



**Survey for *Scleria eggersiana* (Egger's
nut-rush) at Dinner Island Ranch
Wildlife Management Area
Hendry County, Florida**

Final Report to the
Florida Fish and Wildlife
Conservation Commission



July 2019

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Cover Photographs:

- top: Initial discovery of unknown *Scleria* (nut-rush) species at Dinner Island Ranch Wildlife Management Area in January 2015 (Kim Gullledge)
- center: Representative understory at site of January 2015 *Scleria eggersiana* (Egger's nut-rush) discovery, photographed in June 2019 (Dexter Sowell)
- bottom: Egger's nut-rush fruiting raceme, June 2019 (Paul Russo)

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ABSTRACT

A survey for *Scleria eggersiana* (Egger's nut-rush), a potential Early Detection-Rapid Response (EDRR) plant species for Florida, was conducted at Dinner Island Ranch Wildlife Management Area (DIRWMA) in Hendry County, FL on June 18 and 19, 2019. We identified 9 occurrences of Egger's nut-rush, of which one occurrence was a confirmation of discovery in January 2015 of a then unknown *Scleria* species by Florida Natural Areas Inventory staff conducting a rare plant survey and natural community mapping at the time. All 9 occurrences of Egger's nut-rush identified on this survey are within one continuous mesic hammock near the western border with Okaloacoochee Slough State Forest (OSSF). All 9 occurrences are also within one mile of approximately 20 acres of Egger's nut-rush infestation that have been mapped and subsequently treated in OSSF.

Based on our findings, Egger's nut-rush appears to be a slowly spreading species. Treatment of Egger's nut-rush at OSSF have revealed 20-25% survival from belowground biomass of plants. Based on these results, the plants at DIRWMA should be treated as soon as possible, and at least two treatments are likely to be required.

ACKNOWLEDGMENTS

We thank Linda King (FWC) for requesting this survey. Dexter Sowell and Paul Russo conducted the surveys. Dexter Sowell wrote the report. Frank Price (FNAI) and Robert Gundy reviewed an earlier draft of the report. Chad Anderson (FNAI) reviewing an earlier and later draft of the report. Amy Knight (FNAI) proofed GIS data associated with this report for quality control and assuring metadata requirements were met.

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INTRODUCTION

Dinner Island Ranch Wildlife Management Area (DIRWMA) is a 21,714 acre conservation area located in central Hendry County, FL. The natural communities were mapped by FNAI in 2006. At that time, about 69% percent of the landcover at DIRWMA was classified as altered landcover types: improved pasture, semi-improved pasture, and ruderal (FNAI 2006). The natural communities comprise approximately 6,808 acres, while the altered land cover types comprise approximately 14,898 acres.

An unusual *Scleria* sp. was discovered in the Okaloacoochee Slough State Forest (OSSF) in 2016 by the author when employed by the Florida Forest Service. The plant's location is less than one mile from the western boundary of DIRWMA. The *Scleria* occurrence in OSSF was visited a year later by South Florida Water Management District personnel in 2017, with voucher specimens collected and submitted to the herbarium at the University of Florida. The herbarium staff identified the sedge as *Scleria eggersiana* (Egger's nut-rush), a species new to the continental United States with a native range in Central and South America.

Currently, the only known locations of *S. eggersiana* are less than one mile from the western boundary of DIRWMA. Even so, no formal, targeted surveys have been conducted in adjacent areas of similar habitat. In order to determine the extent of this new invasive species, the Florida Fish and Wildlife Conservation Commission's (FWC) Upland Invasive Exotic Plant Management Program requested an Early Detection and Rapid Response (EDRR) survey to locate and map any occurrences of Egger's nut-rush (*Scleria eggersiana*) within DIRWMA.

METHODS

Planning

Little is known about the biology and ecology of Egger's nut-rush in North America. For this reason, it was not immediately clear what areas in DIRWMA should be surveyed. In order to improve the probability of locating the target species, we gathered all existing information. First, we requested all known waypoints from the staff of OSSF. The data provided consisted of 19 waypoints, all in the southeast corner of OSSF, and all less than one mile from the shared boundary with DIRWMA. We also reviewed existing FNAI data collected during previous vegetation surveys. One notable survey from January 2015 was found which recorded a tall, unknown *Scleria* species. Upon review, the unknown plant photo from this survey appeared to have vegetative characteristics similar to Egger's nut rush. We converted the waypoints collected from OSSF and the previous FNAI survey to a shapefile for analysis in ArcMap 10.6. We added the Cooperative Landcover shapefile version 3.3 (CLC), as well as a 5 meter digital elevation model (DEM) generated from LiDAR (Light Detection and Ranging) data from both OSSF and DIRWMA.

By comparing known locations of Egger's nut-rush in OSSF with both the CLC and DEM layers, it became evident that Egger's nut-rush preferred closed canopy habitats such as mesic hammock (Figure 1). Based on the DEM, Egger's nut-rush preferred hydric environments, or was confined to small hydric depressions in larger mesic habitats, and occurred at elevations between 26.26-

27.92 feet above sea level (FASL, FL Albers) within the OSSF. We then isolated the 26.26-27.92 FASL elevation for targeted surveys. Appendix A provides detail on how this was conducted. The inset in Figure 1 shows areas of lower elevation, i.e. hydric inclusions, likely suitable for Egger's nut-rush (arrows).

We then began to identify closed canopy natural communities in DIRWMA (e.g., mesic hammock, dome swamp) via the CLC layer that had the appropriate elevation signature in the DEM. We identified nine areas within management units 1-3 (those management units closest to the shared boundary with OSSF) that contained the desired habitats and elevation. Figure 1 below provides a map of the areas within DIRWMA that were prioritized for surveying.

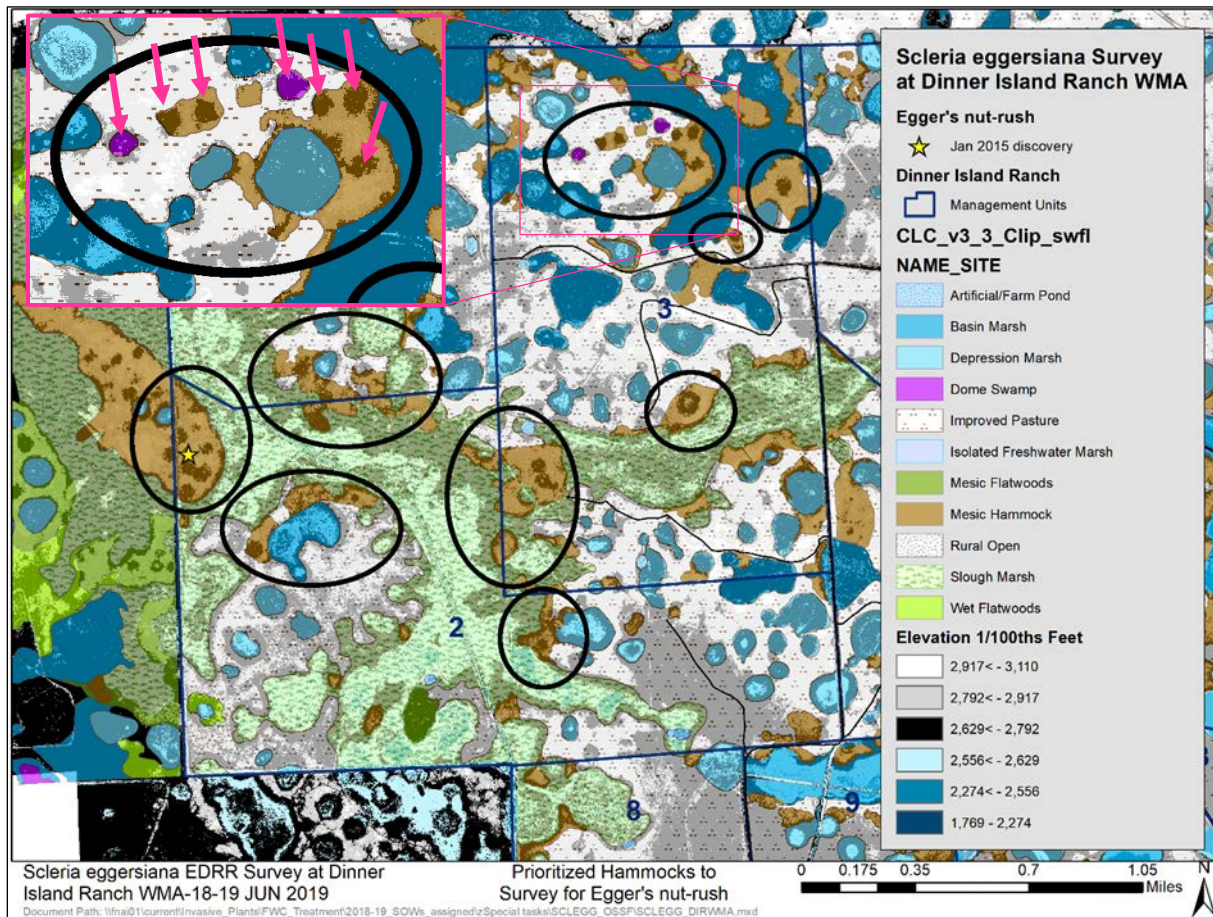


FIGURE 1. Areas prioritized for Egger's nut-rush surveys in DIRWMA.

Field Work

We surveyed seven of the nine prioritized areas within management units 1-3 over the course of two field days on June 18-19, 2019. We first searched the mesic hammock in management unit 2 on the boundary shared between DIRWMA and OSSF. Of the remaining eight prioritized areas, we excluded one mesic hammock from survey upon review of aerial imagery once in the field, as the depression within the mesic hammock was in fact an open canopied marsh. Another mesic hammock was not surveyed due seasonal inaccessibility.

Data Management

GPS points were recorded using a Trimble GPS/datalogger and exported into ArcGIS shapefiles using GPS Pathfinder Office, version 5.8. All data points were edited in ArcMap 10.6 and corrected for consistency. At each focal species occurrence we recorded with a GPS unit numerous data with a data dictionary (see Appendix B for full data collected).

Data were downloaded and exported to shapefiles¹ with GPS Pathfinder Office for use in ArcMap 10.6. We collected invasive species points (including other exotic species of concern), and rare species points using a Trimble Geo XT. We calculated the number of occurrences for each focal species, gross acreage of extent for each focal species, plus the net acreage for each focal species. Net acreage was calculated by multiplying the gross acreage times the mid-point value for a cover class (e.g., 25-50%=37.5%=0.375). Edited data and survey tracks were stored in a project geodatabase based to be provided to FWC.

RESULTS AND DISCUSSION

Egger's Nut-rush

Seven prioritized areas of mesic hammocks and dome swamps were surveyed over the course of two days. We confirmed Egger's nut-rush at the site of the January 2015 FNAI discovery of an unknown *Scleria* (yellow star in Figure 1). We found nine small patches of plants, grouped into three small groupings. Within a grouping, the patches are 5-18 meters apart. The three groupings are 57 and 80 meters apart from each other. The nine distinct patches of Egger's nut-rush, all within the westernmost mesic hammock, are all small in extent. Table 1 below provides descriptive data for each of the nine occurrences of Egger's nut-rush, as well as summary data.

Despite potentially suitable habitat in the remaining seven prioritized areas surveyed, no other Egger's nut-rush plants were found. Figures 2 and 3 provide maps of habitats surveyed, and the location of Egger's nut-rush plants recorded. We include with this report a geodatabase layer of all nine Egger's nut-rush occurrences.

TABLE 1. Data for the nine Egger's nut-rush occurrences in DIRWMA.

CID	Surveyor	Gross Ac	Distribution	% Cover	Net Ac	FNAI NC	Comments
1	Sowell, Dexter	0.01:2 car garage	Scattered plants	<5%	0.000250	hydric hammock	SCLEGG, 4 plants, plants up to 6' tall, plants in 4m x 4m plot
2	Sowell, Dexter	0.001:2 lg desk	Scattered plants	51-75%	0.000625	hydric hammock	SCLEGG, 3 plants
3	Sowell, Dexter	0.001:2 lg desk	Single plant/clump	51-75%	0.000625	hydric hammock	SCLEGG, 1 plant
4	Russo, Paul	0.001:2 lg desk	Scattered plants	5-25%	0.000150	hydric hammock	ZZ
5	Russo, Paul	0.001:2 lg desk	Scattered plants	5-25%	0.000150	hydric hammock	ZZ
6	Russo, Paul	0.001:2 lg desk	Scattered plants	5-25%	0.000150	hydric hammock	ZZ
7	Russo, Paul	0.001:2 lg desk	Scattered plants	5-25%	0.000150	hydric hammock	ZZ
8	Russo, Paul	0.01:2 car garage	Scattered plants	5-25%	0.001500	strand swamp	ZZ
9	Russo, Paul	0.01:2 car garage	Scattered plants	5-25%	0.001500	hydric hammock	ZZ
	Gross Ac	0.0360		Net Ac	0.0051		

¹ We provide a file geodatabase with this report. The first layer has the location and data for Egger's nut-rush observed during this survey (Eggers_nutrush). The second layer (Invasive_Plants) has the location and data for six other invasive plant species observed. The third layer (FNAI_Tracks) has the survey tracks of FNAI personnel. The fourth layer (Rare_Plants) has the location and data of rare plants encountered. A fifth layer (Live_Oak_leaf_drop) has the location of live oak decline/severe leaf drop observed during this survey.

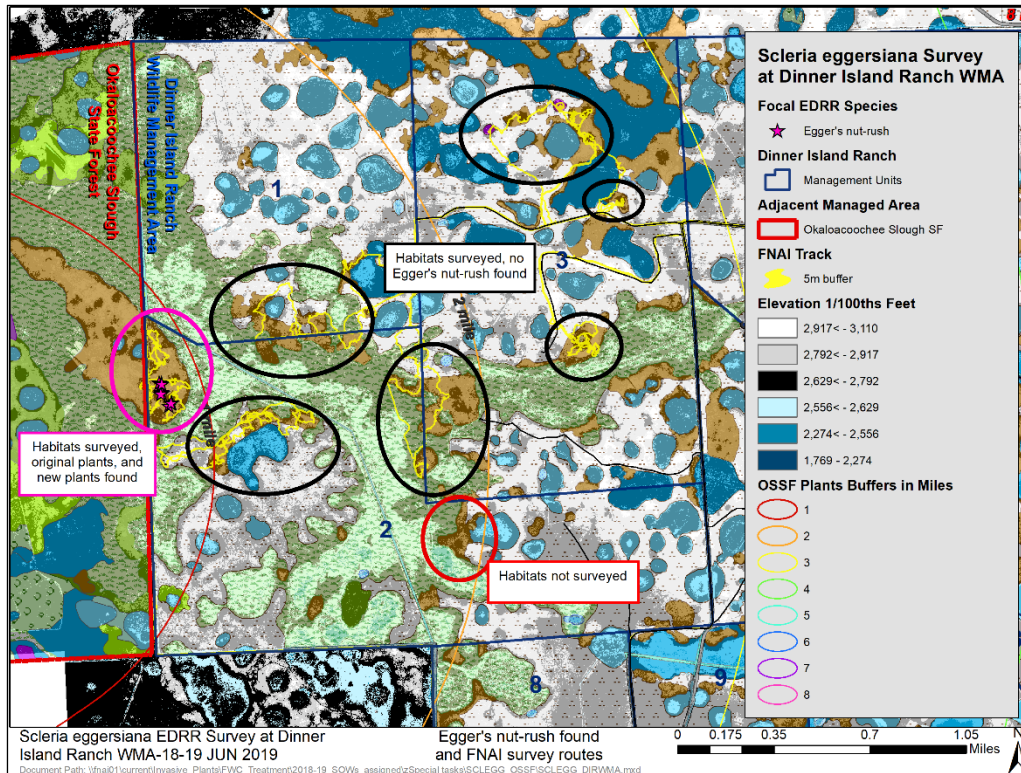


Figure 2. Habitats surveyed, and locations of Egger's nut-rush identified.

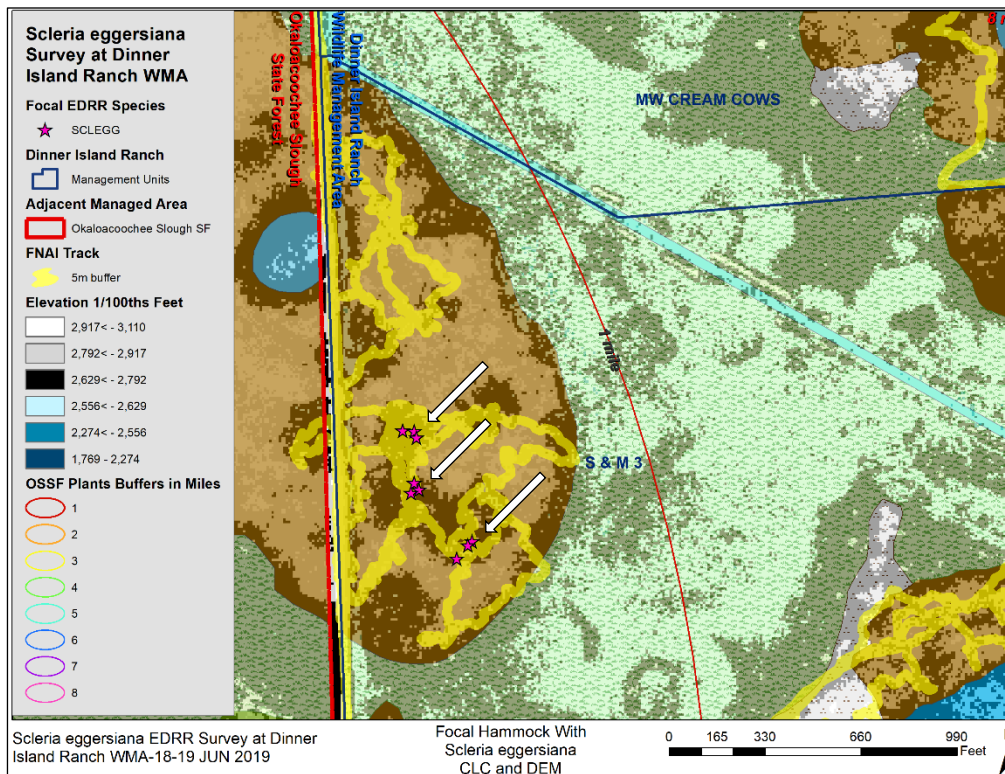


Figure 3. Map focusing on mesic hammock with Egger's nut-rush.

Description of Egger's Nut-rush Habitat

In order to aid future surveys, we provide a description of the habitat niche occupied by Egger's nut-rush. Associate species in the canopy layer include laurel oak (*Quercus laurifolia*), live oak (*Quercus virginiana*), cabbage palm (*Sabal palmetto*), swamp bay (*Persea palustris*), pop ash (*Fraxinus caroliniana*), and less commonly, south Florida slash pine (*Pinus elliottii* var. *densa*). The canopy is typically closed, with direct sunlight penetrating the understory occasionally in small gaps. The midstory is composed of shrubs and liana vines, including immature trees of the canopy species mentioned above, as well as wax-myrtle (*Morella cerifera*), myrsine (*Myrsine cubana*), earleaf greenbrier (*Smilax auriculata*), and silverling (*Baccharis glomeruliflora*).

The understory of the mesic hammock is poorly developed due to the shade within the hammock. When Egger's nut-rush was located, it was typically in open areas without any competing vegetation, or were co-occurring with only a few other herbaceous plants. Plants found beside or in the close vicinity of Egger's nut-rush included swamp fern (*Telmatoblechnum serrulatum*), Virginia chain fern (*Woodwardia virginica*), beaked panicum (*Coleataenia anceps*), climbing hempvine (*Mikania scandens*), and various flat-sedges (*Cyperus* spp.) and beak-rushes (*Rhynchospora* spp.). We provide photographs of Egger's nut-rush and its typical habitat in Appendix C. Note that the Egger's nut-rush locations are strongly correlated with hydric depressions within the mesic hammock (white arrows, Figure 3).

Rare Plants Observed

We observed three state listed plant species while conducting the Egger's nut-rush survey: *Chrysophyllum oliviforme* (satinleaf), *Polystachya concreta* (yellow helmet orchid) and *Tillandsia flexuosa* (banded air-plant). We include a geodatabase layer of these rare species locations within the geodatabase which accompanies this report.

Other Invasive Plant Species

While conducting surveys for Egger's nut-rush, we recorded data for six other invasive plant species we thought could be of management concern to the site manager of DIRWMA: cogon grass (*Imperata cylindrica*), old world climbing fern (*Lygodium microphyllum*), guava (*Psidium guajava*), aquatic soda apple (*Solanum tampicense*), tropical soda apple (*Solanum viarum*), and turkey berry (*Solanum torvum*). Table 2 below provides data for the six invasive species we documented in DIRWMA.

Of the six species, only turkey berry (*Solanum torvum*) has not been identified in any previous FNAI Natural Community mapping (though *Solanum* sp. was listed in the 2006 report), and turkey berry is the only Florida Exotic Pest Plant Council (FLEPPC) Category 2 invasive (the other 5 species are all Category 1). Turkey berry was common in two roadside mesic hammocks heavily impacted by cattle browsing in management unit 4. The author has seen turkey berry co-occurring with tropical soda apple in mesic hammocks in the Kissimmee River-Chandler Slough conservation area, formerly impacted by cattle. It is possible other hammocks impacted by cattle in DIRWMA also contain turkey berry, and this plant may be spreading in southwest Florida's working lands and natural areas.

TABLE 2. Data for six invasive plant species in DIRWMA.

CID	Surveyor	Species	Gross Ac	Distribution	% Cover	Net Ac	FNAI NC
1	Russo, Paul	turkey berry	0.01:2 car garage	Scattered plants	5-25%	0.0015	mesic hammock
2	Russo, Paul	old world climbing fern	0.001:2 lg desk	clump	5-25%	0.00015	hydric hammock
3	Russo, Paul	cogon grass	0.25:4 tennis ct	Linearly scattered	51-75%	0.09375	pasture - improved
4	Sowell, Dexter	old world climbing fern	0.1:bball ct	Dominant cover	51-75%	0.0375	mesic flatwoods
5	Sowell, Dexter	old world climbing fern	0.01:2 car garage	Scatrd dense patches	5-25%	0.0015	mesic hammock
6	Sowell, Dexter	cogon grass	0.01:2 car garage	Dominant cover	>75%	0.00875	mesic hammock
7	Sowell, Dexter	cogon grass	0.01:2 car garage	Dominant cover	>75%	0.00875	mesic hammock
8	Sowell, Dexter	guava	0.001:2 lg desk	Single plant/clump	5-25%	0.00015	mesic hammock
9	Sowell, Dexter	cogon grass	0.01:2 car garage	Scattered plants	<5%	0.00025	pasture - semi-impro
10	Sowell, Dexter	cogon grass	0.01:2 car garage	Scattered plants	5-25%	0.0015	pasture - semi-impro
11	Sowell, Dexter	old world climbing fern	0.01:2 car garage	Dominant cover	5-25%	0.0015	mesic hammock
12	Sowell, Dexter	guava	0.01:2 car garage	Single plant/clump	5-25%	0.0015	mesic hammock
13	Sowell, Dexter	turkey berry	0.25:4 tennis ct	Scattered plants	5-25%	0.0375	mesic hammock
14	Sowell, Dexter	guava	0.001:2 lg desk	Single plant/clump	51-75%	0.000375	mesic hammock
15	Sowell, Dexter	old world climbing fern	0.001:2 lg desk	Single plant/clump	26-50%	0.000375	pasture - semi-impro
16	Sowell, Dexter	old world climbing fern	0.001:2 lg desk	Single plant/clump	>75%	0.000875	pasture - semi-impro
17	Sowell, Dexter	cogon grass	0.1:bball ct	Dominant cover	5-25%	0.015	pasture - semi-impro
18	Sowell, Dexter	cogon grass	0.01:2 car garage	Scattered plants	<5%	0.00025	pasture - semi-impro
19	Sowell, Dexter	cogon grass	0.5:half fball field	Dominant cover	51-75%	0.1875	pasture - semi-impro
20	Sowell, Dexter	cogon grass	0.1:bball ct	Dominant cover	26-50%	0.0375	mesic hammock
21	Sowell, Dexter	aquatic soda apple	1.0:fball field	Scattered plants	26-50%	0.375	hydric hammock
22	Sowell, Dexter	guava	0.001:2 lg desk	Single plant/clump	26-50%	0.000375	hydric hammock
23	Sowell, Dexter	guava	0.001:2 lg desk	Scattered plants	>75%	0.000875	hydric hammock
24	Sowell, Dexter	tropical soda apple	0.001:2 lg desk	Single plant/clump	>75%	0.000875	pasture - semi-impro
25	Sowell, Dexter	tropical soda apple	0.001:2 lg desk	Single plant/clump	>75%	0.000875	hydric hammock
26	Sowell, Dexter	aquatic soda apple	0.5:half fball field	Scattered plants	5-25%	0.075	hydric hammock
27	Sowell, Dexter	guava	0.001:2 lg desk	Single plant/clump	>75%	0.000875	mesic hammock
28	Sowell, Dexter	guava	0.001:2 lg desk	Single plant/clump	>75%	0.000875	mesic hammock
29	Sowell, Dexter	guava	0.001:2 lg desk	Single plant/clump	26-50%	0.000375	mesic hammock
		Gross Ac	2.902		Net Ac	0.891	

Live Oak Leaf Drop

We observed an area of significant leaf drop on live oak (*Quercus virginiana*) in the westernmost hammock surveyed. We provide a photo and a brief description in Appendix D. We also include a layer within the geodatabase of the live oak leaf drop which accompanies this report.

MANAGEMENT RECOMMENDATIONS

We recommend that the staff of DIRWMA treat the Egger's nut-rush plants as soon as possible, given their present low abundance. Staff should expect to conduct at least one retreatment, as the initial treatment of Egger's nut-rush at OSSF showed 20-25% recovery of plants after treatment (Mike Knight, personal communication).

We recommend that the staff of DIRWMA keep an eye out for the presence of turkey berry (*Solanum torvum*) with DIRWMA. Despite its FLEPPC Category 2 rank, it is spreading prolifically in the two hammocks in which it was observed. Though it was not found in natural areas outside of cattle browsing, it could soon spread to areas not impacted by cattle.

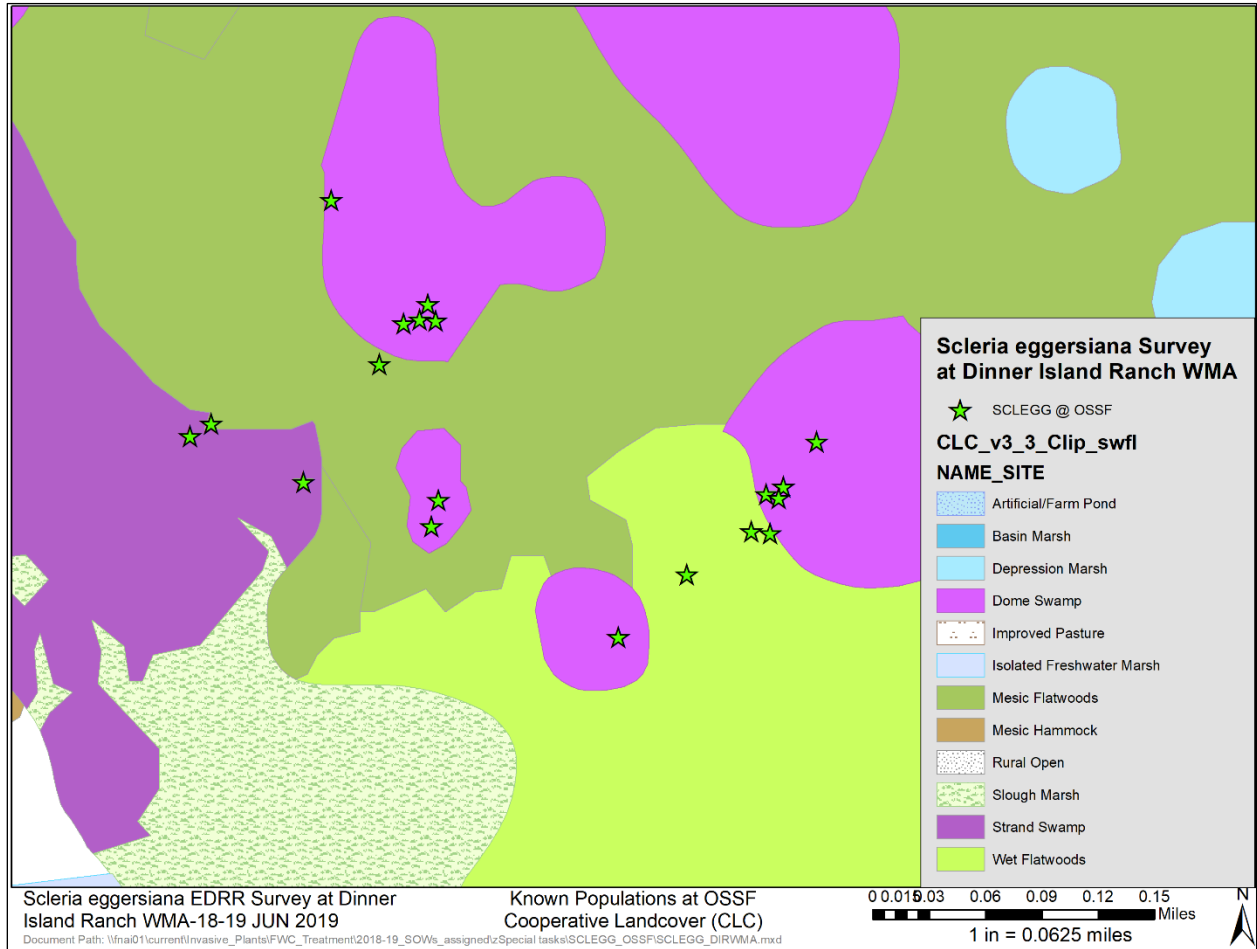
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Florida Natural Areas Inventory (FNAI). 2006. Dinner Island Ranch Natural Community Mapping.

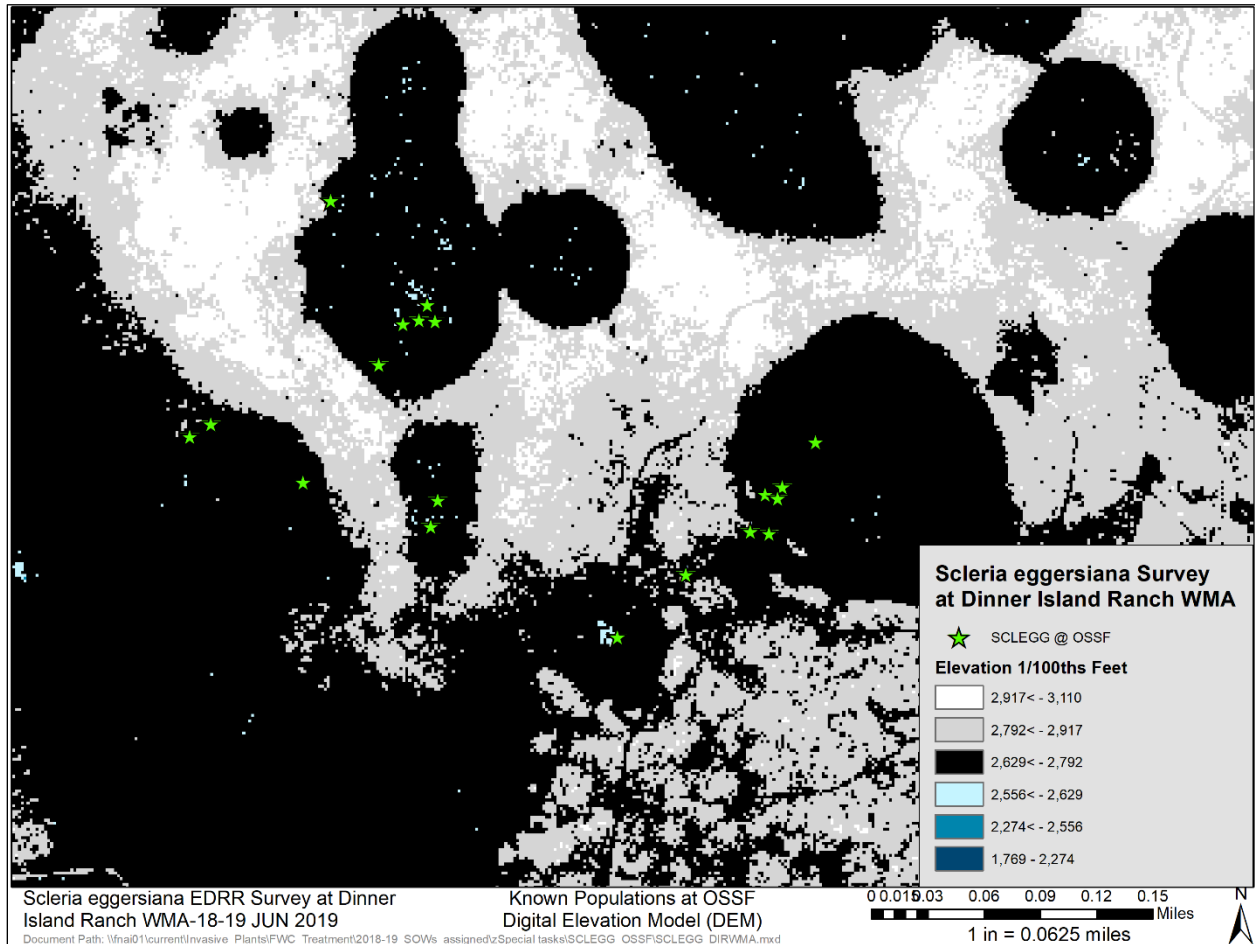
Mike Knight. 2019. Personal communication via email.

APPENDIX A
 MAPPING USED TO IDENTIFY HABITAT AND ELEVATION PREFERENCE IN OSSF



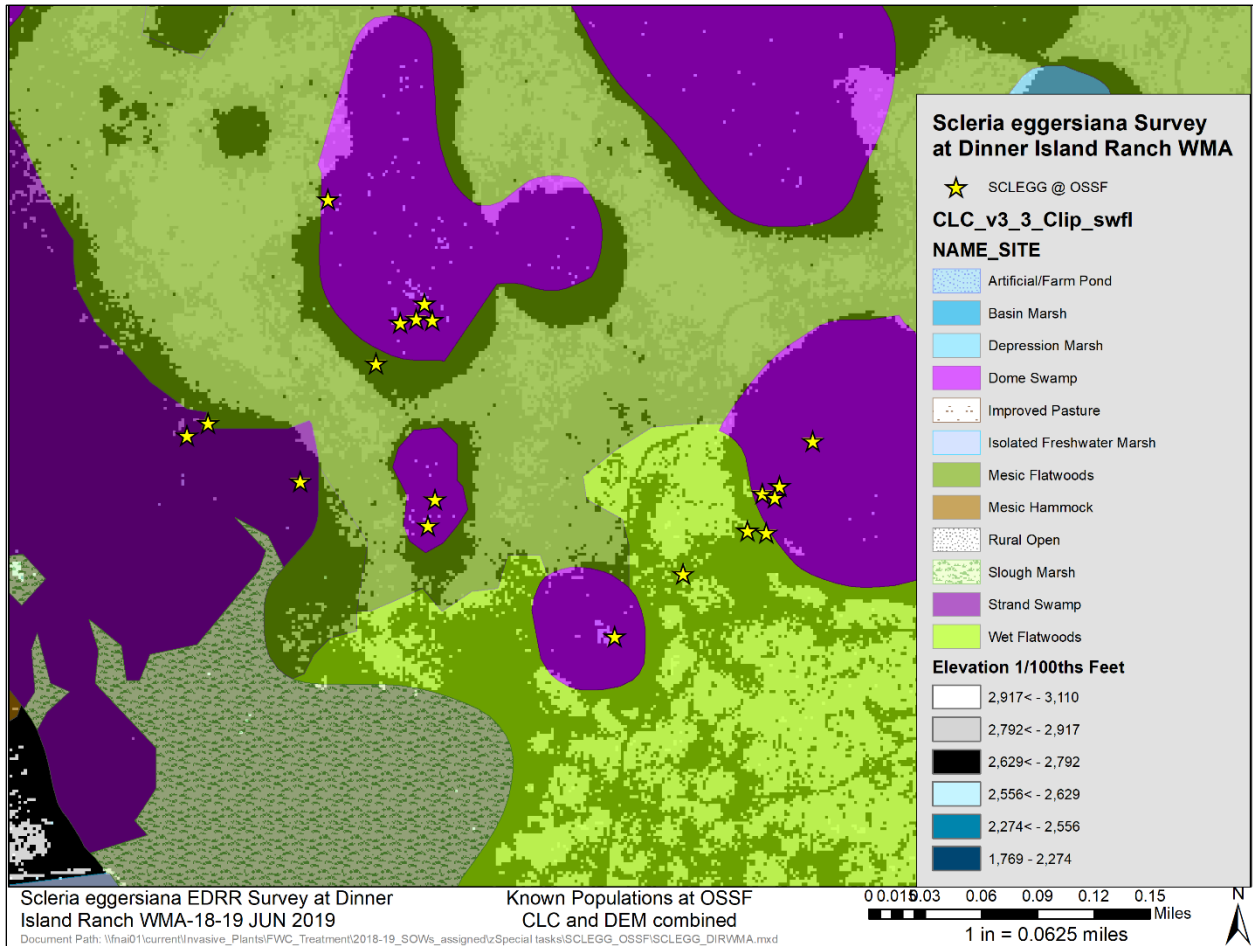
The Cooperative Landcover (CLC) layer shows most known Egger's nut-rush occurrences in OSSF are in closed canopy habitats (dome swamp, strand swamp), with only four occurrences located in more open canopy habitats (wet flatwoods, mesic flatwoods).

APPENDIX A
MAPPING USED TO IDENTIFY HABITAT AND ELEVATION PREFERENCE IN OSSF



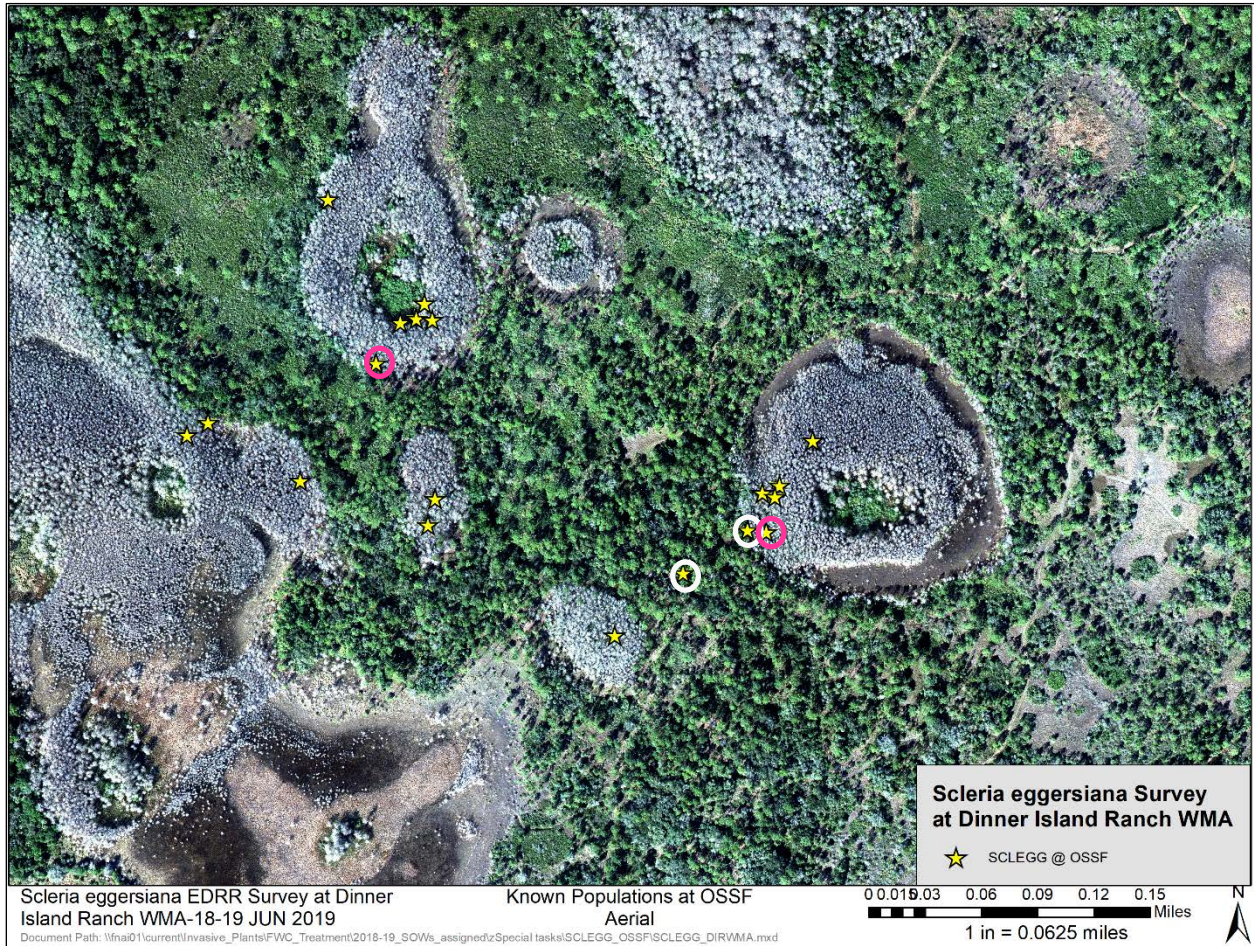
The Digital Elevation Model (DEM) layer shows all Egger’s nut-rush occurrences in OSSF are within an elevation range from 26.29-27.92 feet above sea level (FASL). We modified the DEM so that the elevation range from 26.29-27.92 FASL was isolated and colored black in the DEM. Elevations higher than the target range were colored from grey to white as elevation increased in FASL. Elevations below the target range were colored from light to darker blues as elevation decreased in FASL. Note that in the map legend, elevation values appear in 1/100ths feet, for example, 2629<-2792 is 26.29<-27.92 FASL.

APPENDIX A
 MAPPING USED TO IDENTIFY HABITAT AND ELEVATION PREFERENCE IN OSSF



The combination of the two layers, Cooperative Landcover (CLC) and target Digital Elevation Model (DEM) elevation range provides a good method of prioritization of other areas to search for Egger’s nut-rush in Dinner Island Ranch Wildlife Management Area.

APPENDIX A
MAPPING USED TO IDENTIFY HABITAT AND ELEVATION PREFERENCE IN OSSF



An inspection of the known Egger’s nut-rush occurrences at OSSF in an aerial image reveals that, of the four OSSF occurrences mapped to more open canopy habitats (circled points above), two wholly occur under closed canopy habitat (dome swamp, pink circles). Thus, the habitat mapping in the CLC has a small margin of error in where the boundaries between habitat types occur. The other two open canopy habitat occurrences are located in an area of dense canopy cover within the mesic flatwoods habitat, likely due to cabbage palms (*Sabal palmetto*) and live oaks (*Quercus virginiana*). Thus, aerial imagery should be consulted as well when considering where Egger’s nut-rush may exist for any future survey.

APPENDIX B
DATA ATTRIBUTES, DEFINITIONS, AND VALUES FOR INVASIVE PLANT POINTS

<u>ATTRIBUTES</u>	<u>VALUES</u>
FIELD_ID	Number assigned to this point during field work; not necessarily unique.
POINT_ID	Unique number assigned to each point by ArcMap.
SURVEYSITE	Name of the wildlife management area.
SURVEYDATE	Date of data collection.
SURVEYOR	Name of the FNAI field surveyor
EVAL_TYPE	Type of visit to site. Valid values: Initial - first observation and assessment of a species in that spot Revisit - observations/assessments on subsequent visits Pre-treatment - only an observation /assessment taken directly before treatment is applied Post-treatment – observation /assessment and evaluation of the targeted invasive species post-treatment
SPECIES	Scientific name of exotic plant occurring at that point.
DISTRIBUTN	Pattern of plant distribution within the gross acreage. Possible values are: Single plant or clump – One individual plant or one small clump of a single species. Scattered plants or clumps – Multiple individual plants or small clumps of a single species scattered within the gross area infested. Scattered dense patches – Dense patches of a single species scattered within the gross area infested. Dominant cover – Multiple plants or clumps of a single species that occupy a majority of the gross area infested. Dense monoculture – Generally a dense stand of a single dominant species that not only occupies more than a majority of the gross area infested, but also covers/excludes other plants. Linearly scattered – Plants or clumps of a single species generally scattered along a linear feature, such as a road, trail, property line, ditch, ridge, slough, etc. within the gross area infested. No live plants – No live plants observed
FEAT_TYPE	Conceptual feature type: point or polygon
FEATYPCOM	Comments regarding feature type
ACRES	Estimated area of infestation. Valid values are: 0.001, 0.01, 0.10, 0.25, 0.50, 1, 2, etc. up to 10, other (state acreage in Comments)
PCTCOVER	A visual estimate of the percentage of the area infested that is actually covered by the canopy of the plants. Percent Cover classes are: <5 %, 5-25 %, 26-50 %, 51-75 %, >75 %
MATURITY	Stage of plant development for the recorded infestation. Possible values are: Mature Immature Both
PHENOLOGY	Characteristic phenology of the plants. Phenology values: flower/bud flower/fruit fruit sporulating in leaf dormant

APPENDIX B
DATA ATTRIBUTES, DEFINITIONS, AND VALUES FOR INVASIVE PLANT POINTS

TREATEDB4	Indication of whether or not plants were previously subject to management efforts.
Allowed values are:	
Yes	
No	
Unknown	
FNAL_NC	Natural community present in area of invasive plant occurrence.
POLY_SEVER	Severity of the disturbance(s). Disturbance severity values are:
none	
light	
moderate	
heavy	
severe	
POLYDIST_1	Describes the primary disturbance in the vicinity. Disturbance values are:
not evident	
agriculture	
cattle disturbance	
clearing (includes dove fields, old fields, and food plots that are less than 0.5 acre, i.e., that are not delineated as ruderal polygons)	
ditch/canal	
exotics	
firebreaks	
fire suppression	
forestry operations (e.g., logging, loading areas, bedding, equipment rutting, slash piles, and other mechanical disturbances; does not include burning.)	
hog digging	
impoundment (e.g., artificial ponds and lakes, borrow pits, dams, dikes)	
natural	
ORV trail	
road	
trash dumping	
woody encroachment	
cause unknown	
other (details provided in the DISTURBCOM field)	
POLYDIST_2	Description of the secondary disturbance, if any, in the vicinity of the rare plant record. Disturbance values are the same as DISTURB 1.
POLYDIST_3	Description of the tertiary disturbance, if any, in the vicinity of the rare plant record. Disturbance values are the same as DISTURB 1.
DISTURBCOM	Comments regarding disturbance
PHOTO_INFO	Observation, Assessment, or Treatment Photos
COMMENTS	Comments is an optional field used by the surveyor to provide additional information about the exotic pest plant population.

APPENDIX C
PHOTOS OF EGGER'S NUT-RUSH AND TYPICAL HABITAT



Top left: Inflorescence of a then unknown *Scleria* species discovered during a rare plant survey at DIRWMA in January 2015. *Top right:* Close up of leaf base and sheath, showing wide decurrent wings continuing down the culm. *Bottom:* Clump of then unknown *Scleria*. These plants were subsequently identified as Egger's nut-rush (*Scleria eggersiana*). Plants here are typically no more than 6 feet tall, but have been observed to be up to 9 feet tall when growing in flooded cypress habitats at OSSF.



APPENDIX C
PHOTOS OF EGGER'S NUT-RUSH AND TYPICAL HABITAT



Top: Site of Egger's nut-rush plant discovered in January 2015, visited and photographed by FNAI staff in June 2019. Egger's nut-rush is in foreground at right, and in center in midground of photo. *Bottom:* Typical habitat of Egger's nut-rush. There is a stem arching into view from the left side of the photo, slightly out of focus. Note that the understory is sparsely vegetated, and shade is dense with dappled sunlight penetrating the forest understory.

APPENDIX C
PHOTOS OF EGGER'S NUT-RUSH AND TYPICAL HABITAT



Top: Scattered mature and immature Egger's nut-rush plants (ovals) with swamp fern. Note sunlight does reach forest understory from small gaps in canopy. *Bottom:* Single Egger's nut-rush plant with swamp fern and climbing hempvine. This plant has a decumbent stem with new growth curving upwards.

APPENDIX D
HAMMOCK EXHIBITING LEAF DROP FROM LIVE OAKS



Near the location of the Egger’s nut-rush plants found in 2019, we encountered approximately 1.5 acres of live oaks (*Quercus virginiana*) all exhibiting more than 95% leaf drop. Numerous plants, especially sword ferns (*Nephrolepis* spp.) in the understory appear to have died, from what looked like an herbicide treatment. Our initial thought was that maybe the label rate on an invasive plant control project was exceeded, resulting in herbicide uptake from soil by the live oaks. However, the site manager informed us that non-native sword ferns were not targeted here for any invasive plant control project. It is possible that fluctuating drought and inundation, and residual stress from Hurricane Irma in 2017, are the primary cause of decline of the live oaks in this hammock. We did not observe a decline of live oaks elsewhere in the northwestern management units in DIRWMA.