



Status update:
Long-term monitoring of Sargent's cherry palm
(*Pseudophoenix sargentii*) on Elliott Key,
Biscayne National Park

FEBRUARY 2021

Acknowledgments

Thank you to Biscayne National Park for more than three decades of support for this collaborative project on *Pseudophoenix sargentii* augmentation and demographic monitoring. Monitoring in 2021 was funded by the Florida Dept. of Agriculture and Consumer Services, Division of Plant Industry, under Agreement #027132.

For assistance with field work and logistics we would like to thank Morgan Wagner, Michael Hoffman, Brian Lockwood, Shelby Moneysmith, Vanessa McDonough, and Astrid Santini from Biscayne National Park, Eliza Gonzalez from Montgomery Botanical Center, Dallas Hazelton from Miami-Dade County, and volunteer biologists Joseph Montes de Oca and Elizabeth Wu.

Thank you to the cooperators whose excellent past work on this project has laid the foundation upon which we stand today, especially Carol Lippincott, Rob Campbell, Joyce Maschinski, Janice Duquesnel, Dena Garvue, and Sam Wright. Janice Duquesnel provided important details about the 1991-1994 outplanting efforts.

Suggested citation

Possley, J., J. Lange, S. Wintergerst and L. Cuni. 2021. Status update: long-term monitoring of *Pseudophoenix sargentii* on Elliott Key, Biscayne National Park. Unpublished report from Fairchild Tropical Botanic Garden, funded by Florida Dept. of Agriculture and Consumer Services Agreement #027132.

Background

Pseudophoenix sargentii H.Wendl. ex Sarg., known by the common names ‘Sargent’s cherry palm’ and ‘buccaneer palm,’ is a slow-growing palm native to coastal habitats throughout the Caribbean basin, where it grows on exposed limestone or in humus or sand over limestone. Over the past century, the species has declined throughout its range, due to in part to overharvesting for use in landscaping.

In Florida, the known historical range of *P. sargentii* included Elliott Key and Sands Key, as well as Long Key, more than 50 miles to the south. Currently, Elliott Key in Biscayne National Park (BNP) is the only location where wild plants remain. Beginning in the early 1990s, Fairchild and partners—including the National Park Service and the Florida Park Service—reintroduced 168 individual palms to all three keys (Lippincott 1995). The three individuals planted on Sands Key did not survive, but larger reintroduced populations remain on both Elliott and Long Keys.

As part of a multi-year project in collaboration with federal and state agencies, Fairchild has investigated the biology, demography, and genetic structure of wild and introduced *P. sargentii* on Elliott Key. Herein we report details on population demographic structure, recent population trends, and the status of introduced populations.

Methods

Field methods – Information presented in this report was gathered over three trips. First, in March 2018, Brian Lockwood, Dallas Hazelton, and Jimmy Lange monitored a portion of the *P. sargentii* population while they were visiting the island to map and collect seed of *Aristolochia pentandra*. They made rapid assessments of the wild subpopulations at No Name, Scorpion Bight, Predator South, as well as the outplanted individuals near the Interpretive Trail. As this trip was just five months after Hurricane Irma, they made efforts to clear fallen branches and debris that were impacting *P. sargentii*.

Second, on March 3rd, 2020, BNP biologists Vanessa McDonough and Shelby Moneysmith monitored the *P. sargentii* population with Fairchild biologists Jimmy Lange and Jennifer Possley. On that date, the goal was rapid assessment of known adult plants (Stage 5) and some of the larger (Stage 4) plants.

Third and most recently, on January 13th and 14th, 2021, all known *P. sargentii* were monitored by the authors and Gonzalez, Hoffman, Moneysmith, Montes de Oca, Wagner, and Wu. Every known individual of *P. sargentii* throughout 9 subpopulations was inspected, with the following data collected: location name, permanent tag number, number of leaves, and height in centimeters (from the ground to the tallest photosynthetic tissue, as each plant stood naturally). General comments on plant health were made, when notable (for example: signs of herbivory or other damage).

Regardless of whether an individual *P. sargentii* is wild or planted, each has a round aluminum numbered tag attached around the base of the plant using aluminum or galvanized steel wire. When wire appeared to be damaged or missing, it was replaced. When *P. sargentii* were encountered that had never been tagged, a new tag was attached. For very small plants that lacked pinnate leaves, the tag was attached to an adjacent stainless steel stake instead of wired directly to the plant (**Fig. 1**).

Survey methods – In order to detect individual *P. sargentii* which were not yet included in the demographic dataset, areas adjacent to known populations were surveyed, if the habitat was appropriate (i.e., upland broadleaf forest). In 2021, surveys for undetected plants focused on habitat between Predator North and Predator South, West of No Name, and in the area surrounding Coon Point (See Overview Map, **Appendix I**). For these efforts, seven persons spent approximately 90 minutes searching.



Figure 1. Tag #90 was placed at a palm seedling located within the Scorpion Bight subpopulation. The seedling was too small to identify to species.

Mapping – The methods by which Fairchild mapped *P. sargentii* plants have varied over the years. From the 1990s through 2012, submeter accurate methods were used, including a Trimble ProXR GPS and a laser range finder. These tools enabled the creation of highly accurate maps using ESRI ArcGIS software. After 2012, Fairchild lacked a reliable submeter accurate GPS unit, and thus relied on handheld Garmin GPS units (with accuracy typically within 10-20 feet) to record the location of individual *P. sargentii*.

Data entry/storage/analysis – All field data were entered into a Microsoft Excel spreadsheet. All individual *P. sargentii* that have ever been tagged remain a permanent part of this dataset. Microsoft Excel was used to create figures that are in the Results section of this report.

This study continues to follow size classes as assigned in Maschinski & Duquesnel (2007) where regression analysis was used to determine the relationship between height and ontogeny to categorize plants into five non-overlapping stages (**Table 1**). It should be noted that newly-emerged *P. sargentii* seedlings with only a single small eophyll (=first leaf or leaves, different in morphology from adult leaves) (see **Fig. 1**) are difficult to distinguish from newly-emerged *Thrinax radiata*, which is a common palm on Elliott Key. Thus, it is likely that this study underestimates the total number of *P. sargentii* seedlings present on the island. Once seedlings are large enough that they have at least one fully developed eophyll, it is possible to tell if it is *Pseudophoenix* or *Thrinax* (**Fig. 2**).

Table 1. *P. sargentii* size classes established by Maschinski & Duquesnel (2007) which are referred to throughout this study.

- Stage 1** – Seedling with eophylls*, no pinnate leaves
- Stage 2** – Small plant with pinnate leaves, up to 0.83 m tall
- Stage 3** – Medium plant between 0.83 and 1.6 m tall
- Stage 4** – Large palm taller than 1.6 meters but not yet reproductive
- Stage 5** – Reproductive adult

*eophylls are the first leaves in some plants, including palms, which have different morphology from adult leaves.



Figure 2. *Pseudophoenix sargentii* (left) vs. *Thrinax radiata* (right). By looking at the venation at the base of larger eophylls, it is possible to tell these species apart. In *Pseudophoenix*, veins converge in a line extending from the base of the eophyll. In *Thrinax*, all veins converge at one point at the base of the eophyll.

Ex situ collections at Fairchild – Off-site plant collections can serve as a “back-up” of wild plant populations and are thus an important part of any comprehensive conservation program. In cases involving plants with recalcitrant seeds which cannot be stored (like those of *P. sargentii*), living plant collections are especially important. Fairchild Garden continues to maintain an ex situ population of *P. sargentii* grown from seed collected on Elliott Key, from 1990 to present.

Results

WILD POPULATION

As of January 2021, the total known wild *P. sargentii* population on Elliott Key consists of 203 individuals (**Table 2**). Of these, only 3 plants are reproductive adults (i.e., Stage 5). Between 2017 and 2021, two of the five known wild, reproductive *P. sargentii* adults on Elliott Key died. Both individuals were located at the Scorpion Bight subpopulation. Aside from this significant loss, the overall population has remained relatively stable over the past four years. Since 2007, the number of large juveniles (Stage 4) has been increasing (**Fig. 3**). Currently, nearly half of the wild population (87/203 or 42.8%) is in Stage 4. Since regular monitoring began in 2003, the number of large juveniles has increased by 444%.

Table 2: Number of wild *P. sargentii* individuals of each stage by subpopulation documented in 2021 surveys by FTBG and cooperators. Location names correspond with the map on page 14.

	Stage					Total
	1 (seedling)	2 (sm. juv)	3 (md. juv)	4 (lg. juv)	5 (adult)	
No Name	13	41	37	35	0	126
Scorpion Bight	4	1	11	30	2	48
Predator South	0	1	4	3	1	9
Predator North	0	3	2	9	0	14
Coon Point	0	0	1	5	0	6
Total	17	46	55	82	3	203

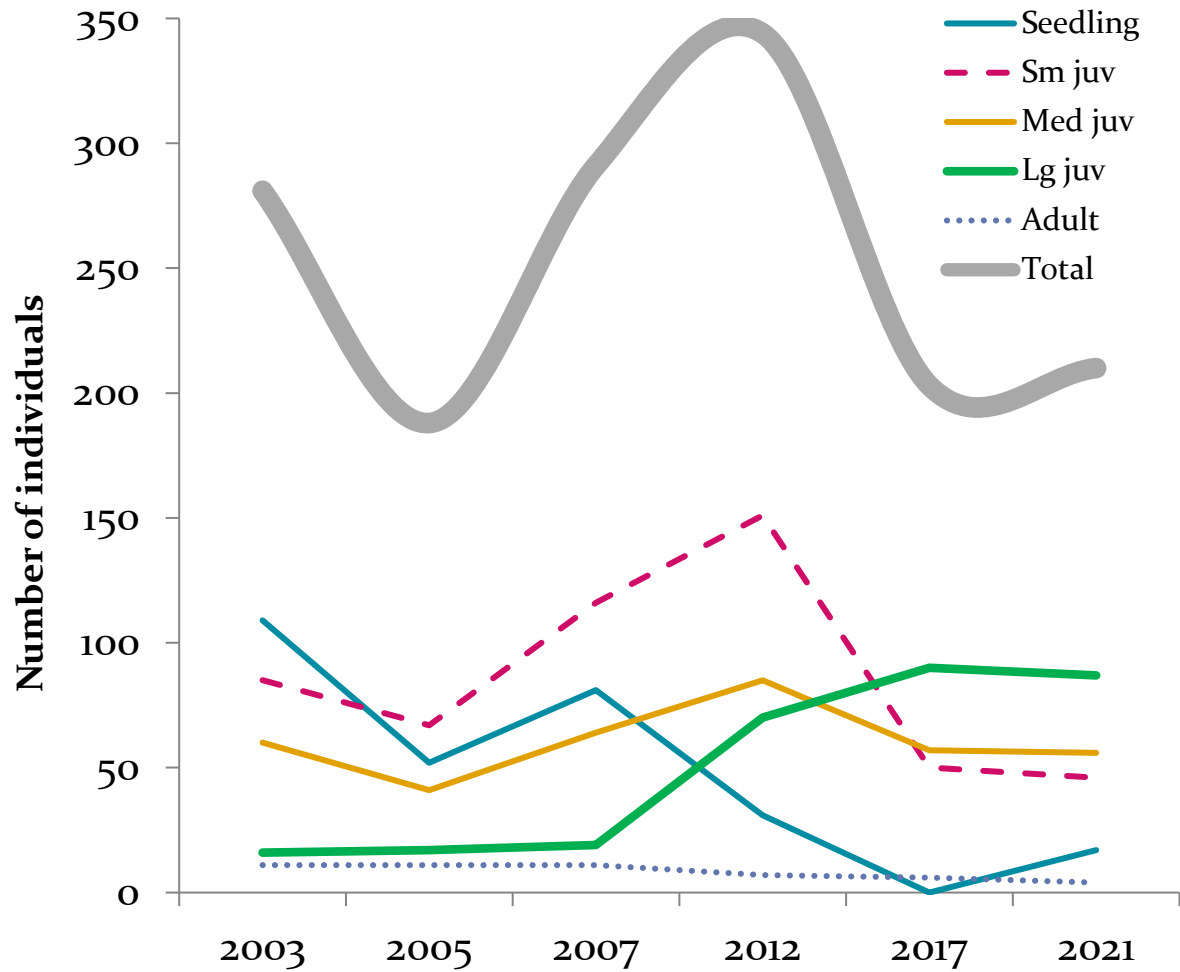


Figure 3: Total number of all *Pseudophoenix sargentii* individuals (wild + planted) on Elliott Key, grouped (gray line) and separated by size class, during censuses conducted by Fairchild Garden between 2003 and 2021.

No Name - The majority of *P. sargentii* individuals on Elliott Key (126/203 or 62%) are located in the “No Name” subpopulation, which also experienced the highest mortality between 2017 and 2021. The number of *P. sargentii* palms in Stages 4, 3, and 2 that died during this interim were 8, 7, and 9 individuals, respectively. Nearly every individual at No Name experienced some level of herbivory, apparently from small mammals, though it is difficult to determine the impacts this has on growth and survival. A number of individuals were observed to have been crushed by falling branches, which resulted in mortality at times. Interestingly, Fairchild documented 9 new *P. sargentii* seedlings (Stage 1) at the No Name subpopulation in 2021, despite not having a reproductive adult present since 2012 when there was one adult in poor condition. This species is not thought to have a long-lived seed bank per Zona (pers comm.) in Maschinski & Duquesnel (2007), but unpublished data at Fairchild does indicate that some level of dormancy may be possible in *P. sargentii*, since one seed germination experiment carried out in soil showed that germination was higher in seeds that were stored for up to 9

months compared to fresh seeds (Garvue and Carrara, 2001) and that seeds can survive desiccation to 12% and 5% seed moisture content (unpublished data at Fairchild). However, results of these germination trials were highly variable between accessions and further research is needed to determine if seeds can indeed remain viable during long-term storage. It is also possible that seeds may germinate and remain as small, nearly undetectable seedlings for years (as in **Fig. 1**) before they begin to produce larger eophylls and, eventually, pinnate leaves.

Scorpion Bight - The “Scorpion Bight” subpopulation has the greatest diversity in *P. sargentii* size classes. Whereas there were 4 reproductive adult palms in 2017, two of them have since died. One apparently died after a large oak branch fell on it; the other likely suffered a similar fate. Several other individuals were impacted by fallen branches from Hurricane Irma in 2017 (**Fig. 5**). Two robust, reproductive adult palms still survive at Scorpion Bight, along with 30 large juveniles, 12 other juveniles (Stages 2+3), and four new seedlings. One of the adult palms (tag #4740) bore fruit in March 2020 (**Fig. 4a**). This individual does appear to exhibit the same fungal pathogen that many adult *P. sargentii* contract (**Fig. 4b**), however it also appears to be otherwise healthy.



Figure 4. Scorpion Bight *Pseudophoenix sargentii* #4740, which has been part of this monitoring study since 2000 when it was first measured as a 2.5-meter-tall juvenile palm. In January 2017, we first noted signs of reproduction, as old infructescences were present. The cherry-like fruits and black crown shaft shown here were photographed on March 3rd, 2020. Note that in the background of the second photo, a dead adult palm is visible; this is the individual that was damaged by a falling oak branch.



Figure 5: Two adult *P. sargentii* at Scorpion Bight that were impacted by fallen branches from Hurricane Irma. These branches were removed upon discovery in March, 2018.

Predator South - The “Predator South” population of *P. sargentii* contains the only other known wild adult *P. sargentii* on Elliott Key. This tree, which has exhibited signs of a fungal pathogen in its crown shaft for at least 5 years, and was treated with fungicide by staff from Montgomery Botanical Center and BNP in 2020, continues to slowly decline and did not show signs of having reproduced in 2020 (it was first noted as being reproductive since 2002) (**Fig. 6**). However, three large juvenile (Stave 4) *P. sargentii* persist in its immediate vicinity, with another nine large juveniles at nearby “Predator North;” these all appear to be in excellent health.

Predator North – This subpopulation was discovered by Fairchild staff during systematic searches in 2012. This is the third largest wild population, with 14 plants, the majority of which are robust, large juveniles.



Figure 6. Adult *P. sargentii* #4750 at Predator South, exhibiting poor health with black crown rot and new leaf that appears to have died before fulling forming. Photo by Eliza Gonzalez, Montgomery Botanical Center.

Coon Point – This subpopulation contains both wild (N=6) and introduced (N=4) plants, all of which are in the juvenile stage. Nine plants are Stage 4 and one is Stage 3.

New finds - During surveys for additional undetected *P. sargentii*, 12 new individuals were documented: three north of No Name, eight west of No Name (now dubbed “Morgan W” in honor of Morgan Wagner for finding these plants, see **Cover Photo**), and one healthy juvenile (Stage 3) palm was located east of the Coon Point subpopulation. These encouraging finds demonstrate the need for further detailed surveys throughout the island.

OUTPLANTED POPULATION

Of the 63 *P. sargentii* that Fairchild and DEP introduced to Elliott Key in 1991-1994, only 7 (11%) have survived to 2021. While this ratio is low, it is notable that two of the outplants, both of which were planted near the Interpretive Trail, have flowered. Five more outplants will be large enough to flower in the next decade, should they survive. These soon-to-be reproductive palms are poised to substantially contribute to the next generation of *P. sargentii* on the island.

Of the two mature outplanted palms along the Interpretive Trail, only one has survived to 2021. The other plant was found to be reproductive during the 2018 reconnaissance mission after Hurricane Irma, however the tree had been severely damaged by a fallen branch. This individual, which took roughly 30 years to reach maturity, died from the injury (**Fig. 7**).

During the January 2021 survey, the area surrounding both of the Interpretive Trail *P. sargentii* was surveyed for seedlings, but none were located.

The status of each surviving introduced palm is summarized below (**Table 3**).



Figure 7: A *P. sargentii* outplant at the Interpretive Trail photographed after a fallen branch was removed from atop its meristem in March 2018. This individual did not recover.

Table 3: Details on the seven surviving outplanted *P. sargentii* individuals on Elliott Key as of January 2021. The total number of individuals planted in 1991-1994 was 63 palms.

Tag #	Subpopulation	January 2021 status	
		Stage	Height (m)
7	Interpretive trail	5	4
4314	Petrel point	4	3
1488	Coon point	4	2
1489	Coon point	4	3
1490	Coon point	4	3
1492	Coon point	4	3.7
4312	Tannehill	3	1.5

EX SITU COLLECTIONS AT FAIRCHILD

As of 2021, Fairchild’s living collections of *Pseudophoenix sargentii* originating from Elliott Key includes 52 trees that were directly collected (as seed) from the wild and 120 seedlings that were grown from two of these trees (**Table 4**). Most wild collections were made between 1990 and 2001, though a single, small seedling was grown from a seed collected from adult #4740 at the Scorpion Bight subpopulation in 2020.

Table 4. Living collections of *Pseudophoenix sargentii* from Elliott Key at Fairchild Tropical Botanic Garden, as of January 2021.

Accession #	Collector	Year received	Origin	Location	Quantity
90404	Carol Lippincott (FTBG)	1990	Elliott Key	Garden	1
90432	Ann Deaton (DEP)	1990	Elliott Key	Garden	3
9170	Ann Deaton (DEP)	1991	Elliott Key	Garden	8
9171	Ann Deaton (DEP)	1991	Elliott Key	Garden	2
9172	Ann Deaton (DEP)	1991	Elliott Key	Garden	2
91557	Joseph Nemecek (DEP)	1991	Elliott Key	Garden	2
91558	Joseph Nemecek (DEP)	1991	Elliott Key	Garden	1
941066	Unknown	1991	Elliott Key	Garden	1
2001-0082	Dena Garvue (FTBG)	2001	Elliott Key	Garden	15
2001-0920	Dena Garvue (FTBG)	2001	Elliott Key	Garden	17
2020-0001	Brian Harding (FTBG)	2020	FTBG 941066 A	Nursery	ca 40
2020-0028	Brian Harding (FTBG)	2020	FTBG 90404 A	Nursery	ca 80
2020-0212	Vanessa McDonough (NPS)	2020	Elliott Key	Nursery	1

Discussion

Pseudophoenix sargentii is one of the rarest and most charismatic plant species in Biscayne National Park—and in the United States, for that matter. While its status in our flora remains tenuous, the overall population on Elliott Key has remained stable in recent years with a total of approximately 200 individuals and a promising number of large juveniles, many of which will likely reach adulthood in the next decade. Large juveniles have demonstrated high survivorship in the past (Maschinski & Duquesnel 2007), so we feel it is reasonable to be optimistic, and to expect the number of adult *P. sargentii* on Elliott Key to surpass past figures in the near future.

It is important to note that there is also a healthy reintroduced population of *P. sargentii* on Long Key. While there are no longer any wild plants left on that island, the reintroduction includes 47 palms as of February 2021 (Janice Duquesnel, pers. comm.). All plants were grown by Fairchild and partners, from seed collected from Elliott Key. Plantings occurred in 1991, 1994, and 2019. None of these palms have yet reached reproductive maturity, but like their wild counterparts on Elliott Key, they are poised to do so in the next decade. This reintroduction project is monitored annually by Florida Parks Service district biologist Janice Duquesnel. Duquesnel noted that plants at “Long Key Point” are the most robust however this subpopulation also suffered the worst impacts from Hurricane Irma in 2017.

With this most recent population assessment, there were two threats to the future of *P. sargentii* observed on Elliott Key which could possibly be mitigated. The first of these was herbivory. Many of the seedlings that were documented as having “herbivory” or “heavy herbivory” in 2017 did not survive to 2021. During this most recent survey, there were several dozen plants noted with herbivory, especially those at No Name and Predator. Sometimes, an entire frond of a palm that only had 2-3 fronds to begin with was completely removed, leaving only a chewed-off petiole. It is not known what type of animal was causing the damage. One possibility is that red-bellied squirrels are removing leaves for use in nest building (Tilmant 1980, as cited in Koprowski et al. 2005). However, nothing that appeared to be a squirrel nest was observed in the vicinity of *P. sargentii* during these surveys. FSP biologist Janice Duquesnel stated that herbivory became an issue with reintroduced palms in 1991, shortly after the first plants were installed. As a result, staff caged all but the largest outplants. All cages were removed once palms reached a height of five feet. Duquesnel further noted that she observed a hermit crab climbing a cage in order to access and feed upon a frond.

The second threat to *P. sargentii* observed which could potentially be mitigated was that of falling trees and branches. From 2012 to 2017 and again between 2017 and 2021, healthy large *P. sargentii* were observed at one monitoring period, only to be found dead at the next monitoring period with a fallen tree or branch that had damaged the palm’s apical meristem. Recommendations to mitigate these threats and other potential threats are included in the next section of this report.

Fairchild Tropical Botanic Garden’s conservation staff hopes to continue to work with Biscayne National Park to monitor this important rare Florida native plant population in perpetuity. As part of that partnership, we have some recommended practices for BNP to continue to safeguard and grow the *P. sargentii* population. Fairchild conservation staff can cooperate with BNP staff to implement any or all of these activities.

RECOMMENDATIONS FOR CONSERVATION OF *P. SARGENTII* ON ELLIOTT KEY, BNP

- Monitor the 4 known adult reproductive *P. sargentii* at least once per year. Look for signs of reproduction, advancing crown rot disease, or potential damage from adjacent trees that can be mitigated.
- Conduct a complete population census at least every 4 years.
- Survey potential habitat for undetected *P. sargentii* on a regular basis (at least every 4 years).
- Consider installing one or more game cameras at the No Name subpopulation (where the worst herbivory was observed) to determine what animals are causing damage.
- Consider protecting a subset of seedlings from herbivory in mesh cages. If future monitoring suggests that the cages promote survival and growth, then cage additional seedlings.
- Consider augmenting small subpopulations, especially the introduced subpopulations at Petrel Point, the Interpretive Trail, and Tannehill.
- Restrict collecting of fruits. Do not permit an entire fruiting stalk to be cut down or otherwise damaged. Limit seed collection to <10% of annual wild crop, per guidelines from the Center for Plant Conservation.
- Consider trimming trees that are adjacent to adult palms and large (trunked) juveniles, especially if there are large branches that could fall and damage the apical meristem of the palms. If resources are limited, start with the four adult *P. sargentii* and expand trimming efforts to other trees in subsequent years. It should be noted that trimming adjacent vegetation will also likely promote healthy growth and flowering of *P. sargentii* trees. Lippincott (1995) noted that “. . . Hurricane Andrew severed 19 of the 47 palms on Elliott Key. However, the surviving Sargent's cherry palms are thriving in the open, sunlit hammock.”
- In the event of a tropical storm or hurricane affecting Elliott Key, conduct rapid assessments as soon as it is safe to do so, focusing on adult trees first. Remove fallen trees or large branches if they landed on top of *P. sargentii*.
- Consider borrowing or purchasing a submeter GPS unit to re-map populations to aid future monitoring efforts.

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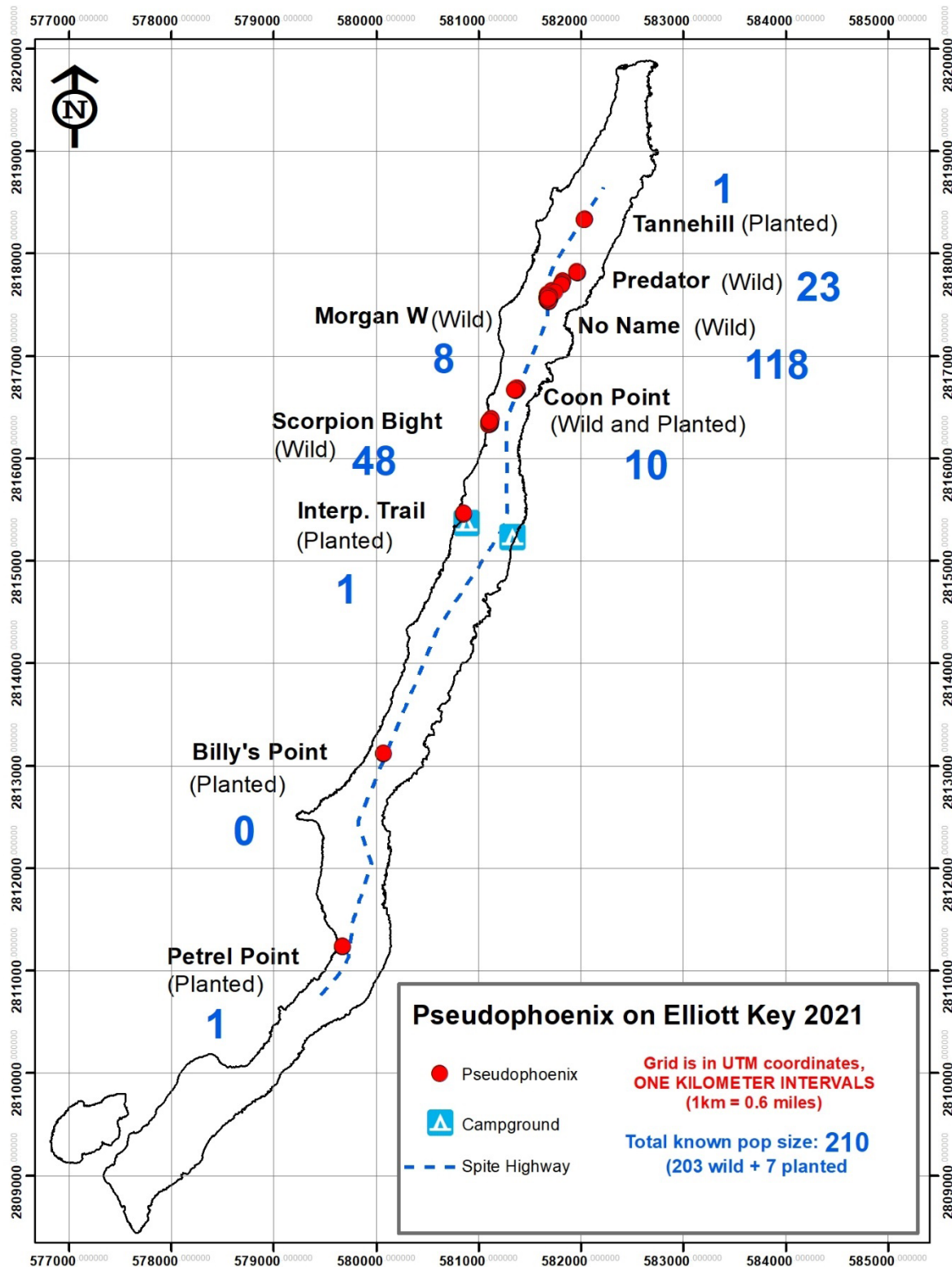
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Appendix I: Overview map of wild and reintroduced *Pseudophoenix sargentii* on Elliott Key, as of January 2021. Detailed maps of each subpopulation are not included with this report but are available upon request to BNP and FTBG.



Appendix 2: Summary data

2021 summary data: *Pseudophoenix sargentii* on Elliott Key, Biscayne National Park

	Stage I		Stage II		Stage III		Stage IV		Stage V		Row
	wild	reintro	wild	reintro	wild	reintro	wild	reintro	wild	reintro	<i>totals</i>
Tannehille						1					1
Predator North			3		2		9				14
Predator South			1		4		3		1		9
No Name	13		41		37		35				126
Coon Point					1		5	4			10
Scorpion	4		1		11		30		2		48
Interp										1	1
Petrel								1			1
<i>Column totals</i>	17	0	46	0	55	1	82	5	3	1	210

Total per stage	17	46	56	87	4
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Total wild	203
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Total reintroduced	7
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Grand total	210
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