, or to update counts following land development. We conducted eleven such ground surveys by vehicle and on foot between June 2021 and August 2023.

Our surveys focused primarily on the inhabited islands and did not include the Florida Everglades or the uninhabited islands of the Marquesas south to the Dry Tortugas. We detected no Australian pine during aerial



surveys of the remote, uninhabited gulf-side and Atlantic side islands and near Florida Bay islands adjacent to the Keys. We also used online mapping resources and information within the databases of Google Earth Pro and the Monroe County Property Appraisers website to collect specific information, such as addresses or ownership, on each Australian pine site identified (see [Resources](#)).

Australian pine sites were classified according to the estimated number of trees per site. In the context of the survey, each site is considered a single stand, although certain

large acreages may contain several stands or multiple disjunct clusters of Australian pine throughout a habitat comprised of other vegetation types. Four “Impact Levels” were designated to describe the degree of infestation present at each site; Low (Single Trees), Low-Medium (Small Clusters), Medium-High (Dense Clusters), and High (Monoculture). Ten stand size categories were established, ranging from individual trees (1-3) to large stands of several hundred specimens (351-450). Five height categories were assigned ranging from 10 ft. to 100 ft., based on the height of the tallest trees in the stand.



Picture 4: Australian pine infestations on vacant land in Grassy Key Beach and Crain Subdivisions in foreground, background Grassy Key Subdivision (see Table 1, pg.17).



Summary of Key Data

Total Trees & Acres

Conservian identified 424 sites in the Florida Keys impacted by Australian pine. Based on aerial and ground surveys, we estimate that the sites contain approximately 18,500 (± 4,500) specimens of Australian pine at the date of publication. These estimates do not include immature trees less than two years old or under ten feet tall, some of which will likely have aged to maturity since the initial surveys were conducted. Of the estimated 18,500 trees, 29%, or about 5,300 (± 1,500), occur on public land, managed by municipal, state, or federal agencies. The majority of the trees (71%) occur on private property, with approximately 8,350 trees (± 1,350) on commercial land (45%) and the other 4,800 (± 1,500) on residential properties (26%) (Figure 2)

The total area of impacted land is estimated to be roughly 1,045 acres (± 10 ac) across the 424 sites. This acreage also principally accounts for mature trees and mature stands. Immature trees are harder to detect, especially if they occur

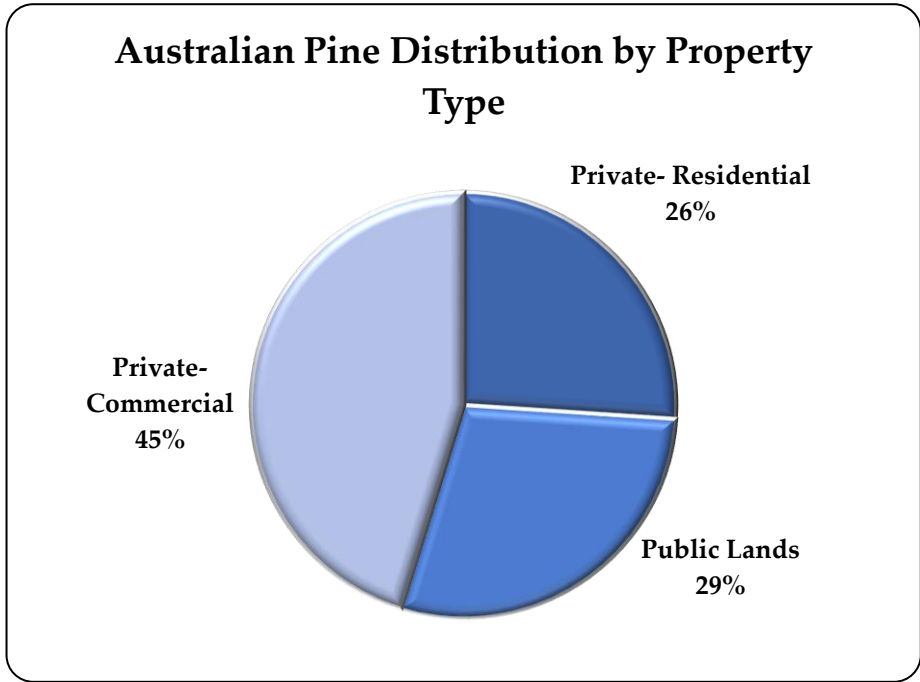


Figure 2: Percentage of trees found in designated property types.

individually, in small numbers, or away from established stands. The distribution of impacted acreage corresponds closely to the distribution of trees. Approximately 31%, 325 acres (± 5 ac), are public land, including municipal, state, and/or federal properties. Private commercial land accounts for about 42%, 438 acres (± 2 ac), while private residential land makes up about 27% at 280 acres (± 5 ac) (Figure 3).



Approximately four-fifths (82%) of the identified Australian pine, an estimated 15,100 trees ($\pm 3,000$), is in proximity to mangrove wetlands, mangrove shorelines, or sandy shorelines (Figure 4). These habitats are particularly vulnerable to impairment by the spread of Australian pine and are among the most ecologically critical in the Keys. Approximately 7,000 of the trees, covering 190 acres, are in monocultural stands within or adjacent to the sensitive

Figure 4: Percentage of infested acres by property type.

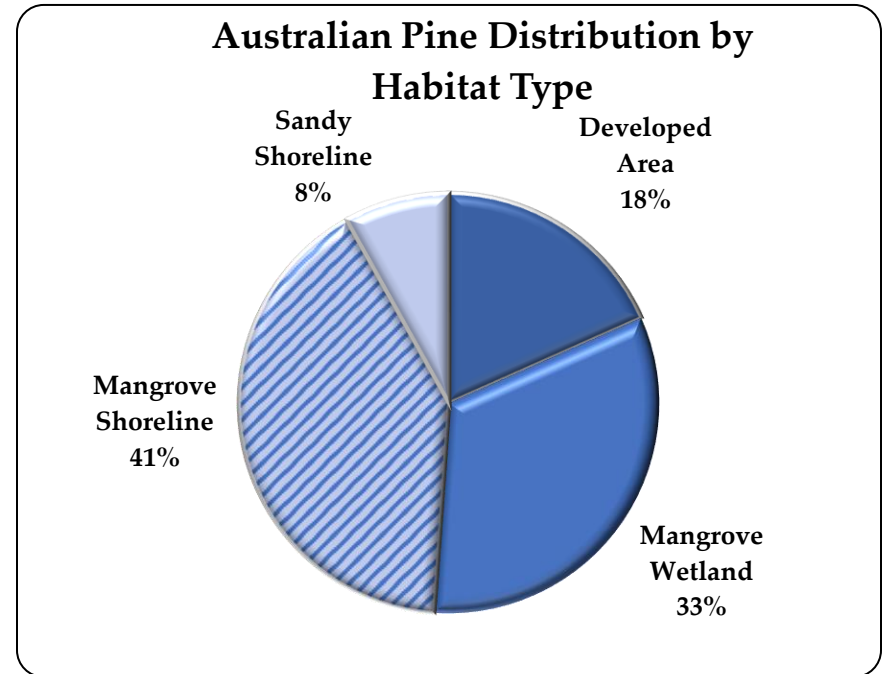
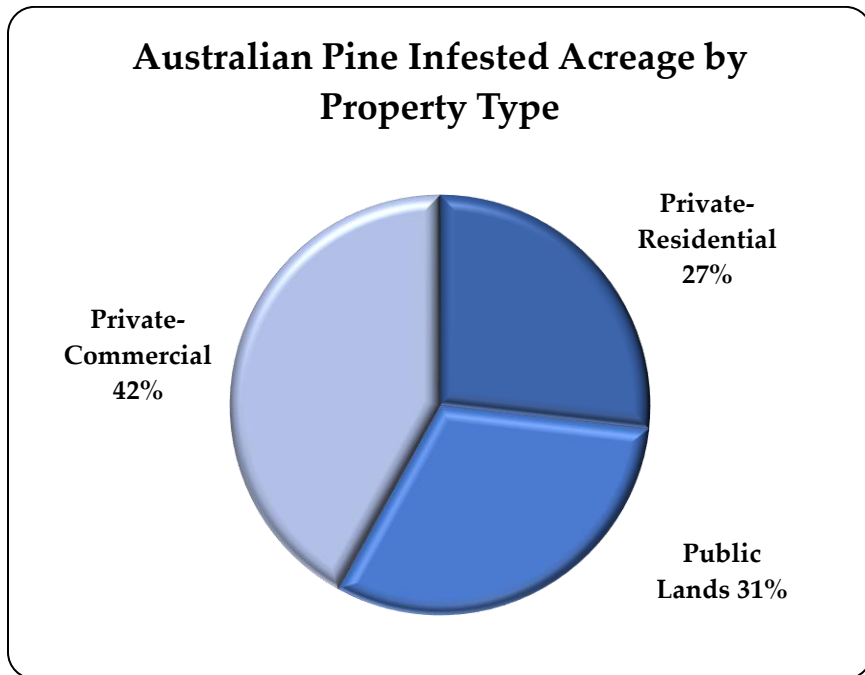


Figure 3: Percentage of trees impacting habitat types.

habitats, which are therefore among the highest priority sites for treatment.

Developed areas account for the other 18% of Australian pine specimens located in the Keys. While such sites may not seem highly ecologically critical, they are important as potential refugia, and sources of propagation and recolonization of more sensitive areas. Also, such stands are necessarily close to infrastructure, making them both



more problematic for people but also easier to reach for treatment.

Australian Pine Stand Size

In terms of total trees, the estimated population of some 18,500 Australian pine is split almost evenly between stands of less than 150 trees and very large or very densely impacted sites of 150 or more trees. Of the 424 total sites,

however, 24 account for 51% of the total trees, while the other 49% are spread across 400 sites (Figures 5 and 6).

This distribution of Australian pine provides both opportunities and difficulties for eradication. The relatively large concentration of trees in 24 sites means that treatment resources can be targeted very efficiently to exterminate a significant proportion of the infestation. Conversely, because there are 291 sites that contain fewer than 20 trees, many of

Figure 5: Number of sites with indicated number of trees.

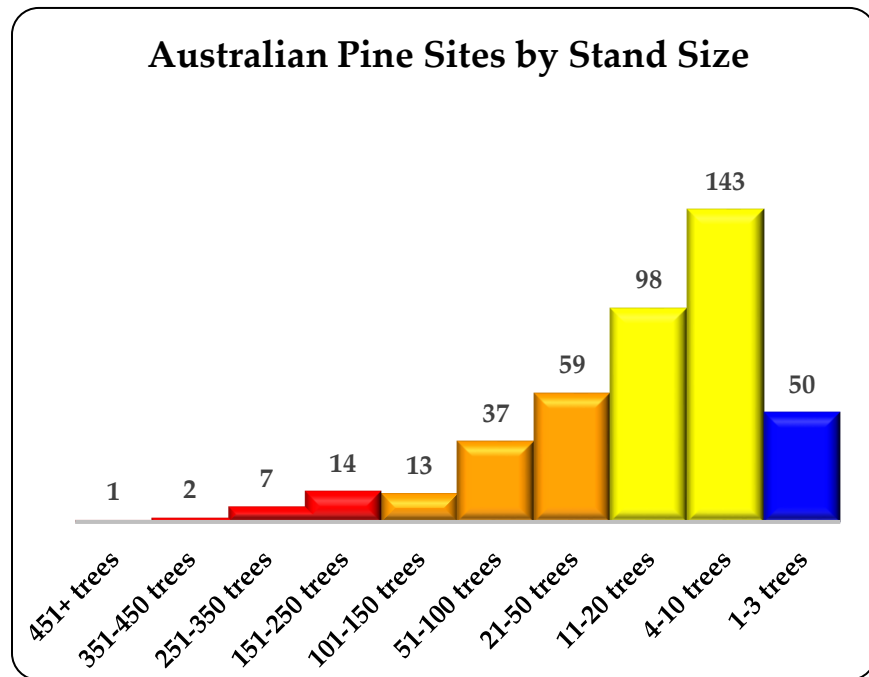
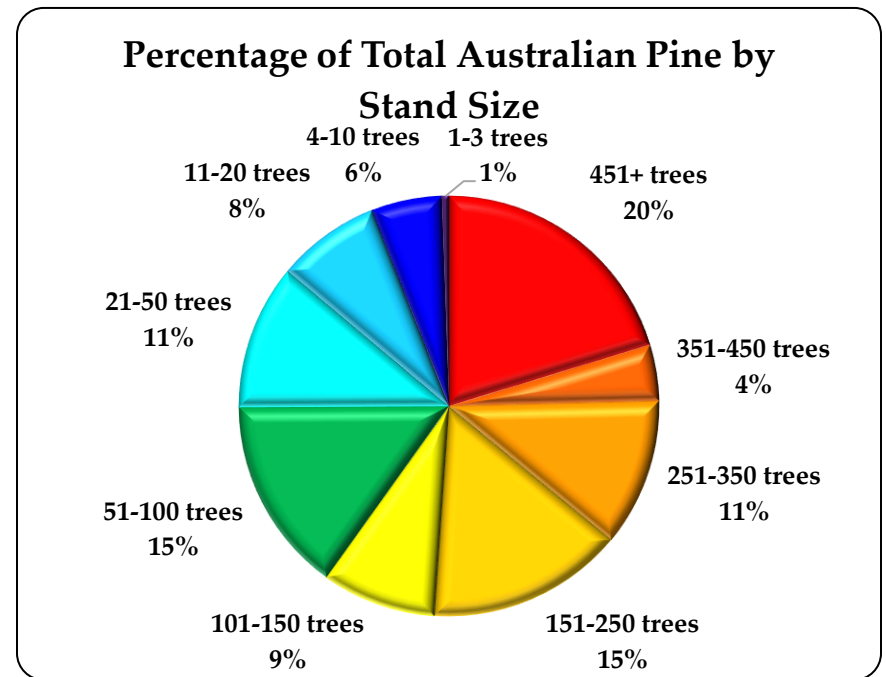


Figure 6: Percentage of trees occurring in indicated stand sizes.



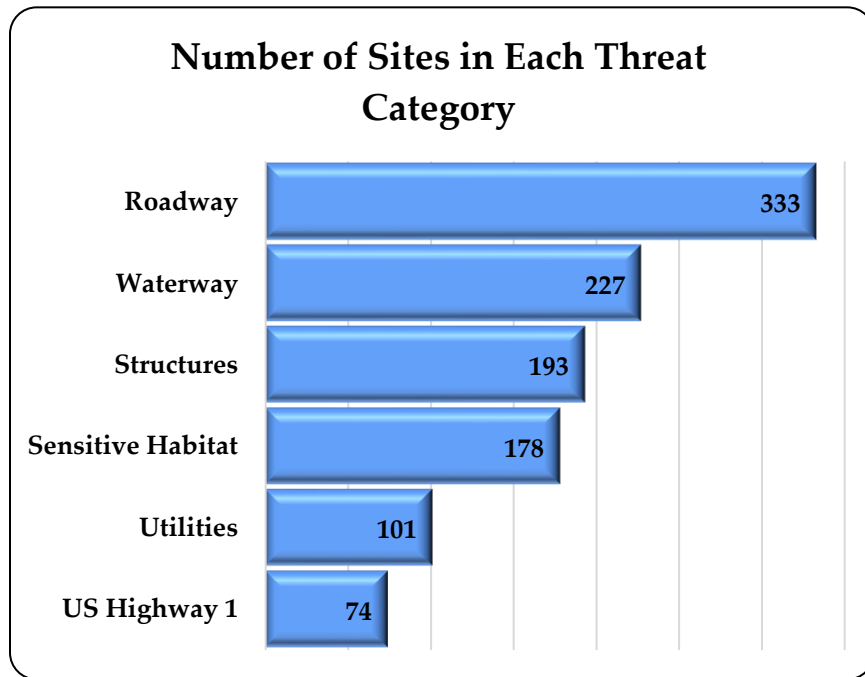


Figure 7: Number of 424 sites presenting indicated threats. Most sites present multiple types of threats.

them on private residential or small commercial properties, total extirpation will require mobilization of the public to effectively eliminate refugia populations of Australian pine.

Breakdown of Threat Categories

Each of the 424 Australian pine sites identified throughout the Florida Keys was classified as impacted by one or more of the six following threat categories, based on

their proximity to habitats or human infrastructure: sensitive habitats, waterways, structures, utilities, roadways, and US Highway One. Most sites overlap categories: any site on US-1 was also classed as a threat to roadways, for example.

Sensitive Habitats & Waterways

Approximately 14,300 trees ($\pm 3,000$) are located in or adjacent to sensitive habitats. A total of 178 of the 424 identified sites are classified as threats to such habitats, and the vast majority of those sites threaten mangrove wetlands. The sites comprise about 734 acres (± 4 ac) of directly impacted land, in addition to adjacent areas that the Australian pine infestation might spread to, or which may already contain immature trees that were not detectable by survey limitations. From a land management perspective, this category of threat could be considered the most vital to address.

Approximately 12,300 trees ($\pm 2,500$) are located along waterways or coastlines, which include tidal creeks or canal waterways. Of the 424 sites, 227 are classified as threats to



waterways or aquatic habitats, although there is a significant degree of overlap with the sensitive habitats category. Waterways and coastlines can facilitate wide dispersal of Australian pine seeds, through ocean and tidal currents. Additionally, the seeds can germinate in salt water (Pernas *et al* 2013).

Approximately three-quarters (74%) of the Australian pine in the Keys occurs in mangrove habitats, where its biological advantages such as nitrogen-fixation give it a powerful competitive edge over native species (see Figure 4 above). Shorelines are also particularly susceptible to invasion and degradation by Australian pine and are prime locations for seed pod dispersal. Forty-nine percent of all Australian pine located in the Florida Keys impacts shoreline habitat.

Although the immediate harm to developed infrastructure may be minimal, disturbed and disrupted habitats are far more difficult to repair or remediate than downed power lines, obstructed roads, or damaged buildings, and the loss of such natural resources can have a

wide variety of detrimental effects on human interests, including reduced biodiversity, reduced wildlife populations, increased erosion of shorelines and other land loss, and weakened ecological resiliency to extreme weather events like hurricanes.

In general, trees in this category could be treated with herbicides and left *in situ* to decay, but there is significant overlap with the following threat categories that involve human infrastructure, and some portion of these Australian pines would need to be completely removed.

US 1 & Other Roads

Approximately 14,600 (\pm 3,400) trees are located in proximity to roads and are tall enough to potentially impair travel in the event that they fall down due to strong winds. In total, 333 of the 424 identified sites fall into this category. Many of the roads identified are residential streets whose blockage would restrict residents from returning to their homes after a windstorm event. Other trees occur on major thoroughfares, however, and could create significant delays



to emergency response, rescue, and clean-up activities associated with a tropical storm or hurricane.

The principal road of concern, of course, is U.S. Highway 1, which is the only route in and out of the Keys. Any downed trees impairing or blocking travel on the Florida Keys Highway could cause severe impediments and delays to travel for residents and visitors, especially in the event of evacuations. There are 74 identified sites that could pose a risk to US-1, containing an estimated 3,000 trees (± 800). Most of the sites of concern are on public land, but several of the largest stands occur on private, commercially-owned properties.

With a potential growth rate of 10ft per year, even immature Australian pine in proximity to roads will quickly become a safety hazard. Treatment of this threat category will involve additional considerations compared to eradication of remote stands. Whereas some trees or tree clusters can be treated with herbicide to eradicate the infestation and allow it to decay naturally, most of the trees in this threat category will

require complete removal to eliminate the risk of road blockage, as stands of dead Australian pine present an even greater hazard of windfall than living ones.

Utilities

Approximately 6,000 trees ($\pm 1,600$) are located in proximity to power lines or other utilities and could cause damages as a result of windfall or other collapse. A total of 101 of the 424 identified sites pose some risk to utilities. The majority of these are located on private lands, particularly in residential neighborhoods, and most of the sites in this category also threaten roadways. Trees along major thoroughfares that bring down a nearby powerline might also cause significant outages in addition to blocking traffic.

As with most stands in developed areas, treatment is likely to require the complete removal of the infestation to prevent increased risk from deadfalls. Individual sites will require close evaluation to determine how many trees can be treated with herbicide versus, treated, cut down and removed.



Structures

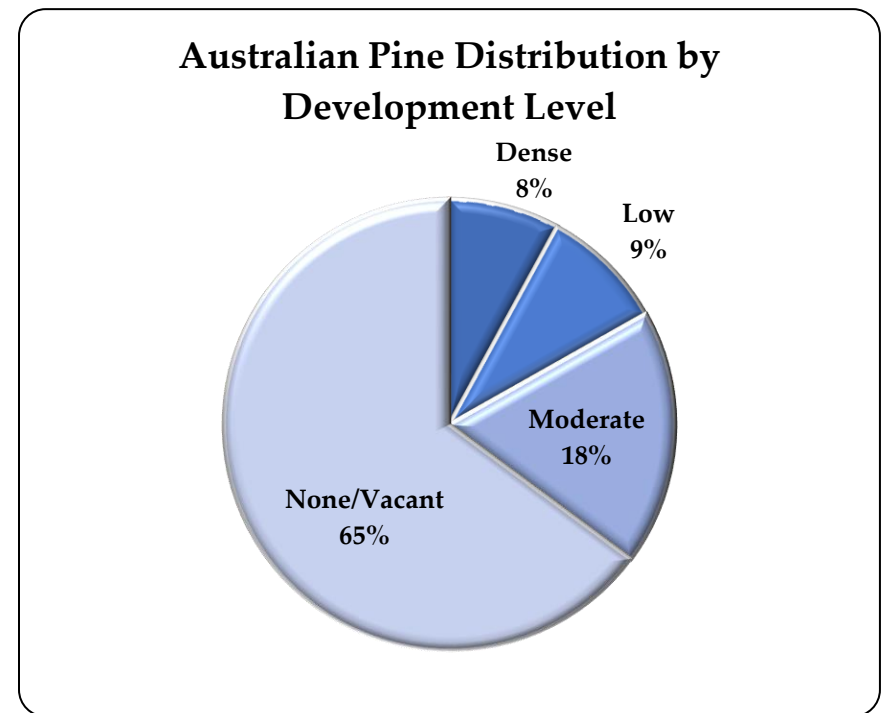
Approximately 6,600 trees ($\pm 1,850$) are located in proximity to structures and are sufficiently large to pose a risk of damaging structures in the event of high winds. There are 193 sites in this category, and the vast majority (154) are on private lands, most of them residential properties (107). Options for treatment on private lands can be problematic, but in general, most of the trees threatening structures would need to be completely removed.

Developed vs. Vacant Land

Australian pine readily invades disturbed or cleared land. Approximately 65% of the trees are located on vacant land compared to 35% that are found on varying levels of developed land (Figure 8). While the trees in developed areas may seem less of an ecological concern than those in more ecologically sensitive habitats, such sites can be refugia for the species and permit eventual reinfestation if left untreated. This is particularly true in residential subdivisions in the Keys, as most are built on connected canal waterway systems,

which can allow Australian pine to spread through water-borne seed pods. Sites in developed areas also represent some of the most accessible locations for treatment, which may constitute 'low-hanging fruit' and can be prioritized for that reason.

Figure 8: Percentage of trees found in areas by development level.





Picture 5: Australian pine encroaching on mangrove wetlands on Crawl Key.

High Priority Sites

There are 24 sites estimated to contain more than 150 Australian pine trees. Ten of the sites are estimated to have more than 250 trees. The stands are primarily monocultures or partial monocultures of dense stands overtaking a large acreage. The sites are a mix of public and private land and occur in several types of habitat. Combined, these sites have about 9,450 trees, accounting for just over 51% of all the identified Australian pine in the Florida Keys. There are an additional 13 sites estimated to contain between 100 and 150 trees, many of which are also monocultures or partial monocultures. These sites have approximately 1,600 trees, on a mix of public and private properties. In total there are 74 sites throughout the Florida Keys that harbor a median estimate of at least 50 trees. The table below lists 30 of the highest priority sites for Australian pine eradication by municipality.



Australian Pine Top Thirty High Priority Sites for Eradication in the Florida Keys

Site Name	Muni	Island	Property	Habitat	Acres	Count	Impact	Threats
Manatee Bay 1-112000 Overseas	City of Key Largo	Key Largo	Public	Mangrove Shoreline	3	101-150 trees	High	Waterway, Habitat
Manatee Bay 2-112000 Overseas	City of Key Largo	Key Largo	Public	Mangrove Shoreline	2	151-250 trees	High	Waterway, Habitat
Buccaneer Point	City of Key Largo	Key Largo	Private-Residential	Developed Area	52	151-250 trees	Low-Med	Roadway, Waterway, Habitat, Structure, Utility
92501 Overseas Hwy Cemex	Villages of Islamorada	Tavernier	Private-Commercial	Developed Area	15	251-350 trees	Med-High	Roadway, Structure, Utility, US-1
86560 Overseas Hwy	Villages of Islamorada	Plantation Key	Private-Commercial	Mangrove Wetland	11	101-150 trees	Med-High	Roadway, Structure, Utility, Habitat, US-1
Turner Trust 84500 Overseas	Villages of Islamorada	Windley Key	Private-Commercial	Mangrove Wetland	4	251-350 trees	High	Utility, Habitat
Parmelee Key Sbdv.	Villages of Islamorada	Matecumbe (Lower)	Private-Residential	Developed Area	46	351-450 trees	Med-High	Roadway, Waterway
72400 Overseas Hwy	Villages of Islamorada	Craig Key	Private-Residential	Developed Area	4	151-250 trees	High	Roadway, Waterway, Structure, Utility, US-1
Grassy Key Pt Sbdv. #3	City of Marathon	Grassy Key	Private-Commercial	Mangrove Wetland	4	101-150 trees	Med-High	Habitat
Grassy Key Pt Sbdv. #1	City of Marathon	Grassy Key	Private-Commercial	Mangrove Wetland	5	151-250 trees	High	Habitat
Grassy Key Pt Sbdv. #2	City of Marathon	Grassy Key	Private-Commercial	Mangrove Wetland	7	151-250 trees	Med-High	Habitat
Crains Sbdv.	City of Marathon	Grassy Key	Private-Residential	Mangrove Shoreline	21	151-250 trees	Med-High	Roadway, Waterway, Structure, Utility, Habitat
Grassy Key Beach Sbdv.	City of Marathon	Grassy Key	Private-Commercial	Mangrove Shoreline	42	251-350 trees	High	Roadway, Waterway, Habitat, US-1
56633 Overseas Hwy	City of Marathon	Crawl Key	Public	Mangrove Wetland	5	151-250 trees	Med-High	Roadway, Structure, Utility, Habitat, US-1
FKA Utility	City of Marathon	Crawl Key	Private-Commercial	Mangrove Wetland	3	251-350 trees	High	Roadway, Waterway, Utility, Habitat



Australian Pine Top Thirty High Priority Sites for Eradication in the Florida Keys

Site Name	Muni	Island	Property	Habitat	Acres	Count	Impact	Threats
56500 Overseas Hwy	City of Marathon	Crawl Key	Public	Mangrove Wetland	3	101-150 trees	High	Roadway, Habitat, US-1
Naval Air Station W. 1180 Gov Rd	City of Marathon	Marathon	Public	Mangrove Wetland	7	151-250 trees	High	Roadway
Boot Key Rd & 931 (DOT)	City of Marathon	Marathon	Public	Mangrove Wetland	23	251-350 trees	Med-High	Roadway, Utility, Habitat
N. Sugarloaf Acres Sbdv.	Monroe Co.	Sugarloaf Key	Private-Residential	Mangrove Wetland	48	251-350 trees	Med-High	Roadway, Structure, Utility, Habitat
Bat Tower Rd	Monroe Co.	Sugarloaf Key	Private-Residential	Mangrove Wetland	4	151-250 trees	High	Roadway, Habitat
17075 Overseas Hwy	Monroe Co.	Sugarloaf Key	Private-Commercial	Mangrove Wetland	6	101-150 trees	High	Waterway, Structure, Utility, Habitat, US-1
16000 Overseas South Point Sbdv.	Monroe Co.	Sugarloaf Key	Private-Commercial	Developed Area	5	151-250 trees	High	Roadway, Structure, Utility, US-1
Orchid Park -1931 Sugarloaf Blvd	Monroe Co.	Sugarloaf Key	Private-Residential	Mangrove Shoreline	4	151-250 trees	Med-High	Roadway, Waterway, Utility, Habitat
Naval Air Station Radar Tower	Monroe Co.	Boca Chica	Public	Mangrove Shoreline	11	251-350 trees	Med-High	Roadway, Structure
Boca Chica Property LLC	Monroe Co.	Boca Chica	Private-Commercial	Mangrove Shoreline	89	3500+ trees	High	Roadway, Waterway, Habitat
500 Park Dr Rockland	Monroe Co.	Rockland Key	Public	Mangrove Wetland	4	151-250 trees	Med-High	Roadway, Structure, Utility, Habitat
Naval Air Station Fleming Key	City of Key West	Fleming Key	Public	Mangrove Shoreline	60	351-450 trees	Med-High	Waterway, Structure, Habitat
Wisteria Island	City of Key West	Wisteria Island	Private-Commercial	Mangrove Shoreline	20	151-250 trees	Med-High	Habitat, Waterway
Key West Int. Airport	City of Key West	Key West	Public	Mangrove Wetland	13	101-150 trees	Low-Med	Roadway, Structure, Utility, Habitat
Fort Zachary Taylor State Park	City of Key West	Key West	Public	Sandy Shoreline	7	351-450 trees	High	Roadway, Waterway, Structure, Habitat





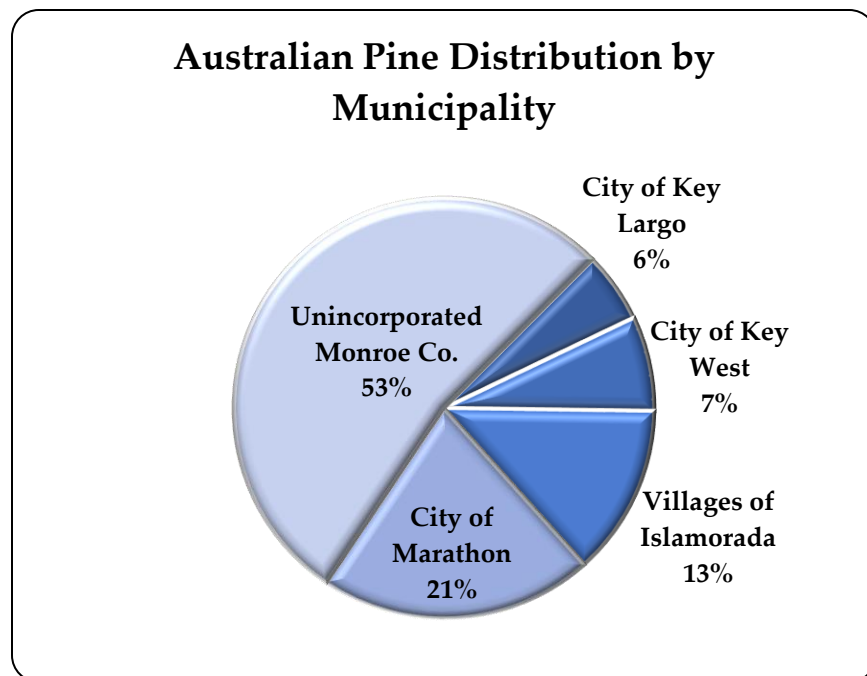
Picture 6: Invasive Australian pine in North Sugarloaf Acres subdivision, Sugarloaf Key (see Table 1, pg 18).



Breakdown By Municipality

More than half (53%) of the Australian pine in the Keys is located in unincorporated portions of Monroe County. The other half can be assigned to the four principal municipalities: Key Largo (6%), Islamorada (13%), Marathon (21%), or Key West (7%). Key Colony Beach is also considered a municipality, but it has only one site, less than an acre, with an estimated 21-50 trees (Figure 9).

Figure 9: Percentage of trees by municipal location.



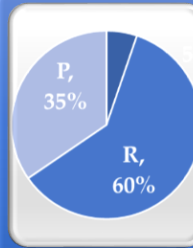
Picture 7: Australian pine threat to a structure on Cudjoe Key.



Key Largo

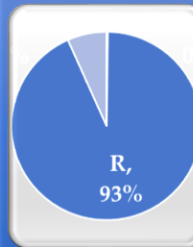
About six percent of the Australian pine in the Keys is located in the municipality of Key Largo. Of the 25 total sites, about two-thirds (17) are estimated to have fewer than 20 trees each, comprising about 18% of the total number of trees. Most of the impacted land is comprised of private residential parcels. The Buccaneer Point Subdivision ([photo pg. 28](#)) is one of the three highest priority sites, with 151-250 trees spread across more than 50 acres of residential land on canal waterways. Approximately 250-400 more Australian pine are located on two disjunct sites on public land in Manatee Bay, impacting sensitive mangrove wetlands and shorelines.

See [Table 1](#) on pages 17-18 for additional details on the high priority sites for eradication.



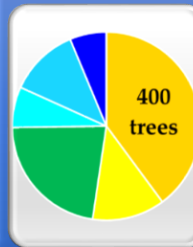
Estimated: 1,000 trees

- 60% on Residential Land
- 35% on Public Land
- 5% on Commercial Land



Estimated: 86 acres

- 93% Residential Land
- 7% Public Land
- >1% Commercial Land



25 Total Sites

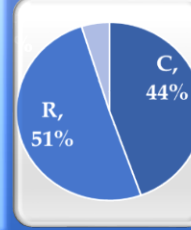
- Manatee Bay: 2 Sites
- Buccaneer Point Subdivision
- Account for about half of total trees



Villages of Islamorada

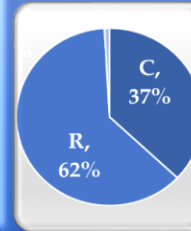
Approximately 13% of the Australian pine in the Keys is located on the islands of the Villages of Islamorada. There are 43 identified sites containing Australian pine, eight of which have more than 100 trees and account for about three-quarters of the trees in Islamorada. About two-thirds of the sites (28) are estimated to have fewer than 20 trees each, comprising about a tenth of the total number of trees. Nearly all of the Australian pine in the Islamorada area is on private land. Parmelee Key Subdivision (approximately 46 acres affected) on Lower Matecumbe Key is infested with 351-450 trees impacting mangrove shoreline ([cover photo](#)), and the Cemex plant (15 acres) in Tavernier has 251-350 invasive Australian pine trees, some adjacent to US-1. The Turner Trust property on Windley Key also has 251-350 Australian pines, a monoculture on about four acres of mangrove wetland.

See [Table 1](#) on pages 17-18 for additional details on the high priority sites for eradication.



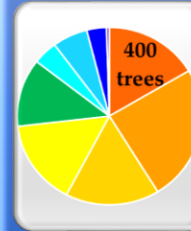
Estimated: 2,400 trees

- 51% on Residential Land
- 44% on Commercial Land
- 5% on Public Land



Estimated: 97 acres

- 62% Residential Land
- 37% Commercial Land
- 1% Public Land



43 Total Sites

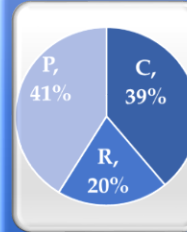
- Parmelee Key Subdivision
- Cemex Mineral Property
- Turner Trust



Marathon

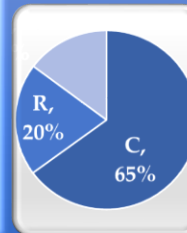
About 21% of the identified Australian pine in the Keys is found in the municipality of Marathon, which includes the island of Marathon and several surrounding islands. About half of the total sites (39) have fewer than 20 trees each, comprising about a tenth of the total number of trees. About a quarter of the total Australian pines are located at the three most impacted sites, each of which have 251-350 trees. Grassy Key Beach subdivision has 42 acres of privately-owned commercial land infested with the invasive tree ([photo pg. 8](#)), while the Florida Keys Aqueduct Authority site on Crawl Key has approximately three acres of impacted land. There are about 23 acres of infested land on Boot Key along Boot Key Road and Rt. 931. All three sites impair mangrove wetlands or shorelines, and Grassy Key Subdivision lies partially along US-1.

See [Table 1](#) on pages 17-18 for additional details on the high priority sites for eradication.



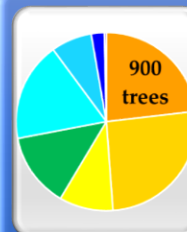
Estimated: 3,900 trees

- 41% on Public Land
- 39% on Commercial Land
- 20% on Residential Land



Estimated: 314 acres

- 65% Commercial Land
- 20% Residential Land
- 15% Public Land



77 Total Sites

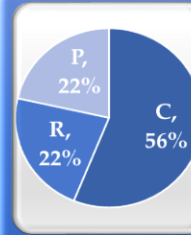
- Grassy Key Beach Subdivision
- FKAA Utility Crawl Key
- Boot Key Rd. & 931



Unincorporated Monroe County

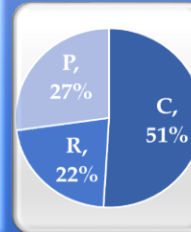
More than half of the estimated Australian pine found in the Florida Keys is located in the unincorporated portions of Monroe County, which includes all the islands south of Marathon to Stock Island. Most of the sites (195) contain fewer than 20 trees. A single commercial site on Boca Chica Key has an estimated 3500-4000 trees spread over 89 acres, and accounts for approximately 38% of the total trees in this category. It is owned by the Boca Chica Property LLC. The Naval Air Station Doppler Radar Tower site is the largest public land area with 251-350 invasive trees infesting approximately 11 acres. Both sites impact mangrove wetlands and shoreline habitat. North Sugarloaf Acres is a residential neighborhood that is partially developed with an estimated 251-350 Australian pines impacting about 48 total acres ([photo pg.19](#)).

See [Table 1](#) on pages 17-18 for additional details on the high priority sites for eradication.



Estimated: 10,000 trees

- 56% on Commercial Land
- 22% on Residential Land
- 22% on Public Land



Estimated: 350 acres

- 51% Commercial Land
- 27% Public Land
- 22% Residential Land



256 Total Sites

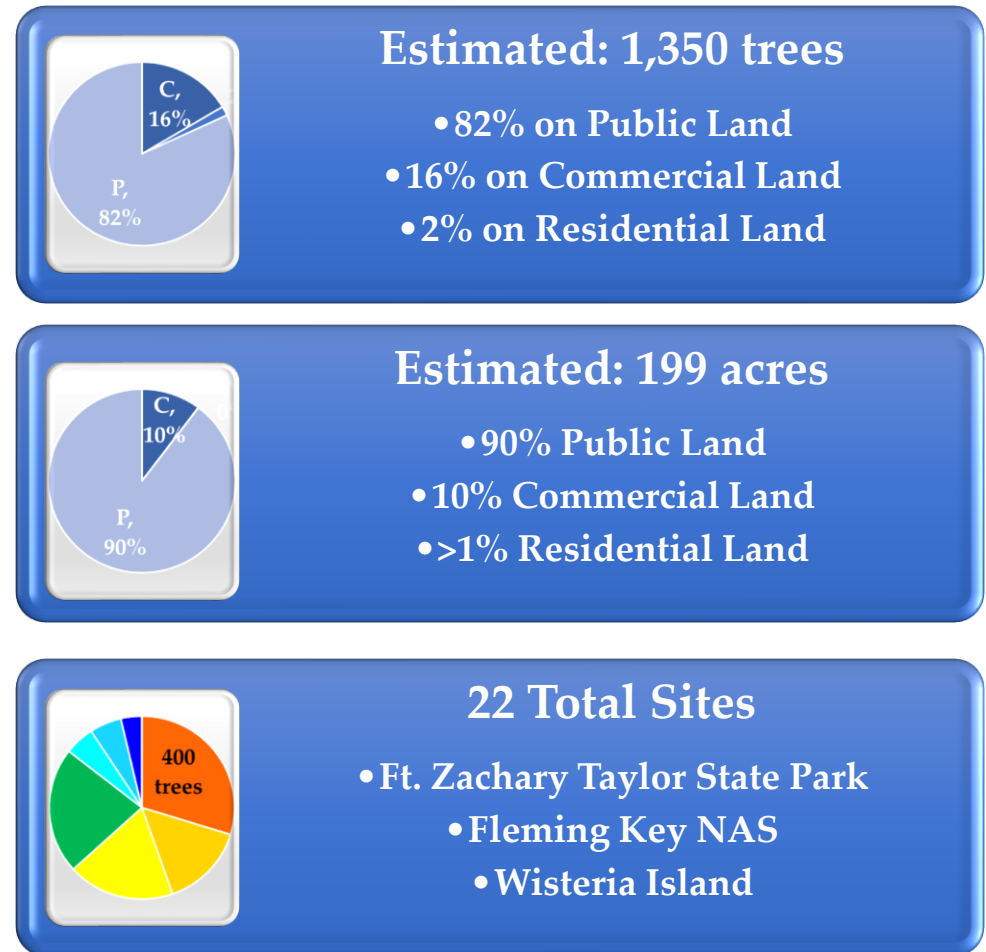
- Boca Chica LLC
- US Naval Air Station Radar
- North Sugarloaf Acres



Key West

An estimated seven percent of the Australian pine in the Keys is located in the municipality of Key West. There are 22 identified sites containing Australian pine, and about half (12) are estimated to have less than 20 trees each, comprising about a tenth of the total number of trees. Public lands (state, federal, municipal) as a group contain more than 80% of the total trees in Key West and 90% of the impacted acreage. The two sites with the highest number of trees (351-450) are Fleming Key Naval Air Station, with approximately 60 acres of Australian pine impacting mangrove wetlands, and Fort Zachary Taylor Historic State Park, with seven acres of beach shoreline habitat impacted (see [Appendix 1](#) for details of the Park's special management situation). Wisteria Island is commercially-owned, with 151-250 trees impacting mangrove shoreline habitat.

See [Table 1](#) on pages 17-18 for additional details on the high priority sites for eradication.



Discussion

Conservian’s assessment has identified a significant level of Australian pine present in the Florida Keys. Because the invasive tree is so aggressive, fast-growing, and able to reproduce in just 2-3 years, it is important that action be taken immediately to stop its spread as soon as possible and eradicate it on every island until the invasive tree is extirpated from the Florida Keys.

Fortunately, Australian pine can be destroyed safely and relatively easily with the highly targeted use of herbicides, as recommended in the *Australian Pine Management Plan of Florida* (Pernas *et al* 2013). Each tree can be terminated with a single treatment, though follow-up is always recommended to ensure full eradication. Pre-mixed, water-based herbicide is available to the public, which does not require a permit if used on one’s own property, which simplifies treatment methods compared to a few decades ago. Owners of private land can legally treat invasive plants on their own property, and there are many free educational resources as well as technical assistance available in the State

of Florida to aid the process (see [Resources](#)). Eradication of Australian pine allows for natural restoration of habitats that support native wildlife. When Australian pine is destroyed, regardless of whether the dead tree is removed, the species’ spread is halted, and its allelopathic needles and seeds cease to proliferate, allowing the poison they contain to gradually break down.

Australian Pine Control in the Florida Keys

Past Eradication Efforts

In 1996, the Florida Keys conservation community formed a well-organized, supervised, volunteer-based invasive plant control network composed of biologists, planners, and natural resource managers from local, state and federal agencies, non-profits, public utilities, and concerned citizens. The organization, called the Florida Keys Invasive Exotics Task Force, was designed “to address the proliferation of invasive exotic plants in the Florida Keys. The mission of the Task Force is to coordinate and increase efforts to eliminate invasive, non-native plants by combining programs and resources to develop and implement a long-term exotics



removal and control plan for the Florida Keys.” The goals of the Task Force include documenting existing invasive populations, prioritization and control of infestations, public education, tracking of relevant legislation, and promotion of interagency cooperation (Florida Keys Invasive Exotics Task Force).

Invasive animals were added to the group’s mission in 2005. The Task Force made significant progress in destroying invasive plants, including Australian pine, on many tracts of public (federal, state, and county) lands with an active on-the-ground program throughout the early 2000s. An Early Detection and Distribution Mapping System (EDDMaps) was utilized to allow recording of invasives within the state. However, over the past decade the network’s focus has shifted towards education regarding Australian pine eradication in the Florida Keys, and currently the invasive tree is not being consistently targeted at a level necessary to halt proliferation.

Invasives on Public Land

The majority of public lands in the Florida Keys are managed by the Monroe County Conservation Land Stewardship Program. The program manages conservation properties owned by the Monroe County Land Authority (MCLA) and the Board of County Commissioners (BOCC). The program also manages state-owned conservation properties where the County is the designated land manager. The program manages approximately 3,850 County parcels (MCLA & BOCC combined) and approximately 500 state-owned parcels. Management activities on conservation properties include invasive exotic plant removal, habitat restoration, native planting projects, clean-up of solid waste, and hazard tree trimming. Typically, conservation lands are prioritized for invasive exotic plants treatment and removal soon after the Land Stewardship program acquires them (Monroe County Conservation Land Stewardship Program).



Invasives on Private Land

Treatment and removal of invasive exotic plant species is required, per Monroe County Land Development Code, prior to construction for all commercial and residential pre-development and new subdivisions, as well as all new home



Picture 8 : Invasive Australian pine on vacant lots in Buccaneer Point subdivision, Key Largo (see Table 1, pg. 17).

construction, as a condition of the building permit. The Monroe County Florida Land Development code states: “All areas of disturbance shall be managed to avoid the introduction and/or establishment of invasive exotic plant species and all invasive exotic plant species shall be removed

from the parcel proposed for development” (Monroe County Land Development Code Section 118-7(e)).

During our survey period, at least two large sites of note were cleared of Australian pine through invasive plant management practices in Monroe County. In Marathon, a private commercial property of five acres on Vaca Cut was cleared for new development. On Sugarloaf Key, five acres of infested private commercial



land was cleared for a new RV resort development. The invasive trees located at these sites were removed as a condition of the building permit. Accordingly, these sites were not included in the site totals. As new construction is always ongoing, there may be other sites with Australian pine that have been addressed since we completed our surveys.

Private property infestation is an ongoing problem, as trees quickly spread seeds back onto adjacent public lands. An estimated 71% of the Australian pine identified in the Florida Keys is found on private lands (45% on commercial, 26% on residential). Although Monroe County General Environmental Design Criteria code sec.118-7(d) states that, “All areas of disturbance shall be managed to avoid the introduction and/or establishment of invasive exotic plant species as defined in Section 101-1,” there is no enforcement or penalty for failing to do so. As the majority of Australian pine in the Florida Keys is located on private, disturbed, vacant lands that often remain undeveloped for decades, these parcels continue to spread the invasive plant to adjacent lands and nearby areas through wind and water-borne

transmission. It is essential that infested private lands be prioritized for eradication, as no effort to extirpate the invasive species can succeed if Australian pine on these properties is not addressed.

While Monroe County codes are effective ordinances to eradicate invasives prior to new building, more is needed to keep Australian pine from spreading, as County regulations do not require private owners to remove invasive plants from their lands unless the owners are applying for a development permit. Additionally, although nearly thirty percent of Australian pine in the Keys occurs on public lands that are governed by federal, state, and municipal regulations that already *allow* for immediate eradication, currently there are no regulations that *require* any public property owner or manager to eradicate invasive plant species on these lands.

The principal means of combating all proliferation of any invasive is through adopting state and municipal ordinances based on the recommendations of the *Florida Australian Pine Management Plan* and then working to ensure all property owners comply with such ordinances.



Recommendations

Conservation Actions

We recommend aggressive targeting of Australian pine regardless of property ownership. To facilitate and implement eradication with the goal of ridding the Florida Keys of Australian pine within ten years, the following conservation actions are needed.

New Ordinances and Implementation

From a management standpoint, it is well understood that invasive plant species eradication on private property represents the greatest challenge, as there are currently no legal requirements in Monroe County to remove Australian pine unless an owner is applying for a building permit. With 70% of all Australian pine occurring on private lands, invasive species eradication in Monroe County could be greatly facilitated by the creation and rigorous enforcement of a few new ordinances. In the same manner that the County currently requires removal of invasive exotic plant species before development, it could require such eradication before

a property could be sold or transferred to a new owner. Invasive species assessments could be required as part of a property appraisal and inspection process prior to sale. The County could also require realtors and sellers to include guidance for new owners with all property sales.

Special Property Tax Assessments

Municipalities commonly require special assessments for specific county projects that are not included in annual budgets. The County could enact measures to compel property owners to pay for invasive species removal through a special assessment property tax. Owners could avoid the tax assessment by removing the invasives themselves. All property owners, including public land managers, could be required to conduct invasive plant management at least every three years as new Australian pine growth (seedlings and saplings) are much easier to eradicate and remove compared to massive 80-100 ft. adult trees. An eradication cycle required every three years would also ensure that Australian pine would not mature sufficiently to reproduce. Hillsborough County, Florida's *Invasive Plant Removal, Disposal and*



Maintenance Plan is a good example of county ordinances that require monitoring and continuing eradication and removal of invasive plants for a five-year period (see [Resources](#)).

New Florida Statutes

Eradication of invasive plants could also be required through the state statutes (718 and 720) that govern all Florida condominium and home-owners' associations (HOAs). The statutes are updated annually and are enforced by the State through fines, and thus could promote timely removal of invasive plants on such residential properties state-wide. The removal of invasive exotics could also be self-implemented as part of appearance standards and rules within each HOA and

Condominium association subdivision, as many associations in mainland Florida already implement.

RECOMMENDED

New State Ordinance

Require invasive plant eradication for Condominium and Homeowners Associations through new Florida Statutes

New County Ordinances

Require invasive plant removal before sale of property

Require eradication every three years for all properties

Fund invasive plant removal through a special assessment property tax

Reinforce new ordinances with a public awareness campaign

Right-of-Way Safety

The Florida Department of Transportation (FDOT) is responsible for the maintenance and safety of the State's highways and roads. Local road maintenance is the responsibility of the public works department in each municipality. These state and municipal entities are required to keep highways and roads free of obstructions and to address potential road and safety hazards which includes the removal of Australian pine. In the same manner, local utility companies are responsible for the safety and

maintenance of their utility infrastructure.



FDOT and public works departments will generally remove trees from state and municipal property if they are found to be a potential hazard to roads. Utility companies will also remove trees identified as encroaching on utility infrastructure. However, due to the high number of Australian pine sites throughout the Keys, such entities may be unaware of specific locations of the invasive tree that constitute safety hazards. An educated public could assist by submitting requests to assess the potential hazards, and remove Australian pine in proximity to roads, power lines, electric, and water or sewer infrastructure as a pre-emptive action to avoid future damages.

Public Education and Awareness

A Monroe County public awareness effort throughout the Keys would be of great value and a necessary part of any new Monroe County invasive exotic eradication ordinances, as some landowners with Australian pine on their private property may be unaware of its existence or the severe damages that it can cause. Owners of developed or vacant private lands may be encouraged to remove Australian pine

through safety and hazard education. Educational photos showing the immediate damage that fallen Australian pine causes to homes, vehicles, utilities, etc. may provide the impetus necessary to spur private property owners to remove hazardous Australian pine and reinforce the need for the new eradication ordinances. Local radio and free newspapers are fairly popular sources of information in the Florida Keys. PSAs, flyers, posters, and presentations are still viable methods of conveying information within the relatively small local populations of each island. Printed and digital educational materials can be distributed explaining new County or State eradication ordinances and why the State, County, or private owner needs to treat the infestation, encouraging citizens to assist by removing or replacing any such invasive plants in their yards.

Potential Incentives

Private property owners, whether commercial or residential, might be offered incentives to allow the removal of any Australian pine on their property. Although the tree has little commercial value for construction or woodworking,



it can be used as firewood, pulpwood, or potentially converted to fuel pellets when properly processed. Similarly, property owners might receive assistance from state agencies or non-profit partners to replace the invasive with nursery-grown native trees. The County might also consider property tax discounts or reimbursements for cooperative private property owners to incentivize invasive plant eradication.

The Town of Longboat Key in southwest mainland Florida implemented a property owner reimbursement program in 2018 to promote eradication and removal of the invasive tree that provides the following monetary incentives:

- \$1800 for removal of trees that may impact Gulf of Mexico Drive
- \$1250 for removal of trees impacting roads, buildings, and utilities
- Five qualifying removal incentives annually

The town has designated a maximum annual cap of \$60K for the Australian Pine Removal Program.

The Florida Fish and Wildlife Conservation Commission provides no-cost technical assistance, education, and conservation plan preparation for private landowners. There are also a few organizations in Florida that provide grants or incentives for improving wildlife habitats on private lands, which includes reducing invasive species and restoring native species (see [Resources](#)).

Re-establish Volunteer Force

An on-the-ground volunteer work force is greatly needed throughout the Florida Keys, to aggressively target all Australian pine and other invasive plant species including Brazilian pepper, scavola, lead tree, etc. Neighborhood invasive eradication volunteer groups would be particularly valuable in residential subdivisions. Volunteer groups could be re-established by municipality under the Florida Keys Invasive Exotics Task Force, as this entity is already well experienced and able to provide the necessary education and guidance.





Picture 9: Invasive Australian pine on the Florida Keys Overseas Highway, Craig Key (see Table 1, pg. 17).



Conclusion

Conservian's Keys-wide surveys identified an estimated median of 18,500 specimens of invasive, exotic Australian pine in the Florida Keys. The trees are spread across 424 identified sites, comprising some 1,045 acres of directly impacted land, stretching the length of the island chain from Key Largo to Key West. The infestation is particularly problematic for its detrimental effects on sensitive habitats (178 sites) and waterways (227 sites), where it imperils species that depend on those environments and contributes to increased coastal erosion, especially during storm events. Trees in proximity to buildings pose a significant threat to structures and the people inhabiting them (193 sites). Furthermore, a significant amount of Australian pine is large enough and close enough to utility lines (101 sites) and roadways (333 sites) to pose significant risks to public safety in the event of a strong storm, especially sites that could impede traffic on US-1 (74 sites).

Previous attempts at eradication have been unsuccessful, in part because of a focus on primarily public

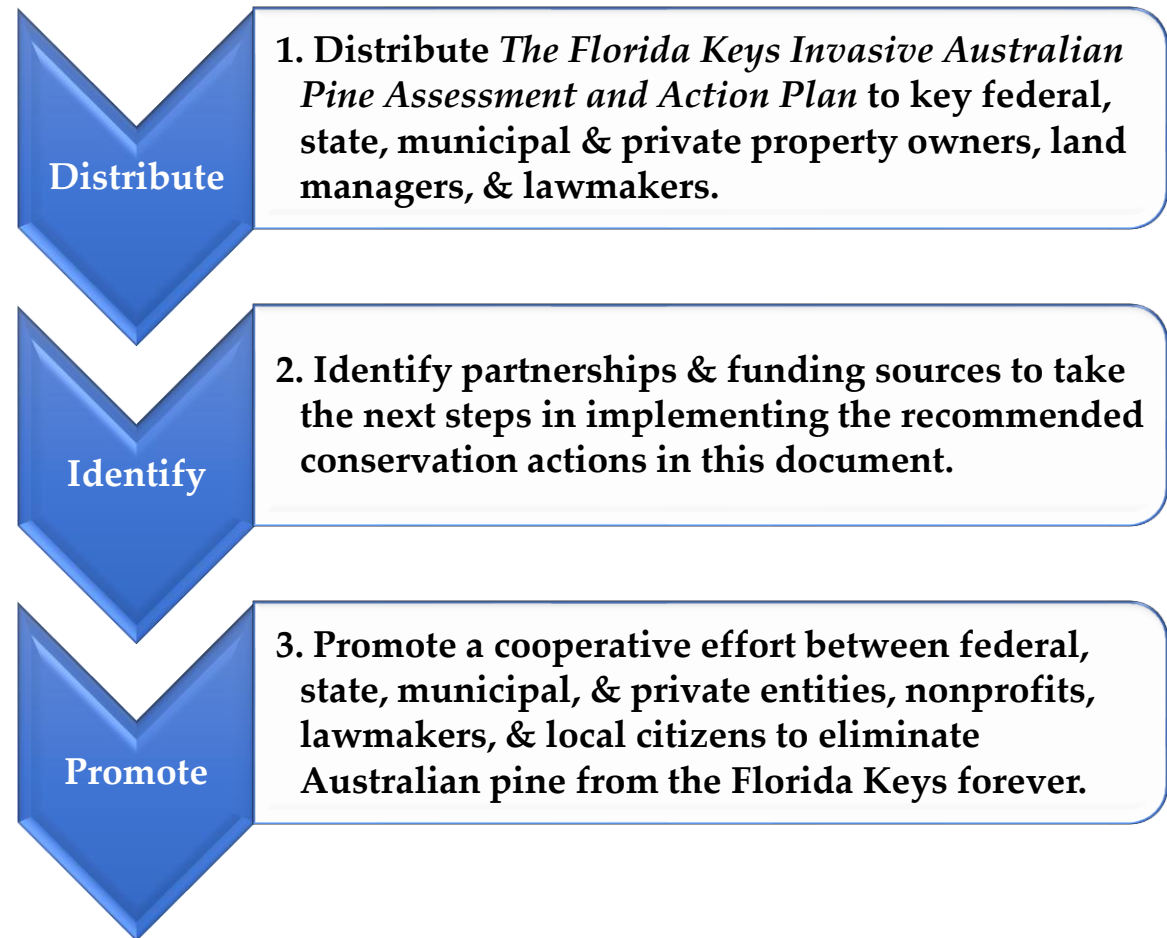
lands, and an incomplete picture of the distribution and scope of the Australian pine infestation in the Keys. Conservian's Australian pine assessment provides new abundance and distribution data and can increase awareness of Australian pine locations by providing the granular details needed to eliminate potential refugia for the species to prevent subsequent recolonization of treated areas. A successful program of extirpation will require both a 'top-down' and 'bottom-up' approach applied to all properties, public and private. State and municipal officials can enact and enforce the recommended actions with new public ordinances and information campaigns. Land management agencies and elected officials can aggressively pursue eradication efforts with the recommended legislative solutions for eradicating Australian pine on all properties. Local efforts by the state, county, non-profits, and volunteer groups can help educate and motivate the general public about the negative impacts of Australian pine infestation. Such groups can also take the lead on re-establishing an on-the-ground, volunteer work force to eradicate invasive plant species.



Next Steps

Conservian's Australian pine assessment and action plan is a key initial step in the process of Florida Keys-wide extirpation of the invasive tree. This information, once disseminated, can assist property managers and landowners in estimating the required resources, identifying the ways and means to eradicate the species, and promoting the partnerships necessary to make it a reality. The methods and conservation actions recommended, if consistently implemented, will prevent Australian pine from re-colonizing, and eliminate it from the Florida Keys within a decade.

Conservian's immediate goals include the following:



Acknowledgements



Picture 10: Cessna Skyhawk survey plane



Picture 11: Pilot, Antonio Davila & photographer, Margo Zdravkovic

Conservian thanks the supporters who made this project possible: The Batchelor Foundation, Bass Pro Shops/Cabelas Outdoor Fund, The Curtis & Edith Munson Foundation, and the Cynthia T. Bailey Foundation. We thank the U.S. Naval Air Station Boca Chica Base for approving aerial clearance for the surveys. Special thanks go to our survey pilot Antonio Davila for his flying skills and time, and to Elaine Sweet Mason, retired Florida State Parks ranger for reviewing the document. We also thank Monroe County's Bruce Franck and Beth Bergh for guidance regarding Monroe County Land Development Code Ordinances and the Monroe County Land Stewardship Program.



References

Literature Cited

Florida Australian Pine Management Plan ([link](#))

Florida Invasives Species Council ([link](#))

Florida Keys Invasive Exotics Task Force ([link](#))

Hillsborough County Invasive Plant Removal,
Disposal and Maintenance Plan ([link](#))

Invasive Plants-Monroe County
Land Development Code Section 118-
7(e) ([link](#))

Johnson, A.F. and Barbour, M.G.
1990. *Dunes and maritime forests in
Ecosystems of Florida*. R.L. Myers and J.J.
Ewel, (eds.). University of Central Florida
Press, Orlando, Florida. pp. 429-480.

Longboat Key Town Government
Public Works ([link](#))

Monroe County Conservation Land
Stewardship Program ([link](#))

Monroe County Property
Appraisers website ([link](#))

Monroe County Conservation Land Maps, 2023 ([link](#))

Pernas T, Wheeler G., Langeland K, Golden E, Purcell
M., Taylor J, Brown K, Taylor DS, and Allen E. April 2013.
*Recommendations of the Australian Pine Task Force Australian
Pine Management Plan for Florida*. Florida Exotic Pest Plant
Council. [https://bugwoodcloud.org/CDN/fleppc/publications
/Casuarinamgmtplan_FINAL-05-13-13.pdf](https://bugwoodcloud.org/CDN/fleppc/publications/Casuarinamgmtplan_FINAL-05-13-13.pdf)

Picture 12: Tarpon Creek, mangrove wetlands & tidal creek in Sugarloaf Key. No Australian pine here!



Appendices

Appendix 1: Fort Zachary Taylor Historic State Park



Picture 13: Invasive Australian pine in foreground at Fort Zachary Taylor Historic State Park, Key West.



Although removal of invasive, exotic species is the mission of all Florida State Parks, Fort Zachary Taylor Historic State Park has been the site of a two-decade long contest between the Park and an aggressive citizens' group promoting "conservation" of invasive Australian pine and bent on proliferation of the noxious species on one of the very few beach habitats found in Key West. Unfortunately, the group waged a successful campaign in 2007 against removal of the Australian pines by spreading misinformation and denying the serious and well-documented harm caused by the invasive trees. Due to lack of local political fortitude to stand up to the citizens' group and their attorneys, the Park was forced, against State law, to allow

a very large, monoculture, infestation of more than 700 invasive trees to remain on the beachfront.

The Fort Zachary Taylor Historic State Park Unit Management Plan of 2008 states "*Although DEP has a policy of*



Picture 14: Australian pine monoculture in Fort Zachary Taylor Historic State Park (see Table 1, pg 18).



eradicating Australian pine in State Parks, DEP agrees to the following policy which shall be unique and applicable only to the Australian pines located in Fort Zachary Taylor Historic State Park. DEP will remove the Australian pines in Fort Zachary Taylor Historic State Park only if the pines have died, are toppled by windstorms, or constitute a public safety hazard. No Australian pines shall be removed for building, landscaping, or hardscaping purposes. The existing pines shall remain unencumbered on the property until their natural death. DEP, at their discretion, may remove new Australian pine seedlings.”

Allowing exotic, invasive plants within a high profile, tourist destination State Park like Zachary Taylor, is highly problematic, as it supports fallacies that contradict Florida state laws, all research, literature, and logic, regarding invasive Australian pine. The situation weakens the State’s stance on invasives and confuses public education efforts with conflicting messages regarding the serious damage caused by invasives. Micro-managing invasive Australian pine to co-exist with native plants or beach habitats is not possible, regardless of removal of new growth because seed

pod dispersal by wind and water cannot be controlled. The invasive trees’ carpet of poison needles extirpates all surrounding native plant growth creating a monoculture. As long as the species is present it will continue to cause destabilization and erosion of the beach at Fort Zachary. If the State Park had been politically supported, the Australian pine infestation could have been eradicated years ago, as it should have been by law. In its place the Park would have nurtured abundant, native, shade trees and shrubs to restore, stabilize and increase the beach making it more resilient to storm events. Regardless of the imposed environmentally detrimental restrictions, Fort Zachary Taylor State Park is to be commended, as the number of invasive trees has been greatly reduced by several hurricanes, consistent removal of damaged trees, and diligent Park management to halt proliferation and encourage the growth of native trees and plants that support the beach ecosystem. As long as the Florida Department of Environmental Protection stands behind the park plan to allow no new proliferation, the remaining, aging, invasive trees will eventually, naturally cease to exist.



Appendix 2: Resources

[Florida Australian Pine Management Plan](#)

[Florida Keys Invasive Exotics Task Force](#)

[Florida Native Plant Society Grants and Recognition](#)

[Florida Wildflower Foundation Grants](#)

[Fort Zachary Historic State Park Unit Management Plan](#)

[Google Earth Pro](#)

[Information on Herbicides](#)

[Invasive Exotic Plants](#)

[Landowner Assistance Program](#)

[Native Landscaping](#)

[Rare Florida Plants](#)

[UF Institute of Food and Agricultural Sciences Extension \(UF IFAS\)](#)

[US Fish and Wildlife Service Partners Program](#)

Picture 15: Mangrove islands in Northern Key Largo. No Australian pine here!



Appendix 3: About Conservian

Conservian's Coastal Restoration

Conservian is a 501C3 nonprofit organization based in the Florida Keys, dedicated to conserving, and restoring coastal habitats and coastal bird and wildlife populations. Our projects are catalysts for habitat and biodiversity restoration, working on the local, governmental, and commercial level to build effective defenses against climate change and sea level rise impacts. *Conservian's strategic restoration approach is streamlined to target negative site-specific impacts only as necessary, and then allow Nature to regenerate, stabilize, and restore the coastal ecosystem.* Conservian's restoration methods are supported by more than two decades of U.S. federally initiated recovery and management plans, proven to stabilize and restore coastal habitats and imperiled coastal wildlife.

Conservian in the Bahamas

In 2014 Conservian began conservation work in the Bahamas with aerial surveys sponsored by LightHawk

International, collecting over 8000 geo-referenced, digital aerial photographs of the Bahamas Islands from Grand Bahama Island south to Ragged Island to document coastal habitats, and invasive Australian pine impacts. Conservian aerially assessed Australian pine levels throughout most of the Bahamas and produced infestation level maps for specific island sites. Since 2016 Conservian has focused on eradicating invasive Australian pine within the Bahamas National Park system working cooperatively with the Bahamas National Trust, improving shoreline and wetland habitat in Lucayan National Park, Exuma Land & Sea Park, Joulter Cays, Berry Islands, and Petersen Cay National Park. In 2018 Conservian began a new Australian pine control summer internship program cooperatively with the Bahamas Government and universities. Conservian's joint restoration work with Bahamas National Trust and the Bahamas Government establishes the first continuing effort to engage local Bahamians in on-the-ground restorative measures for shorebirds, seabirds, sea turtles, and other native wildlife and habitat through protection and invasive plant eradication. Conservian works with partners in the Bahamas



(stakeholders, private and public landowners, managers, and volunteers) to control invasive Australian pine to restore coastal ecosystems.

Selected Publications

Zdravkovic, M. G., 2020. Protection and Restoration of Piping Plover Habitat in the Bahamas Archipelago. Project Report Submitted to International Conservation Fund of Canada, Bahamas Environment, Science & Technology, and Bahamas National Trust. <https://www.coastalbird.org/copy-of-about>

Zdravkovic, M. G., C. A. Corbat, and P. W. Bergstrom (2020). Wilson's Plover (*Charadrius wilsonia*), version 1.0. In Birds of the World (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA.

<https://doi.org/10.2173/bow.wilplo.01>

Deveaux, E.D. and Zdravkovic, M.G. 2017. A National Casuarina Management Plan for the Commonwealth of The Bahamas. Submitted to the Government of The Bahamas, at the request of the Minister of Public Works, by Providence Energy Partners Holdings, (Bahamas) and Conservian Inc. (USA). Plan summary <https://www.coastalbird.org/copy-of-about>

Zdravkovic, M.G. 2013. Wilson's Plover (*Charadrius wilsonia*) Range-wide Species Conservation Action Plan for

the U.S., Caribbean, Mexico, Central and South America. Manomet Center for Conservation Sciences and the Western Hemisphere Shorebird Reserve Network.

https://whsrn.org/wp-content/uploads/2019/02/conservationplan_wipl_v1.0_2013.pdf

Conservian Contact Information: Director Margo Zdravkovic, Email: MargoZ@Coastalbird.org Website: <https://www.coastalbird.org/>



Picture 16: Wilson's Plover nest in the Bahamas



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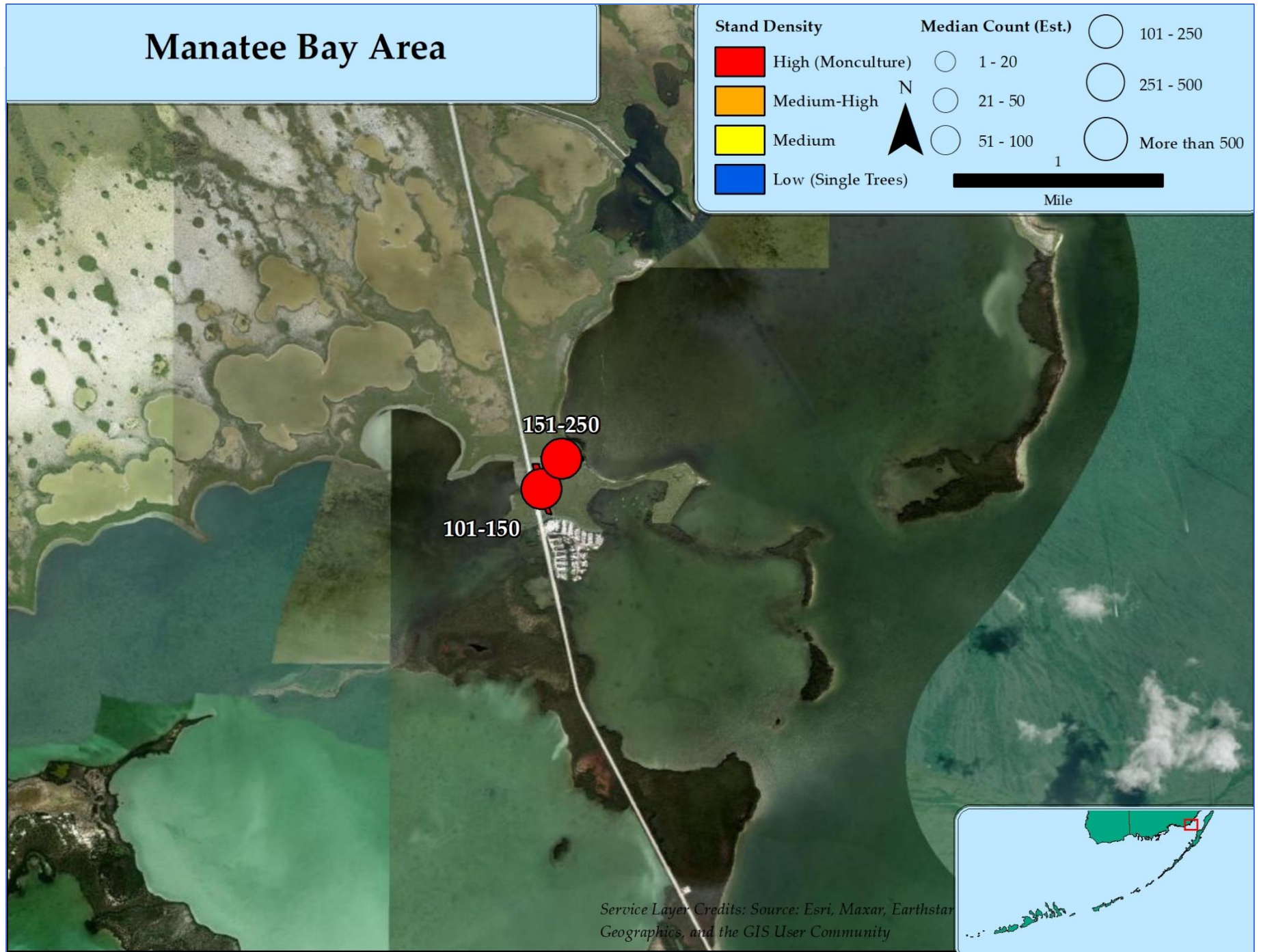
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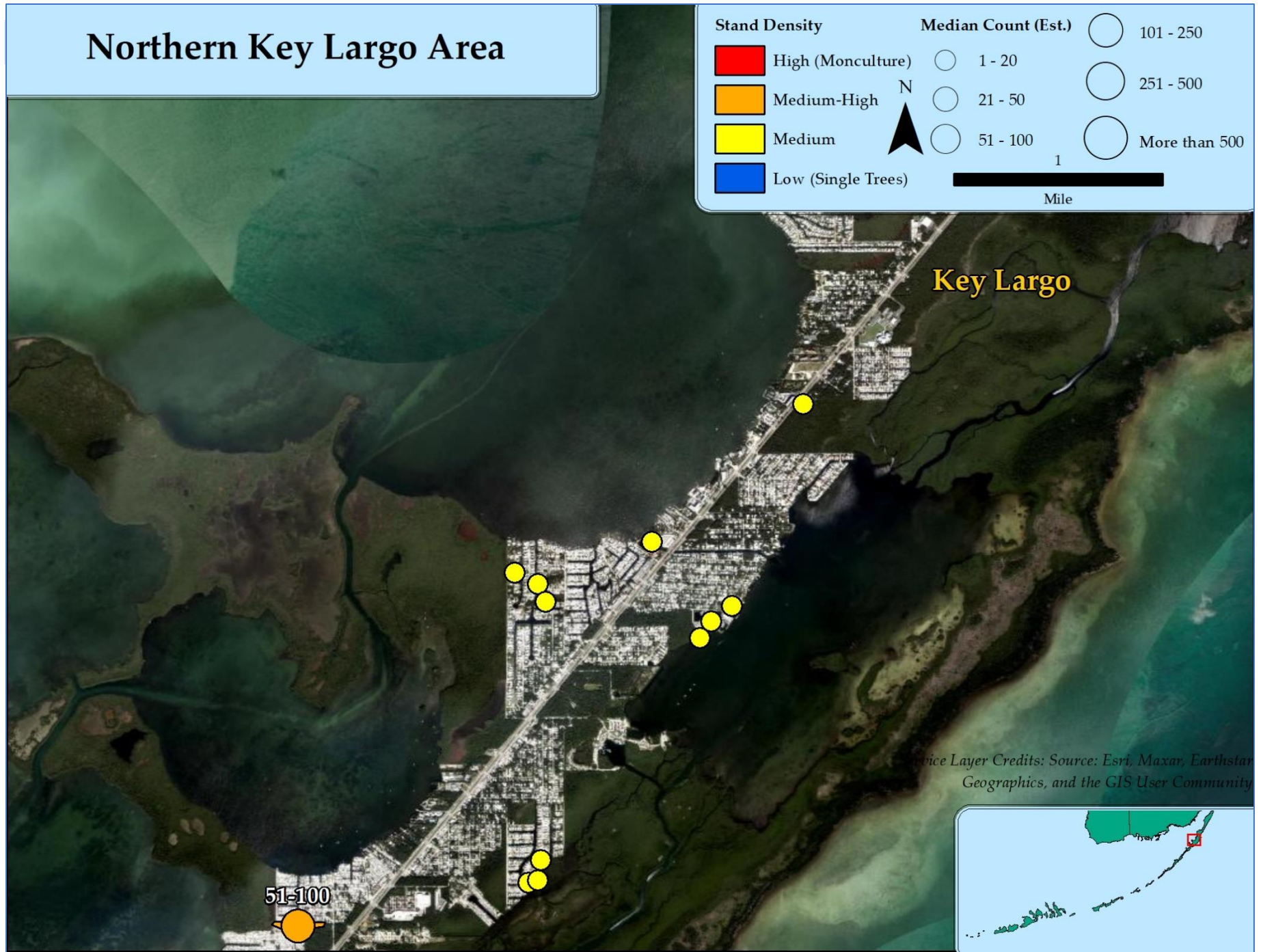
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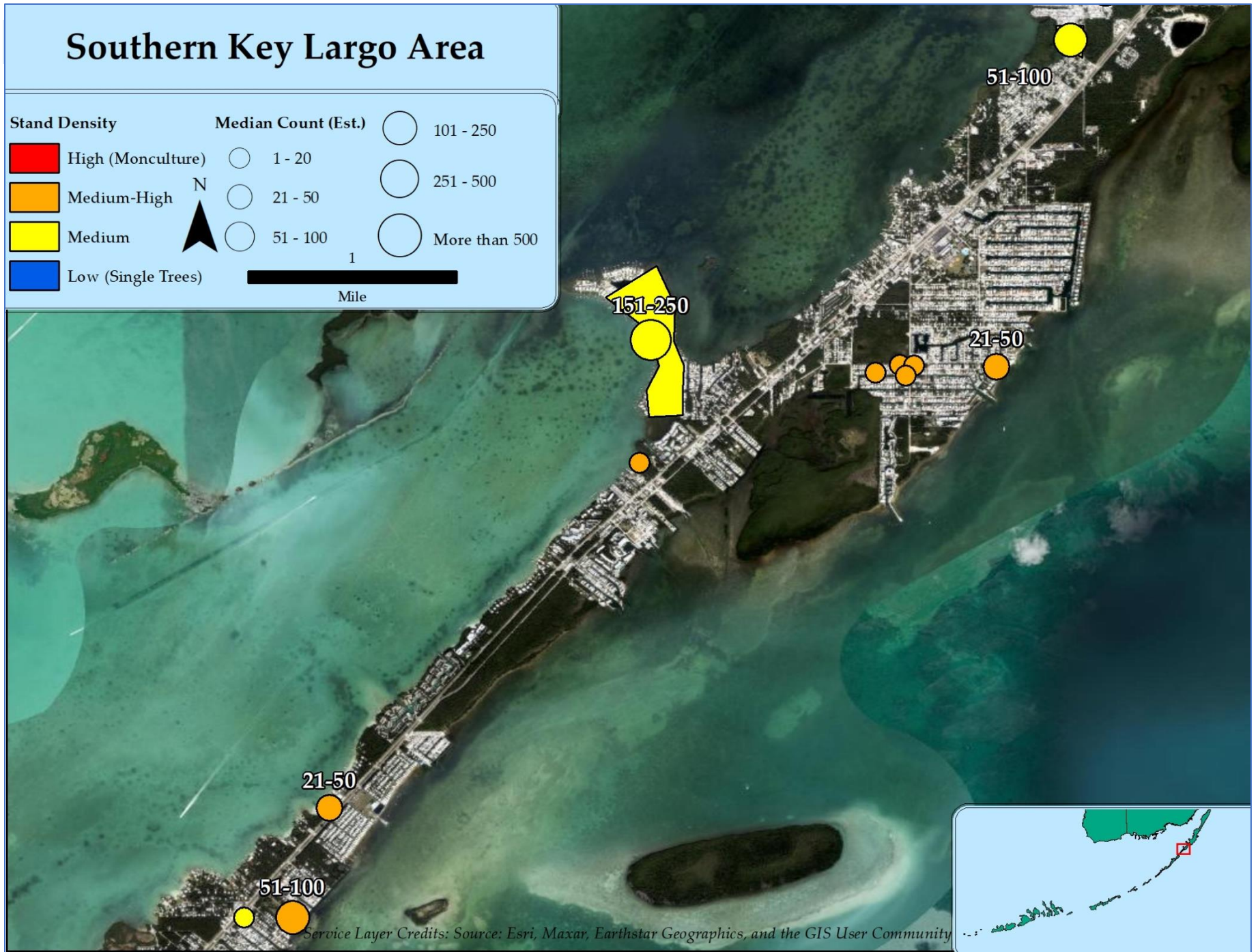
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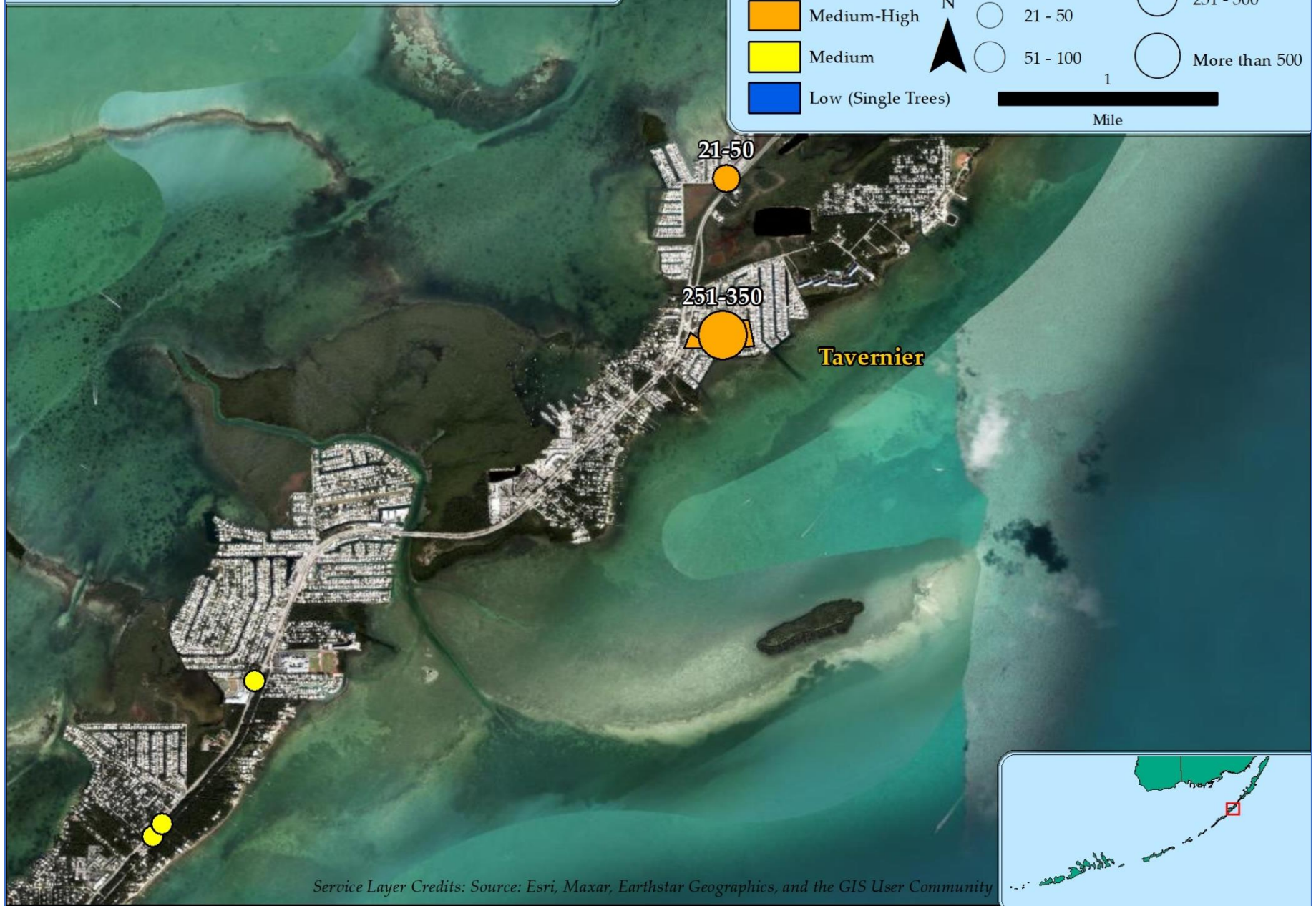
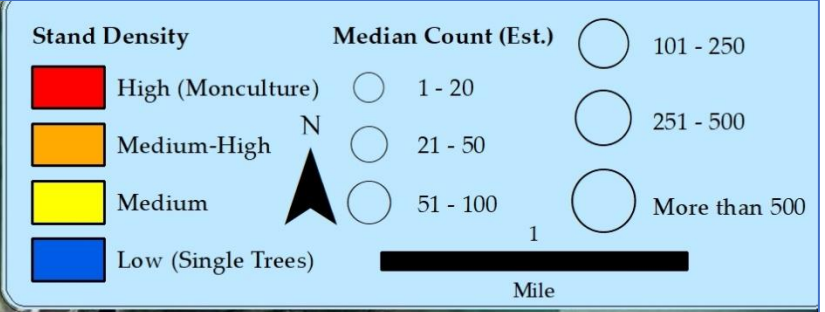






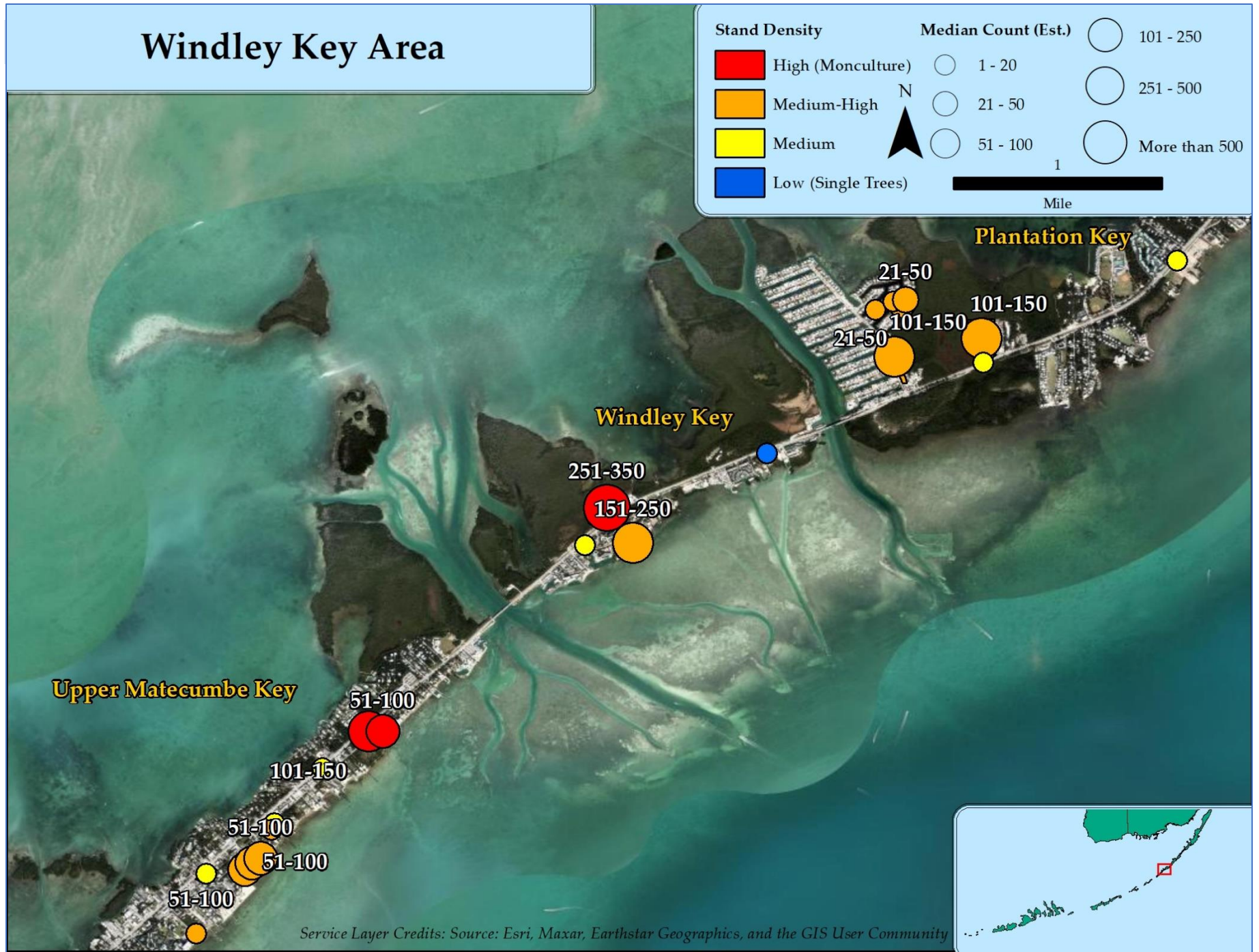


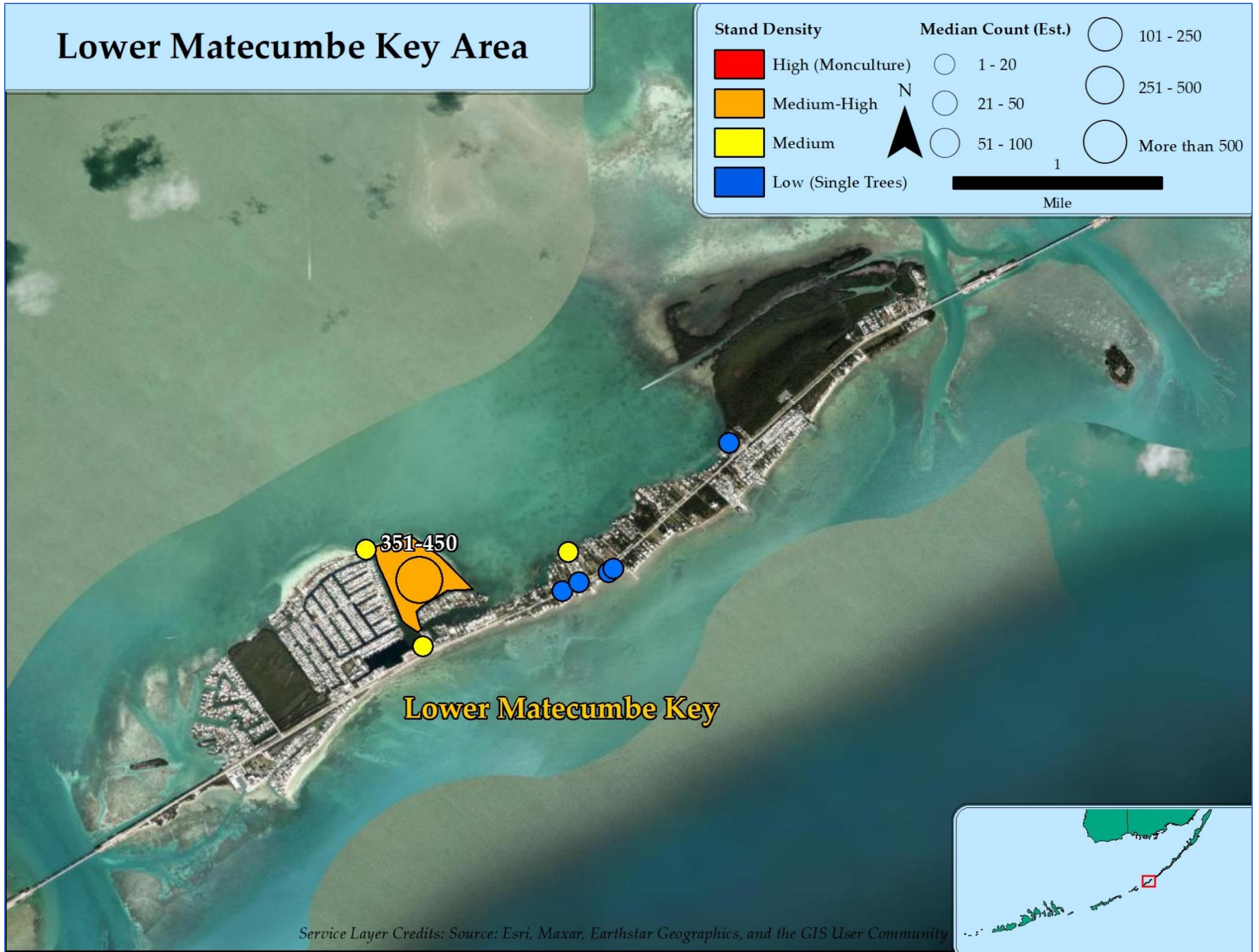
Tavernier Key Area

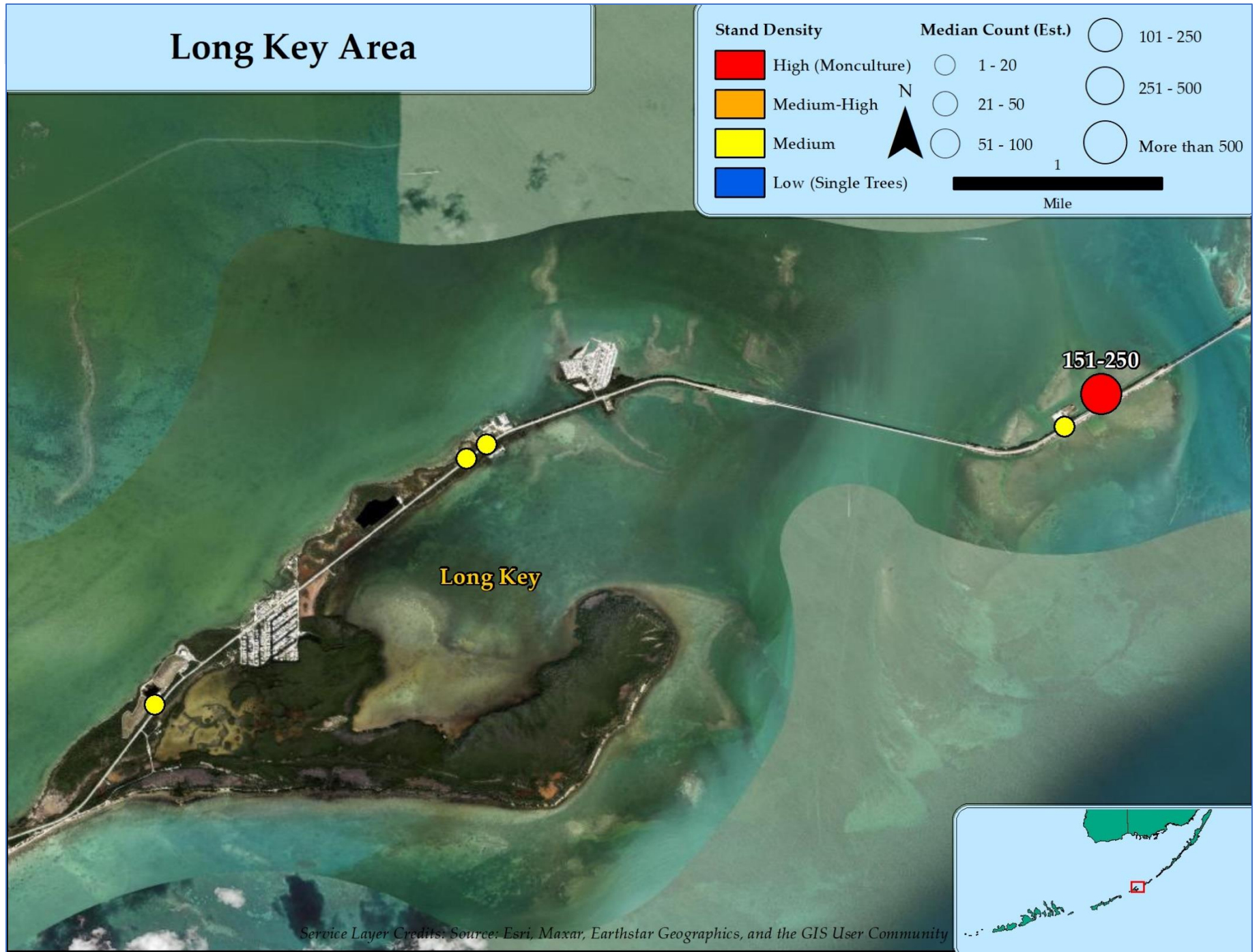


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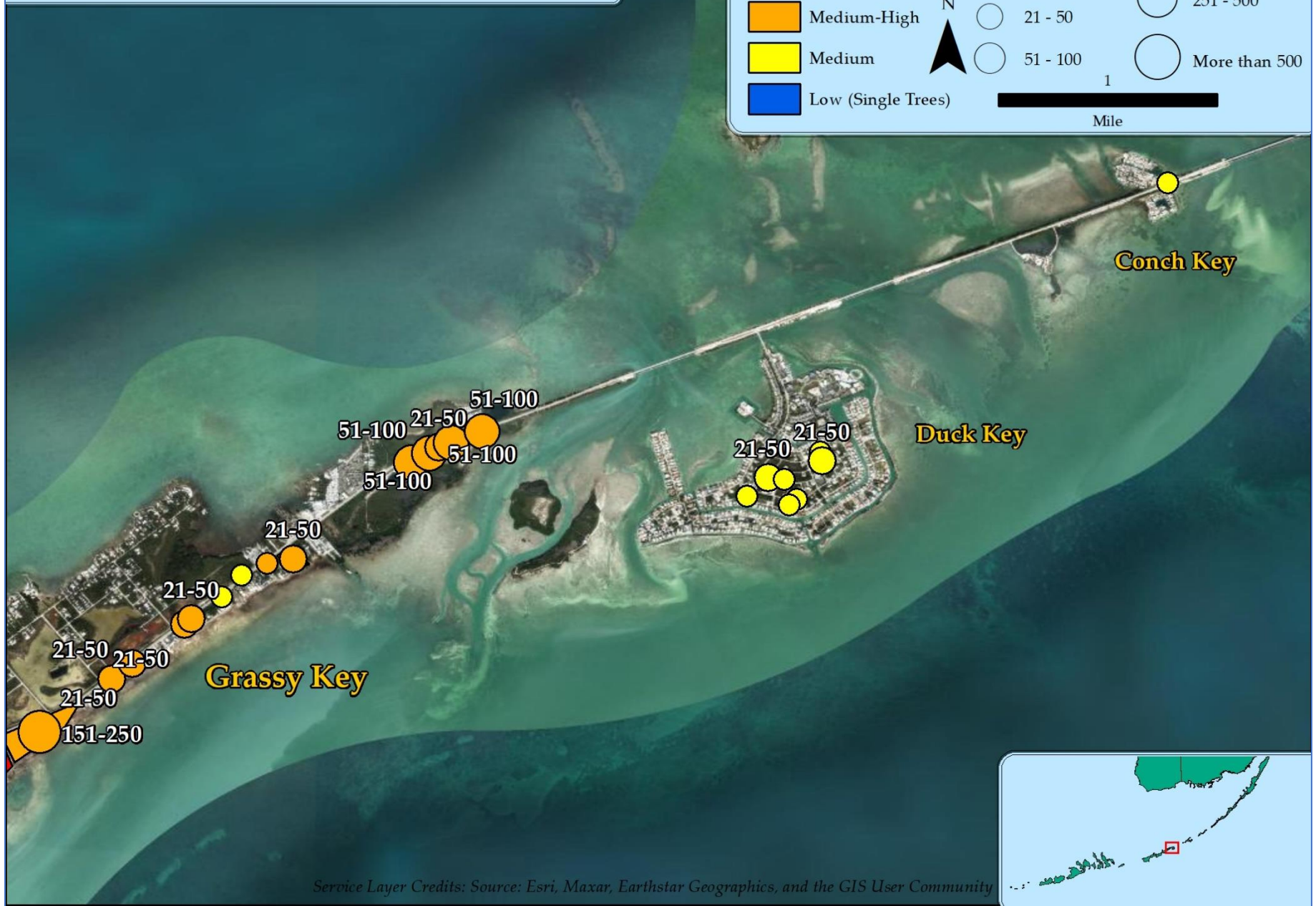
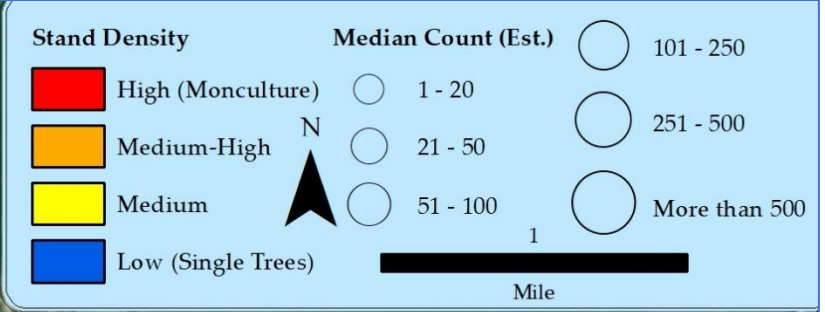








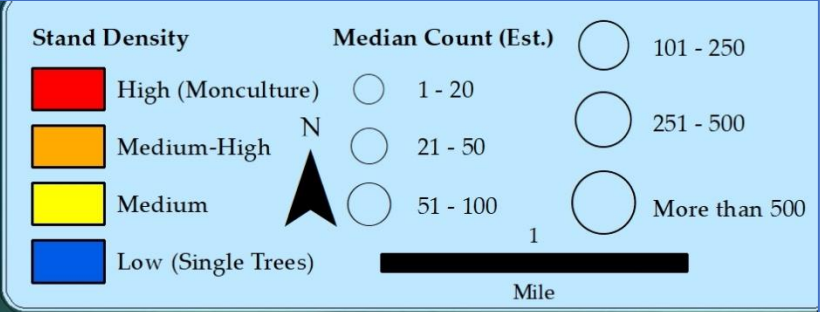
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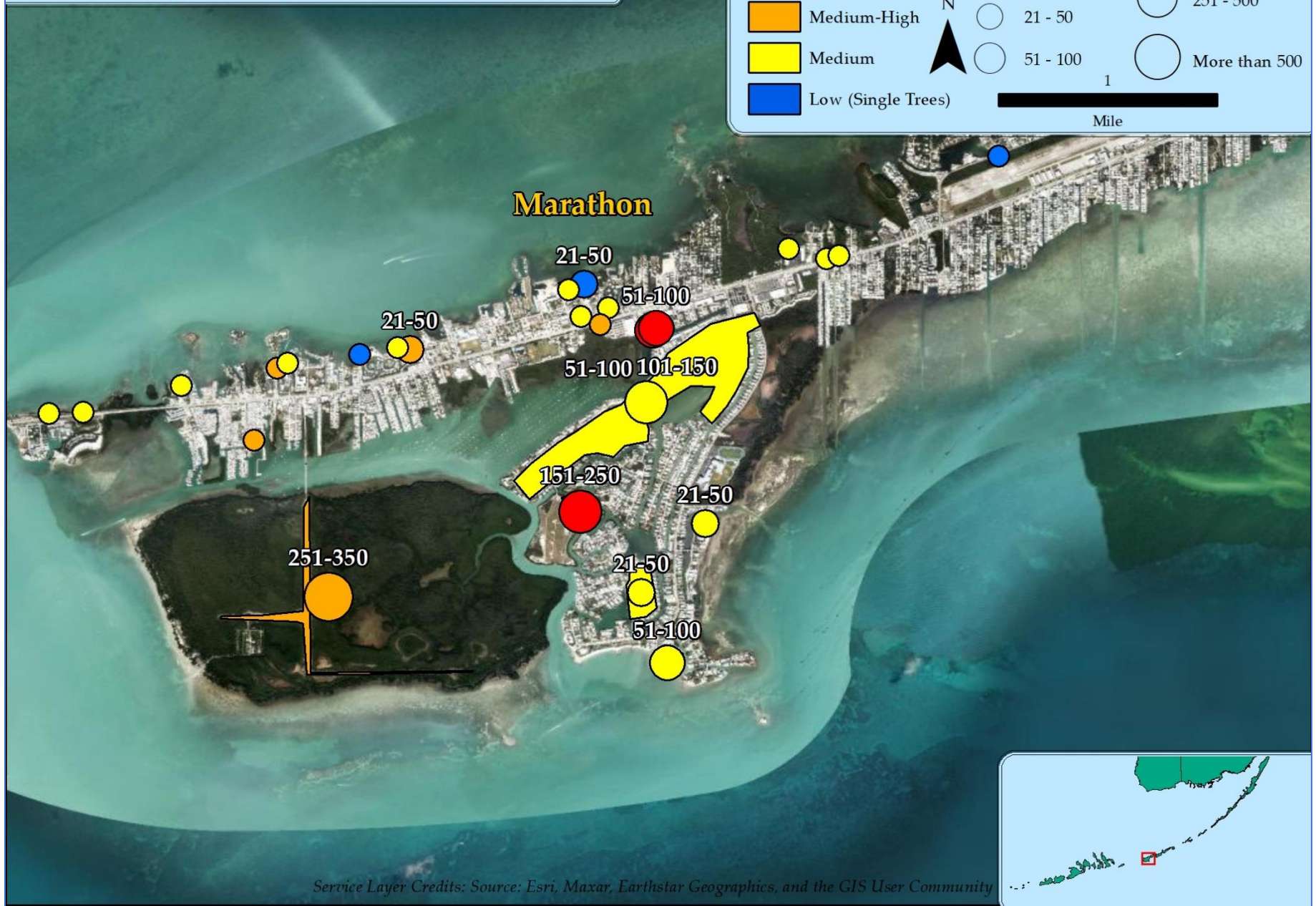
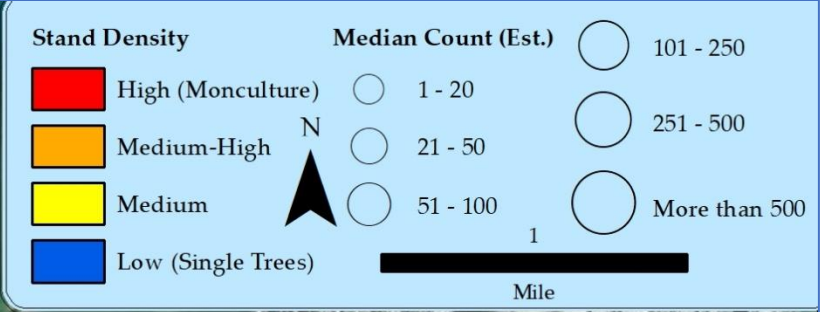
Eastern Marathon Key Area



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Western Marathon Key Area



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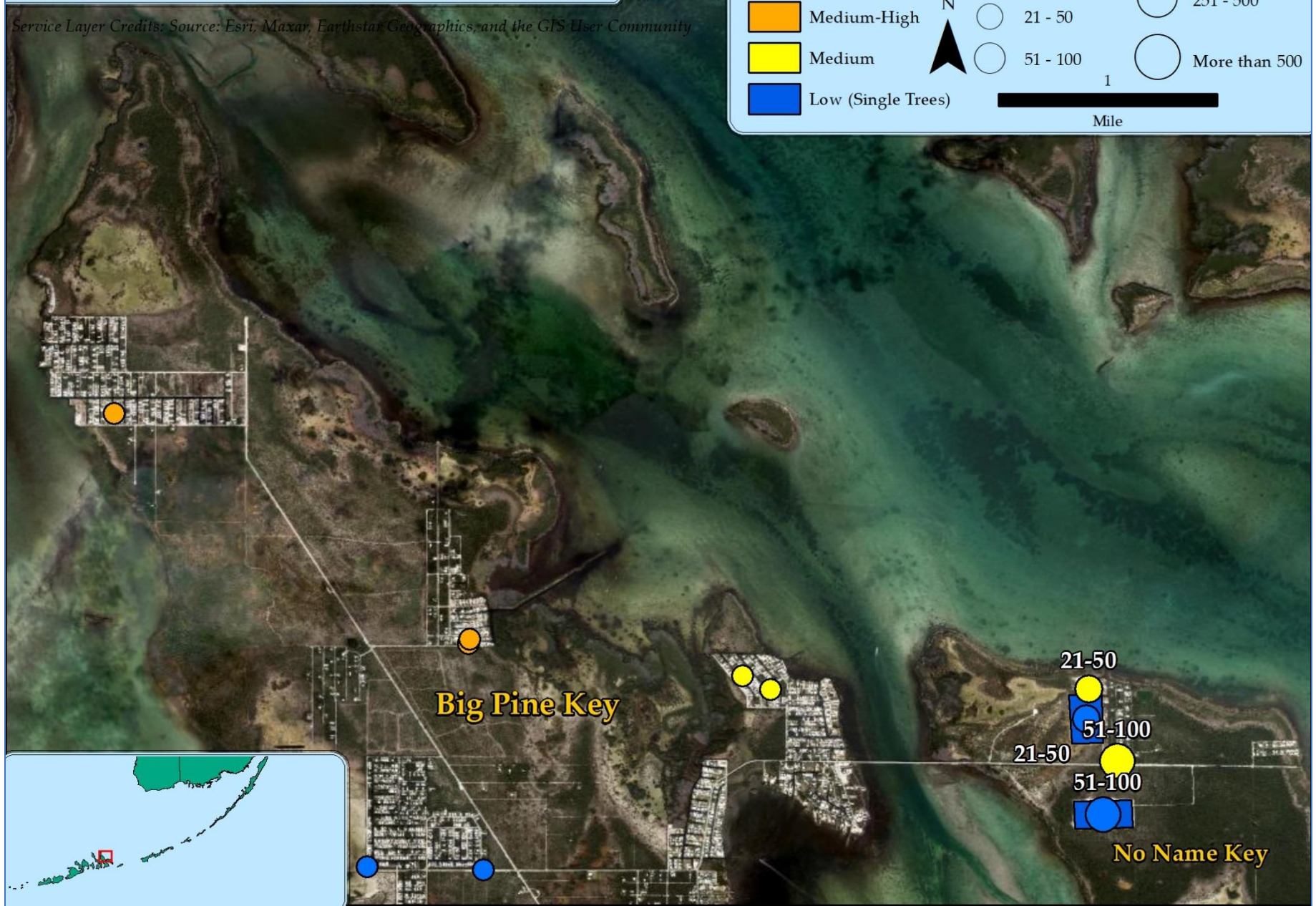


Northern Big Pine Key Area

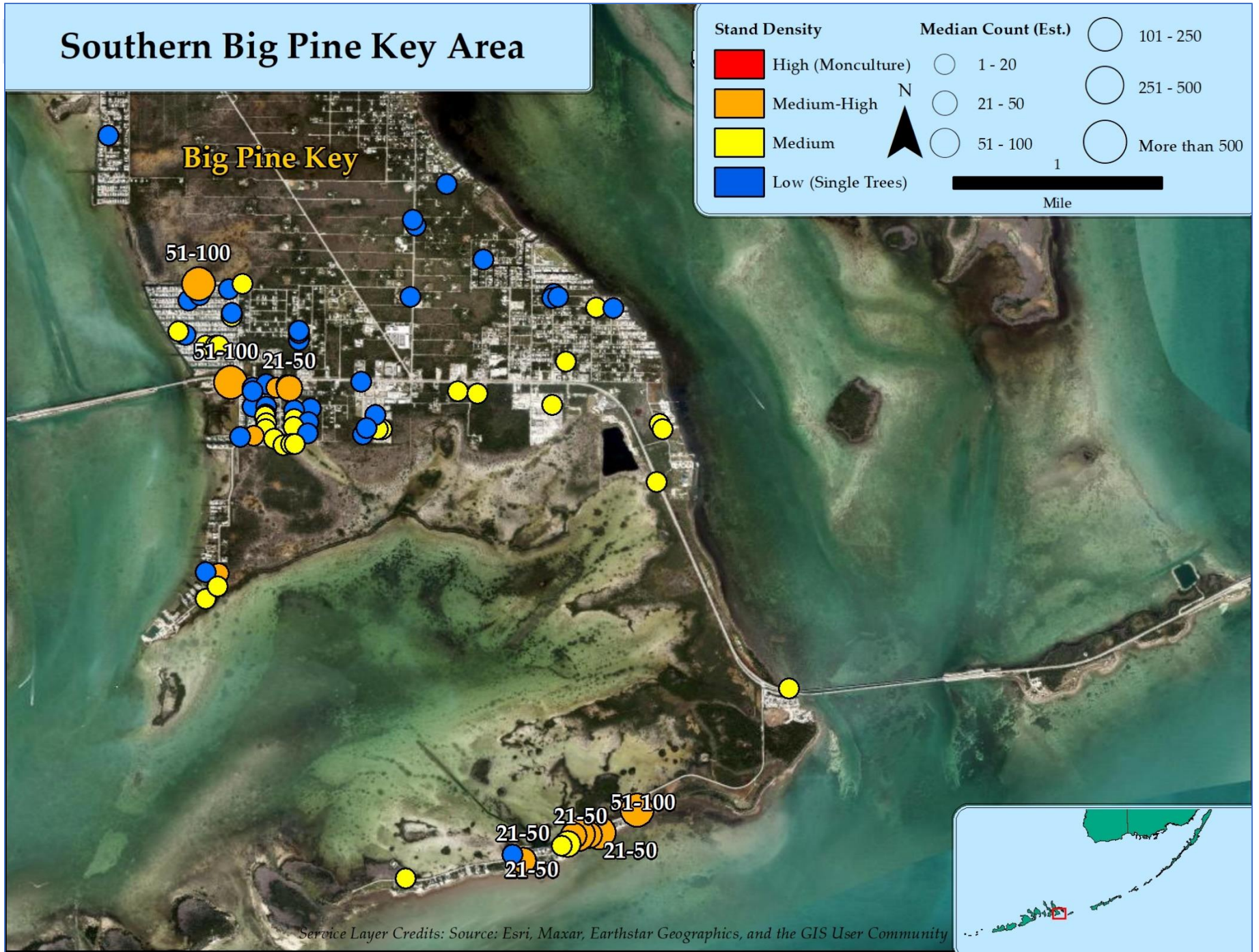
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Stand Density	Median Count (Est.)	Symbol
High (Monculture)	1 - 20	Small white circle
Medium-High	21 - 50	Medium white circle
Medium	51 - 100	Large white circle
Low (Single Trees)	More than 500	Very large white circle

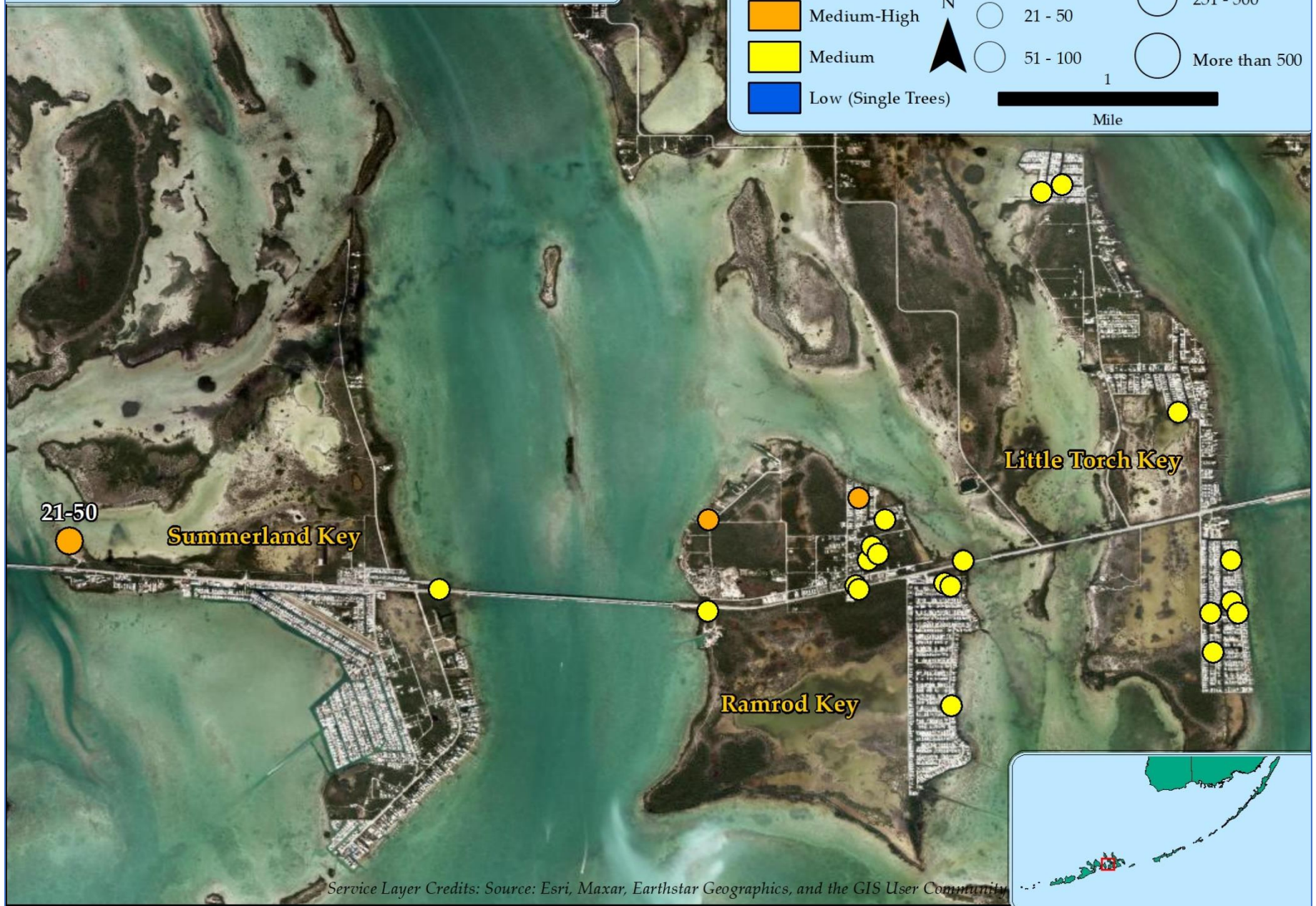
1 Mile



Southern Big Pine Key Area

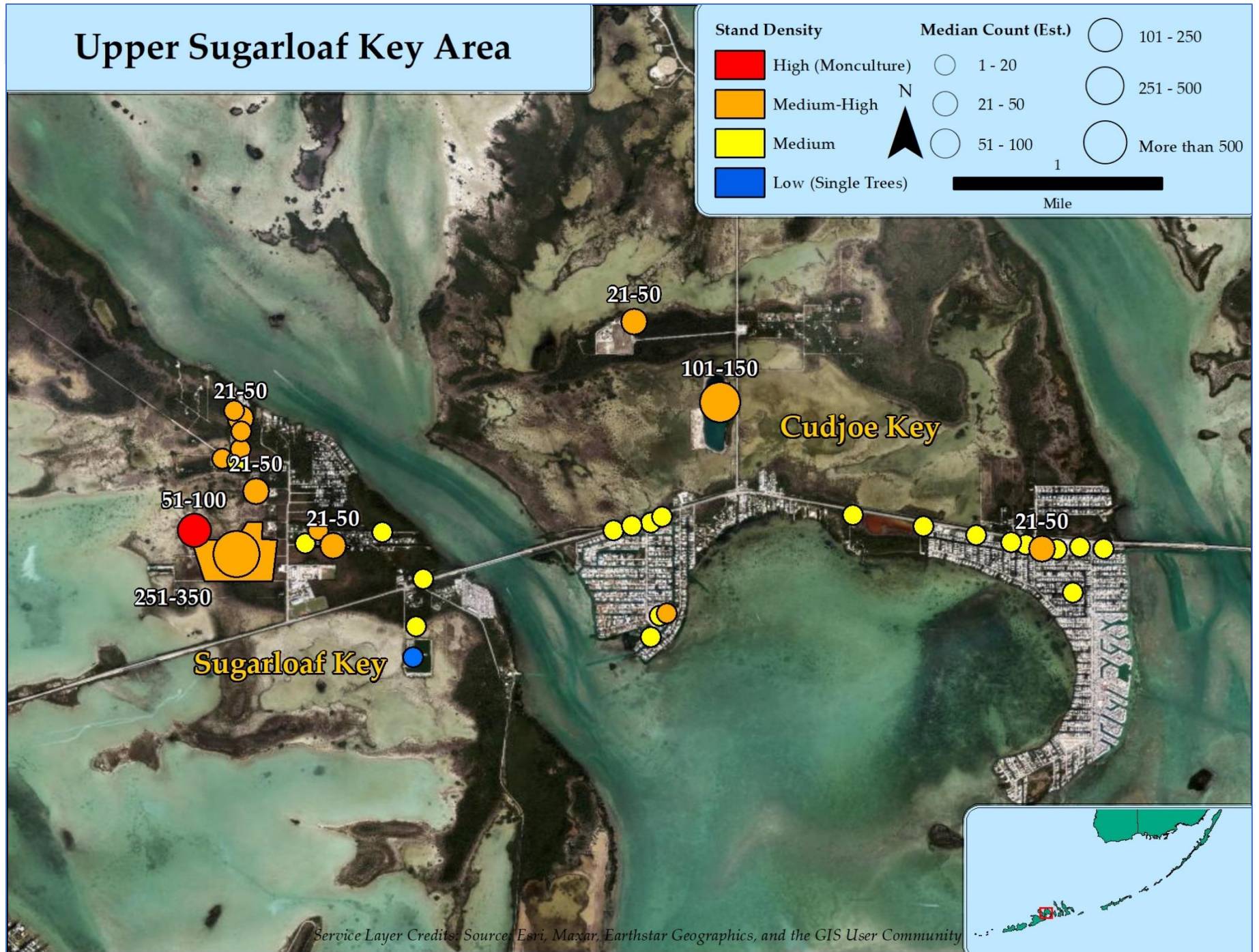


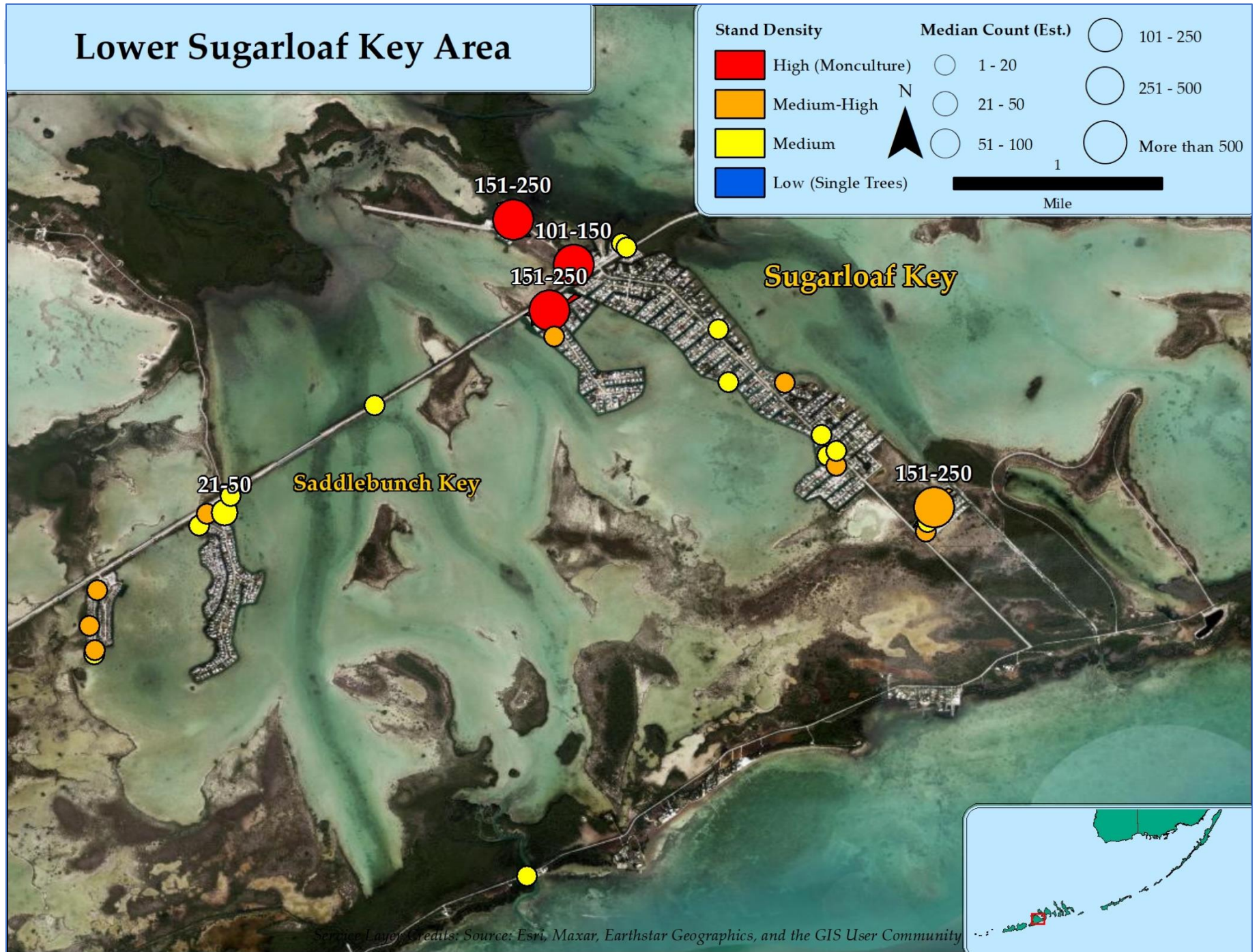
Summerland & Torch Keys Area



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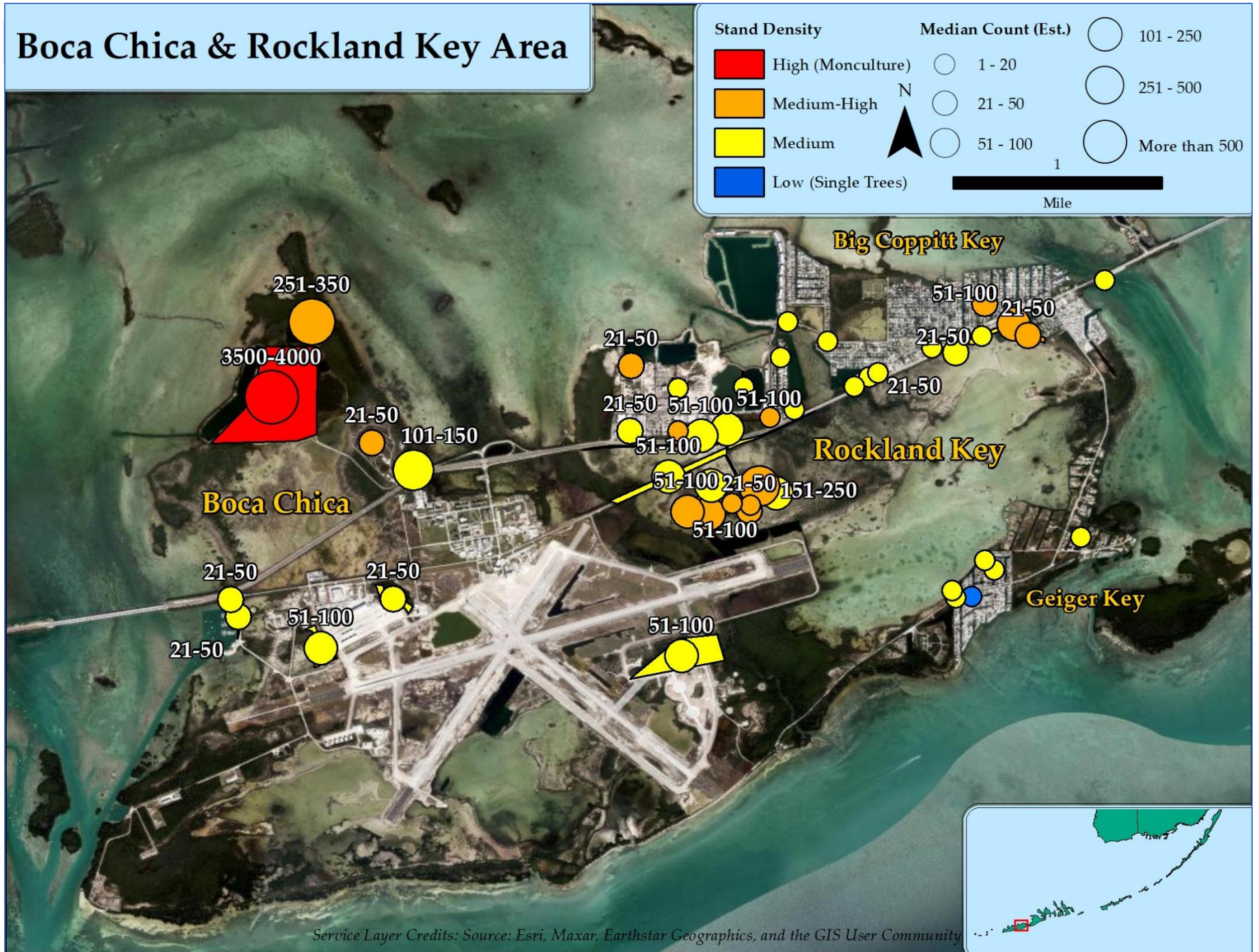






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Key West & Stock Island Area

