

**2018 NGCR Monitoring Report**  
Fish and Wildlife Research Institute  
Ecosystem Assessment and Restoration Section  
Upland Habitat Research and Monitoring

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Project: Native Ground Cover Restoration

Investigation: **Vegetation Monitoring at FFWCC Native Ground Cover Restoration Sites.**

Period covered: October 2018-December 2018

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*Abstract:* The Florida Fish and Wildlife Conservation Commission (FWC) is the lead agency charged with the protection and management of approximately 1.5 million acres of land. Many of these lands are former agricultural areas and include many areas of improved or semi-improved pasture. In order to enhance wildlife habitat and ecosystem function, the Wildlife Habitat Management Section is restoring these areas to native ground cover. As part of this effort, the Restoration Team requested scientific assistance from the Fish and Wildlife Research Institute's (FWRI) Upland Habitat Research and Monitoring subsection in monitoring development of vegetation communities on restoration sites. The goal of this project was to determine composition and relative abundance of plant species at restoration areas. This information will document the development of the vegetation community resulting from seeding efforts. This information will also aid area managers in anticipating possible problems of competition from non-native and/or weedy species. Three out of the original 4 FWC restoration sites selected for long-term monitoring have now manifested problems with exotics and/or sand blackberry that require immediate action. This report provides the results of FWRI's monitoring efforts conducted on 8 Native Ground Cover Restoration (NGCR) fields during the fall of 2018. This report provides species accounts, summary statistics for vegetation, and management implications identified at all sites.

# **2018 MONITORING REPORT**

## **FFWCC Native Ground Cover Restoration Sites Vegetation Monitoring.**

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As the lead agency on approximately 1.5 million acres of land, the Florida Fish and Wildlife Conservation Commission (FWC) is charged with the protection and management of large tracts of degraded habitat and agricultural lands. The Wildlife Habitat Management Section has been restoring many of these lands, including areas of improved or semi-improved pasture, to native ground cover to enhance wildlife habitat and ecosystem functions. The overall goal for the restoration areas is to restore the historical natural communities. To achieve this objective, efforts have been aimed at elimination of the exotic groundcover and restoration of a functional native groundcover base. Specific restoration objectives for the restoration sites are: to eliminate bahiagrass (*Paspalum notatum*); to increase and maintain native groundcover and structure (including plant species as well as bare soil and litter) at greater than 90% cover; and to create and maintain the native structure of a longleaf pine-wiregrass community that would benefit native wildlife, restore natural functions, and be conducive to the recruitment of native plants.

FWRI intensively monitored 8 previously established NGCR sites during the fall of 2018. These sites included Half Moon WMA 05-06, Hilochee WMA North and South 05-06, L. Kirk Edwards WMA 13-14 (Woodsink), L. Kirk Edwards WMA 14-15, Okaloacoochee Slough (OK Slough) WMA 05-06, Three Lakes WMA 05-06, Three Lakes WMA 08-09, and Triple N Ranch WMA 13-14. In addition, we conducted final site assessments on Apalachicola River WEA 12-13, L. Kirk Edwards WMA 12-13, OK Slough WMA 12-13, and Three Lakes WMA 12-13. This report provides maps and summaries of these assessments. Subsequent chapters describe the results for each site in greater detail. In addition, these chapters also provide management recommendations.

FWRI selected the original 4 FWC restoration sites which include Half Moon FY05/06, Hilochee FY05/06, Three Lakes FY05/06, and OK Slough FY05/06 for long-term monitoring. We have learned that over time even the best sites are not immune from exotic invasion. Unfortunately, only OK Slough remains in outstanding shape. The other 3 sites are now in need of intervention.

Except for OK Slough, all these fields have outstanding wiregrass germination and establishment. The problem is the phenomenal ability of bahiagrass to persist and multiply throughout the years. Mean cover estimates of bahiagrass have increased steadily since 2006 to the point where it now cracks the top 10 most abundant cover lists on Half Moon, Hilochee, and Three Lakes. If left untreated, bahiagrass will most likely begin to affect the integrity of these otherwise outstanding fields. In addition, Three Lakes has also been invaded by small patches of cogongrass (*Imperata cylindrica*) and limpograss (*Hemarthria altissima*) which should be treated immediately with glyphosate while they are still manageable.

Sand blackberry (*Rubus cuneifolius*) is another problematic species that occurs on every restoration field, but it is especially bad on Half Moon where it currently ranks 1<sup>st</sup> and 3<sup>rd</sup> in frequency of occurrence and mean cover, respectively. It continues to increase despite frequent burning. It is unfortunate because this field would be a nice product, otherwise. Chemical intervention is needed to get this species back under control.

Long-term monitoring has shown that ground cover restoration is a never-ending process. Staff must remain vigilant and continue to control problematic species. Otherwise, the objectives of this program will not be achieved.

## VEGETATION MONITORING METHODS

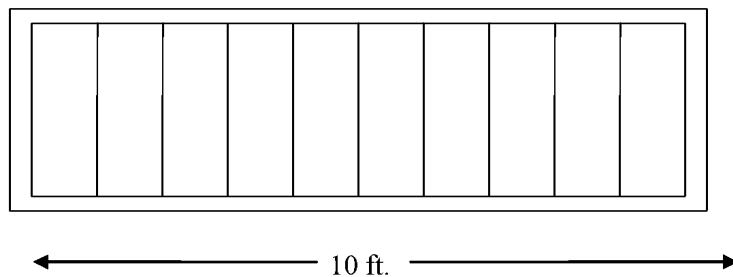
FALL 2018

### **Sampling Station Selection**

We used ArcGIS to generate 30 random points within the restored area boundary to obtain a representative subsample of the community.

### **Quadrat Sampling Methodology**

The sampling design was adapted from the method developed by the Ecosystem Research Corporation (©ERC, 1992, Gainesville, Florida) (Garren 1998). Monitoring of herbaceous vegetation occurred within a 2 x 10 ft. quadrat. We divided each quadrat into 10 2 x 1 ft. subsections (Figure 1). We identified all plant species within the quadrat. Frequency for each plant species was determined by counting the number of subsections in which that species was present. We estimated percent cover for each species over the entire 2 x 10 ft. quadrat using a 7-category classification system: <1%; 1-10%; 11-30%; 31-50%; 51-70%; 71-90%; and >90%. We also recorded bare ground and litter frequency/cover. We defined bare ground as mineral soil devoid of plant material. This includes soil surface exposed between plants as well as the easily visible (without moving vegetation) litter-free ground surface under vegetation. We defined litter as dead plant material that is either standing or lying flat on the ground. We estimated cover ranges for both the total sampled area and for occurrence area. Occurrence area includes only those quadrats where staff observed the particular taxa. This document reports the mean cover estimates for each sampled area.



**Figure 1.** Example of the 10 ft. x 2 ft. PVC frame (quadrat) used for sampling vegetation. Note frame contains 10, 1 ft. x 2 ft. sections used for presence/absence.

This method provides a large number of individual frequency measurements for each recorded species and the use of cover classes or ranges enables more consistent percent cover estimates among sampling events and field personnel. Unlike traditional square plot techniques, use of an elongated quadrat provides a larger, spatially contiguous area of measurement. This allows us to capture small changes in vegetative patterns and is particularly useful on newly established sites where succession is rapid. This analysis yields a thorough assessment of the developing community and allows for detailed tracking of the migration of herbaceous species. Along with

tracking vegetation, we also track bare ground because of its importance for seedling recruitment and small animal habitat.

## Data Analysis

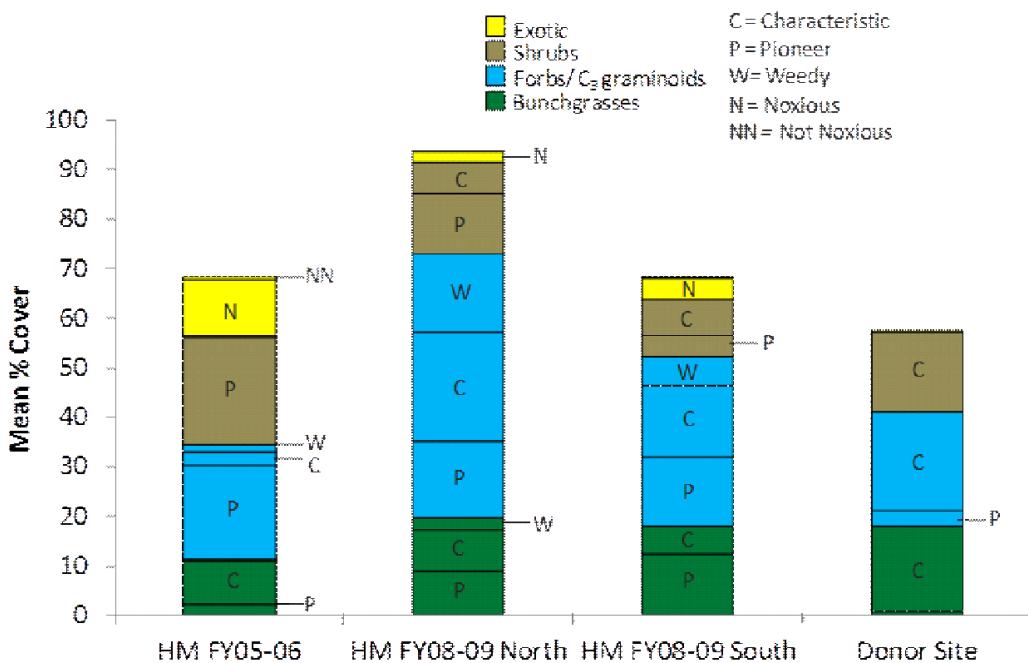
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We calculated relative frequency as the total number of 1ft. x 2 ft. subsections (frequency intervals) in which a species occurred divided by the total number of pooled sections within each site. We calculated percent cover for the total sampled area by summing the midpoints of each cover class and dividing by the total number of quadrats sampled within each site. To calculate percent cover for the total occurrence, we divided by the total number of quadrats in which a given species occurred. All nomenclature follows that of Wunderlin & Hansen (2011).

## Description of Structure Graphs

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For several of the sites discussed in this year's report, we have included a bar graph in which the plant community is broken down into three functional groups: *Bunchgrasses*, *Native Non-Structural Forbs/Graminoids*, and *Native Shrubs*. We found that breaking down the plant community in this way revealed important similarities and differences between NGCR sites and reference sites. We have also broken the primary structural groups further into successional status categories: pioneer, characteristic, weedy, and noxious and non-noxious exotics following Bissett (2003) and McCollom (2005) ([Figure 2](#) and [Table 1](#)). The reason for breaking species down this way is to provide more information about the floristic quality of the NGCR sites. We chose these categories because they emphasize the primary early goals of the NGCR program: restoration of a native grass-dominated (i.e. fire-carrying) understory, elimination of noxious exotics, and a reduction in native weed cover.



**Figure 2.** Structure of the NGCR sites at Half Moon WMA as compared to the mean donor site values (see **Calculation of Donor Site Values** for an explanation of how donor site values were determined). This graph depicts the mean percent cover of each functional group in each field.

Total percent greater than 100 is possible because of overlapping layers of vegetation (e.g. small forbs growing beneath larger grasses). This graph also breaks down the mean percent cover within each functional group by successional status (Pioneer, Characteristic, Weedy, Noxious, and Not Noxious). Each bar depicts the relative proportion of successional categories within each functional group. Legumes are included in the native non-structural forbs category here.

Our intent for the graphs is to convey basic structural information about our restoration sites. Many other important characteristics of the plant community are not reflected here (i.e. the abundance of rarer/more desirable plant species, wildlife food plants, and legume species, etc.), but these issues are discussed elsewhere in the text. A discussion of the criteria we used to classify species follows below.

In creating the seven structure/function categories, we drew from the Floristic Status functional groups developed by Nancy Bissett for the Disney Wilderness Preserve (2003) and used by Jean McCollom (2005) to classify species at OK Slough, as well as using our own criteria (Freeman et al. 2017). We defined the seven categories according to the criteria outlined in Table 1. An appendix at the end of each chapter provides a complete list of species used in the structure/function graphs.

Table 1. Definitions of functional groups and successional status categories used in the analysis (Freeman et al. In Review).

Functional Groups	
Bunchgrasses	Medium- to large-statured clump-forming C <sub>4</sub> grasses that create the fine fuel structure needed to carry frequent fires and an open habitat structure conducive to nesting/foraging wildlife and plant diversity (Giuliano et al. 2007; Myers and Harms 2009)
Nonstructural Forbs/Graminoids	All other herbaceous species, including forbs, legumes, sedges, rushes, rhizomatous grasses, C <sub>3</sub> grasses, and small-statured grasses
Shrubs	Woody species (including vines) and palmettos
Successional Status Categories	
Characteristic	Native species found primarily in undisturbed ecosystems
Pioneer	Native species that readily reseed in unnaturally or severely disturbed areas but persist and are also characteristic of undisturbed ecosystems
Weedy	Native species that depend on unnatural or severe disturbances to become established and are <i>not</i> found in undisturbed ecosystems
Noxious	Exotic species that outcompete weedy species and sometimes even outcompete characteristic species in undisturbed ecosystems
Non-Noxious	Exotic species that do not spread aggressively, but otherwise occupy niches that we would rather see filled by native species.

## Calculation of Donor Site Values

Using a single donor site as a reference community can be misleading, as there is substantial variability between donor sites in any region. For our tables and graphics, we averaged the data from multiple donor site surveys (where possible) to account for this variability. The structure graphs for Caravelle Ranch and Half Moon WMAs include averaged reference community data from five separate donor site surveys in

central and south Florida. Table 2. shows the data from these five surveys. Only individual donor site surveys were available for the panhandle clayhill and flatwoods sites, including Apalachee (Apalachee WMA) and Aucilla (St. Mark's NWR). Several sites including Big Bend, Dinner Island, Lake Wales Ridge, Moody Branch, and Spirit of the Wild either contracted out the planting process or planted seed purchased from seed distributors. These sites do not have donor site information for comparison.

**Table 2.** Mean percent cover and mean species richness on five donor sites in central and south Florida, showing how means were derived for use throughout the report. Values are presented by functional group (Bunchgrasses, Native Non-Structural Forbs/Graminoids, Native Shrubs/Vines) and successional status (Pioneer and Characteristic). P = Pioneer and C = Characteristic. Legumes are included in the native non-structural category.

	Bunchgrasses			Native Non-Structural Forbs/ Graminoids			Native Shrubs		
Three Lakes Fall 2006	P	C	Total	P	C	Total	P	C	Total
Mean % Cover	0%	21%	21%	2%	18%	20%	0%	16%	16%
Mean Species Richness (#of species/quadrat)	0	3	3	1	8	9	0	2	2
Three Lakes Fall 2007	P	C	Total	P	C	Total	P	C	Total
Mean % Cover	2%	23%	25%	5%	17%	22%	0%	27%	27%
Mean Species Richness (#of species/quadrat)	1	3	4	2	9	11	0	3	3
Three Lakes Fall 2008	P	C	Total	P	C	Total	P	C	Total
Mean % Cover	1%	21%	22%	2%	20%	22%	0%	19%	19%
Mean Species Richness (#of species/quadrat)	1	5	6	2	12	14	0	3	3
Babcock-Webb Fall 2006	P	C	Total	P	C	Total	P	C	Total
Mean % Cover	0%	11%	11%	0%	15%	15%	0%	18%	18%
Mean Species Richness (#of species/quadrat)	0	2	2	0	9	9	0	2	2
Babcock-Webb Fall 2007	P	C	Total	P	C	Total	P	C	Total
Mean % Cover	1%	7%	8%	6%	29%	35%	0%	1%	1%
Mean Species Richness (#of species/quadrat)	1	2	3	3	12	15	0	1	1
Mean (All Donor Sites)	P	C	Total	P	C	Total	P	C	Total
Mean % Cover	1%	17%	18%	3%	20%	23%	0%	16%	16%
Mean Species Richness (#of species/quadrat)	1	3	4	2	10	12	0	2	2

## Interpretation of Maps

This report provides maps depicting the random sample points for each restoration site. Blue stars indicate points dominated by wiregrass but no other bunchgrasses, green stars indicate

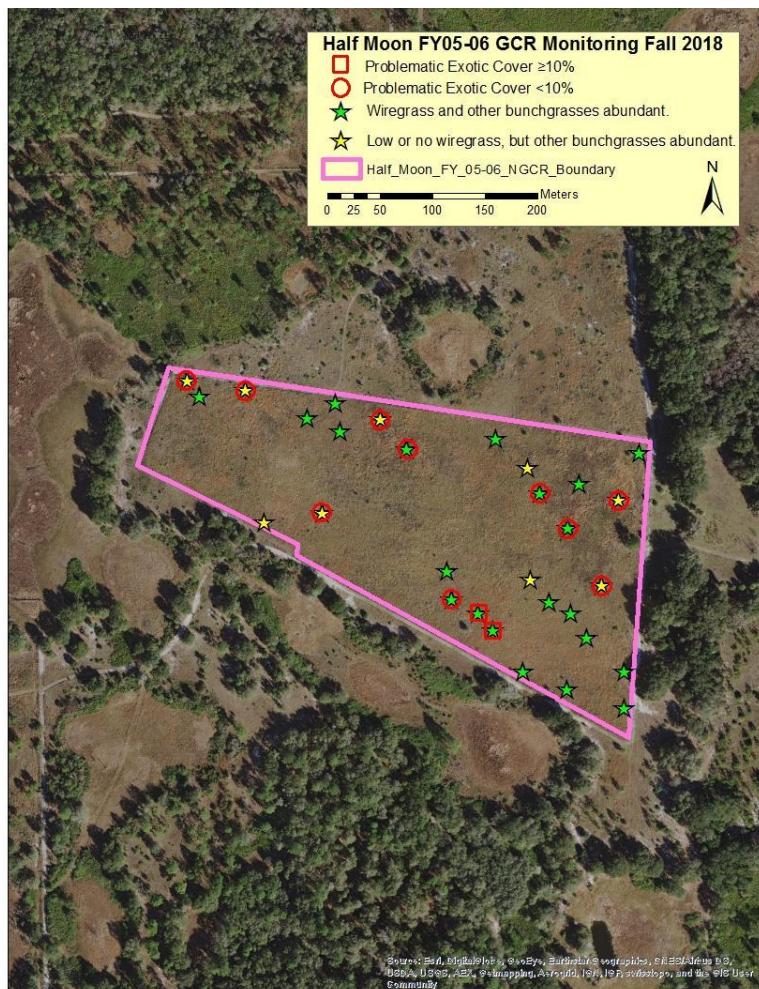
points with both wiregrass and other native bunchgrasses present, yellow stars indicate points with other bunchgrasses present but not wiregrass, and solid red circles indicate points with low or zero bunchgrass cover. Points outlined with red squares indicate points where exotics covered less than 10% of the quadrat; points outlined with red circles indicate points where exotics covered 10% or more of the quadrat.

### Site Assessments

#### Half Moon WMA – FY 05-06 FIELD

FALL 2018

The first restoration phase would be largely complete if not for the lingering presence of sand blackberry. Despite frequent burning, sand blackberry continues to be problematic in this field, and is the main reason why shrub cover has more than doubled since the previous survey (Figure HM1; Table HM1). In 2018, sand blackberry was the most frequently occurring species in this field occurring in 75% of the sample quadrats, and it also ranked 3<sup>rd</sup> in mean cover (Figures HM2-HM3). It appears chemical intervention will now be required to get this species under control. Otherwise, the field has very good wiregrass establishment ranking 1<sup>st</sup> in mean cover and 3<sup>rd</sup> in frequency of occurrence. In fact, overall bunchgrasses, especially in the characteristic category, continue to increase, and are distributed throughout the field (Table HM1; Map HM1). The cover of noxious exotics was less than the 2016 survey due to the decline in both frequency and cover of the other problematic shrub, hairy indigo (*Indigofera hirsuta*). Frequency and cover of bahiagrass remained about the same as the 2016 survey.

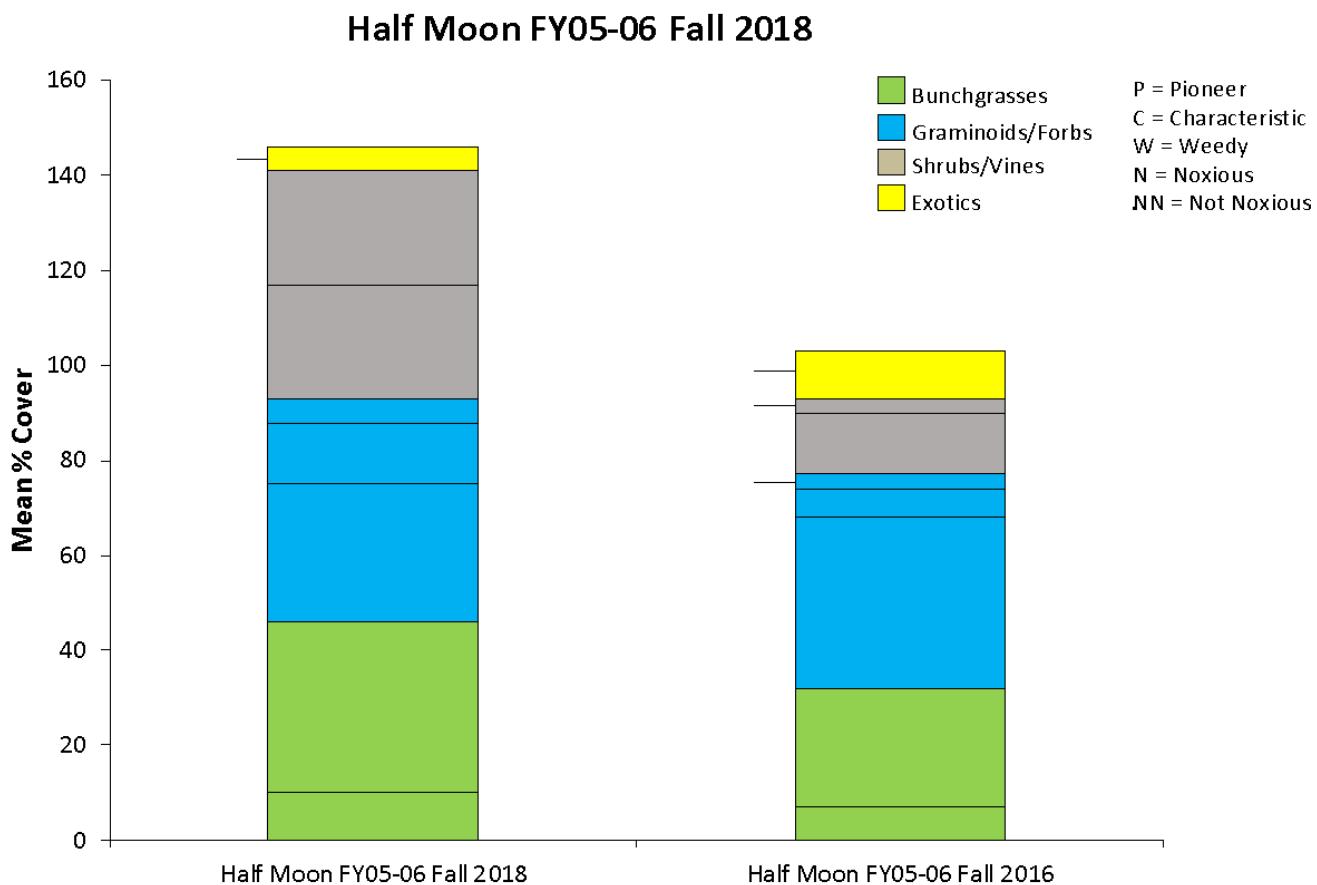


**Map HM1.** Fall 2018 random sample points on the FY05-06 Half Moon NGCR site.

**Management Recommendations:**

- Maintain prescribed fire on a regular 2-3 year interval.
- Spot treat bahiagrass with Plateau.
- Continue to mow hairy indigo areas during the summer while they are in flower but before it produces seed.
- Treat sand blackberry using an herbicide mix of Milestone and Garlon.

**Detailed Sampling Results:**

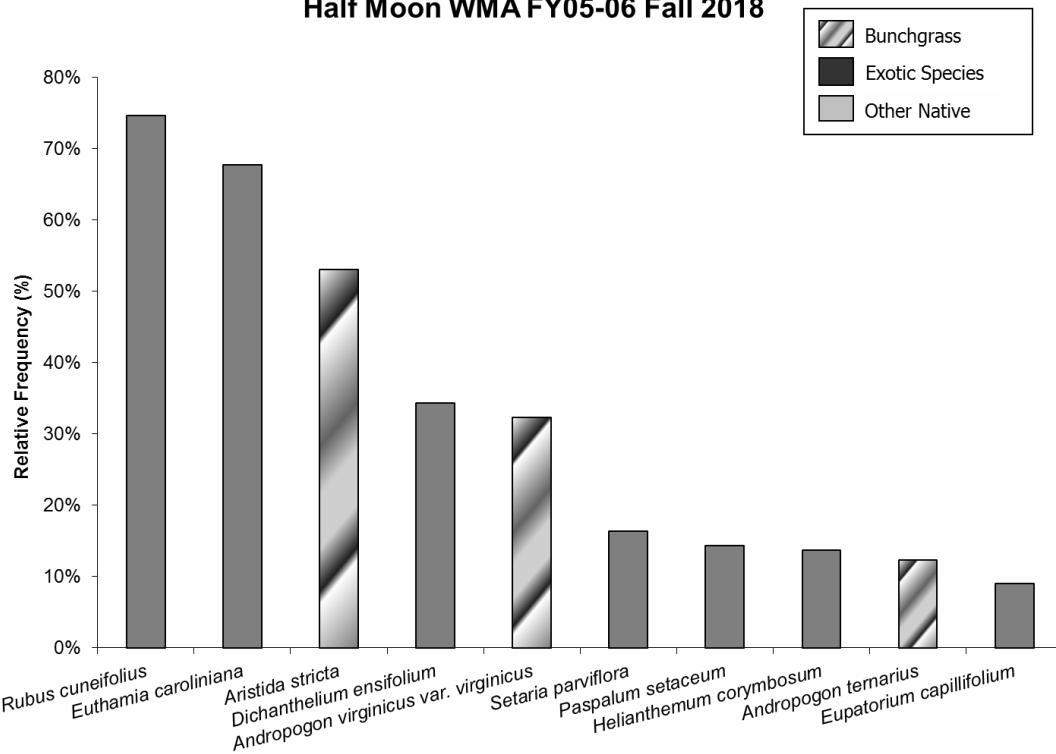


**Figure HM1.** Structure of the NGCR site at Half Moon as compared to the Fall 2016 survey results. This graph depicts the mean percent cover of each functional group in the FY05-06 field. Total percent greater than 100 is possible because of overlapping layers of vegetation (e.g. small forbs growing beneath larger grasses). Legumes are included in the forb/graminoid category.

**Table HM1.** Mean percent cover and mean species richness at Half Moon as compared to the mean values from 2016. Values are presented by functional group (Native Bunchgrasses, Native Forbs/Graminoids, Native Shrubs/Vines) and successional status (Pioneer = P, Characteristic = C, and Weedy = W). Legumes are included in the native forbs/graminoids category.

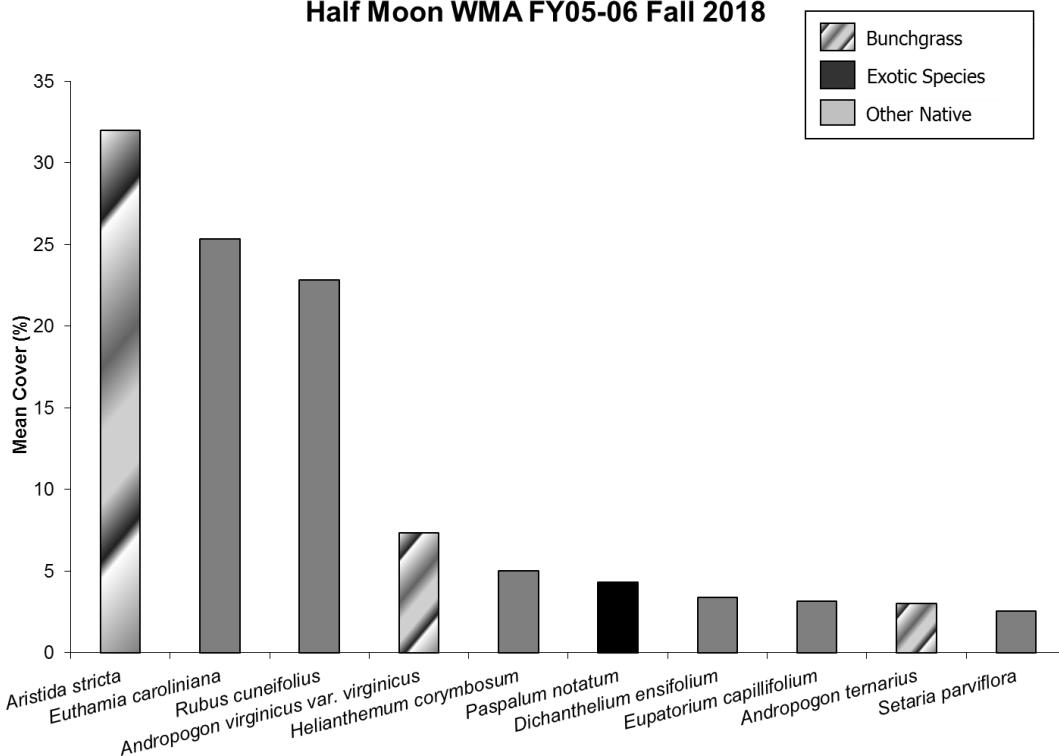
	Native Bunchgrasses				Native Non-Structural Forbs/ Graminoids				Native Shrubs/Vines		
Half Moon Fall 2018	P	C	W	Total	P	C	W	Total	P	C	Total
Mean % Cover	10%	36%	0%	46%	29%	13%	5%	47%	24%	24%	48%
Mean Species Richness (# of species/quadrat)	1	1	0	2	2	2	1	5	1	1	2
Half Moon Fall 2016	P	C	W	Total	P	C	W	Total	P	C	Total
Mean % Cover	7%	25%	0%	32%	36%	6%	3%	45%	13%	3%	16%
Mean Species Richness (# of species/quadrat)	1	1	0	2	3	1	0	4	1	0	1

### Half Moon WMA FY05-06 Fall 2018



**Figure HM2.** Top occurring species based on relative frequency surveyed within the Half Moon FY05-06 restoration field.

### Half Moon WMA FY05-06 Fall 2018



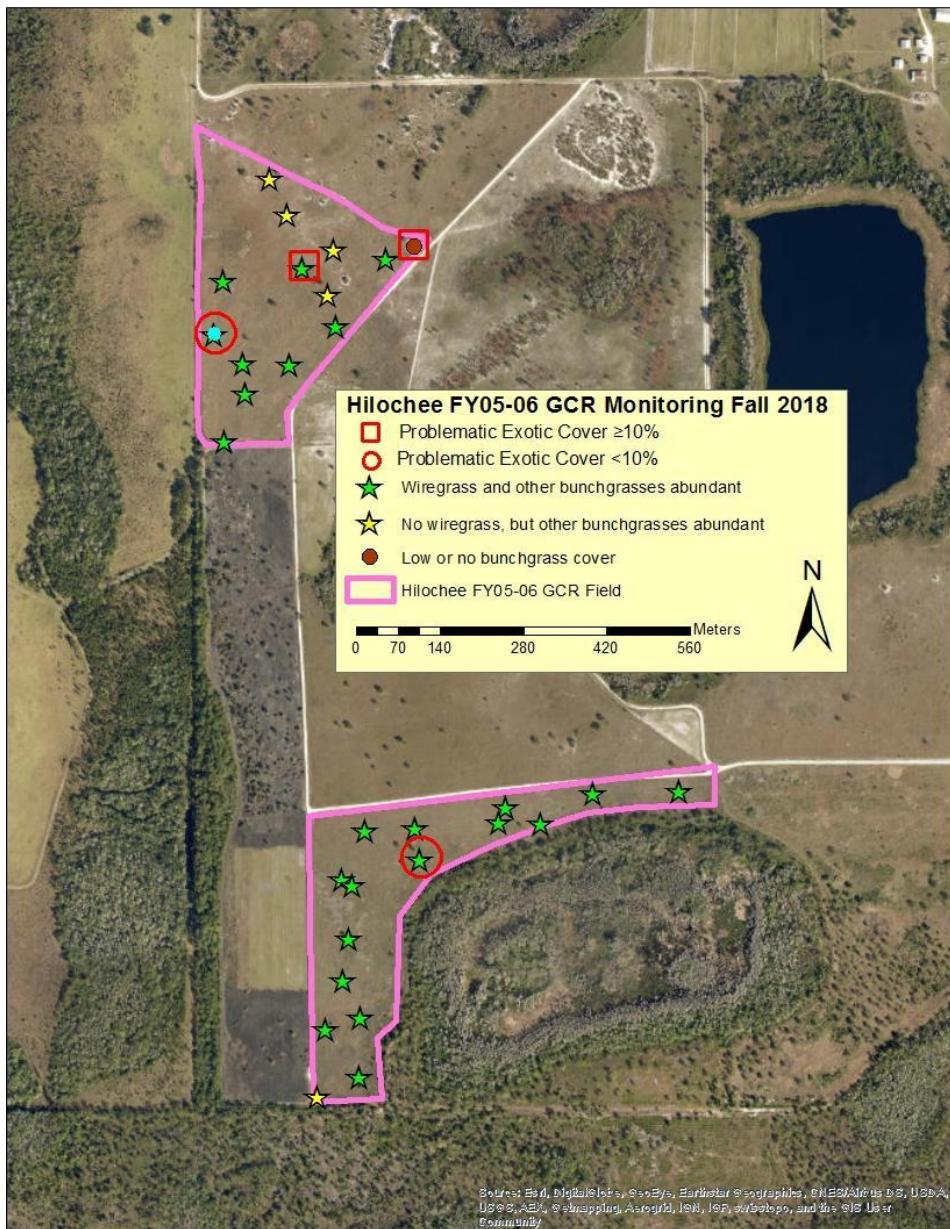
**Figure HM3.** Top occurring species based on mean percent cover surveyed within the Half Moon FY05-06 restoration field.

**Appendix HM1: Half Moon Fall 2018 Plant List**

Native Bunchgrasses		
<i>Andropogon ternarius</i>	splitbeard bluestem	Characteristic
<i>Andropogon virginicus</i> var. <i>virginicus</i>	broomsedge bluestem	Pioneer
<i>Aristida stricta</i>	wiregrass	Characteristic
<i>Eragrostis elliottii</i>	Elliott's lovegrass	Pioneer
<i>Eragrostis virginica</i>	coastal lovegrass	Pioneer
<i>Schizachyrium scoparium</i>	little bluestem	Characteristic
<i>Setaria parviflora</i>	yellow bristlegrass; knotroot foxtail	Pioneer
Native Forbs/Graminoids		
<i>Acalypha gracilens</i>	slender threeseed mercury	Pioneer
<i>Conyza canadensis</i>	Canadian horseweed	Weedy
<i>Crotalaria rotundifolia</i>	rabbitbells	Pioneer
<i>Croton michauxii</i>	rushfoil	Characteristic
<i>Cyperus croceus</i>	Baldwin's flatsedge	Pioneer
<i>Dichanthelium ensifolium</i>	cypress witchgrass	Characteristic
<i>Dichanthelium ovale</i>	eggleaf witchgrass	Characteristic
<i>Dichanthelium portoricense</i>	hemlock witchgrass	Pioneer
<i>Elephantopus elatus</i>	tall elephantsfoot	Characteristic
<i>Eupatorium capillifolium</i>	dogfennel	Weedy
<i>Euthamia caroliniana</i>	slender flattop goldenrod	Pioneer
<i>Galactia elliottii</i>	Elliott's milkpea	Characteristic
<i>Helianthemum corymbosum</i>	pinebarren frostweed	Characteristic
<i>Houstonia procumbens</i>	innocence; roundleaf bluet	Pioneer
<i>Juncus marginatus</i>	shore rush; grassleaf rush	Characteristic
<i>Ludwigia maritima</i>	seaside primrosewillow	Pioneer
<i>Oldenlandia uniflora</i>	clustered mille graines	Pioneer
<i>Oxalis corniculata</i>	common yellow wood sorrel	Weedy
<i>Paspalum setaceum</i>	thin paspalum	Pioneer
<i>Pityopsis graminifolia</i>	narrowleaf silkgrass	Characteristic
<i>Polypremum procumbens</i>	rustweed	Pioneer
<i>Proserpinaca palustris</i>	marsh mermaidweed	Characteristic
<i>Rhexia mariana</i>	pale meadowbeauty; Maryland meadowbeauty	Characteristic
<i>Rhexia sp.</i>	meadowbeauty	Characteristic
<i>Rhexia virginica</i>	handsome Harry	Characteristic
<i>Rumex hastatalus</i>	heartwing dock	Weedy
<i>Scoparia dulcis</i>	sweetbroom; licoriceweed	Weedy
<i>Solidago odora</i>	chapman's goldenrod	Characteristic
<i>Solidago tortifolia</i>	twistedleaf goldenrod	Characteristic
<i>Stillingia sylvatica</i>	queensdelight	Characteristic
Native Shrubs/Vines		
<i>Opuntia humifusa</i>	pricklypear	Pioneer

<i>Quercus geminata</i>	sand live oak	Characteristic
<b>Native Shrubs/Vines (Cont.)</b>		
<i>Quercus laurifolia</i>	laurel oak; diamond oak	Characteristic
<i>Rhus copallina</i>	winged sumac	Pioneer
<i>Rubus cuneifolius</i>	sand blackberry	Pioneer
<i>Serenoa repens</i>	saw palmetto	Characteristic
<i>Vitis rotundifolia</i>	muscadine	Pioneer
<b>Exotics</b>		
<i>Cynodon dactylon</i>	bermudagrass	Noxious
<i>Desmodium triflorum</i>	threeflower ticktrefoil	Not Noxious
<i>Indigofera hirsuta</i>	hairy indigo	Noxious
<i>Murdannia nudiflora</i>	nakedstem dewflower	Not Noxious
<i>Paspalum notatum</i>	bahiagrass	Noxious

The first restoration phase is complete, and the field has advanced to Phase II, although bahiagrass appears to be increasing especially in the north field. However, characteristic bunchgrasses, especially wiregrass, remain dominant and the distribution occurs throughout both the north and south sections (Map HL1). Wiregrass ranks just behind broomsedge bluestem in frequency and was number one in terms of cover (Figures HL2-HL3). The overall structure remained virtually unchanged from the 2016 survey with only slight decreases in the amount of characteristic bunchgrasses and graminoids/forbs (Table HL1). The only concern is that there was an increase in bahiagrass to the point where it now ranks 7<sup>th</sup> on the top ten cover list (Figure HL3). If not treated, long term monitoring has shown it most likely will get worse.

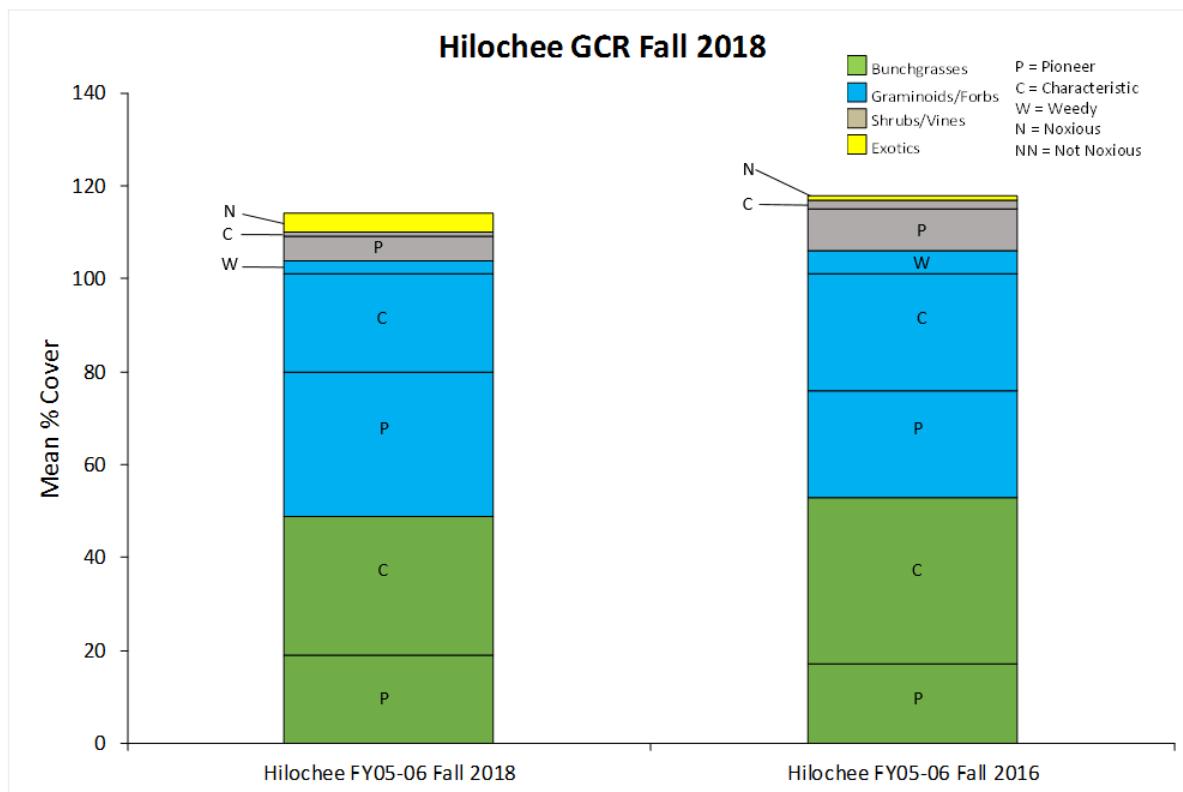


**Map HL1.** Fall 2018 random sample points on the FY05-06 Hilochee NGCR site.

### Management Recommendations:

- Maintain prescribed fire on a regular 2-3 return interval.
- Plant characteristic shrubs including blueberries (*Vaccinium* spp.), huckleberries (*Gaylussacia* spp.), saw palmetto (*Serenoa repens*), running oaks (*Quercus pumila*) on the mesic northern field; *Hypericum* spp., wax myrtle, coastalplain staggerbrush (*Lyonia fruticosa*), dahoo holly (*Ilex cassine* var *cassine*) and yaupon (*I. vomitoria*) in the wetter southern field.
- Treat sand blackberry using an herbicide mix of Milestone and Garlon.
- Treat bahiagrass with glyphosate.
- *Praxelis clematidea* was present on the perimeter roads around the site. Recommend treating with a 3% glyphosate mixture immediately before it invades the field.

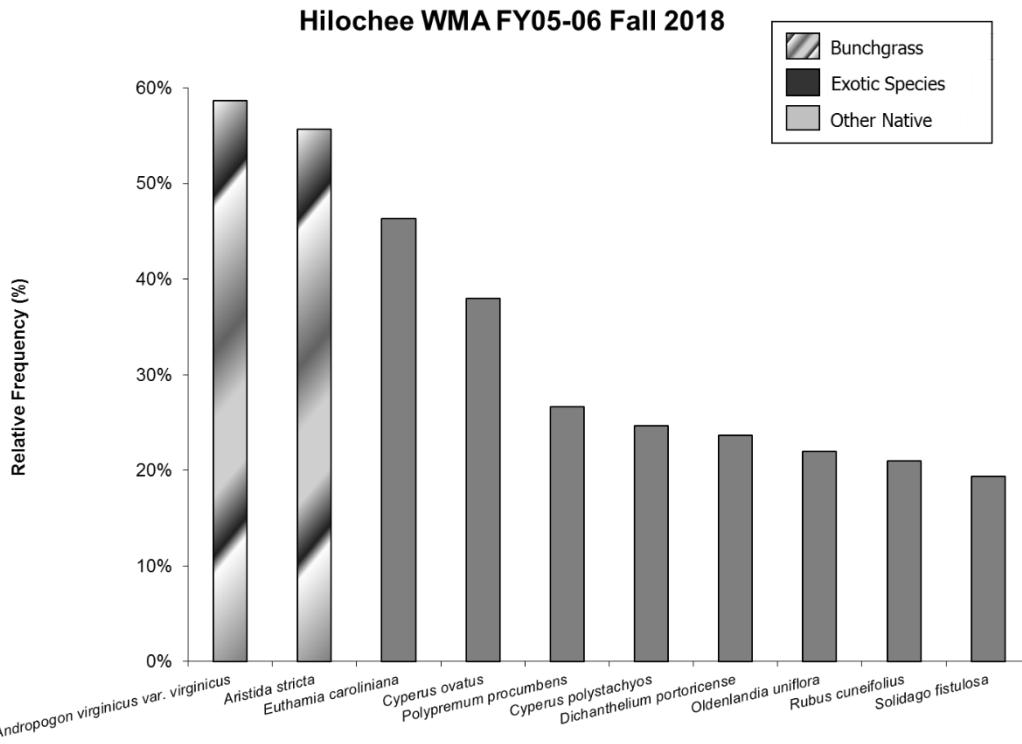
### Detailed Sampling Results:



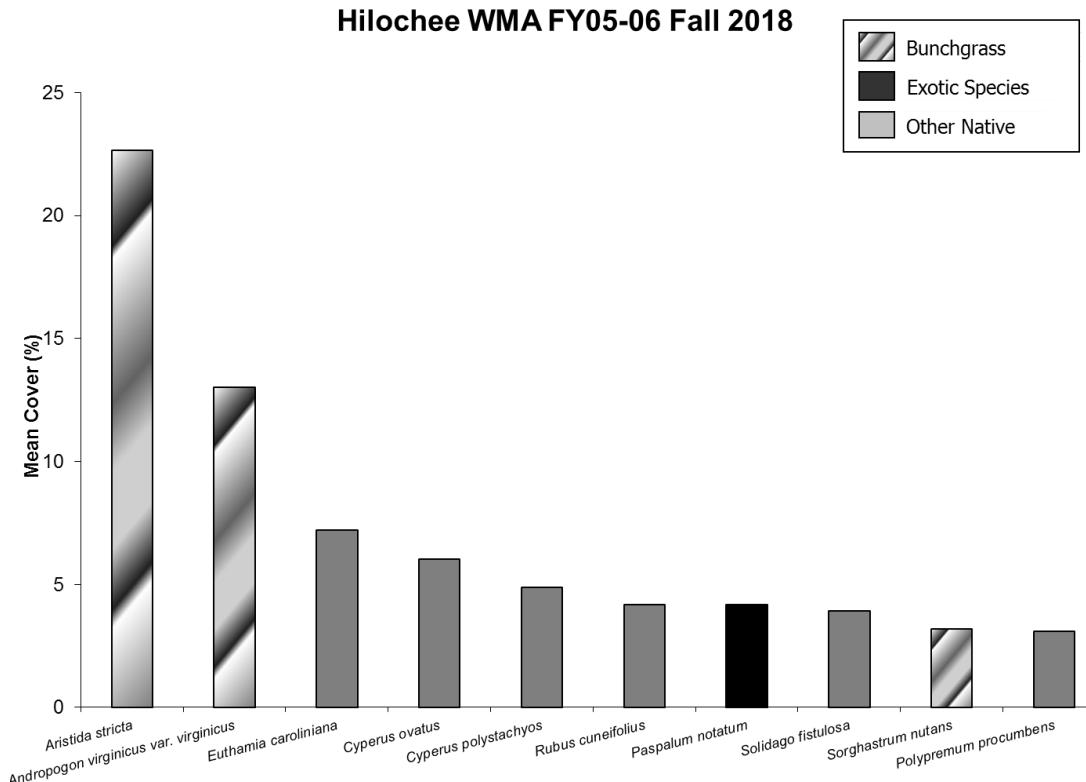
**Figure HL1.** Structure of the NGCR site at Hilochee as compared to the Fall 2016 survey results. This graph depicts the mean percent cover of each functional group in the FY05-06 field. Total percent greater than 100 is possible because of overlapping layers of vegetation (e.g. small forbs growing beneath larger grasses). Legumes are included in the forb/graminoid category.

**Table HL1.** Mean percent cover and mean species richness at Hilochee as compared to the mean values from 2016. Values are presented by functional group (Native Bunchgrasses, Native Forbs/Graminoids, Native Shrubs/Vines) and successional status (Pioneer = P, Characteristic = C, and Weedy = W). Legumes are included in the native forbs/graminoids category.

	Native Bunchgrasses				Native Non-Structural Forbs/ Graminoids				Native Shrubs/Vines		
	P	C	W	Total	P	C	W	Total	P	C	Total
<b>Hilochee Fall 2018</b>											
Mean % Cover	19%	30%	0%	49%	31%	21%	3%	55%	5%	1%	6%
Mean Species Richness (# of species/quadrat)	1	2	0	3	5	4	1	10	0	0	0
<b>Hilochee Fall 2016</b>	P	C	W	Total	P	C	W	Total	P	C	Total
Mean % Cover	17%	36%	0%	53%	23%	25%	5%	53%	9%	2%	11%
Mean Species Richness (# of species/quadrat)	2	2	0	4	3	3	1	7	0	0	0



**Figure HL2.** Top occurring species based on relative frequency surveyed within the Hilochee FY05-06 restoration field.



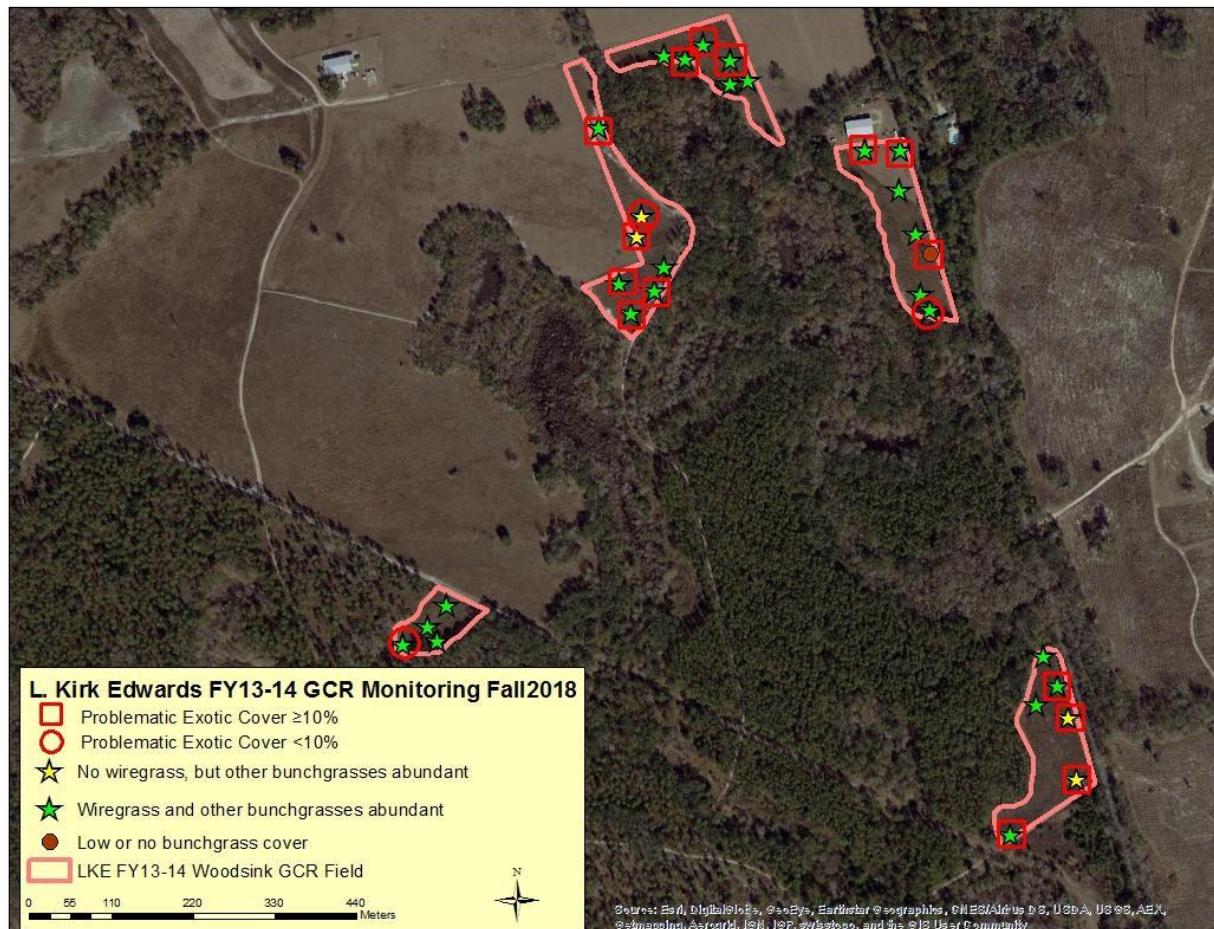
**Figure HL3.** Top occurring species based on mean percent cover surveyed within the Hilochee FY05-06 restoration field.

## Appendix HL1: Hilochee Fall 2018 Plant List

Native Bunchgrasses		
<i>Andropogon brachystachyus</i>	shortspike bluestem	Characteristic
<i>Andropogon glomeratus var. glaucopsis</i>	purple bluestem	Pioneer
<i>Andropogon ternarius</i>	splitbeard bluestem	Characteristic
<i>Andropogon virginicus var. glaucus</i>	chalky bluestem	Characteristic
<i>Andropogon virginicus var. virginicus</i>	broomsedge bluestem	Pioneer
<i>Aristida stricta</i>	wiregrass	Characteristic
<i>Eragrostis elliottii</i>	Elliott's lovegrass	Pioneer
<i>Eragrostis spectabilis</i>	purple lovegrass	Pioneer
<i>Panicum rigidulum</i>	red top panicum	Pioneer
<i>Panicum verrucosum</i>	warty panicgrass	Characteristic
<i>Schizachyrium sanguineum</i>	crimson bluestem	Characteristic
<i>Schizachyrium scoparium</i>	little bluestem	Characteristic
<i>Sorghastrum nutans</i>	yellow Indiangrass	Characteristic
<i>Sorghastrum secundum</i>	lopsided Indiangrass	Characteristic
Native Forbs/Graminoids		
<i>Agalinis linifolia</i>	false-foxfoglove, flax-leaf	Characteristic
<i>Bulbostylis ciliatifolia</i>	capillary hairsedge	Characteristic
<i>Chamaecrista nictitans</i>	sensitive pea	Pioneer
<i>Crotalaria rotundifolia</i>	rabbitbells	Pioneer
<i>Cyperus compressus</i>	poorland flatsedge	Pioneer
<i>Cyperus croceus</i>	Baldwin's flatsedge	Pioneer
<i>Cyperus haspan</i>	haspan flatsedge	Pioneer
<i>Cyperus ovatus</i>	pinebarren flatsedge	Pioneer
<i>Cyperus polystachyos</i>	manyspike flatsedge	Pioneer
<i>Dichanthelium ensifolium</i>	cypress witchgrass	Characteristic
<i>Dichanthelium portoricense</i>	hemlock witchgrass	Pioneer
<i>Diodia virginiana</i>	buttonweed	Characteristic
<i>Eleocharis baldwinii</i>	Baldwin's spikerush; roadgrass	Characteristic
<i>Eleocharis geniculata</i>	Canada spikerush	Characteristic
<i>Elephantopus elatus</i>	tall elephantsfoot	Characteristic
<i>Euthamia caroliniana</i>	slender flattop goldenrod	Pioneer
<i>Fimbristylis autumnalis</i>	slender fimbry	Pioneer
<i>Fimbristylis dichotoma</i>	forked fimbry	Weedy
<i>Galactia elliottii</i>	Elliott's milkpea	Characteristic
<i>Hydrocotyle umbellata</i>	manyflower marshpennywort	Pioneer
<i>Juncus effusus</i>	soft rush	Characteristic
<i>Juncus marginatus</i>	shore rush; grassleaf rush	Characteristic
<i>Juncus megacephalus</i>	bighead rush	Characteristic
<i>Juncus tenuis</i>	path rush	Characteristic
<i>Lachnocaulon anceps</i>	whitehead bogbutton	Characteristic
<i>Ludwigia maritima</i>	seaside primrosewillow	Pioneer

Native Forbs/Graminoids (Cont.)		
<i>Ludwigia octovalvis</i>	Mexican primrosewillow	Pioneer
<i>Ludwigia repens</i>	creeping primrosewillow	Characteristic
<i>Mimosa quadrivalvis</i>	sensitive brier	Characteristic
<i>Oldenlandia uniflora</i>	clustered mille graines	Pioneer
<i>Osmunda cinnamomea</i>	cinnamon fern	Characteristic
<i>Panicum hemitomon</i>	maidencane	Pioneer
<i>Paspalum setaceum</i>	thin paspalum	Pioneer
<i>Passiflora incarnata</i>	purple passionflower	Pioneer
<i>Pityopsis graminifolia</i>	narrowleaf silkgrass	Characteristic
<i>Polypteron procumbens</i>	rustweed	Pioneer
<i>Rhexia sp.</i>	meadowbeauty	Characteristic
<i>Rhynchospora fascicularis</i>	fascicled beaksedge	Characteristic
<i>Scleria reticularis</i>	netted nutrush	Characteristic
<i>Scoparia dulcis</i>	sweetbroom; licoriceweed	Weedy
<i>Solidago fistulosa</i>	pinebarren goldenrod	Characteristic
<i>Woodwardia virginica</i>	virginia chain fern	Characteristic
<i>Xyris ambigua</i>	coastalplain yelloweyed grass	Characteristic
<i>Xyris brevifolia</i>	shortleaf yelloweyed grass	Characteristic
<i>Xyris caroliniana</i>	Carolina yelloweyed grass	Characteristic
<i>Xyris jupicai</i>	Richard's yelloweyed grass	Characteristic
Native Shrubs/Vines		
<i>Asimina reticulata</i>	netted pawpaw	Characteristic
<i>Hypericum tetrapetalum</i>	fourpetal St. John's-wort	Characteristic
<i>Opuntia humifusa</i>	pricklypear	Pioneer
<i>Pinus palustris</i>	longleaf pine	Characteristic
<i>Rubus cuneifolius</i>	sand blackberry	Pioneer
Exotics		
<i>Aeschynomene rufa</i>	zigzag jointvetch	Not Noxious
<i>Kyllinga brevifolia</i>	shortleaf spikesedge	Not Noxious
<i>Paspalum notatum</i>	bahiagrass	Noxious
<i>Paspalum urvillei</i>	vaseygrass	Noxious

The first restoration phase is on track, provided that the bahiagrass is treated aggressively. Good bunchgrass structure established throughout the various parcels (Map LKE1). Characteristic bunchgrasses dominate over pioneer species, which is unusual for a new restoration field and is indicative of excellent wiregrass germination/establishment (Figure LKE1). Wiregrass ranks first in frequency of occurrence, and 2<sup>nd</sup> in cover just behind bahiagrass (Figures LKE2-LKE3). Most of the forb/graminoid cover is also characteristic species, although some pioneer and weedy species remain. Due to the outstanding wiregrass establishment, these fields have the potential to be a very nice product if not for the continued encroachment of exotic bahiagrass. Bahiagrass was found in all fields with it being most abundant and dense in the southern and western fields. Data currently ranks this species in the top ten in both frequency of occurrence and mean cover (Figures (LKE2 – LKE3)). We recommend treating the fields aggressively with Plateau to selectively target bahiagrass. Staff should also attack sand blackberry, which currently ranks 4<sup>th</sup> in both frequency and cover, and most likely will continue to get worse.

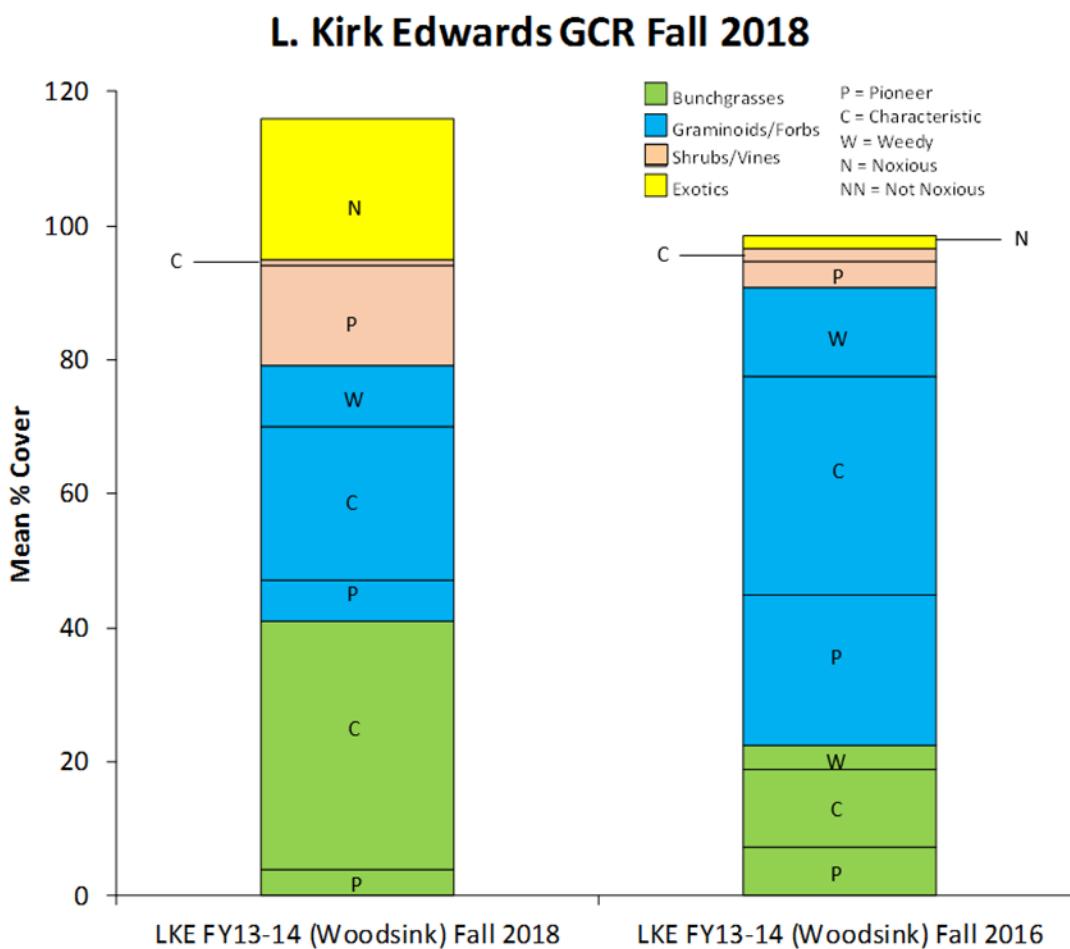


**Map LKE1.** Fall 2018 random sample points on the FY13-14 L. Kirk Edwards NGCR site.

### Management Recommendations:

- Introduce/maintain prescribed fire on a regular 2-3 year return interval.
- Treat bahiagrass with Plateau after growing season burn.
- Treat sand blackberry with an herbicide mixture of Milestone and Garlon before it becomes more dominant.

### Detailed Sampling Results:

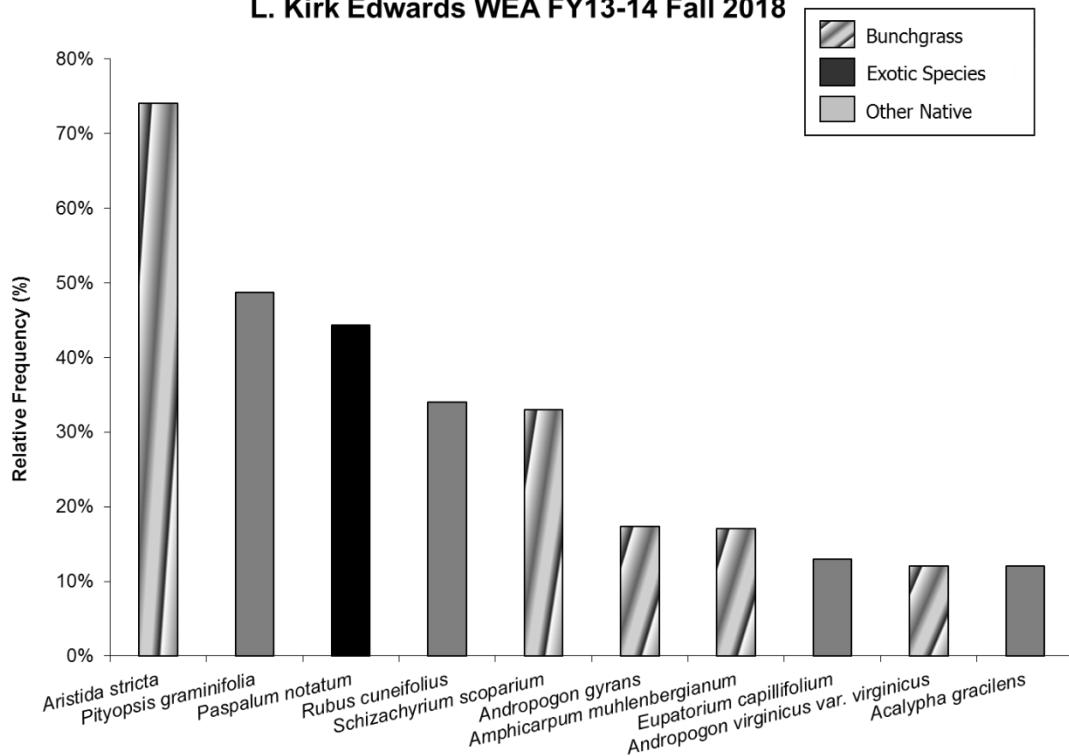


**Figure LKE1.** Structure of the NGCR site at L. Kirk Edwards WEA as compared to the fall 2016 survey. This graph depicts the mean percent cover of each functional group in the FY13-14 field. Total percent greater than 100 is possible because of overlapping layers of vegetation (e.g. small forbs growing beneath larger grasses). Legumes are included in the forb/graminoid category.

**Table LKE1.** Mean percent cover and mean species richness at L. Kirk Edwards WEA as compared to values from the 2016 survey. Values are presented by functional group (Native Bunchgrasses, Native Forbs/Graminoids, Native Shrubs/Vines) and successional status (Pioneer = P, Characteristic = C, and Weedy = W). Legumes are included in the native forbs/graminoids category.

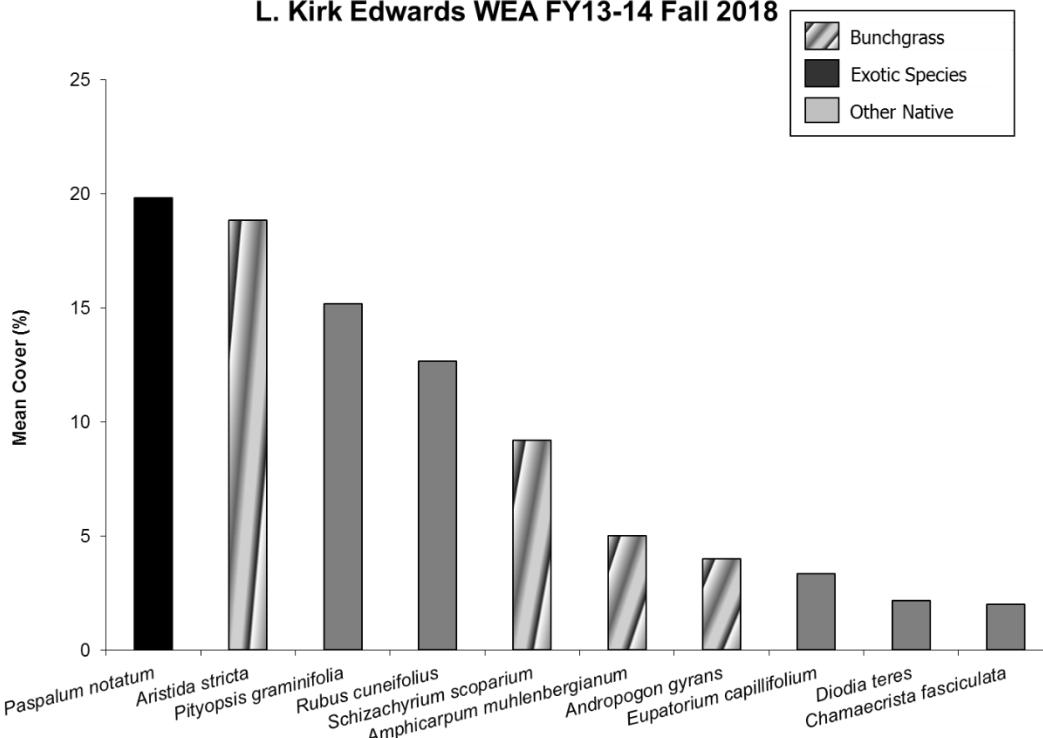
	Native Bunchgrasses				Native Non-Structural Forbs/ Graminoids				Native Shrubs/Vines		
LKE WEA Fall 2018	P	C	W	Total	P	C	W	Total	P	C	Total
Mean % Cover	4%	37%	0%	41%	6%	23%	9%	38%	15%	1%	16%
Mean Species Richness (# of species/quadrat)	1	2	0	3	1	3	1	5	1	0	1
LKE WEA Fall 2016	P	C	W	Total	P	C	W	Total	P	C	Total
Mean % Cover	2%	9%	0%	11%	3%	14%	12%	29%	6%	1%	7%
Mean Species Richness (# of species/quadrat)	0.4	1.3	0	1.7	0.4	1.5	1.3	3.2	0.5	0.2	0.7

**L. Kirk Edwards WEA FY13-14 Fall 2018**



**Figure LKE2.** Top occurring species based on relative frequency surveyed within the L. Kirk Edwards FY13-14 restoration field.

**L. Kirk Edwards WEA FY13-14 Fall 2018**



**Figure LKE3.** Top occurring species based on mean percent cover surveyed within the L. Kirk Edwards FY13-14 restoration field.



**Appendix LKE1: L. Kirk Edwards FY13-14 Fall 2018 Plant List**

Native Bunchgrasses		
<i>Amphicarpum muhlenbergianum</i>	blue maidencane	Characteristic
<i>Andropogon gyrans</i>	Elliott's bluestem	Characteristic
<i>Andropogon virginicus var. virginicus</i>	broomsedge bluestem	Pioneer
<i>Aristida stricta</i>	wiregrass	Characteristic
<i>Digitaria ciliaris</i>	southern crabgrass	Weedy
<i>Eragrostis elliottii</i>	Elliott's lovegrass	Pioneer
<i>Eustachys petraea</i>	pinewoods fingergrass	Pioneer
<i>Schizachyrium scoparium</i>	little bluestem	Characteristic
<i>Setaria parviflora</i>	yellow bristlegrass; knotroot foxtail	Pioneer
Native Forbs/Graminoids		
<i>Acalypha gracilens</i>	slender threeseed mercury	Pioneer
<i>Agalinis linifolia</i>	false-foxglove, flax-leaf	Characteristic
<i>Bulbostylis ciliatifolia</i>	capillary hairsedge	Characteristic
<i>Bulbostylis warei</i>	Ware's hairsedge	Characteristic
<i>Chamaecrista fasciculata</i>	partridge pea	Pioneer
<i>Chamaecrista nictitans</i>	sensitive pea	Pioneer
<i>Conyza canadensis</i>	Canadian horseweed	Weedy
<i>Crocanthemum carolinianum</i>	Carolina frostweed	Characteristic
<i>Croptilon divaricatum</i>	slender scratchdaisy	Weedy
<i>Crotalaria rotundifolia</i>	rabbitbells	Pioneer
<i>Croton michauxii</i>	rushfoil	Characteristic
<i>Cyperus ovatus</i>	pinebarren flatsedge	Pioneer
<i>Desmodium strictum</i>	pinebarren ticktrefoil	Characteristic
<i>Dichanthelium aciculare</i>	needleleaf witchgrass	Pioneer
<i>Dichanthelium ensifolium</i>	cypress witchgrass	Characteristic
<i>Dichanthelium laxiflorum</i>	openflower witchgrass	Characteristic
<i>Diodia teres</i>	poor Joe	Weedy
<i>Eupatorium capillifolium</i>	dogfennel	Weedy
<i>Eupatorium compositifolium</i>	yankeeweek	Weedy
<i>Helianthemum corymbosum</i>	pinebarren frostweed	Characteristic
<i>Helianthus radula</i>	stiff sunflower	Characteristic
<i>Heterotheca subaxillaris</i>	camphorweed	Pioneer
<i>Hibiscus aculeatus</i>	comfortroot	Weedy
<i>Juncus repens</i>	lesser creeping rush	Characteristic
<i>Lechea mucronata</i>	hairy pinweed	Characteristic
<i>Lechea sessiliflora</i>	pineland pinweed	Characteristic
<i>Mecardonia acuminata</i>	axilflower	Pioneer
<i>Oldenlandia uniflora</i>	clustered mille graines	Pioneer
<i>Oxalis corniculata</i>	common yellow woodsorrel	Weedy
<i>Panicum hemitomon</i>	maidencane	Pioneer
<i>Paspalum setaceum</i>	thin paspalum	Pioneer

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<b>Native Forbs/Graminoids (Cont.)</b>		
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<i>Pityopsis graminifolia</i>	narrowleaf silkglass	Characteristic
<i>Polypremum procumbens</i>	rustweed	Pioneer
<i>Pseudognaphalium obtusifolium</i>	sweet everlasting; rabbit tobacco	Characteristic
<i>Rhexia mariana</i>	meadowbeauty	Characteristic
<i>Rumex hastatalus</i>	heartwing dock	Weedy
<i>Scleria ciliata</i>	fringed nutrush	Characteristic
<i>Scleria triglomerata</i>	tall nutgrass; whip nutrush	Characteristic
<i>Solidago odora</i>	chapman's goldenrod	Characteristic
<i>Stylosanthes biflora</i>	sidebeak pencilflower	Characteristic
<i>Tragia smallii</i>	Small's noseburn	Characteristic
<i>Trichostema dichotomum</i>	forked bluecurls	Characteristic

<b>Native Shrubs/Vines</b>		
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<i>Campsis radicans</i>	trumpet	Pioneer
<i>Hypericum cistifolium</i>	roundpod St. John's-wort	Characteristic
<i>Myrica cerifera</i>	southern bayberry; wax myrtle	Characteristic
<i>Pinus palustris</i>	longleaf pine	Characteristic
<i>Quercus laurifolia</i>	laurel oak; diamond oak	Characteristic
<i>Rubus cuneifolius</i>	sand blackberry	Pioneer
<i>Rubus trivialis</i>	southern dewberry	Pioneer
<i>Smilax auriculata</i>	earleaf greenbrier	Pioneer
<i>Smilax glauca</i>	cat greenbrier; wild sarsaparilla	Characteristic

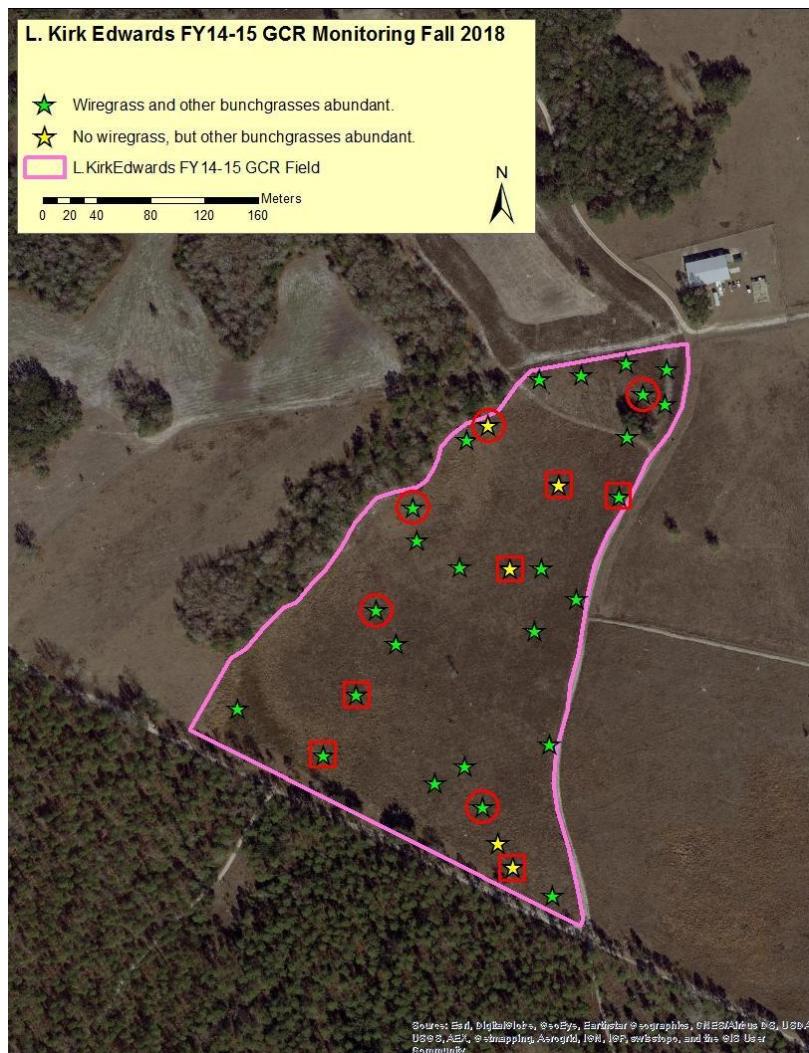
<b>Exotics</b>		
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<i>Crotalaria spectabilis</i>	showy rattlebox	Not Noxious
<i>Desmodium triflorum</i>	threeflower ticktrefoil	Not Noxious
<i>Panicum repens</i>	torpedograss	Noxious
<i>Paspalum notatum</i>	bahiagrass	Noxious
<i>Sporobolus indicus</i>	smutgrass	Noxious

## L. Kirk Edwards WEA – FY 14-15 FIELD

FALL 2018

Staff have completed the first restoration phase in a remarkably short period of time, and the field is currently in Phase II. Longleaf pines have been planted and were recorded in about 6% of the sample quadrats. Many woody species are establishing on their own including red maple (*Acer rubrum*), dwarf huckleberry (*Gaultheria dumosa*), and St. Andrew's-cross (*Hypericum hypericoides*) in addition to 3 species of blackberry (Appendix LKE2). Characteristic bunchgrasses (wiregrass; Elliott's bluestem) occur throughout the entire field (Map LKE2). Structure is currently dominated by native graminoids/forbs which is not unusual at this early stage of restoration (Figure LKE4; Table LKE2). The two major issues are sand blackberry encroachment and the persistence of bahiagrass. Sand blackberry currently ranks 3<sup>rd</sup> in frequency of occurrence, and 5<sup>th</sup> in mean cover (Figures LKE5-LKE6). Chemical intervention will most likely be necessary as prescribed burning on other restoration sites appears to have minimal effect. Bahiagrass averages 10% in cover which is enough to rank it 4<sup>th</sup> overall. Staff should aggressively treat chemically with Plateau. Otherwise, this field is well on its way to becoming a successful product.

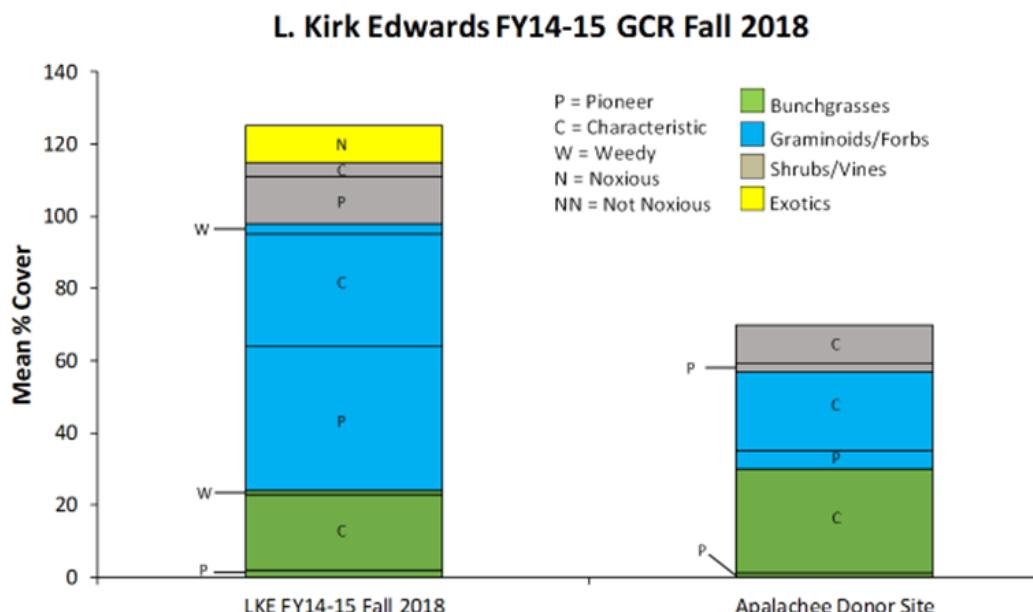


**Map LKE2.** Fall 2018 random sample points on the FY12-13 L. Kirk Edwards NGCR site.

**Management Recommendations:**

- Introduce/maintain prescribed fire on a regular 2-3 year return interval.
- Treat bahiagrass with Plateau after growing season burn.
- In addition to longleaf pine, plant native shrubs such as saw palmetto, blueberries (*Vaccinium* spp.), huckleberries (*Gaylussacia* spp.), and running oaks (*Quercus pumila*) throughout the field.

**Detailed Sampling Results:**

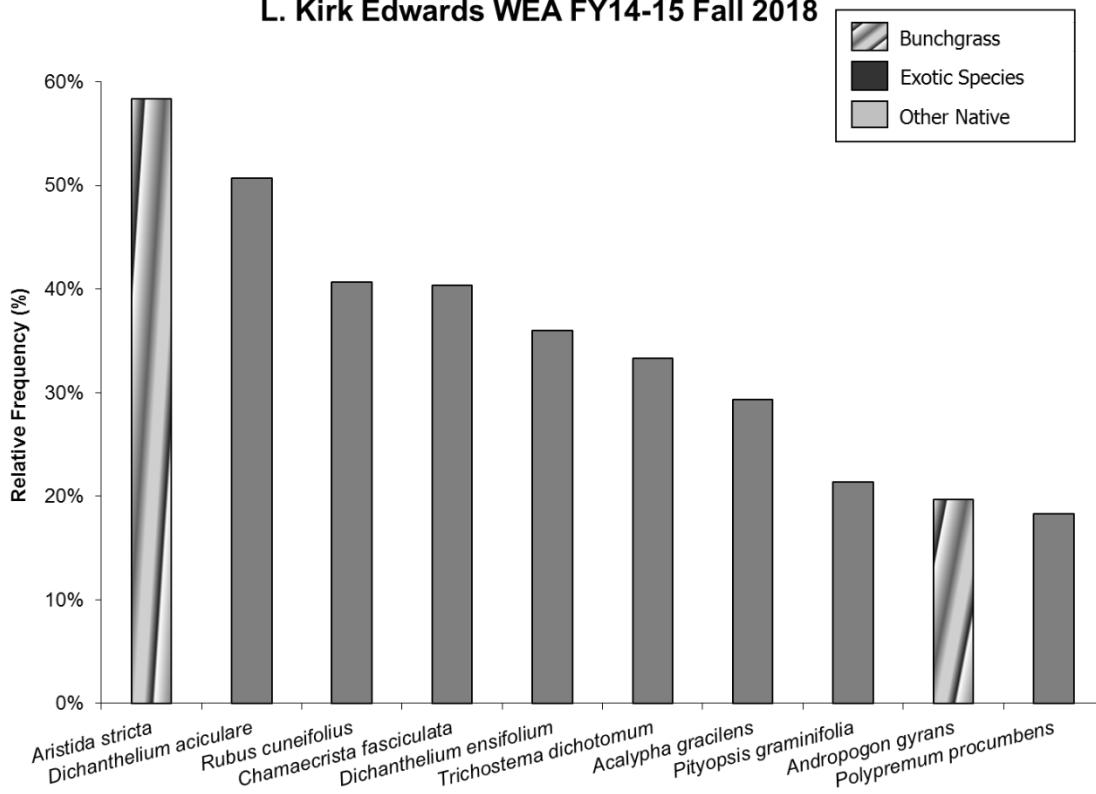


**Figure LKE4.** Structure of the FY14-15 NGCR site at L. Kirk Edwards WEA as compared to the Apalachee Donor Site. This graph depicts the mean percent cover of each functional group in the FY14-15 field. Total percent greater than 100 is possible because of overlapping layers of vegetation (e.g. small forbs growing beneath larger grasses). Legumes are included in the forb/graminoid category.

**Table LKE2.** Mean percent cover and mean species richness at L. Kirk Edwards WEA as compared to values from the Apalachee Donor Site. Values are presented by functional group (Native Bunchgrasses, Native Forbs/Graminoids, Native Shrubs/Vines) and successional status (Pioneer = P, Characteristic = C, and Weedy = W). Legumes are included in the native forbs/graminoids category.

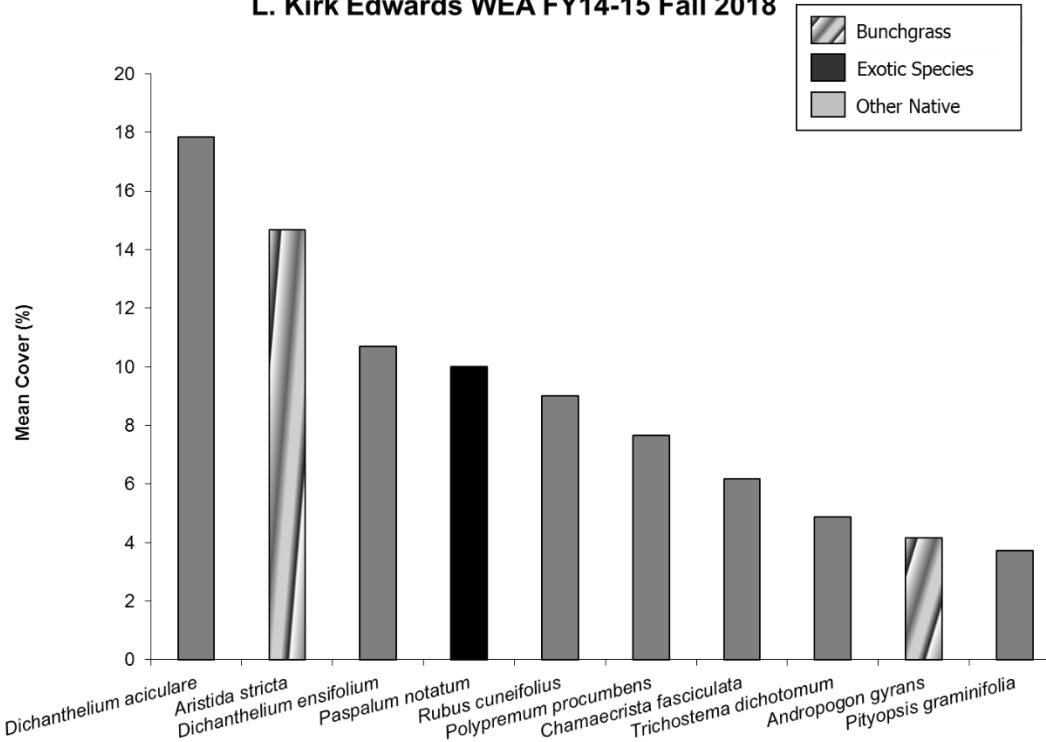
	Native Bunchgrasses				Native Non-Structural Forbs/ Graminoids				Native Shrubs/Vines		
LKE FY14-15 Fall 2018	P	C	W	Total	P	C	W	Total	P	C	Total
Mean % Cover	2%	21%	1%	24%	40%	31%	3%	74%	13%	4%	17%
Mean Species Richness (# of species/quadrat)	0	2	1	3	3	5	0	8	1	1	2
<b>Apalachee Donor Site</b>											
Mean % Cover	1%	29%	0%	30%	5%	22%	0%	27%	2%	11%	13%
Mean Species Richness (# of species/quadrat)	1	3	0	4	2	8	0	10	1	3	4

### L. Kirk Edwards WEA FY14-15 Fall 2018



**Figure LKE5.** Top occurring species based on relative frequency surveyed within the L. Kirk Edwards FY14-15 restoration field.

### L. Kirk Edwards WEA FY14-15 Fall 2018



**Figure LKE6.** Top occurring species based on mean percent cover surveyed within the L. Kirk Edwards FY14-15 restoration field.

**Appendix LKE2: L. Kirk Edwards Fall 2018 Plant List**

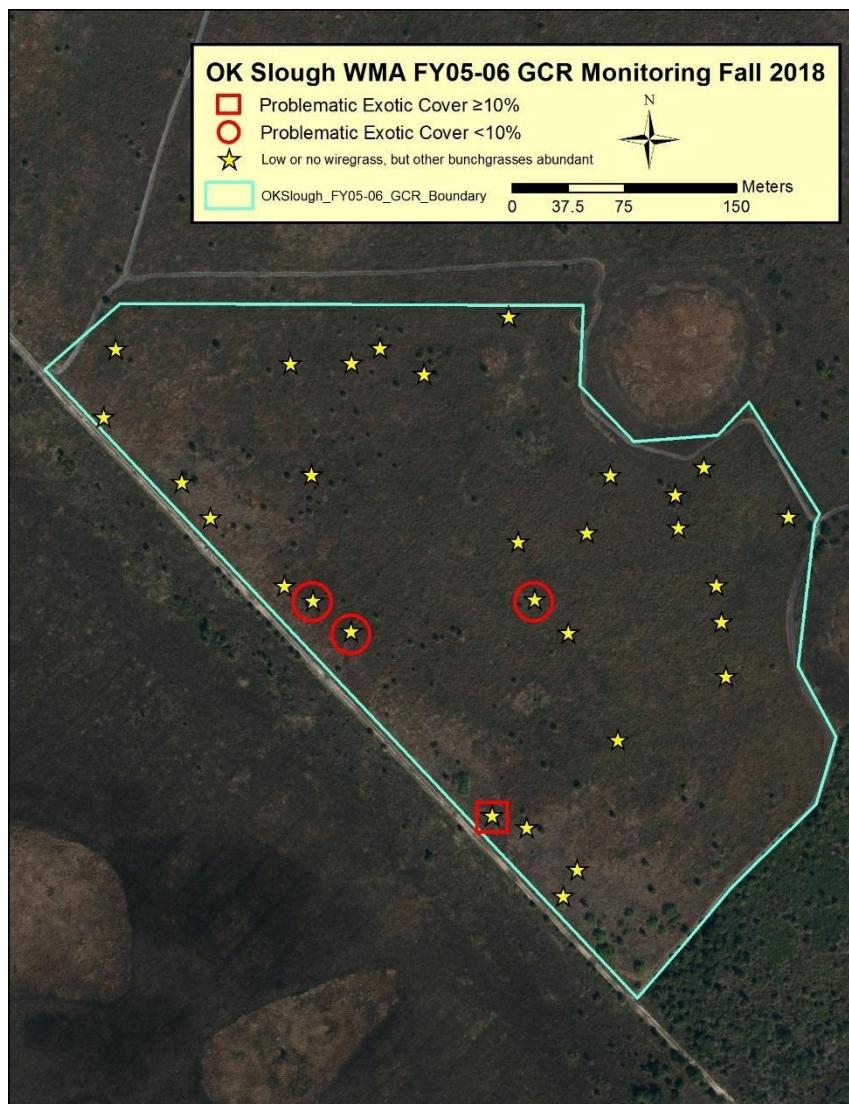
Native Bunchgrasses		
<i>Amphicarpum muhlenbergianum</i>	blue maidencane	Characteristic
<i>Andropogon gyrans</i>	Elliott's bluestem	Characteristic
<i>Andropogon virginicus</i> var. <i>virginicus</i>	broomsedge bluestem	Pioneer
<i>Aristida purpurascens</i>	arrowfeather threeawn	Characteristic
<i>Aristida stricta</i>	wiregrass	Characteristic
<i>Digitaria ciliaris</i>	southern crabgrass	Weedy
<i>Eragrostis elliottii</i>	Elliott's lovegrass	Pioneer
<i>Eustachys glauca</i>	saltmarsh fingergrass	Pioneer
<i>Eustachys petraea</i>	pinewoods fingergrass	Pioneer
<i>Panicum anceps</i>	beaked panicum	Characteristic
<i>Panicum verrucosum</i>	warty panicgrass	Characteristic
<i>Panicum virgatum</i>	switchgrass	Pioneer
<i>Schizachyrium scoparium</i>	little bluestem	Characteristic
<i>Sorghastrum secundum</i>	lopsided Indiangrass	Characteristic
Native Forbs/Graminoids		
<i>Acalypha gracilens</i>	slender threeseed mercury	Pioneer
<i>Agalinis fasciculata</i>	beach false-foxglove	Characteristic
<i>Agalinis linifolia</i>	false-foxglove, flax-leaf	Characteristic
<i>Bidens mitis</i>	smallfruit beggarticks	Characteristic
<i>Bulbostylis ciliatifolia</i>	capillary hairsedge	Characteristic
<i>Chamaecrista fasciculata</i>	partridge pea	Pioneer
<i>Chamaecrista nictitans</i>	sensitive pea	Pioneer
<i>Chrysopsis gossypina</i>	cottony goldenaster	Characteristic
<i>Conyza canadensis</i>	Canadian horseweed	Weedy
<i>Croptilon divaricatum</i>	slender scratchdaisy	Weedy
<i>Crotalaria rotundifolia</i>	rabbitbells	Pioneer
<i>Croton glandulosus</i> var. <i>glandulosus</i>	vente conmigo	Pioneer
<i>Croton michauxii</i>	rushfoil	Characteristic
<i>Cyperus ovatus</i>	pinebarren flatsedge	Pioneer
<i>Dichanthelium aciculare</i>	needleleaf witchgrass	Pioneer
<i>Dichanthelium ensifolium</i>	cypress witchgrass	Characteristic
<i>Dichanthelium ensifolium</i> var. <i>ensifolium</i>	cypress witchgrass	Characteristic
<i>Dichanthelium portoricense</i>	hemlock witchgrass	Pioneer
<i>Diodia teres</i>	poor Joe	Weedy
<i>Diodia virginiana</i>	buttonweed	Characteristic
<i>Elephantopus elatus</i>	tall elephantsfoot	Characteristic
<i>Erechtites hieracifolius</i>	fireweed	Pioneer
<i>Eupatorium compositifolium</i>	yankeeweed	Weedy
<i>Eupatorium mohrii</i>	Mohr's thoroughwort	Characteristic
<i>Helianthemum corymbosum</i>	pinebarren frostweed	Characteristic

<i>Heterotheca subaxillaris</i>	camphorweed	Pioneer
<b>Native Forbs/Graminoids (Cont.)</b>		
<i>Hypericum gentianoides</i>	pineweeds; orangegrass	Characteristic
<i>Juncus marginatus</i>	shore rush; grassleaf rush	Characteristic
<i>Lechea mucronata</i>	hairy pinweed	Characteristic
<i>Lechea sessiliflora</i>	pineland pinweed	Characteristic
<i>Ludwigia maritima</i>	seaside primrosewillow	Pioneer
<i>Oxalis corniculata</i>	common yellow woodsorrel	Weedy
<i>Paspalum setaceum</i>	thin paspalum	Pioneer
<i>Pityopsis graminifolia</i>	narrowleaf silkgrass	Characteristic
<i>Polypremum procumbens</i>	rustweed	Pioneer
<i>Pseudognaphalium obtusifolium</i>	sweet everlasting; rabbit tobacco	Characteristic
<i>Rhexia sp.</i>	meadowbeauty	Characteristic
<i>Rumex hastatulus</i>	heartwing dock	Weedy
<i>Scleria trigloomerata</i>	tall nutgrass; whip nutrush	Characteristic
<i>Stillingia sylvatica</i>	queensdelight	Characteristic
<i>Stylosma humistrata</i>	southern dawnflower	Characteristic
<i>Tragia urens</i>	wavyleaf noseburn	Characteristic
<i>Trichostema dichotomum</i>	forked bluecurls	Characteristic
<i>Viola lanceolata</i>	bog white violet	Characteristic
<i>Xyris caroliniana</i>	Carolina yelloweyed grass	Characteristic
<b>Native Shrubs/Vines</b>		
<i>Acer rubrum</i>	red maple	Characteristic
<i>Campsis radicans</i>	trumpet	Pioneer
<i>Diospyros virginiana</i>	common persimmon	Pioneer
<i>Gaylussacia dumosa</i>	dwarf huckleberry	Characteristic
<i>Hypericum hypericoides</i>	St. Andrew's-cross	Characteristic
<i>Pinus palustris</i>	longleaf pine	Characteristic
<i>Rhus copallina</i>	winged sumac	Pioneer
<i>Rubus cuneifolius</i>	sand blackberry	Pioneer
<i>Rubus trivialis</i>	southern dewberry	Pioneer
<i>Smilax auriculata</i>	earleaf greenbrier	Pioneer
<i>Smilax glauca</i>	cat greenbrier; wild sarsaparilla	Characteristic
<b>Exotics</b>		
<i>Paspalum notatum</i>	bahiagrass	Noxious

## Okaloacoochee Slough WMA – FY 05-06 FIELD

FALL 2018

The first phase of restoration is complete. Staff have restored the native bunchgrass structure and exotics are under control. This is one of the original fields selected for long term monitoring, and it continues to exhibit high species richness for a restoration field (97 species; Appendix OK1). Although wiregrass has declined over the years (most likely the field is too wet for the phenotype collected), characteristic bunchgrasses continue to increase. Broomsedge bluestem and purple bluestem (*Andropogon glomeratus* var. *glaucopsis*) account for the majority of cover in this category (Figures OK2-OK3) and should provide adequate fine fuel to carry fire. However, the field is comprised mostly of native non-structural forbs/graminoids, which increased substantially since 2016 in both the characteristic and pioneer categories (Figure OK1). Exotic cover is minimal comprised of mostly species of the non-noxious category such as wild bushbean (*Macroptilium lathyroides*), and Indian cupscale (*Sacciolepis indica*). Smutgrass (*Sporobolus indicus*), vaseygrass (*Paspalum urvillei*), and Peruvian primrosewillow (*Ludwigia peruviana* were the most common noxious exotics albeit in low numbers.

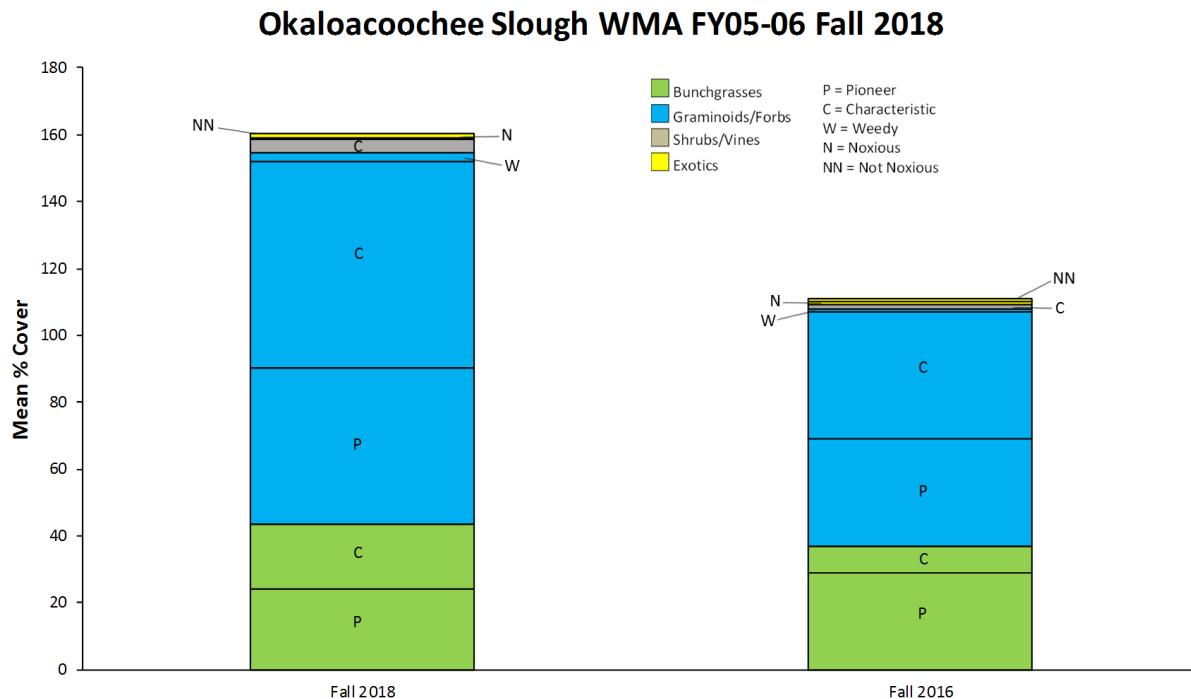


**Map OK1.** Fall 2018 random sample points on the FY05-06 Okaloacoochee Slough NGCR site.

**Management Recommendations:**

- Maintain prescribed fire on a regular 2-3 year return interval.
- Plant characteristic shrubs and trees suitable for a wet site such as coastalplain staggerbush (*Lyonia fruticosa*), dahooon holly (*Ilex cassine* var *cassine*) and yaupon (*I. vomitoria*).
- Treat smutgrass with glyphosate before seed develops (late May-June); repeat as often as possible.

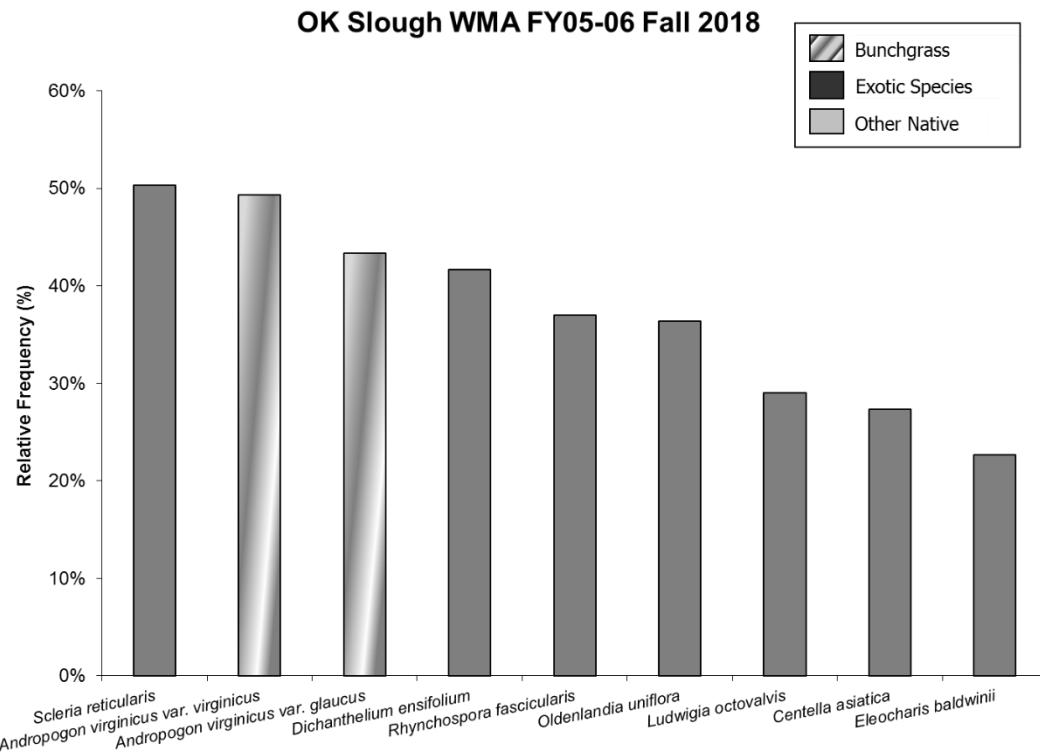
**Detailed Sampling Results:**



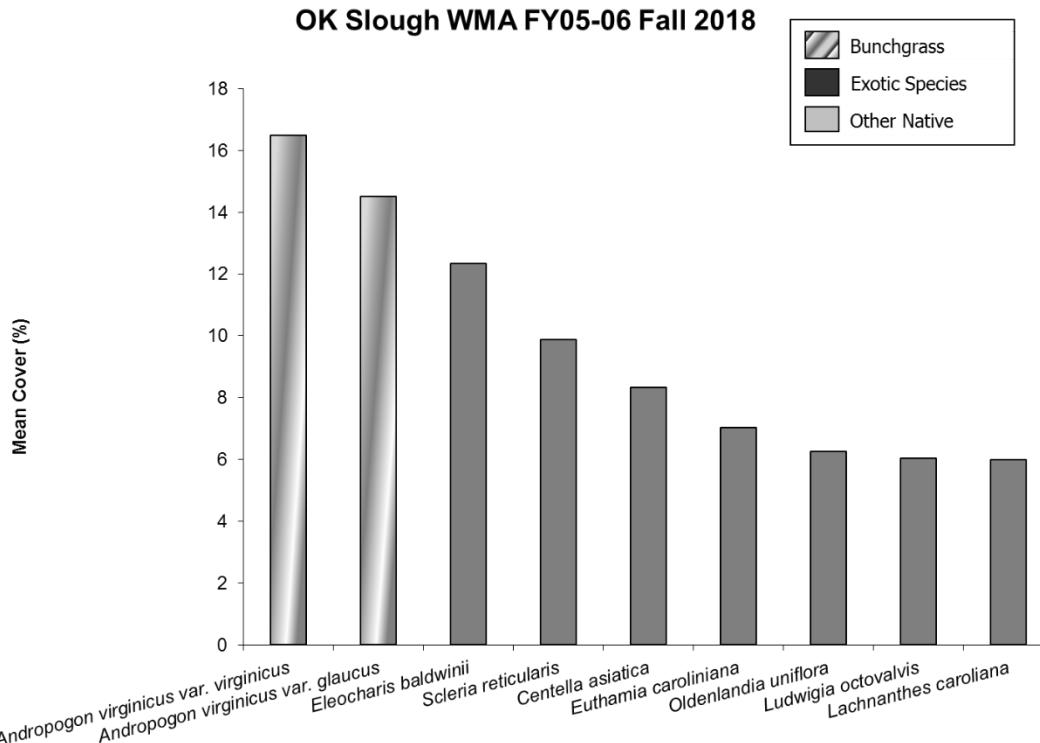
**Figure OK1.** Structure of the NGCR site at Okaloacoochee Slough as compared to the 2016 survey results. This graph depicts the mean percent cover of each functional group in the FY05-06 field. Total percent greater than 100 is possible because of overlapping layers of vegetation (e.g. small forbs growing beneath larger grasses). Legumes are included in the forb/graminoid category.

**Table OK1.** Mean percent cover and mean species richness at Okaloacoochee Slough WMA as compared to the mean values from 2016. Values are presented by functional group (Native Bunchgrasses, Native Forbs/Graminoids, Native Shrubs/Vines) and successional status (Pioneer = P, Characteristic = C, and Weedy = W). Legumes are included in the native forbs/graminoids category.

	Native Bunchgrasses				Native Non-Structural Forbs/ Graminoids				Native Shrubs/Vines		
OK Slough WMA Fall 2018	P	C	W	Total	P	C	W	Total	P	C	Total
Mean % Cover	24%	19%	0%	43%	47%	62%	3%	112%	0%	4%	4%
Mean Species Richness (# of species/quadrat)	1.3	1	0	2.3	5.1	6.3	0.5	11.9	0	0.3	0.3
OK Slough WMA Fall 2016	P	C	W	Total	P	C	W	Total	P	C	Total
Mean % Cover	29%	8%	0%	37%	32%	38%	1%	71%	0%	1%	0%
Mean Species Richness (# of species/quadrat)	2.2	0.8	0	3	4	5.6	0.3	9.9	0	0.2	0.2



**Figure OK2.** Top occurring species based on relative frequency surveyed within the Okaloacoochee Slough FY05-06 restoration field.



**Figure OK3.** Top occurring species based on mean percent cover surveyed within the Okaloacoochee Slough FY05-06 restoration field.

## Appendix OK1: Okaloacoochee Slough FY05-06 Fall 2018 Plant List

Native Bunchgrasses		
<i>Andropogon brachystachyus</i>	shortspike bluestem	Characteristi c
<i>Andropogon glomeratus</i> var. <i>glauopsis</i>	purple bluestem	Pioneer
<i>Andropogon ternarius</i>	splitbeard bluestem	Characteristi c
<i>Andropogon virginicus</i> var. <i>glaucus</i>	chalky bluestem	Characteristi c
<i>Andropogon virginicus</i> var. <i>virginicus</i>	broomsedge bluestem	Pioneer
<i>Coelorachis tuberculosa</i>	florida jointtailgrass; piedmont jointgrass	Characteristi c
<i>Eragrostis ellottii</i>	Elliott's lovegrass	Pioneer
<i>Eragrostis</i> sp.	lovegrass	Pioneer
<i>Panicum dichotomiflorum</i>	fall panicgrass	Pioneer
<i>Panicum rigidulum</i>	red top panicum	Pioneer
<i>Saccharum giganteum</i>	sugarcane plumegrass	Characteristi c
<i>Schizachyrium scoparium</i>	little bluestem	Characteristi c
<i>Schizachyrium</i> sp.	bluestem	Characteristi c
<i>Setaria parviflora</i>	yellow bristlegrass; knotroot foxtail	Pioneer
Native Forbs/Graminoids		
<i>Bacopa monnieri</i>	herb-of-grace	Characteristi c
<i>Boltonia diffusa</i>	smallhead doll's daisy	Pioneer
<i>Bulbostylis ciliatifolia</i>	capillary hairsedge	Characteristi c
<i>Caperonia castaneifolia</i>	chestnutleaf falsecroton	Characteristi c
<i>Centella asiatica</i>	spadeleaf	Pioneer
<i>Cirsium nuttallii</i>	Nuttall's thistle	Pioneer
<i>Cyperus compressus</i>	poorland flatsedge	Pioneer
<i>Cyperus haspan</i>	haspan flatsedge	Pioneer
<i>Cyperus polystachyos</i>	manyspike flatsedge	Pioneer
<i>Cyperus surinamensis</i>	tropical flatsedge	Characteristi c
<i>Dichanthelium ensifolium</i>	cypress witchgrass	Characteristi c
<i>Dichanthelium ovale</i>	eggleaf witchgrass	Characteristi c
<i>Dichanthelium portoricense</i>	hemlock witchgrass	Pioneer
<i>Diodia virginiana</i>	buttonweed	Characteristi c

<i>Eleocharis baldwinii</i>	Baldwin's spikerush; roadgrass	Characteristi
<i>Erechtites hieraciifolius</i>	fireweed	c
<i>Erigeron vernus</i>	early whitetop fleabane	Pioneer
<i>Eryngium baldwinii</i>	baldwin's eryngo	Pioneer
<i>Eupatorium capillifolium</i>	dogfennel	Weedy
<i>Euthamia caroliniana</i>	slender flattop goldenrod	Pioneer
<i>Fimbristylis autumnalis</i>	slender fimbry	Pioneer
<i>Fimbristylis</i> sp.	fimbry	Pioneer
<i>Fuirena breviseta</i>	saltmarsh umbrellasedge	Characteristi
		c

#### Native Forbs/Graminoids (Cont.)

<i>Helianthus radula</i>	stiff sunflower	Characteristi
<i>Hydrocotyle umbellata</i>	manyflower marshpennywort	c
<i>Hyptis alata</i>	clustered bushmint; musky mint	Pioneer
<i>Ipomoea sagittata</i>	saltmarsh morning-glory	Characteristi
<i>Juncus megacephalus</i>	bighead rush	c
<i>Juncus scirpoides</i>	needlepod rush	Characteristi
<i>Lachnanthes caroliana</i>	Carolina redroot	c
<i>Ludwigia octovalvis</i>	Mexican primrosewillow	Pioneer
<i>Ludwigia</i> sp.	ludwigia; water-primrose	Pioneer
<i>Melothria pendula</i>	creeping cucumber	Pioneer
<i>Mikania scandens</i>	climbing hempvine	Characteristi
<i>Oldenlandia uniflora</i>	clustered mille graines	c
<i>Oxalis corniculata</i>	common yellow wood sorrel	Pioneer
<i>Paspalum setaceum</i>	thin paspalum	Weedy
<i>Paspalum</i> sp.	paspalum	Pioneer
<i>Phyla nodiflora</i>	turkey tangle fogfruit; capeweed	Pioneer
<i>Pluchea baccharis</i>	rosy camphorweed	Characteristi
<i>Pluchea foetida</i>	stinking camphorweed	c
<i>Pluchea odorata</i>	sweetscent	Characteristi
<i>Polygala rugelii</i>	yellow milkwort	c

<i>Polygonum hydropiperoides</i>	mild waterpepper; swamp smartweed	Characteristic
<i>Polypremum procumbens</i>	rustweed	c Pioneer
<i>Rhexia mariana</i>	pale meadowbeauty; Maryland meadowbeauty	Characteristic
<i>Rhexia</i> sp.	meadowbeauty	c Characteristic
<i>Rhexia virginica</i>	handsome Harry	c Characteristic
<i>Rhynchospora fascicularis</i>	fascicled beaksedge	c Characteristic
<i>Rhynchospora fernaldii</i>	Fernald's beaksedge	c Characteristic
<i>Rhynchospora microcephala</i>	bunched beaksedge	c Characteristic
<i>Sacciolepis striata</i>	American cupscale	Pioneer
<i>Sagittaria graminea</i>	grassy arrowhead	Characteristic
<i>Scleria reticularis</i>	netted nutrush	c Characteristic
<i>Scleria</i> sp.	nutrush	c Weedy
<i>Scoparia dulcis</i>	sweetbroom; licoriceweed	Weedy
<i>Sesbania herbacea</i>	danglepod	Characteristic
<i>Solidago fistulosa</i>	pinebarren goldenrod	c Characteristic
<i>Solidago</i> sp.	goldenrod	c Characteristic
<i>Symphyotrichum adnatum</i>	scaleleaf aster	c Characteristic
<i>Thelypteris interrupta</i>	hottentot fern; Willdenow's fern	Pioneer
<i>Vicia acutifolia</i>	fourleaf vetch	Pioneer
<i>Viola lanceolata</i>	bog white violet	Characteristic

#### Native Forbs/Graminoids (Cont.)

<i>Woodwardia virginica</i>	virginia chain fern	Characteristic
<i>Xyris ambigua</i>	coastalplain yelloweyed grass	Characteristic
<i>Xyris brevifolia</i>	shortleaf yelloweyed grass	Characteristic
<i>Xyris caroliniana</i>	Carolina yelloweyed grass	Characteristic
<i>Xyris jupicai</i>	Richard's yelloweyed grass	Characteristic
<i>Xyris</i> sp.	yelloweyed grass	c Characteristic

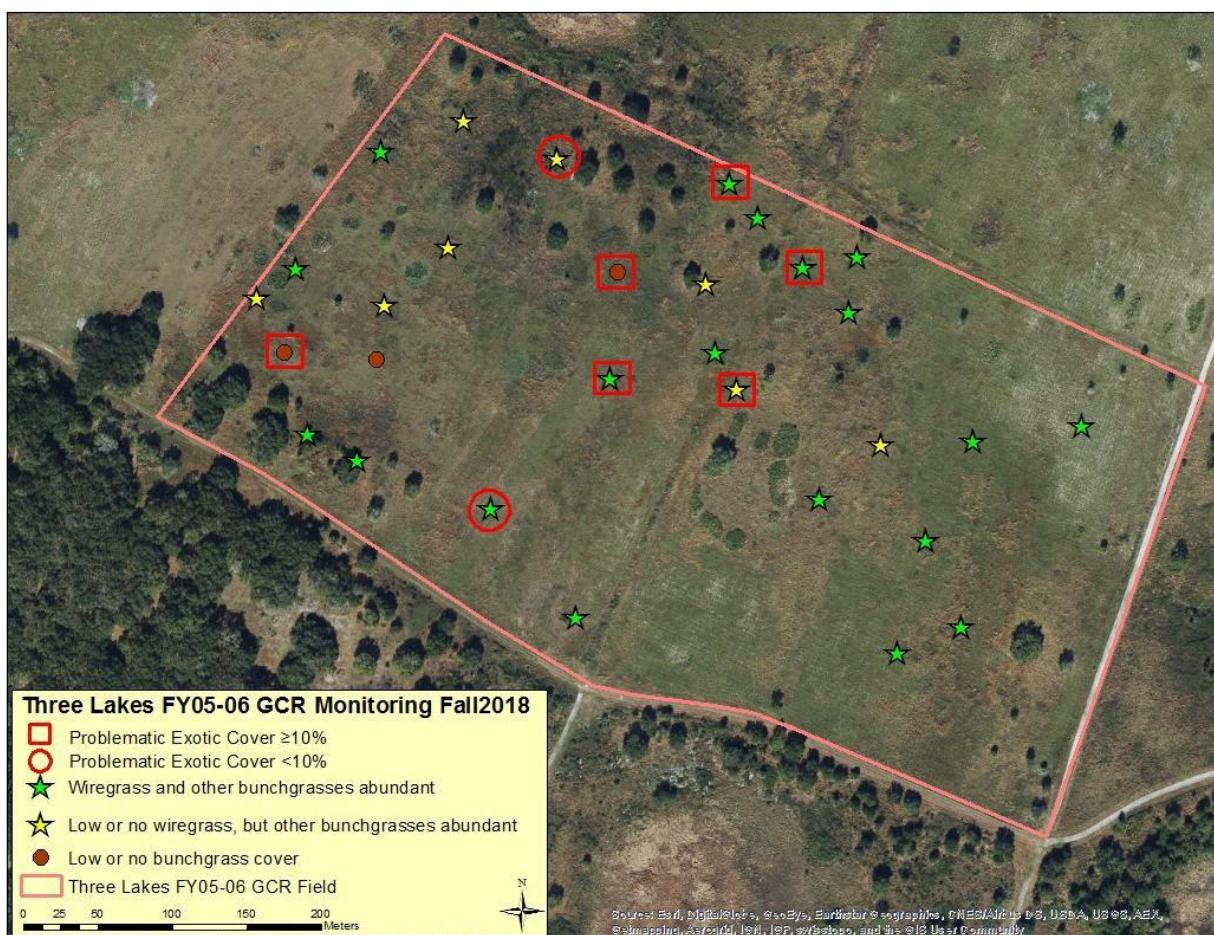
Native Shrubs/Vines		
<i>Cornus</i> sp.	dogwood	Characteristi c
<i>Hypericum cistifolium</i>	roundpod St. John's-wort	Characteristi c
<i>Hypericum tetrapetalum</i>	fourpetal St. John's-wort	Characteristi c
<i>Myrica cerifera</i>	southern bayberry; wax myrtle	Characteristi c
<i>Sabal palmetto</i>	cabbage palm	Characteristi c
Exotics		
<i>Eragrostis atrovirens</i>	thalia lovegrass	Noxious
<i>Kyllinga brevifolia</i>	shortleaf spikesedge	Not Noxious
<i>Lindernia crustacea</i>	Malaysian false pimpernel	Not Noxious
<i>Ludwigia peruviana</i>	Peruvian primrosewillow	Noxious
<i>Macroptilium lathyroides</i>	wild bushbean	Not Noxious
<i>Melochia corchorifolia</i>	chocolateweed	Not Noxious
<i>Paspalum urvillei</i>	vaseygrass	Noxious
<i>Sacciolepis indica</i>	Indian cupscale	Not Noxious
<i>Sporobolus indicus</i>	smutgrass	Noxious

Three Lakes WMA – FY 05-06 FIELD

FALL 2018

The first phase of restoration is complete, and the field has moved into Phase II.  
 Restoration of the native bunchgrass structure has occurred, and longleaf pines have been planted. Historically, this field was one of the finest products of ground cover restoration

undertaken by the agency to date. However, problems are beginning to manifest which threaten the integrity of this site, if left untreated. Nevertheless, it still has the most characteristic bunchgrass cover of any site sampled in 2018 (Figure TL1). Wiregrass continues to be the dominant species in terms of frequency and cover (Figures TL2 – TL3). The increase in shrub cover is due to the continued encroachment of sand blackberry which now ranks 3<sup>rd</sup> and 2<sup>nd</sup> in frequency and cover, respectively, and requires chemical intervention. Bahiagrass is still present, but mean cover estimates declined slightly from 10% in 2016 to 8% during the current survey. However, there was also an increase in both frequency and mean cover of limpograss (*Hemarthria altissima*) resulting in minimal change in overall noxious exotic cover (Figure TL1). Although not recorded in a quadrat, cogongrass was observed in the northwest section of the field in addition to localized hog damage.



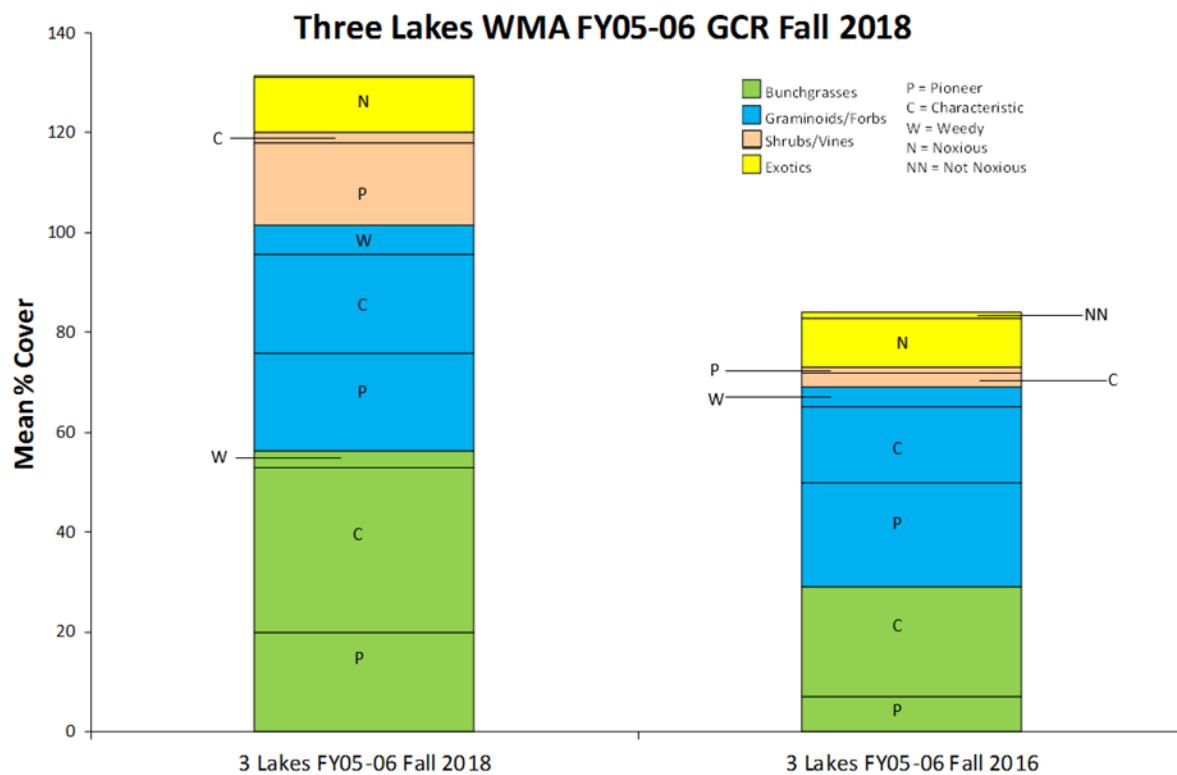
**Map TL1.** Fall 2018 random sample points on the FY05-06 Three Lakes NGCR site.

#### Management Recommendations:

- Maintain prescribed fire on a regular 2-3 year return interval,
- Treat bahiagrass with Plateau after a growing season burn,
- Treat limpograss with glyphosate at a rate of 2.24 kg/ha

- Continue to plant characteristic shrubs and trees, such as *Hypericum spp.*, saw palmetto (*Serenoa repens*), blueberries (*Vaccinium spp.*), huckleberries (*Gaylussacia spp.*), running oaks (*Quercus pumila*), and long leaf pine throughout the field.
- Treat sand blackberry using an herbicide mix of Milestone and Garlon.

### Detailed Sampling Results:

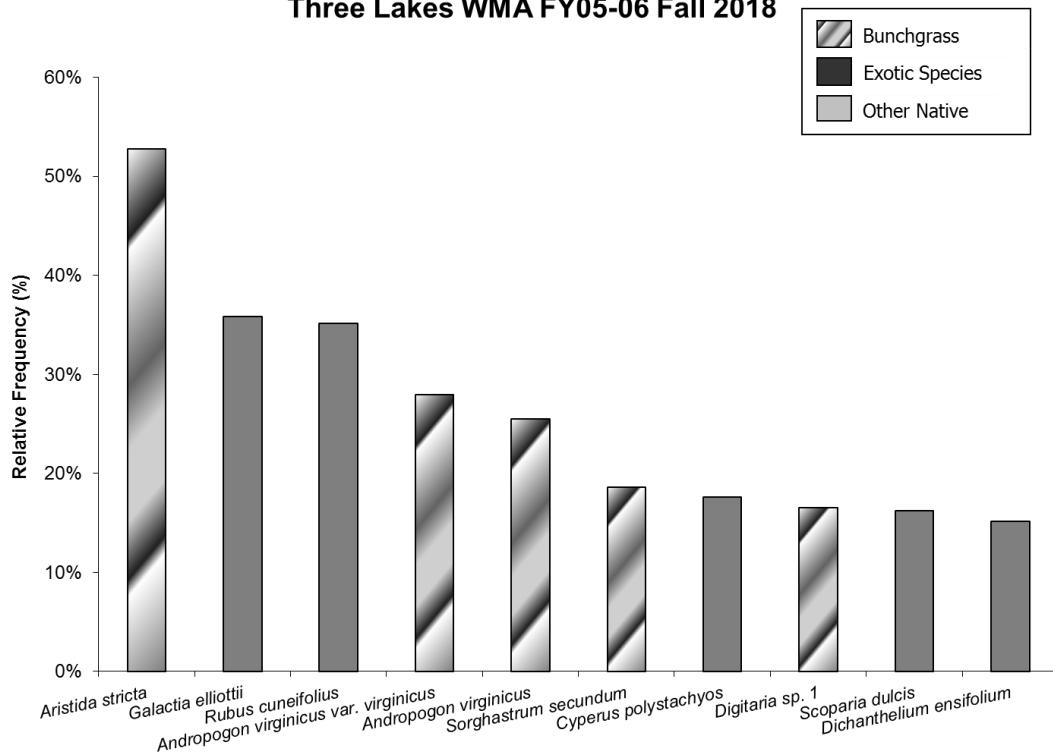


**Figure TL1.** Structure of the FY05-06 NGCR site at Three Lakes as compared to the Fall 2016 survey results. This graph depicts the mean percent cover of each functional group in the FY05-06 field. Total percent greater than 100 is possible because of overlapping layers of vegetation (e.g. small forbs growing beneath larger grasses). Legumes are included in the forb/graminoid category.

**Table TL1.** Mean percent cover and mean species richness at Three Lakes as compared to the previous sampling values. Values are presented by functional group (Native Bunchgrasses, Native Forbs/Graminoids, Native Shrubs/Vines) and successional status (Pioneer = P, Characteristic = C, and Weedy = W). Legumes are included in the native forbs/graminoids category.

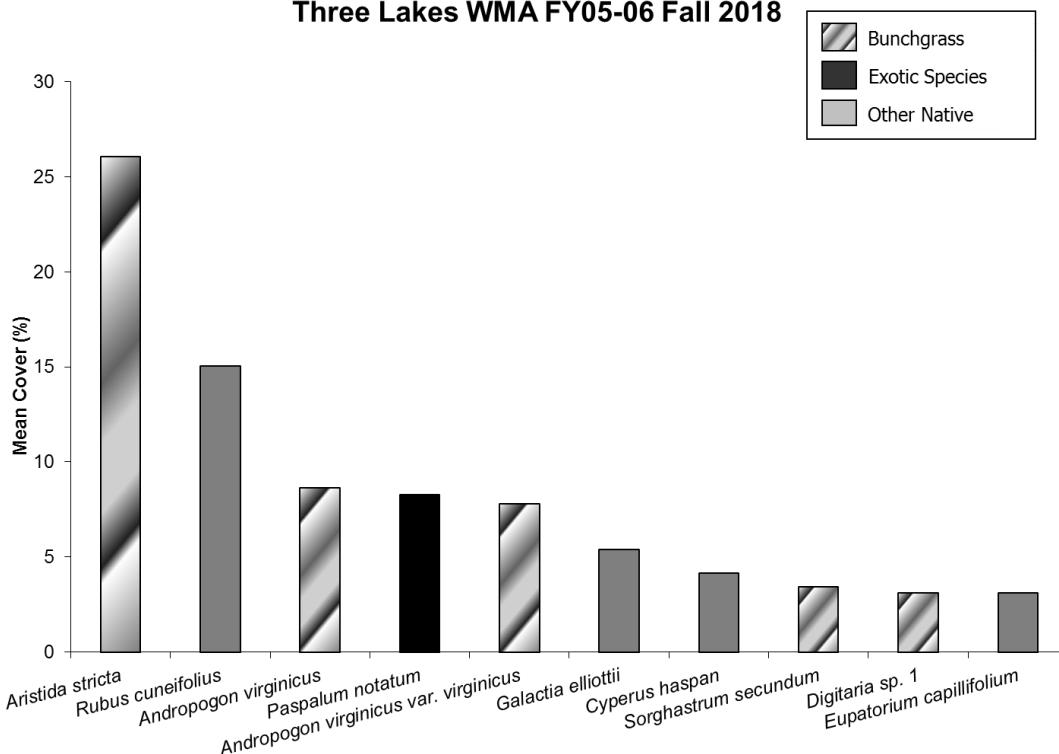
	Native Bunchgrasses				Native Non-Structural Forbs/ Graminoids				Native Shrubs/Vines		
3 Lakes WMA Fall 2018	P	C	W	Total	P	C	W	Total	P	C	Total
Mean % Cover	20%	33%	3%	56%	20%	20%	6%	46%	16%	2%	18%
Mean Species Richness (# of species/quadrat)	2	1	0	3	3	3	1	7	1	0	1
3 Lakes WMA Fall 2016	P	C	W	Total	P	C	W	Total	P	C	Total
Mean % Cover	7%	22%	0%	29%	21%	15%	4%	40%	3%	1%	4%
Mean Species Richness (# of species/quadrat)	1	1	0	2	5	3	1	9	0	0	0

### Three Lakes WMA FY05-06 Fall 2018



**Figure TL2.** Top occurring species based on relative frequency surveyed within the Three Lakes FY05-06 restoration field.

### Three Lakes WMA FY05-06 Fall 2018



**Figure TL3.** Top occurring species based on mean percent cover surveyed within the Three Lakes FY05-06 restoration field.

**Appendix TL1: Three Lakes WMA FY 05-06 Fall 2018 Plant List**

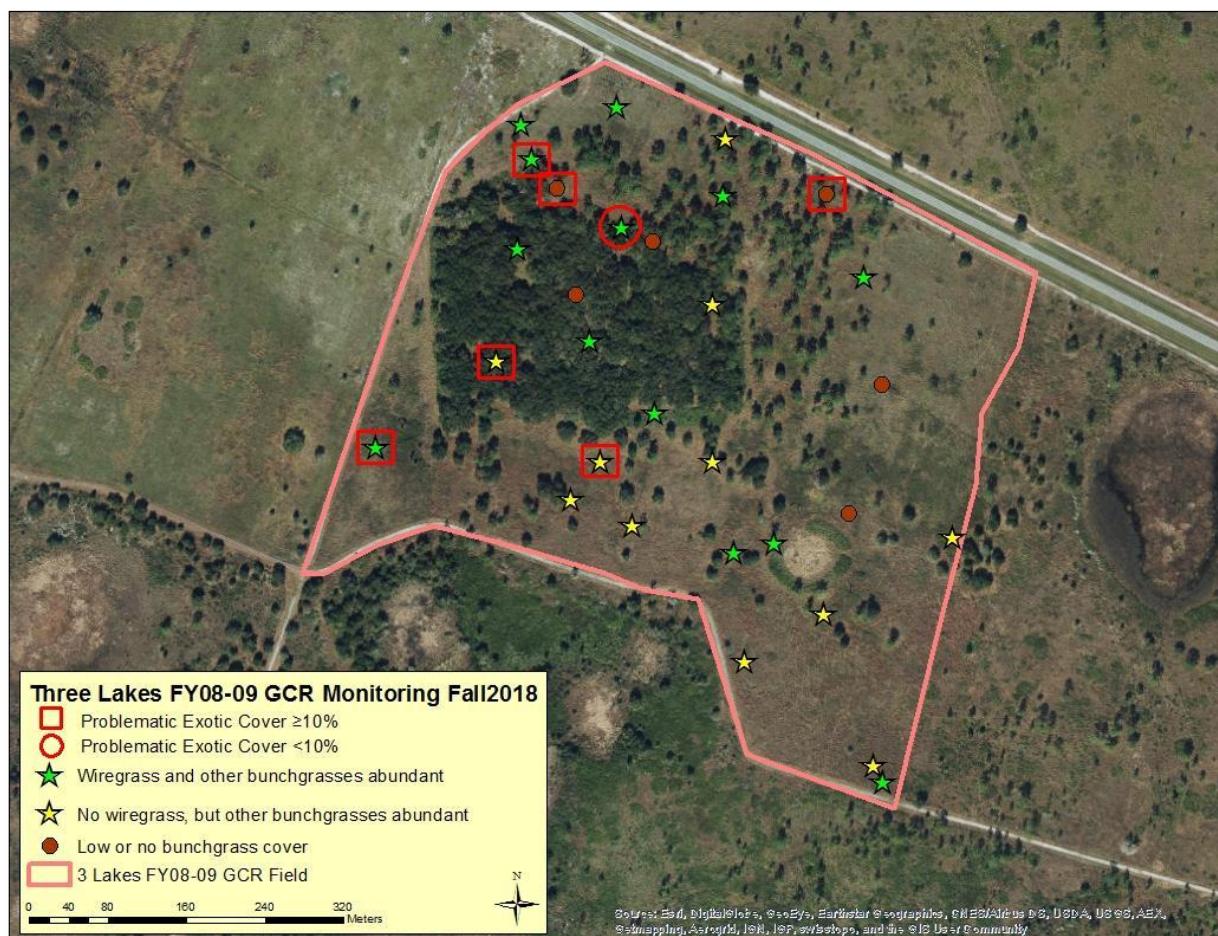
Native Bunchgrasses		
<i>Andropogon brachystachyus</i>	shortspike bluestem	Characteristic
<i>Andropogon glomeratus</i> var. <i>glaucopsis</i>	purple bluestem	Pioneer
<i>Andropogon glomeratus</i> var. <i>glomeratus</i>	bushy bluestem	Pioneer
<i>Andropogon virginicus</i> var. <i>glaucus</i>	chalky bluestem	Characteristic
<i>Andropogon virginicus</i> var. <i>virginicus</i>	broomsedge bluestem	Pioneer
<i>Aristida purpurascens</i>	arrowfeather threeawn	Characteristic
<i>Aristida stricta</i>	wiregrass	Characteristic
<i>Digitaria ciliaris</i>	southern crabgrass	Weedy
<i>Eragrostis elliottii</i>	Elliott's lovegrass	Pioneer
<i>Eragrostis spectabilis</i>	purple lovegrass	Pioneer
<i>Eragrostis virginica</i>	coastal lovegrass	Pioneer
<i>Panicum anceps</i>	beaked panicum	Characteristic
<i>Panicum rigidulum</i>	red top panicum	Pioneer
<i>Schizachyrium scoparium</i>	little bluestem	Characteristic
<i>Setaria parviflora</i>	yellow bristlegrass; knotroot foxtail	Pioneer
<i>Sorghastrum secundum</i>	lopsided Indiangrass	Characteristic
Native Forbs/Graminoids		
<i>Axonopus furcatus</i>	big carpetgrass	Pioneer
<i>Chamaecrista fasciculata</i>	partridge pea	Pioneer
<i>Chamaecrista nictitans</i>	sensitive pea	Pioneer
<i>Cirsium horridulum</i>	purple thistle	Pioneer
<i>Cirsium nuttallii</i>	Nuttall's thistle	Pioneer
<i>Crotalaria rotundifolia</i>	rabbitbells	Pioneer
<i>Cyperus compressus</i>	poorland flatsedge	Pioneer
<i>Cyperus haspan</i>	haspan flatsedge	Pioneer
<i>Cyperus ovatus</i>	pinebarren flatsedge	Pioneer
<i>Cyperus polystachyos</i>	manyspike flatsedge	Pioneer
<i>Cyperus surinamensis</i>	tropical flatsedge	Pioneer
<i>Dichanthelium ensifolium</i>	cypress witchgrass	Characteristic
<i>Diodia virginiana</i>	buttonweed	Characteristic
<i>Elephantopus elatus</i>	tall elephantsfoot	Characteristic
<i>Erechtites hieraciifolius</i>	fireweed	Pioneer
<i>Eupatorium capillifolium</i>	dogfennel	Weedy
<i>Eupatorium mohrii</i>	Mohr's thoroughwort	Characteristic
<i>Euthamia caroliniana</i>	slender flattop goldenrod	Pioneer
<i>Fimbristylis puberula</i>	hairy fimbry	Characteristic
<i>Galactia elliottii</i>	Elliott's milkpea	Characteristic
<i>Helianthus heterophyllus</i>	variableleaf sunflower	Characteristic
<i>Hyptis alata</i>	clustered bushmint; musky mint	Characteristic
<i>Juncus repens</i>	lesser creeping rush	Characteristic

<i>Juncus roemerianus</i>	needle rush	Characteristic
<b>Native Forbs/Graminoids (Cont.)</b>		
<i>Juncus tenuis</i>	path rush	Characteristic
<i>Lachnocaulon anceps</i>	whitehead bogbutton	Characteristic
<i>Liatris elegans</i>	pinkscale gayfeather	Characteristic
<i>Ludwigia octovalvis</i>	Mexican primrosewillow	Pioneer
<i>Oldenlandia uniflora</i>	clustered mille graines	Pioneer
<i>Oxalis corniculata</i>	common yellow woodsorrel	Weedy
<i>Paspalum setaceum</i>	thin paspalum	Pioneer
<i>Pityopsis graminifolia</i>	narrowleaf silkglass	Characteristic
<i>Polypremum procumbens</i>	rustweed	Pioneer
<i>Rhynchospora fascicularis</i>	fascicled beaksedge	Characteristic
<i>Rhynchospora microcarpa</i>	southern beaksedge	Characteristic
<i>Rhynchospora microcephala</i>	bunched beaksedge	Characteristic
<i>Scleria reticularis</i>	netted nutrush	Characteristic
<i>Scoparia dulcis</i>	sweetbroom; licoriceweed	Weedy
<i>Solidago fistulosa</i>	pinebarren goldenrod	Characteristic
<i>Solidago odora</i>	chapman's goldenrod	Characteristic
<i>Sympyotrichum dumosum</i>	rice button aster	Characteristic
<i>Xyris ambigua</i>	coastalplain yelloweyed grass	Characteristic
<i>Xyris brevifolia</i>	shortleaf yelloweyed grass	Characteristic
<i>Xyris caroliniana</i>	Carolina yelloweyed grass	Characteristic
<i>Xyris flabelliformis</i>	savannah yelloweyed grass	Characteristic
<b>Native Shrubs/Vines</b>		
<i>Baccharis halimifolia</i>	groundsel tree; sea myrtle	Pioneer
<i>Hypericum tetrapetalum</i>	fourpetal St. John's-wort	Characteristic
<i>Quercus geminata</i>	sand live oak	Characteristic
<i>Rubus cuneifolius</i>	sand blackberry	Pioneer
<i>Rubus pensylvanicus</i>	sawtooth blackberry	Pioneer
<i>Vitis rotundifolia</i>	muscadine	Pioneer
<b>Exotics</b>		
<i>Cuphea carthagenensis</i>	Colombian waxweed	Weedy
<i>Desmodium triflorum</i>	threeflower ticktrefoil	Weedy
<i>Hemarthria altissima</i>	limpograss	Noxious
<i>Paspalum notatum</i>	bahiagrass	Noxious
<i>Paspalum urvillei</i>	vaseygrass	Weedy
<i>Phyllanthus urinaria</i>	chamber bitter	Weedy
<i>Sacciolepis indica</i>	Indian cupscale	Weedy

## Three Lakes WMA – FY 08-09 FIELD

FALL 2018

The first phase of restoration is complete. Staff have done an excellent job restoring the native bunchgrass structure. It has nice wiregrass distribution throughout (Map TL2), and overall characteristic bunchgrass cover is virtually unchanged from the 2016 survey (Figure TL4). There was a substantial increase in the nonstructural forb/graminoid category due to increased frequency and cover of clustered mille-graines (*Oldenlandia uniflora*) and witchgrasses (*Dichanthelium* spp.) (Figures TL5-TK6). In 2016, sand blackberry was ranked 1<sup>st</sup> in both frequency of occurrence and mean cover. In 2018, it continues to be dominant in the shrub layer, although the rankings have declined to 5<sup>th</sup> and 4<sup>th</sup>, respectively. Other components of the shrub layer have increased such as characteristic St. John's worts (*Hypericum* spp.) and netted pawpaw (*Asimina reticulata*). Bahiagrass was still a widespread issue in this field. Although it declined from 3<sup>rd</sup> to 8<sup>th</sup> in frequency, mean cover estimates increased from about 10% to 15% and it now ranks 2<sup>nd</sup> (Figures TL5-TL6). Given the amount of wiregrass and other bunchgrasses established, this field still has the potential to be a very nice product once the issues with sand blackberry and bahiagrass are brought under control.

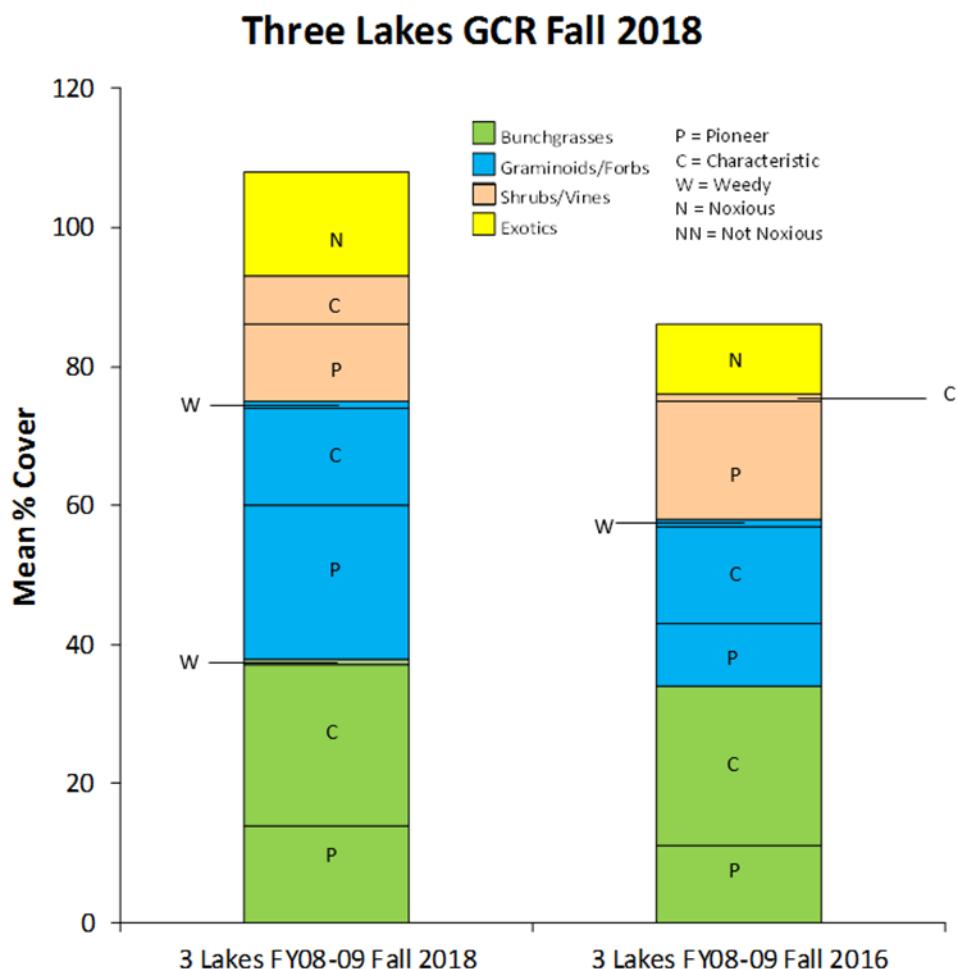


**Map TL2.** Fall 2018 random sample points on the FY08-09 Three Lakes WMA NGCR site.

### Management Recommendations:

- Maintain prescribed fire on a regular 2-3 year return interval.
- Plant Phase II characteristic shrubs and trees such as *Hypericum spp.*, saw palmetto (*Serenoa repens*), blueberries (*Vaccinium spp.*), huckleberries (*Gaylussacia spp.*), and running oaks (*Quercus pumila*).
- Aggressively treat bahiagrass with Plateau to selectively target bahiagrass while preserving wiregrass.
- Treat sand blackberry with a mix of Milestone and Garlon on northern perimeter and south of the oak hammock.

### Detailed Sampling Results:

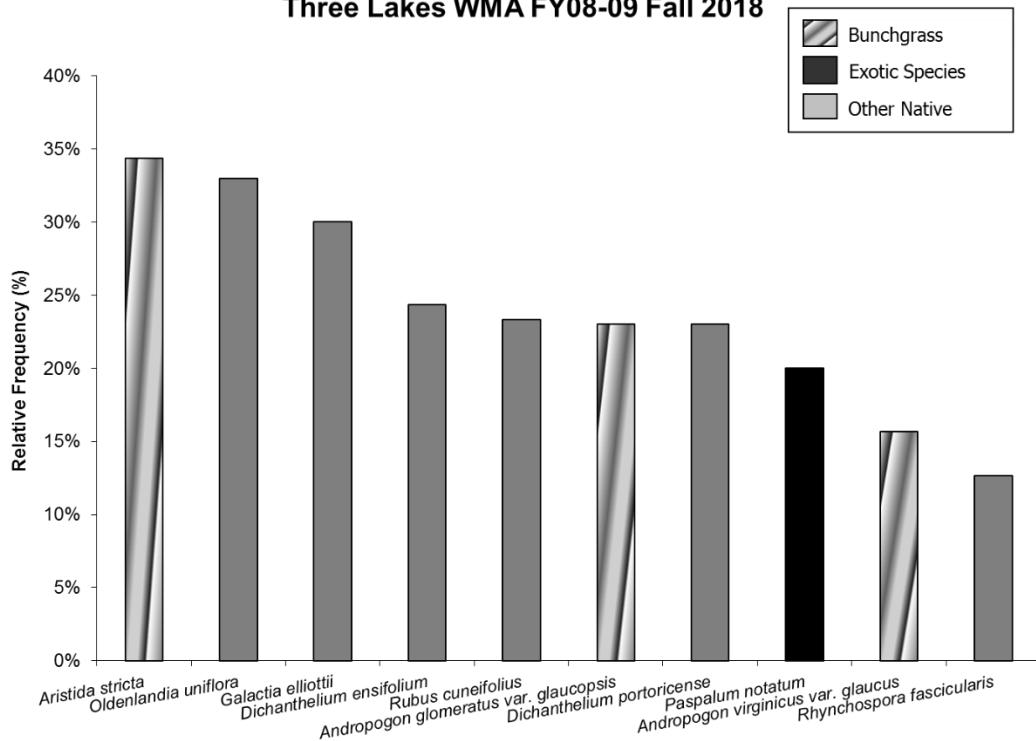


**Figure TL4.** Structure of the Three Lakes WMA FY08-09 Fall 2018 NGCR as compared to the Fall 2016 survey results. This graph depicts the mean percent cover of each functional group in the FY08-09 field for each year. We further broke down the functional groups' (Bunchgrasses, Forbs/Graminoids, Shrubs, and Exotics) mean percent cover by successional status (Pioneer, Characteristic, Weedy, Noxious, and Not Noxious). Legumes are included in the Native Forb/Graminoid category.

**Table TL2.** Mean percent cover and mean species richness at Three Lakes WMA FY08-09 field comparing the Fall 2018 and Fall 2016 survey results. Values are presented by functional group (Native Bunchgrasses, Native Forbs/Graminoids, Native Shrubs/Vines) and successional status (Pioneer = P, Characteristic = C, and Weedy = W). Legumes are included in the Native Forbs/Graminoids category.

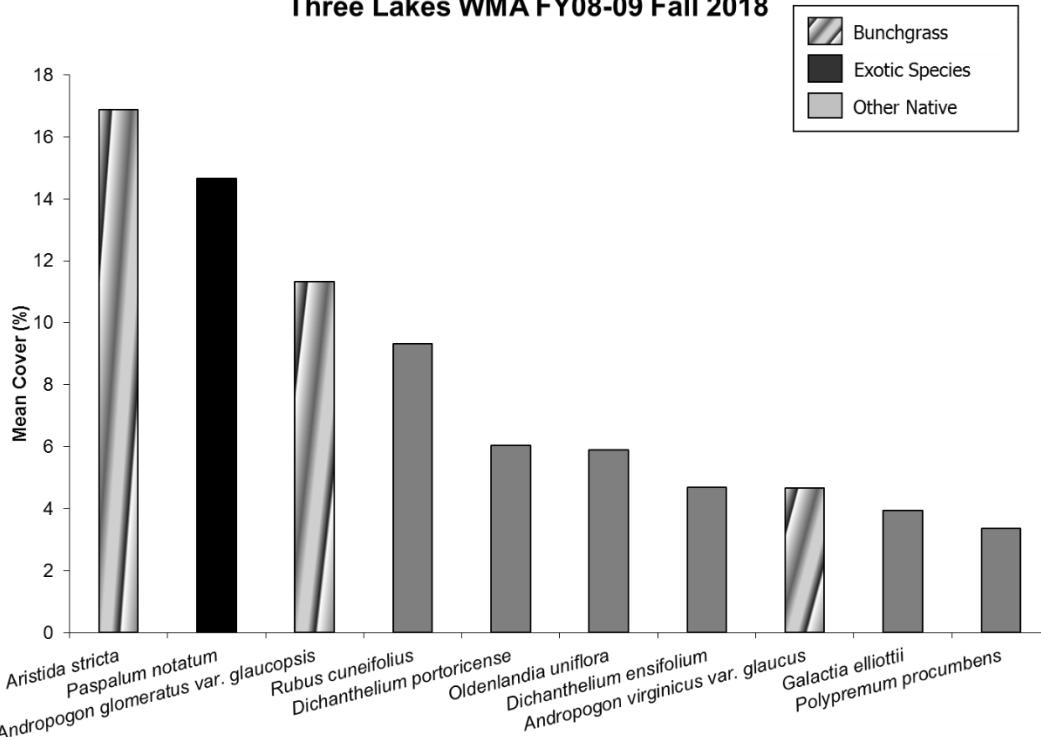
	Native Bunchgrasses				Native Non-Structural Forbs/ Graminoids				Native Shrubs/Vines		
3 Lakes WMA Fall 2018	P	C	W	Total	P	C	W	Total	P	C	Total
Mean % Cover	14%	23%	1%	38%	22%	14%	1%	37%	11%	7%	18%
Mean Species Richness (# of species/quadrat)	1	1	0	2	2	3	0	5	1	1	2
3 Lakes WMA Fall 2016	P	C	W	Total	P	C	W	Total	P	C	Total
Mean % Cover	11%	23%	0%	34%	9%	14%	1%	24%	17%	1%	18%
Mean Species Richness (# of species/quadrat)	1	1	0	2	2	3	0	5	1	0	1

### Three Lakes WMA FY08-09 Fall 2018



**Figure TL5.** Top occurring species based on relative frequency surveyed within the Three Lakes WMA FY08-09 restoration field.

### Three Lakes WMA FY08-09 Fall 2018



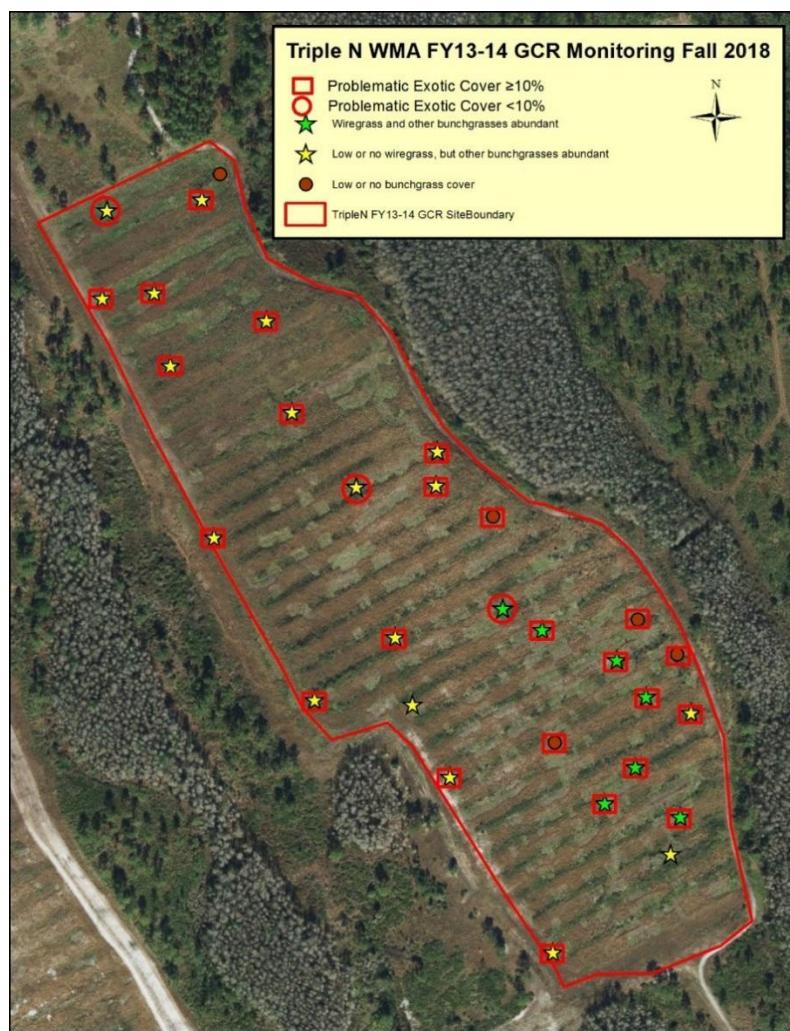
**Figure TL6.** Top occurring species based on mean percent cover surveyed within the Three Lakes WMA FY08-09 restoration field.

## Appendix TL2: Three Lakes WMA FY08-09 Fall 2018 Plant List

Native Bunchgrasses		
<i>Andropogon glomeratus</i> var. <i>glaucopsis</i>	purple bluestem	Pioneer
<i>Andropogon virginicus</i> var. <i>glaucus</i>	chalky bluestem	Characteristic
<i>Andropogon virginicus</i> var. <i>virginicus</i>	broomsedge bluestem	Pioneer
<i>Aristida stricta</i>	wiregrass	Characteristic
<i>Digitaria ciliaris</i>	southern crabgrass	Weedy
<i>Eragrostis ellottii</i>	Elliott's lovegrass	Pioneer
<i>Eustachys petraea</i>	pinewoods fingergrass	Pioneer
<i>Panicum anceps</i>	beaked panicum	Characteristic
<i>Panicum rigidulum</i>	red top panicum	Pioneer
<i>Sorghastrum secundum</i>	lopsided Indiangrass	Characteristic
Native Forbs/Graminoids		
<i>Axonopus fissifolius</i>	common carpetgrass	Pioneer
<i>Axonopus furcatus</i>	big carpetgrass	Pioneer
<i>Buchnera americana</i>	American bluehearts	Pioneer
<i>Chamaecrista fasciculata</i>	partridge pea	Pioneer
<i>Chamaecrista nictitans</i>	sensitive pea	Pioneer
<i>Crotalaria rotundifolia</i>	rabbitbells	Pioneer
<i>Croton michauxii</i>	rushfoil	Characteristic
<i>Cyperus ovatus</i>	pinebarren flatsedge	Pioneer
<i>Cyperus polystachyos</i>	manyspike flatsedge	Pioneer
<i>Dichanthelium acuminatum</i> var. <i>acuminatum</i>	tapered witchgrass	Characteristic
<i>Dichanthelium ensifolium</i>	cypress witchgrass	Characteristic
<i>Dichanthelium portoricense</i>	hemlock witchgrass	Pioneer
<i>Dichanthelium aciculare</i>	needleleaf witchgrass	Pioneer
<i>Eupatorium mohrii</i>	Mohr's thoroughwort	Characteristic
<i>Euthamia caroliniana</i>	slender flattop goldenrod	Pioneer
<i>Galactia elliottii</i>	Elliott's milkpea	Characteristic
<i>Gratiola hispida</i>	rough hedgehyssop	Characteristic
<i>Helianthemum corymbosum</i>	pinebarren frostweed	Characteristic
<i>Houstonia procumbens</i>	innocence; roundleaf bluet	Pioneer
<i>Juncus effusus</i>	soft rush	Characteristic
<i>Juncus megacephalus</i>	bighead rush	Characteristic
<i>Lachnocaulon anceps</i>	whitehead bogbutton	Characteristic
<i>Ludwigia octovalvis</i>	Mexican primrosewillow	Pioneer
<i>Oldenlandia uniflora</i>	clustered mille graines	Pioneer
<i>Oxalis corniculata</i>	common yellow woodsorrel	Weedy
<i>Paspalum setaceum</i>	thin paspalum	Pioneer
<i>Pityopsis graminifolia</i>	narrowleaf silkgrass	Characteristic
<i>Polypremum procumbens</i>	rustweed	Pioneer
<i>Pterocaulon pycnostachyum</i>	blackroot	Pioneer

<i>Rhexia mariana</i>	pale meadowbeauty;	Characteristic
<b>Native Forbs/Graminoids</b>		
<i>Rhynchospora fascicularis</i>	fascicled beaksedge	Characteristic
<i>Scleria reticularis</i>	netted nutrush	Characteristic
<i>Scoparia dulcis</i>	sweetbroom; licoriceweek	Weedy
<i>Solidago fistulosa</i>	pinebarren goldenrod	Characteristic
<i>Solidago odora</i>	chapman's goldenrod	Characteristic
<i>Stillingia sylvatica</i>	queensdelight	Characteristic
<i>Xyris brevifolia</i>	shortleaf yelloweyed grass	Characteristic
<i>Xyris caroliniana</i>	Carolina yelloweyed grass	Characteristic
<i>Xyris jupicai</i>	Richard's yelloweyed grass	Characteristic
<b>Native Shrubs/Vines</b>		
<i>Asimina reticulata</i>	netted pawpaw	Characteristic
<i>Hypericum cistifolium</i>	roundpod St. John's-wort	Characteristic
<i>Hypericum tetrapetalum</i>	fourpetal St. John's-wort	Characteristic
<i>Hypericum crux-andreae</i>	St. Peter's-wort	Characteristic
<i>Quercus geminata</i>	sand live oak	Characteristic
<i>Quercus laurifolia</i>	laurel oak; diamond oak	Characteristic
<i>Quercus minima</i>	dwarf live oak	Characteristic
<i>Rubus cuneifolius</i>	sand blackberry	Pioneer
<i>Rubus pensylvanicus</i>	sawtooth blackberry,	Pioneer
<i>Serenoa repens</i>	saw palmetto	Characteristic
<i>Smilax auriculata</i>	earleaf greenbrier	Pioneer
<i>Smilax laurifolia</i>	laurel greenbrier; bamboo vine	Characteristic
<i>Vaccinium myrsinites</i>	shiny blueberry	Characteristic
<i>Vitis rotundifolia</i>	muscadine	Pioneer
<b>Exotics</b>		
<i>Paspalum notatum</i>	bahiagrass	Noxious

Once on track for success, this field has degraded to the point where it may be a complete redo. Native bunchgrasses occurred at most of the sample points (Map TN1) and consisted mostly of broomsedge bluestem at densities sufficient to carry fire. In fact, characteristic bunchgrasses have increased substantially since 2016 (Figure TN1; Table TN1). Wiregrass ranked 7<sup>th</sup> and 9<sup>th</sup> in terms of frequency and cover, respectively (Figures TN2–TN3). Unfortunately, problematic exotics were also recorded at almost every sample point. Noxious exotics have also continued to increase since 2016 and are now one of the dominant components of this field (Table TN1). Five noxious exotics including cogongrass, smutgrass, Peruvian primrosewillow, hairy indigo, and bahiagrass ranked in the top ten mean cover list having higher mean cover estimates than wiregrass (Figure TN3). Overall, only 77 species were recorded in 2018, substantially fewer than the 122 species observed in 2016. Although characteristic bunchgrasses had a slight increase in species richness, it decreased in almost every other category except for shrubs and vines. Furthermore, most of the exotics recorded in 2016 were of the non-noxious variety and were a relatively minor component of the vegetation. This field is a classic example of what can happen if management does not continue to stay on top of and treat exotics. It will take tremendous effort to get this field back under control.

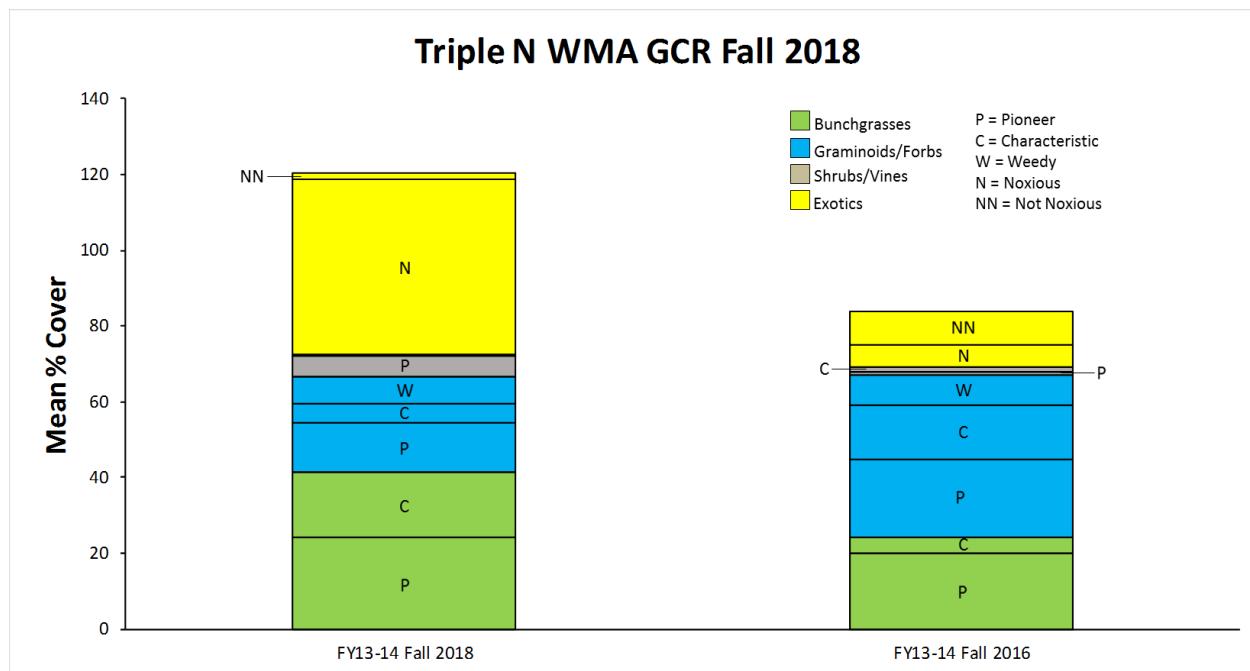


**Map TN1.** Fall 2018 random sample points on the FY13-14 Triple N WMA NGCR site.

**Management Recommendations:**

- Scrap and convert into wildlife food plot.

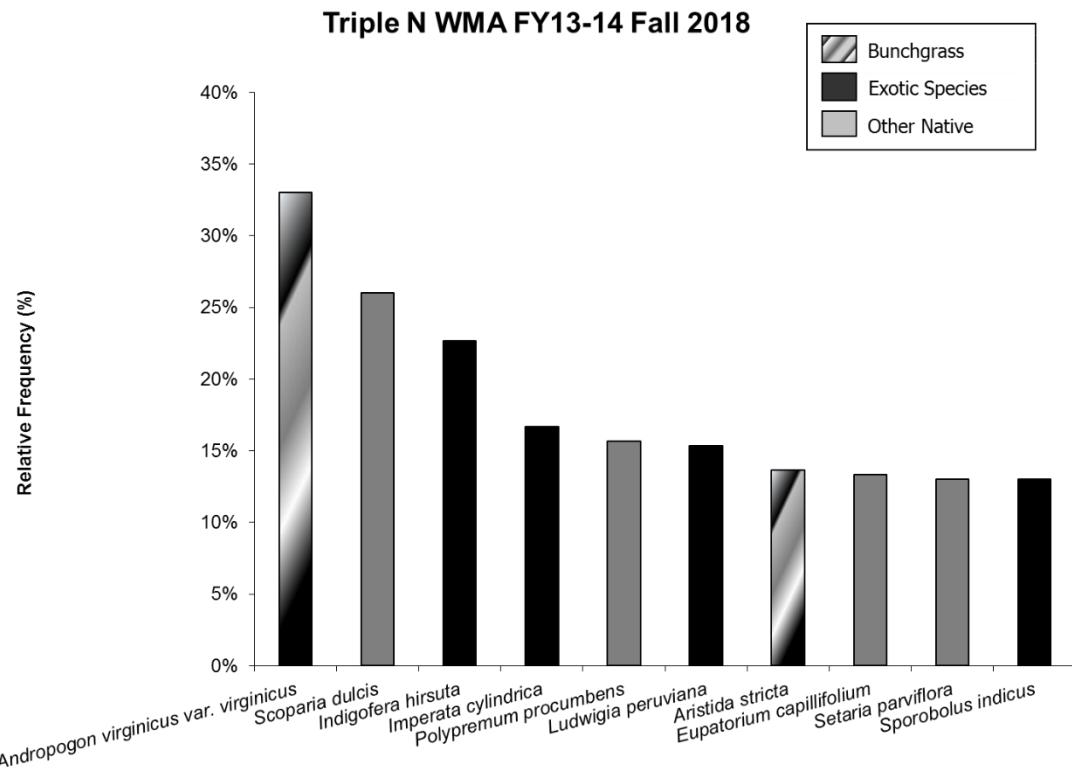
**Detailed Sampling Results:**



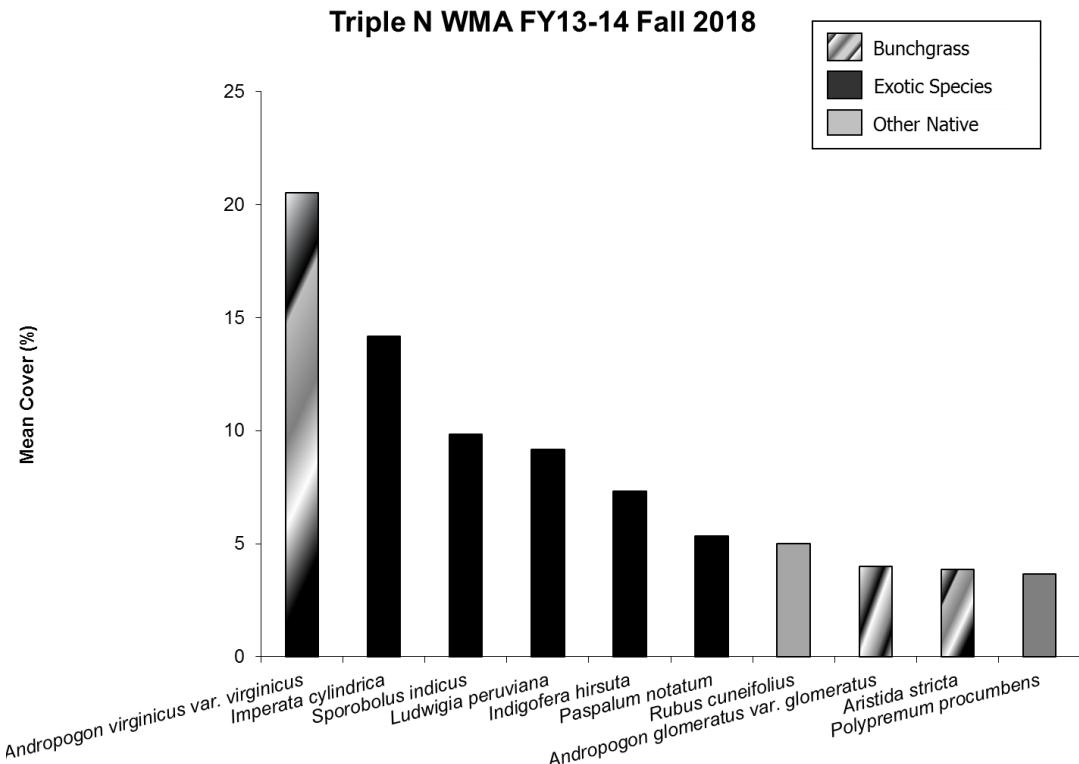
**Figure TN1.** Structure of the NGCR site at Triple N WMA comparing the Fall 2018 survey results of the FY13-14 field to the Fall 2016 survey results. This graph depicts the mean percent cover of each functional group in each field. We further broke down the functional groups' (Bunchgrasses, Forbs/Graminoids, Shrubs, and Exotics) mean percent cover by successional status (Pioneer, Characteristic, Weedy, Noxious, and Not Noxious). Legumes are included in the Native Forb/Graminoid category.

**Table TN1.** Mean percent cover and mean species richness at Triple N WMA comparing the Fall 2018 and Fall 2016 survey results. Values are presented by functional group (Native Bunchgrasses, Native Forbs/Graminoids, Native Shrubs/Vines) and successional status (Pioneer = P, Characteristic = C, and Weedy = W). Legumes are included in the Native Forbs/Graminoids category.

	Native Bunchgrasses				Native Non-Structural Forbs/ Graminoids				Native Shrubs/Vines		
Triple N WMA Fall 2018	P	C	W	Total	P	C	W	Total	P	C	Total
Mean % Cover	24%	17%	0%	41%	13%	5%	7%	25%	6%	0%	6%
Mean Species Richness (# of species/quadrat)	1.3	1.1	0	2.4	2.3	1.3	1.1	4.7	0.3	0.1	0.4
Triple N WMA Fall 2016	P	C	W	Total	P	C	W	Total	P	C	Total
Mean % Cover	20%	4%	0%	24%	21%	14%	8%	43%	1%	1%	2%
Mean Species Richness (# of species/quadrat)	2.1	0.7	0.1	2.9	4.1	2.7	1	7.8	0	0.2	0.2



**Figure TN2.** Top occurring species based on relative frequency surveyed within the Triple N WMA FY13-14 restoration field.



**Figure TN3.** Top occurring species based on mean percent cover surveyed within the Triple N WMA FY13-14 restoration field.

**Appendix TN1: Triple N FY13-14 Fall 2018 Plant List**

Native Bunchgrasses		
<i>Andropogon brachystachyus</i>	shortspike bluestem	Characteristic
<i>Andropogon glomeratus</i> var. <i>glomeratus</i>	bushy bluestem	Pioneer
<i>Andropogon virginicus</i> var. <i>glaucus</i>	chalky bluestem	Characteristic
<i>Andropogon virginicus</i> var. <i>virginicus</i>	broomsedge bluestem	Pioneer
<i>Aristida stricta</i>	wiregrass	Characteristic
<i>Eragrostis elliottii</i>	Elliott's lovegrass	Pioneer
<i>Eragrostis spectabilis</i>	purple lovegrass	Pioneer
<i>Eustachys petraea</i>	pinewoods fingergrass	Pioneer
<i>Schizachyrium scoparium</i>	little bluestem	Characteristic
<i>Setaria parviflora</i>	yellow bristlegrass; knotroot foxtail	Pioneer
<i>Sorghastrum secundum</i>	lopsided Indiangrass	Characteristic
Native Forbs/Graminoids		
<i>Aeschynomene americana</i>	shyleaf	Weedy
<i>Bacopa caroliniana</i>	lemon bacopa; blue waterhyssop	Characteristic
<i>Boltonia diffusa</i>	smallhead doll's daisy	Pioneer
<i>Chamaecrista nictitans</i>	sensitive pea	Pioneer
<i>Conyza canadensis</i>	Canadian horseweed	Weedy
<i>Crotalaria rotundifolia</i>	rabbitbells	Pioneer
<i>Cyperus compressus</i>	poorland flatsedge	Pioneer
<i>Cyperus haspan</i>	haspan flatsedge	Pioneer
<i>Cyperus ovatus</i>	pinebarren flatsedge	Pioneer
<i>Cyperus polystachyos</i>	manyspike flatsedge	Pioneer
<i>Cyperus surinamensis</i>	tropical flatsedge	Pioneer
<i>Dichanthelium ensifolium</i>	cypress witchgrass	Characteristic
<i>Diodia virginiana</i>	buttonweed	Characteristic
<i>Elephantopus elatus</i>	tall elephantsfoot	Characteristic
<i>Erechtites hieraciifolius</i>	fireweed	Pioneer
<i>Eupatorium capillifolium</i>	dogfennel	Weedy
<i>Euthamia caroliniana</i>	slender flattop goldenrod	Pioneer
<i>Fimbristylis puberula</i>	hairy fimbry	Characteristic
<i>Galactia elliottii</i>	Elliott's milkpea	Characteristic
<i>Helianthemum corymbosum</i>	pinebarren frostweed	Characteristic
<i>Helianthus radula</i>	stiff sunflower	Characteristic
<i>Hydrocotyle umbellata</i>	manyflower marshpennywort	Pioneer
<i>Juncus megacephalus</i>	bighead rush	Characteristic
<i>Ludwigia octovalvis</i>	Mexican primrosewillow	Pioneer
<i>Mikania scandens</i>	climbing hempvine	Characteristic
<i>Mimosa quadrivalvis</i>	sensitive brier	Characteristic
<i>Oldenlandia uniflora</i>	clustered mille graines	Pioneer
<i>Ophioglossum petiolatum</i>	stalked adder's tongue	Pioneer
<i>Oxalis corniculata</i>	common yellow woodsorrel	Weedy
<i>Pityopsis graminifolia</i>	narrowleaf silkgrass	Characteristic
<i>Polypremum procumbens</i>	rustweed	Pioneer
<i>Rhynchospora cephalantha</i>	bunched beaksedge	Characteristic

<i>Rhynchospora fascicularis</i>	fascicled beaksedge	Characteristic
<i>Rhynchospora microcephala</i>	bunched beaksedge	Characteristic
<b>Native Forbs/Graminoids (Cont.)</b>		
<i>Rhynchospora plumosa</i>	plumed beaksedge	Characteristic
<i>Scoparia dulcis</i>	sweetbroom; licoriceweed	Weedy
<i>Solidago odora</i>	chapman's goldenrod	Characteristic
<i>Sympyotrichum adnatum</i>	scaleleaf aster	Characteristic
<i>Sympyotrichum dumosum</i>	rice button aster	Characteristic
<i>Xyris ambigua</i>	coastalplain yelloweyed grass	Characteristic
<i>Xyris brevifolia</i>	shortleaf yelloweyed grass	Characteristic
<i>Xyris flabelliformis</i>	savannah yelloweyed grass	Characteristic
<b>Native Shrubs/Vines</b>		
<i>Baccharis halimifolia</i>	groundsel tree; sea myrtle	Pioneer
<i>Hypericum tetrapetalum</i>	fourpetal St. John's-wort	Characteristic
<i>Rubus penssilvanicus</i>	sawtooth blackberry	Pioneer
<i>Rubus cuneifolius</i>	sand blackberry	Pioneer
<b>Exotics</b>		
<i>Cuphea carthagenensis</i>	Colombian waxweed	Not Noxious
<i>Eragrostis atrovirens</i>	thalia lovegrass	Noxious
<i>Imperata cylindrica</i>	cogongrass	Noxious
<i>Indigofera hirsuta</i>	hairy indigo	Noxious
<i>Lindernia crustacea</i>	Malaysian false pimpernel	Not Noxious
<i>Ludwigia peruviana</i>	Peruvian primrosewillow	Noxious
<i>Macroptilium lathyroides</i>	wild bushbean	Not Noxious
<i>Paspalum notatum</i>	bahiagrass	Noxious
<i>Phyllanthus urinaria</i>	chamber bitter	Not Noxious
<i>Sacciolepis indica</i>	Indian cupscale	Not Noxious
<i>Senna obtusifolia</i>	coffeeweed, sicklepod	Not Noxious
<i>Sporobolus indicus</i>	smutgrass	Noxious
<i>Urena lobata</i>	caesarweed	Noxious

## Final Site Assessments

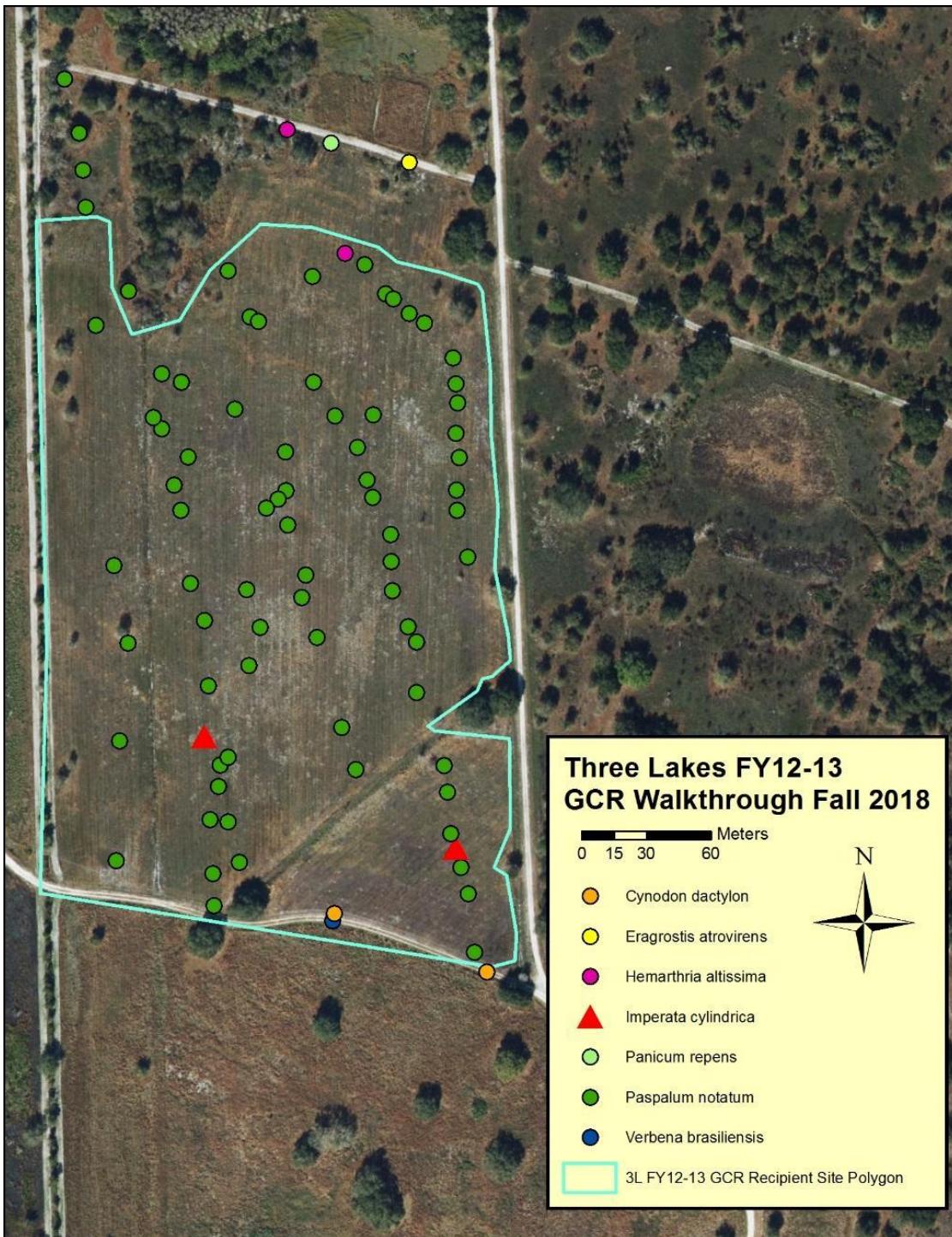
During 2018 initial and final site assessments, FWRI recorded exotic species occurrences as GPS waypoints during our initial and final field canvassing. These files are available upon request, and hopefully will aid managers in locating the remaining exotic holdouts. We provided a summary and map of each assessment below.

### Three Lakes Wildlife Management Area FY12-13 (Final walkthrough)

First phase of restoration is on track for success. Native bunchgrass structure appears to be restored, although noxious exotics continue to be an issue. Pasture grasses and exotic species are still problematic at such a level that spot treatments might not be as effective as treating the whole field. Bahiagrass was still widespread and found in large areas throughout (Map SA1). Although a fair density of native bunchgrasses including broomsedge bluestem, purple bluestem, and lopsided Indiangrass were observed, bahiagrass was so pervasive that spot treatments might leave the field mostly barren. Wiregrass was not abundant and was observed primarily in the southern end. Other exotic species were also present at this site. Two small areas of cogongrass (*Imperata cylindrica*) were observed along two transects and are currently at manageable densities, if treated immediately. Other exotics such as noxious bermudagrass (*Cynodon dactylon*), and non-noxious Indian cupscale (*Sacciolepis indica*) are consistently found throughout the field with Brazilian vervain (*Verbena brasiliensis*), torpedograss (*Panicum repens*), and limpograss (*Hemarthria altissima*) found at the borders. Overall this site is in fair condition, but aggressive management of exotics is still necessary. Additional monitoring is recommended.

### **Management Recommendations:**

- Consider option to retreat whole field and replant
- Treat all noxious exotics:
  - Bermudagrass - spot treat with Arsenal (imazapyr) + Roundup (glyphosate) as recommended by the implementation guidebook (FWC 2010). Do not disk!
  - Bahiagrass - spot treat with Roundup; Roundup Ultra (glyphosate) as recommended by the implementation guidebook (FWC 2010).
  - Torpedograss - multiple treatments with glyphosate (3%), imazapyr (1%) or both to eliminate as recommended by the implementation guidebook (FWC 2010)
  - Smutgrass - spot treat with glyphosate before seed develops (late May - June); as recommended by the implementation guidebook (FWC 2010). Repeat as often as possible.
  - Vaseygrass - same as for smutgrass, however it seems to decrease over time if native species are predominant.
- Introduce/maintain prescribed fire on a regular 2-3 year return interval.
- Recommend further monitoring



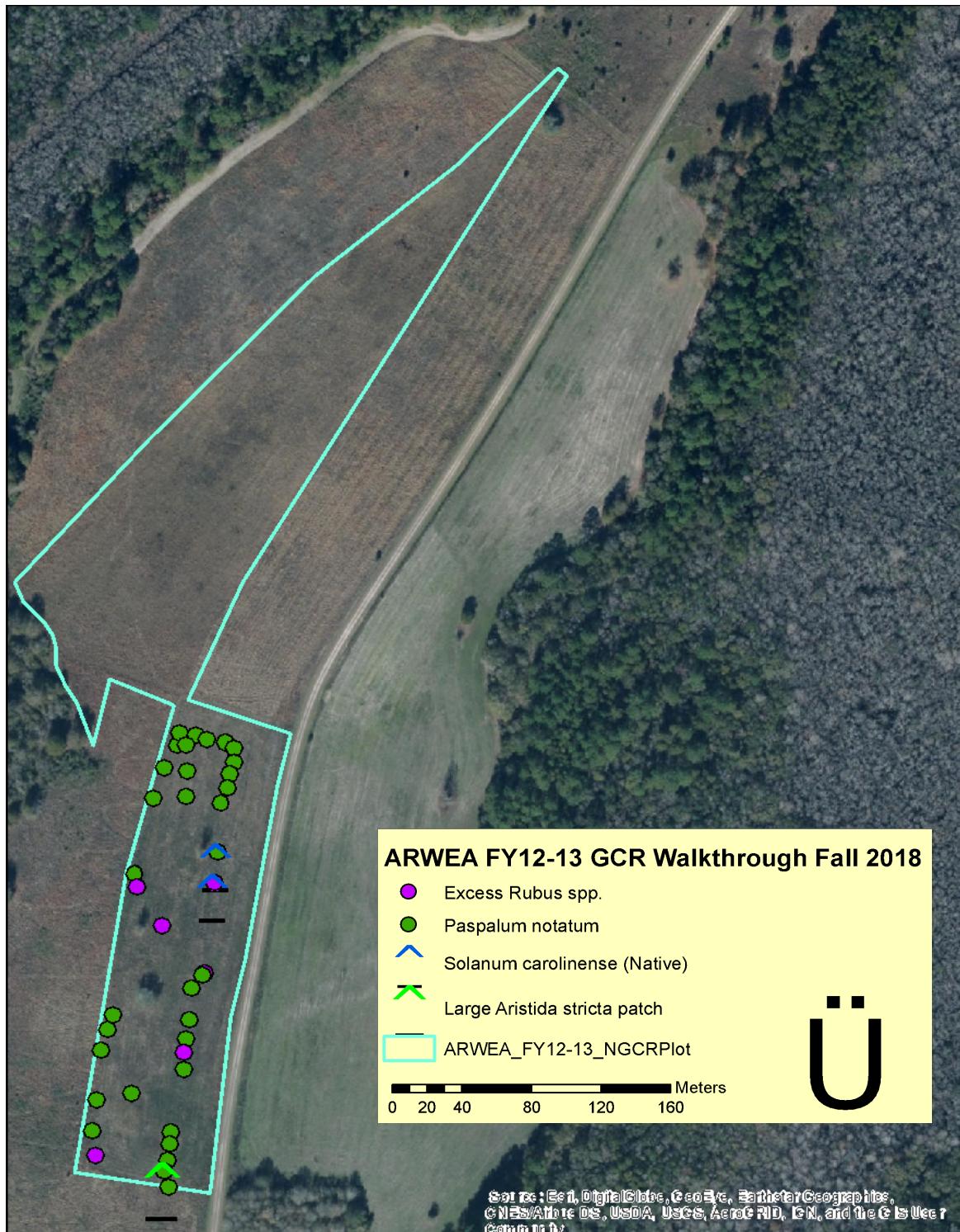
**Map SA1.** GPS marked locations for exotic species occurring within the Three Lakes Wildlife Management Area FY12-13 restoration field.

### Apalachicola River Wildlife and Environmental Area FY12-13 (Final walkthrough)

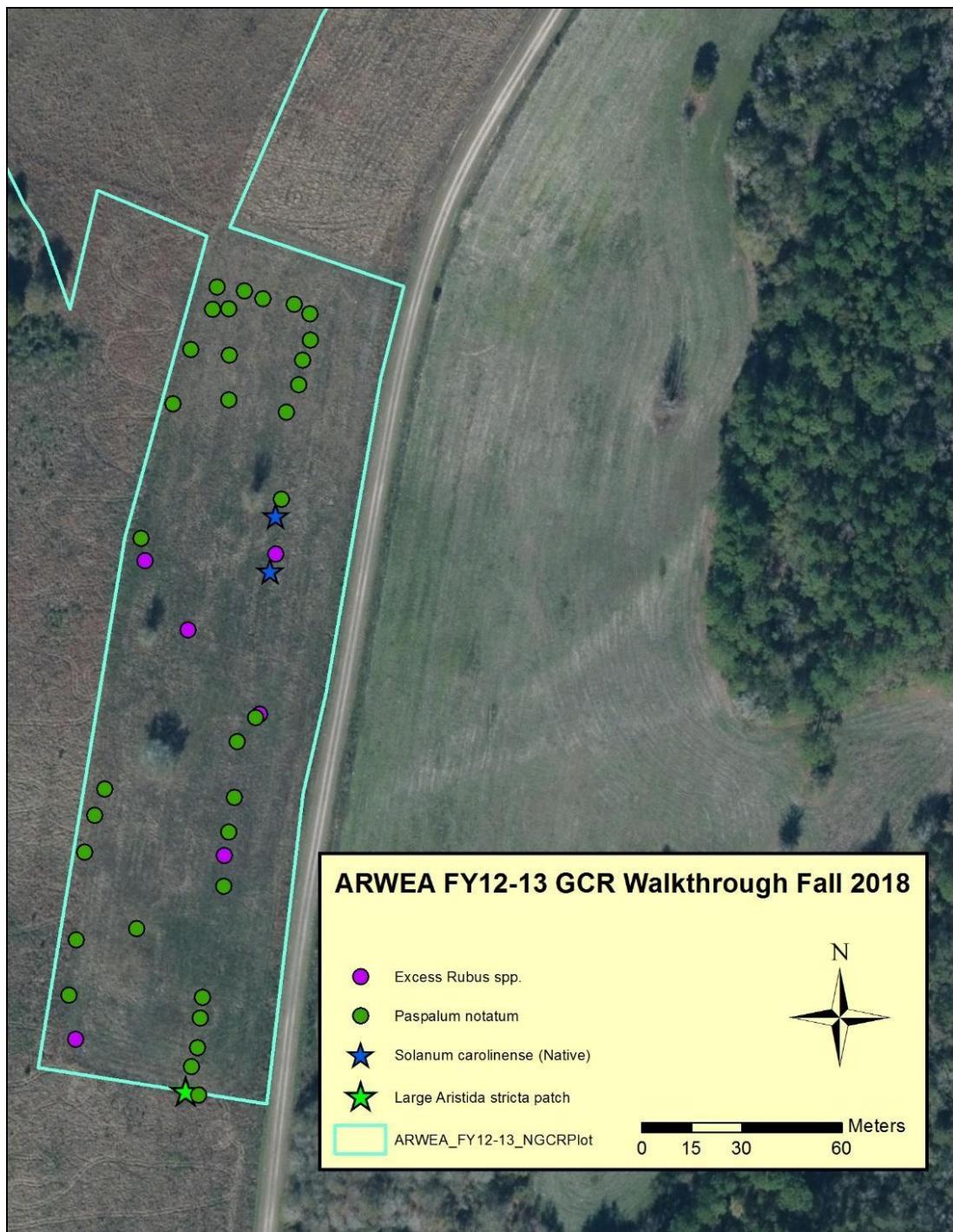
The first restoration phase for the northern end of the field is complete and is an excellent example of an NGCR field. Restoration of the native bunchgrass structure has occurred. Wiregrass was common throughout, and exotics are under control (Map SA2). There is good cover of graminoids/forbs throughout, the majority of which are characteristic species, with no observations of bahiagrass. Shrub cover is predominantly comprised of 3 species of blackberry (*Rubus* spp.) which may need control if cover increases but currently they remain present in manageable patches. The Southern portion of this field was originally the FY06-07 NGCR field, but due to the high blackberry cover, lack of wiregrass, and persistent bahiagrass, it was started over in FY12-13 with another round of site preparation and seeding. However, it continues to have issues with bahiagrass which is currently densely spread throughout the field in large areas. Blackberries are also becoming dominant in this section. Although bunchgrasses such as broomsedge bluestem have been able to establish, they soon might be overwhelmed by blackberry (Map SA3). Staff should continue to spot treat the southern end aggressively and continue monitoring the north end for invasive species.

#### **Management Recommendations:**

- Introduce/maintain prescribed fire for the northern end on a regular 2-3 year return interval.
- Plant characteristic shrubs, forbs, and trees, such as St. John's wort (*Hypericum* spp.), blueberries (*Vaccinium* spp.), huckleberries (*Gaylussacia* spp), wax myrtles, Dahoon holly (*Ilex cassine* var *cassine*), and longleaf pine on the northern end of the field.
- Reseed/Plant wiregrass plugs on the southern end of the field.
- Spot treat bahiagrass with Plateau.
- Treat blackberries using an herbicide mix of Milestone and Garlon.
- Continue monitoring the southern end of the field.



**Map SA2.** GPS marked locations for exotic species occurring within the Apalachicola River Wildlife and Environmental Area FY12-13 restoration field.



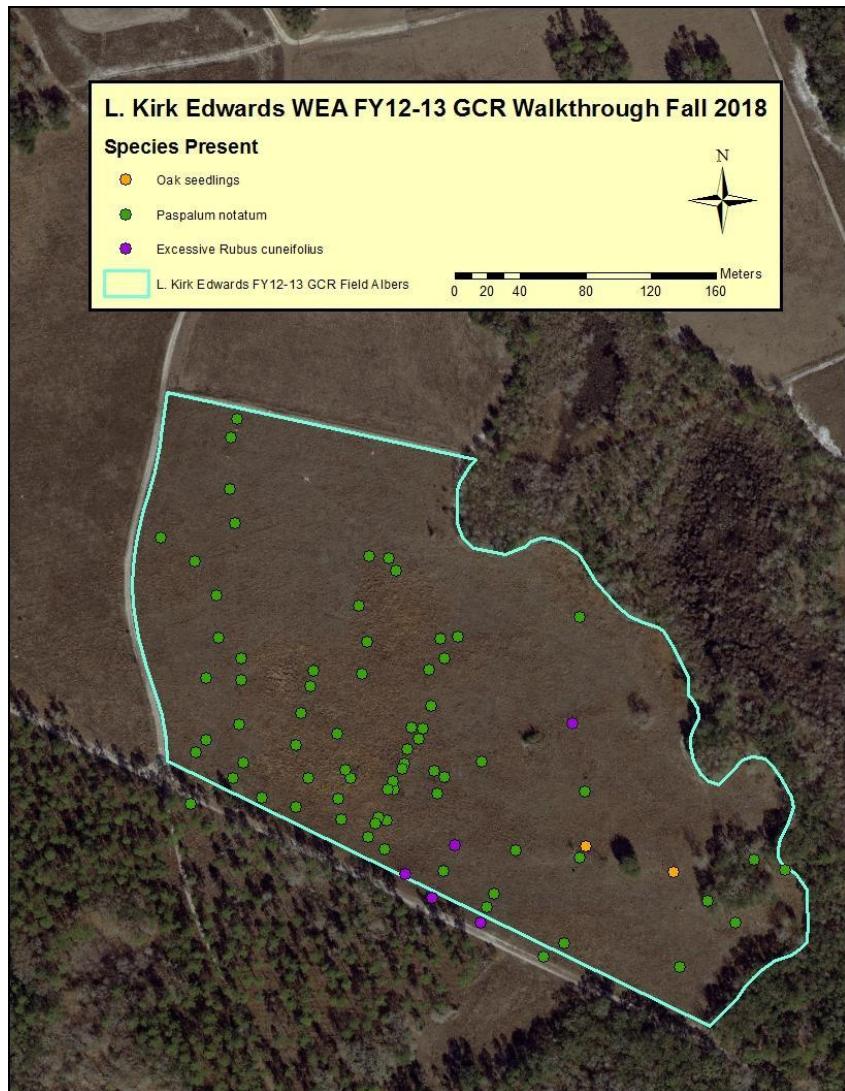
**Map SA3.** GPS marked locations for exotic species occurring within the Apalachicola River Wildlife and Environmental Area FY12-13 restoration field.

#### L. Kirk Edwards Wildlife and Environmental Area FY12-13 (Final walkthrough)

Restoration of the native bunchgrass structure has occurred. Characteristic bunchgrasses continue to increase from the prior sampling period, and the bunchgrass distribution occurs throughout the entire field. There was an excellent mix of wiregrass, bluestems, and other forbs as well as good amounts of bare ground. Though there were patches of blackberry, bahiagrass, and oaks, these can be spot-treated easily if treated as soon as possible.

#### **Management Recommendations:**

- Introduce/maintain prescribed fire on a regular 2-3 year return interval.
- Spot treat bahiagrass using Plateau after a growing season burn and replant with natives after successful treatment.
- Plant characteristic trees such as longleaf pine, and native shrubs such as saw palmetto, blueberries (*Vaccinium* spp,), huckleberries (*Gaylussacia* spp), and running oaks (*Quercus pumila*) throughout the field.



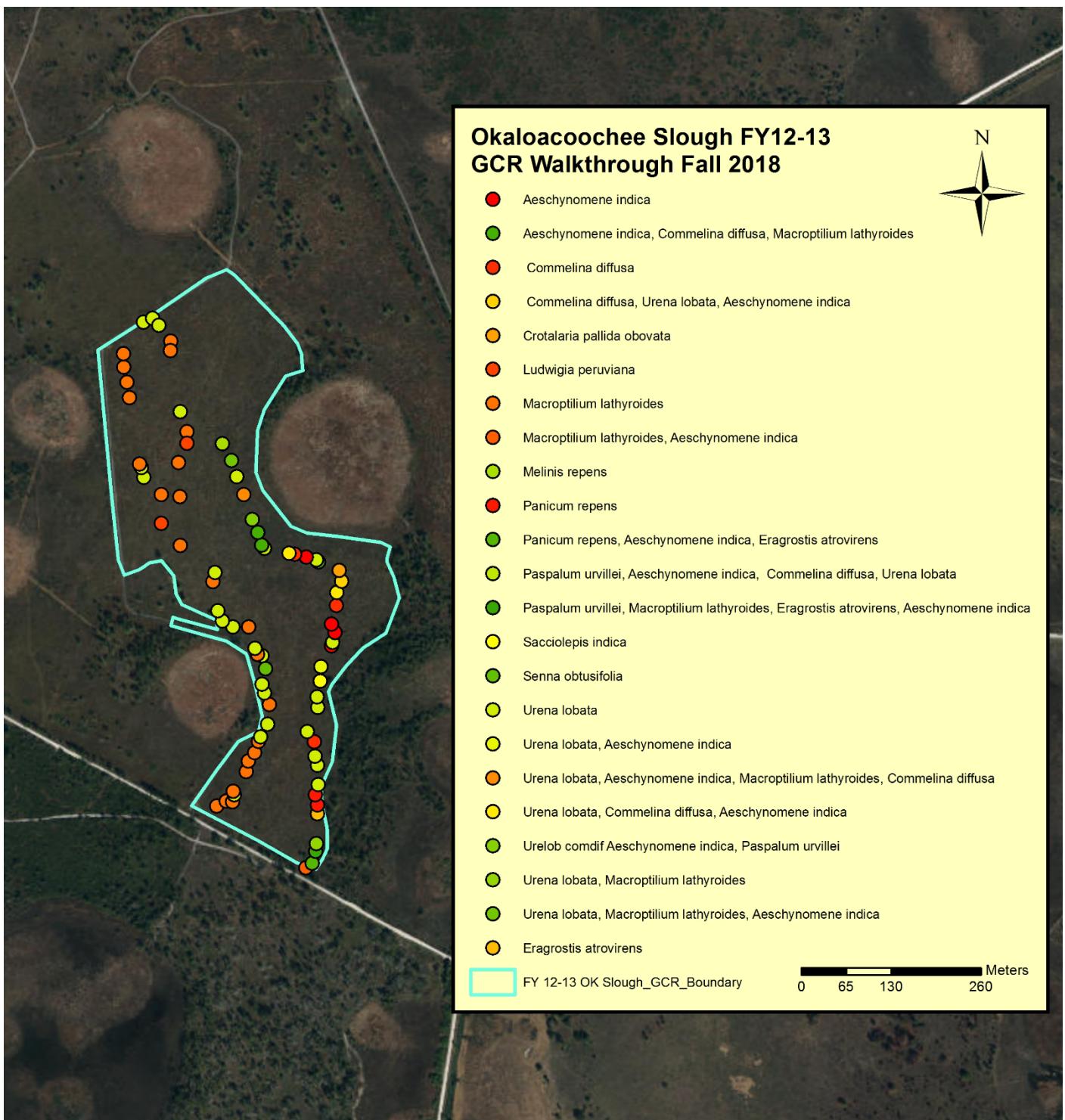
**Map SA4.** GPS marked locations for exotic species occurring within the L. Kirk Edwards Wildlife and Environmental Area FY12-13 restoration field.

#### Okaloacoochee Slough Wildlife Management Area FY 12-13

Invasive and nonnative plants have extensively spread throughout this field, since it was last monitored 2 years ago. Caesarweed (*Urena lobata*), Indian jointvetch (*Aeschynomene indica*), and common dayflower (*Commelina diffusa*) were observed in dense widespread patches. Vaseygrass, torpedograss (*Panicum repens*), and wild bushbean (*Macroptilium lathyroides*) were also observed but scattered throughout the field. Indian jointvetch was the dominant species across the entire landscape. Bunchgrasses, such as bluestems and muhlygrass (*Muhlenbergia capillaris*), were very thinly dispersed throughout the field. It will take a tremendous effort to get this field back under control. This field is probably a total redo.

#### **Management Recommendations:**

- Scrap and convert into wildlife food plot.



Map SA4. GPS marked locations for exotic species occurring within the Okaloacoochee Slough Wildlife Management Area FY 12-13 restoration field.

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