

Exhibit U

Recreation Map

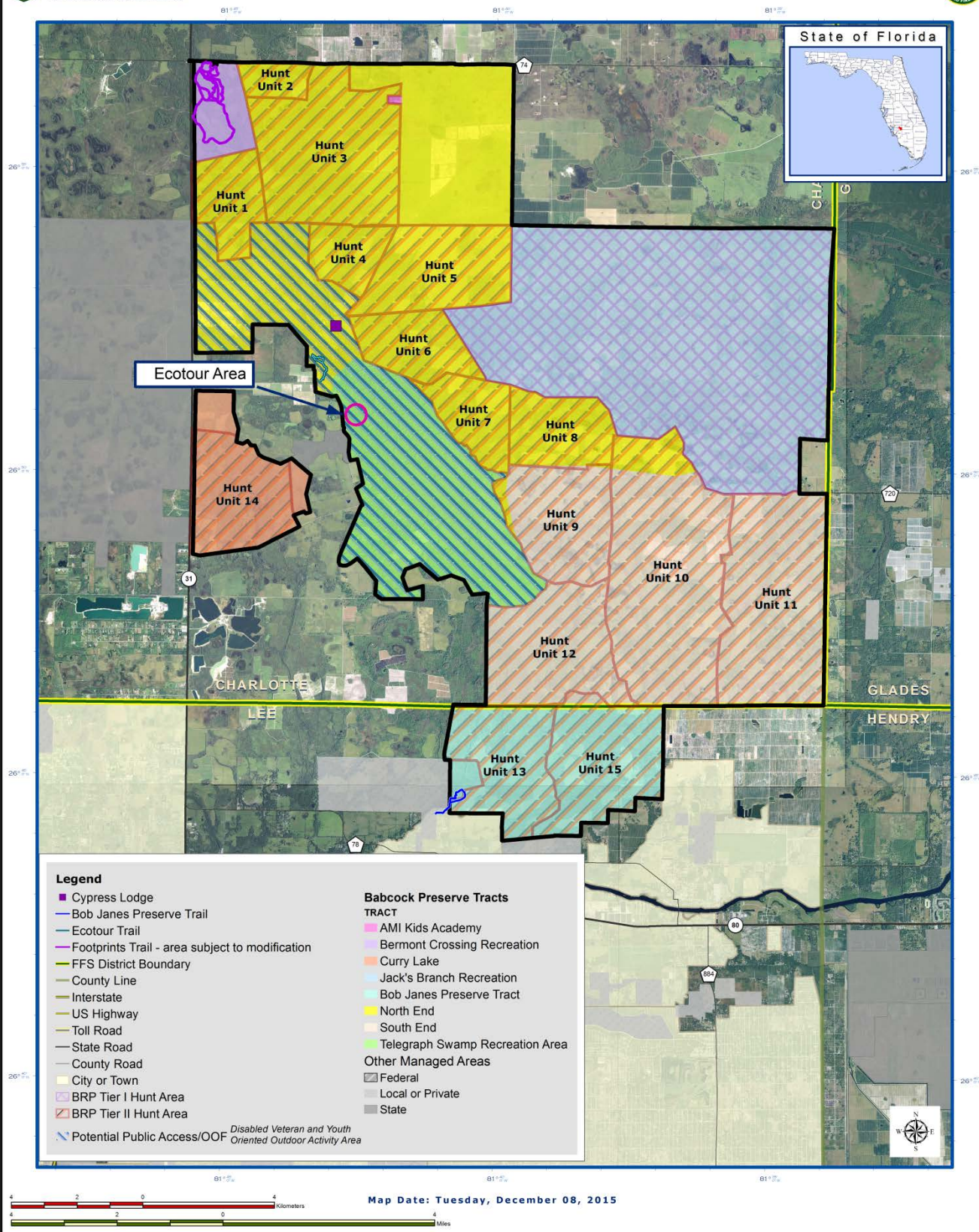


Exhibit V

Florida Natural Areas Inventory 2008 Non-Native Invasive Species Inventory

Invasive Exotic Plant Inventory of Babcock Ranch

FINAL REVISED REPORT

May, 2008

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Introduction

The Florida Natural Areas Inventory (FNAI) is part of the Florida Resources and Environmental Analysis Center at Florida State University. Our mission is to gather, interpret, and disseminate information that is critical to the conservation of Florida's biological diversity. As part of a continuing relationship with the Florida Fish and Wildlife Conservation Commission, FNAI was contracted to conduct an invasive exotic plant surveys at Babcock Ranch. This survey was part of a comprehensive inventory of natural communities, rare plants and animals and invasive exotic plant species listed by the Florida Exotic Pest Plant Council (FLEPPC). The ranch occupies approximately 73,239 acres in Charlotte and Lee counties just west of Babcock-Webb Wildlife Management Area, north of the Caloosahatchee River.

Methods

The Babcock Ranch invasive exotic survey was conducted from March 2007 through April 2008. All plants on the Florida Exotic Pest Plant Council list for 2007 (Appendix 1) were the target of the survey. These surveys used standard protocols developed by FNAI in accordance with the Florida Department of Environmental Protection's Bureau of Invasive Plant Management (BIPM). This includes searches for invasive plants conducted on foot or by four-wheel drive vehicle. Surveyors targeted areas likely to have invasive species present, focusing on disturbed areas including roads, agricultural fields, developed areas, and semi-natural areas. Approximately 25 percent of the effort was given to natural areas. The protocol did not use parallel transects because we determined them to be impractical for such a large-scale project. Standard field survey protocol was as follows: The perimeters of target areas or sub-units (defined by roads or canal borders) were searched. If invasive plant species were found, internal areas were searched via roads or access trails. Spur routes off main trails were occasionally searched to determine the presence or extent of infestation of exotic plants in internal areas. Effort given to internal areas was determined by the extent of infestation evident in initial searches off main trails or roads. If no invasive exotic plants were found during initial searches of interior areas, surveyors continued with perimeter searches then moved on to other areas where this protocol was repeated. Locations and data describing the occurrences of invasive exotic plant species were recorded using Trimble Recon data loggers with a Pathfinder XB or XC GPS antenna. Data fields describing the occurrences of invasive plant species were developed in association with BIPM; these data fields are described in Appendix 2. All data were downloaded using Trimble Pathfinder Office and exported as an ESRI shapefile. All data were reviewed for quality control and are provided in the disc or electronic folder along with this document.

Results

Field crews recorded 3871 occurrences of 33 invasive exotic plant species (Table 1). These species were distributed throughout Babcock Ranch (Figure 1) concentrated in the vicinity of pastures and agricultural fields. Descriptions, photographs and additional information for each of the species observed are provided in Appendix 3. Control methods for invasive exotic plants are provided in Appendix 4.

Table 1. Invasive exotic plant species observed on Babcock Ranch.

Species	Common name	occurrences
<i>Abrus precatorius</i>	rosary pea	6
<i>Albizia lebbbeck</i>	woman's tongue	15
<i>Alternanthera philoxeroides</i>	alligator weed	1
<i>Cinnamomum camphora</i>	camphor tree	1
<i>Cupaniopsis anacardioides</i>	Carrotwood	1
<i>Eichhornia crassipes</i>	water hyacinth	9
<i>Hydrilla verticillata</i>	Hydrilla	14
<i>Hymenachne amplexicaulis</i>	West Indian marsh grass	151
<i>Imperata cylindrica</i>	cogon grass	218
<i>Lantana camara</i>	Lantana	14
<i>Leucaena leucocephala</i>	lead tree	11
<i>Ludwigia peruviana</i>	Peruvian primrosewillow	161
<i>Lygodium microphyllum</i>	old world climbing fern	214
<i>Melaleuca quinquenervia</i>	Melaleuca	535
<i>Melia azedarach</i>	Chinaberry	1
<i>Neyraudia reynaudiana</i>	Burma reed	6
<i>Panicum repens</i>	torpedo grass	268
<i>Pistia stratiotes</i>	water-lettuce	4
<i>Psidium cattleianum</i>	strawberry guava	1
<i>Psidium guajava</i>	Guava	39
<i>Pteris vittata</i>	Chinese brake fern	3
<i>Rhynchelytrum repens</i>	Natal grass	94
<i>Ruellia tweediana</i>	Mexican petunia	2
<i>Sapium sebiferum</i>	Chinese tallow	1
<i>Schinus terebinthifolius</i>	Brazilian pepper	898
<i>Senna pendula</i> var. <i>glabrata</i>	Valamuerto	2
<i>Sesbania punicea</i>	purple sesban	3
<i>Solanum viarum</i>	tropical soda apple	113
<i>Syagrus romanzoffiana</i>	queen palm	1
<i>Syzygium cumini</i>	Java plum	6
<i>Tradescantia fluminensis</i>	white-flowered wandering jew	10
<i>Urena lobata</i>	Caesar's weed	582
<i>Urochloa mutica</i>	para grass	15

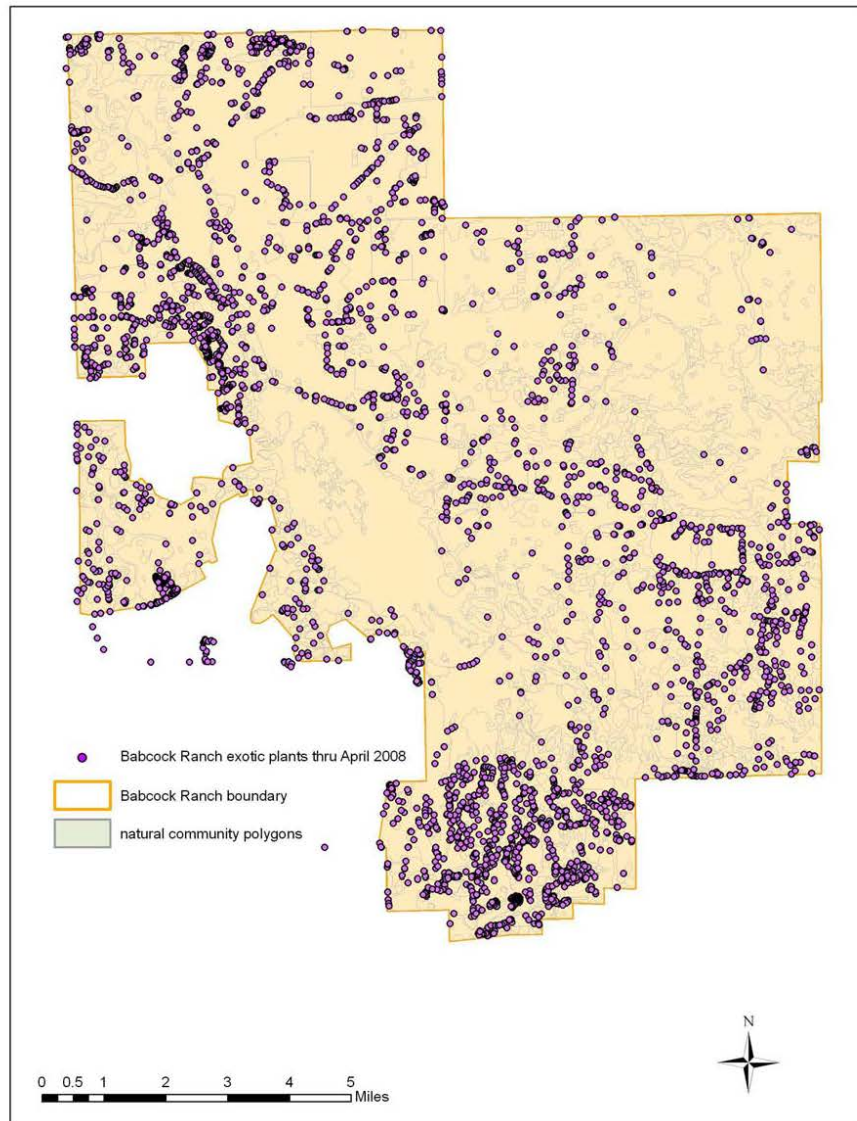


Figure 1. Distribution of invasive exotic plants observed on Babcock Ranch during 2007-2008 inventory by Florida Natural Areas Inventory

APPENDIX 1. FLEPPC INVASIVE EXOTIC PLANT LIST

The 2007 list is provided in the following pages. The current list is available at <http://www.fleppc.org/list/list.htm>

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The 2007 list is provided in the following pages. The current list is available at <http://www.fleppc.org/list/list.htm>

Florida Exotic Pest Plant Council's 2007 List of Invasive Plant Species

Purpose of the List: To focus attention on —

- ▶ the adverse effects exotic pest plants have on Florida's biodiversity and plant communities,
- ▶ the habitat losses from exotic pest plant infestations,
- ▶ the impacts on endangered species via habitat loss and alteration,
- ▶ the need to prevent habitat losses through pest-plant management,
- ▶ the socio-economic impacts of these plants (e.g., increased wildfires in certain areas),
- ▶ changes in the seriousness of different pest plants over time,
- ▶ the need to provide information that helps managers set priorities for control programs.

CATEGORY I

Invasive exotics that are altering native plant communities by displacing native species, changing community structures or ecological functions, or hybridizing with natives. This definition does not rely on the economic severity or geographic range of the problem, but on the documented ecological damage caused.

Scientific Name	Common Name	FLEPPC Cat.	Gov. List	Reg. Dist.
<i>Abrus precatorius</i>	rosary pea	I	N	C, S
<i>Acacia auriculiformis</i>	earleaf acacia	I		C, S
<i>Albizia julibrissin</i>	mimosa, silk tree	I		N, C
<i>Albizia lebeck</i>	woman's tongue	I		C, S
<i>Ardisia crenata</i> (= <i>A. crenulata</i> misapplied)	coral ardisia	I		N, C, S
<i>Ardisia elliptica</i> (= <i>A. humilis</i> misapplied)	shoebutton ardisia	I	N	C, S
<i>Asparagus aethiopicus</i> (= <i>A. sprengeri</i> ; <i>A. densiflorus</i> misapplied)	asparagus-fern	I		N, C, S
<i>Bauhinia variegata</i>	orchid tree	I		C, S
<i>Bischofia javanica</i>	bishopwood	I		C, S
<i>Calophyllum antillanum</i> (= <i>C. calaba</i> and <i>C. inophyllum</i> misapplied)	santa maria (names "mast wood," "Alexandrian laurel" used in cultivation)	I		S
<i>Casuarina equisetifolia</i>	Australian-pine, beach sheoak	I	P, N	N, C, S
<i>Casuarina glauca</i>	suckering Australian-pine, gray sheoak	I	P, N	C, S
<i>Cinnamomum camphora</i>	camphor tree	I		N, C, S
<i>Colocasia esculenta</i>	wild taro	I		N, C, S
<i>Colubrina asiatica</i>	lather leaf	I	N	S
<i>Cupaniopsis anacardioides</i>	carrotwood	I	N	C, S
<i>Dioscorea alata</i>	winged yam	I	N	N, C, S
<i>Dioscorea bulbifera</i>	air-potato	I	N	N, C, S
<i>Eichhornia crassipes</i>	water-hyacinth	I	P	N, C, S
<i>Eugenia uniflora</i>	Surinam cherry	I		C, S
<i>Ficus microcarpa</i> (<i>F. nitida</i> and <i>F. retusa</i> var. <i>nitida</i> misapplied)	laurel fig	I		C, S
<i>Hydrilla verticillata</i>	hydrilla	I	P, U	N, C, S
<i>Hygrophila polysperma</i>	green hygro	I	P, U	N, C, S
<i>Hymenachne amplexicaulis</i>	West Indian marsh grass	I		C, S
<i>Imperata cylindrica</i> (<i>I. brasiliensis</i> misapplied)	cogon grass	I	N, U	N, C, S
<i>Ipomoea aquatica</i>	waterspinach	I	P, U	C
<i>Jasminum dichotomum</i>	Gold Coast jasmine	I		C, S
<i>Jasminum fluminense</i>	Brazilian jasmine	I		C, S
<i>Lantana camara</i>	lantana, shrub verbenas	I		N, C, S
<i>Ligustrum lucidum</i>	glossy privet	I		N, C
<i>Ligustrum sinense</i>	Chinese privet, hedge privet	I		N, C, S

FLEPPC 2007 List of Invasive Plant Species – Fall 2007

FLEPPC List Definitions:

Exotic – a species introduced to Florida, purposefully or accidentally, from a natural range outside of Florida.

Native – a species whose natural range included Florida at the time of European contact (1500 AD).

Naturalized exotic – an exotic that sustains itself outside cultivation (it is still exotic; it has not "become" native).

Invasive exotic – an exotic that not only has naturalized, but is expanding on its own in Florida native plant communities.

Abbreviations:

Government List (Gov. List):

P = Prohibited by Florida

Department of Environmental Protection;

N = Noxious weed listed by Florida Department of Agriculture & Consumer Services;

U = Noxious weed listed by U.S. Department of Agriculture.

Regional Distribution (Reg. Dist.):
N = north, C = central,
S = south, referring to each species' current distribution in general regions of Florida (not its potential range in the state). Please refer to the map below.



Changes to the 2007 List:

Ludwigia peruviana
added to list as Category I

Peruvian primrose willow (*Ludwigia peruviana*) is a shrub known from at least 48 Florida counties, from the Panhandle to the Keys. It is also known in the United States from North Carolina, Georgia, Alabama, Mississippi, and Texas. While always known as an aggressive weed in wetlands in Florida, there has been debate about its nativity. After an evaluation of available data, the Committee now agrees that this species was introduced into Florida, probably from South America, by the late 1800s, and has subsequently spread throughout the state and to other states. It can form monospecific stands in both disturbed and undisturbed wetlands, especially river and lake edges, and dramatically change ecosystem structure.

Tradescantia spathacea moved from Category I to Category II

Oyster plant (*Tradescantia spathacea*) is an herb known from at least 12 counties in southern Florida, although many populations have not been documented. A native of tropical America, this species was a very common ornamental plant decades ago, and is still grown occasionally for its green and purple foliage. The species spreads readily, both by vegetation offshoots and by seed. In urban areas, plants often appear on rooftops or on rock walls. It does spread into natural areas, but Committee members are unaware of sites where it has invaded natural areas and displaced native species to the extent of other Category I species. It has been moved to Category II.

Scientific Name	Common Name	FLEPPC Cat.	Gov. List	Reg. Dist.
<i>Lonicera japonica</i>	Japanese honeysuckle	I		N, C, S
<i>Ludwigia peruviana</i>	Peruvian primrosewillow	I		N, C, S
<i>Lygodium japonicum</i>	Japanese climbing fern	I	N	N, C, S
<i>Lygodium microphyllum</i>	Old World climbing fern	I	N	C, S
<i>Macfadyena unguis-cati</i>	cat's claw vine	I		N, C, S
<i>Manilkara zapota</i>	sapodilla	I		S
<i>Melaleuca quinqueriviera</i>	melaleuca, paper bark	I	P, N, U	C, S
<i>Mimosa pigra</i>	catclaw mimosa	I	P, N, U	C, S
<i>Nandina domestica</i>	nandina, heavenly bamboo	I		N, C
<i>Nephrolepis cordifolia</i>	sword fern	I		N, C, S
<i>Nephrolepis multiflora</i>	Asian sword fern	I		C, S
<i>Neyraudia reynaudiana</i>	Burma reed, cane grass	I	N	S
<i>Paederia cruddasiana</i>	sewer vine, onion vine	I	N	S
<i>Paederia foetida</i>	skunk vine	I	N	N, C, S
<i>Panicum repens</i>	torpedo grass	I		N, C, S
<i>Pennisetum purpureum</i>	Napier grass	I		N, C, S
<i>Pistia stratiotes</i>	waterlettuce	I	P	N, C, S
<i>Psidium cattleianum</i> (=P. littorale)	strawberry guava	I		C, S
<i>Psidium guajava</i>	guava	I		C, S
<i>Pueraria montana</i> var. <i>lobata</i> (=P. lobata)	kudzu	I	N	N, C, S
<i>Rhodomyrtus tomentosa</i>	downy rose-myrtle	I	N	C, S
<i>Rhynchosyris repens</i> (=Melinis repens)	Natal grass	I		N, C, S
<i>Ruellia tweediana</i> (=R. brittoniana, R. coerulacea)	Mexican petunia	I		N, C, S
<i>Sapientia sebiferum</i> (=Triadica sebifera)	popcorn tree, Chinese tallow tree	I	N	N, C, S
<i>Scaevola taccada</i> (=Scaevola sericea, S. frutescens)	scaevola, half-flower, beach naupaka	I	N	C, S
<i>Schefflera actinophylla</i> (=Brassia actinophylla)	schefflera, Queensland umbrella tree	I		C, S
<i>Schinus terebinthifolius</i>	Brazilian pepper	I	P, N	N, C, S
<i>Senna pendula</i> var. <i>glabrata</i> (=Cassia columboides)	climbing cassia, Christmas cassia, Christmas senna	I		C, S
<i>Solanum tampicense</i> (=S. houstonii)	wetland nightshade, aquatic soda apple	I	N, U	C, S
<i>Solanum viarum</i>	tropical soda apple	I	N, U	N, C, S
<i>Syngonium podophyllum</i>	arrowhead vine	I		N, C, S
<i>Syzygium cumini</i>	jambolan plum, Java plum	I		C, S
<i>Tectaria incisa</i>	incised halberd fern	I		S
<i>Thespesia populnea</i>	seaside mahoe	I		C, S
<i>Tradescantia fluminensis</i>	white-flowered wandering jew	I		N, C
<i>Urochloa mutica</i> (=Brachiaria mutica)	Para grass	I		C, S

CATEGORY II

Invasive exotics that have increased in abundance or frequency but have not yet altered Florida plant communities to the extent shown by Category I species. *These species may become ranked Category I, if ecological damage is demonstrated.*

Scientific Name	Common Name	FLEPPC Cat.	Gov. List	Reg. Dist.
<i>Adenanthura pavonina</i>	red sandalwood	II		S
<i>Agave sisalana</i>	sisal hemp	II		C, S
<i>Aleurites fordii</i> (=Vernicia fordii)	tung oil tree	II		N, C
<i>Alstonia macrophylla</i>	devil tree	II		S
<i>Alternanthera philoxeroides</i>	alligator weed	II	P	N, C, S
<i>Antigonon leptopus</i>	coral vine	II		N, C, S
<i>Aristolochia littoralis</i>	calico flower	II		N, C, S

Scientific Name	Common Name	FLEPPC Cat.	Gov. List	Reg. Dist.
<i>Asystasia gangetica</i>	Ganges primrose	II		C, S
<i>Begonia cucullata</i>	wax begonia	II		N, C, S
<i>Blechnum pyramdatum</i>	green shrimp plant, Brown's blechnum	II		N, C, S
<i>Broussonetia papyrifera</i>	paper mulberry	II		N, C, S
<i>Callisia fragrans</i>	inch plant, spironema	II		C, S
<i>Casuarina cunninghamiana</i>	river sheoak, Australian-pine	II	P	C, S
<i>Cecropia palmata</i>	trumpet tree	II		S
<i>Cestrum diurnum</i>	day jasmine	II		C, S
<i>Chamaedorea seifrizii</i>	bamboo palm	II		S
<i>Clematis temiflora</i>	Japanese clematis	II		N, C
<i>Cryptostegia madagascariensis</i>	rubber vine	II		C, S
<i>Cyperus involucratus</i> (<i>C. alternifolius</i> misapplied)	umbrella plant	II		C, S
<i>Cyperus proflifer</i>	dwarf papyrus	II		C, S
<i>Dalbergia sissoo</i>	Indian rosewood, sissoo	II		C, S
<i>Elaeagnus pungens</i>	silvertorn, thorny olive	II		N, C
<i>Epipremnum pinnatum</i> cv. Aureum	pothos	II		C, S
<i>Ficus altissima</i>	false banyan, council tree	II		S
<i>Flacourtia indica</i>	governor's plum	II		S
<i>Hemarthria altissima</i>	limpo grass	II		C, S
<i>Hibiscus tiliaceus</i> (= <i>Talipariti tiliaceum</i>)	mahoe, sea hibiscus	II		C, S
<i>Ipomoea fistulosa</i> (= <i>I. carnea</i> ssp. <i>fistulosa</i>)	shrub morning-glory	II	P	C, S
<i>Jasminum sambac</i>	Ambian jasmine	II		S
<i>Kalanchoe pinnata</i>	life plant	II		C, S
<i>Koeleruteria elegans</i> ssp. <i>formosana</i> (= <i>K. formosana</i> ; <i>K. paniculata</i> misapplied)	flamegold tree	II		C, S
<i>Leucaena leucocephala</i>	lead tree	II	N	N, C, S
<i>Linnophila sessiliflora</i>	Asian marshweed	II	P, U	N, C, S
<i>Livistona chinensis</i>	Chinese fan palm	II		C, S
<i>Melia azedarach</i>	Chinaberry	II		N, C, S
<i>Melinis minutiflora</i>	Molassesgrass	II		C, S
<i>Merremia tuberosa</i>	wood-rose	II		S
<i>Murraya paniculata</i>	orange-jessamine	II		S
<i>Myriophyllum spicatum</i>	Eurasian water-milfoil	II	P	N, C, S
<i>Nymphoides cristata</i>	snowflake	II		C, S
<i>Panicum maximum</i>	Guinea grass	II		N, C, S
<i>Passiflora biflora</i>	two-flowered passion vine	II		S
<i>Pennisetum setaceum</i>	green fountain grass	II		S
<i>Phoenix reclinata</i>	Senegal date palm	II		C, S
<i>Phyllostachys aurea</i>	golden bamboo	II		N, C
<i>Pittosporum pentandrum</i>	Philippine pittosporum, Taiwanese cheesewood	II		S
<i>Pteris vittata</i>	Chinese brake fern	II		N, C, S
<i>Ptychosperma elegans</i>	solitaire palm	II		S
<i>Rhoo spathacea</i> (see <i>Tradescantia spathacea</i>)				
<i>Ricinus communis</i>	castor bean	II		N, C, S
<i>Rotala rotundifolia</i>	roundleaf toothcup, dwarf Rotala,	II		S
<i>Sansevieria hyacinthoides</i>	bowstring hemp	II		C, S
<i>Scleria lacustris</i>	Wright's nutrush	II		C, S
<i>Sesbania punicea</i>	purple sesban, rattlebox	II		N, C, S
<i>Solanum diphyllum</i>	two-leaf nightshade	II		N, C, S
<i>Solanum jamaicense</i>	Jamaica nightshade	II		C
<i>Solanum torvum</i>	susumber, turkey berry	II	N, U	N, C, S

FLEPPC 2007 List of Invasive Plant Species – Fall 2007

Changes to the 2007 List:

Melinis minutiflora

added to list as Category II

Molasses grass (*Melinis minutiflora*) is a grass known from at least 6 Florida counties, mostly along the lower eastern coast. It is native to Africa and western Asia and was originally introduced as a forage grass in southern Florida. While it has been known to be established for some time, its populations have been expanding recently into undisturbed natural areas, especially pine rocklands in Miami-Dade County. Once established, it forms locally dense stands and excludes other herbs and graminoids. The strong molasses smell given off by the plants makes it especially easy to identify, particularly when it is stepped on.

Rotala rotundifolia

added to list as Category II

Roundleaf toothcup (*Rotala rotundifolia*) is an aquatic herb known from at least three Florida counties in southern Florida (Broward, Lee, and Palm Beach). It is also introduced in Alabama. It is native to India and Southeast Asia. The species is commonly grown as an aquarium plant and has been introduced after aquarium grown plants were discarded into Florida wetlands. It has become established in canals and along rivers. It reproduces readily through sexual and asexual means and is expected to spread within the state. It is also known as dwarf rotala.

Use of the FLEPPC List

FLEPPC encourages use of the Invasive Species List for prioritizing and implementing management efforts in natural areas, for educating lay audiences about environmental issues, and for supporting voluntary invasive plant removal programs. When a non-native plant species is to be restricted in some way by law, FLEPPC encourages use of the List as a first step in identifying species worth considering for particular types of restriction. For more information on using the FLEPPC List of Invasive Plant Species, see *Wildland Weeds* Summer 2002 issue (Vol. 5, No. 3), pp. 16-17.

NOTE: Not all exotic plants brought into Florida become pest plants in natural areas. The FLEPPC List of Invasive Plant Species represents only about 10% of the 1,300+ exotic species that have been introduced into Florida and subsequently established outside of cultivation. Most escaped exotics usually present only minor problems in highly disturbed areas (such as roadsides). And there are other exotics cultivated in Florida that are "well-behaved" — that is, they don't escape cultivation at all.



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Scientific Name	Common Name	FLEPPC Cat.	Gov. List	Reg. Dist.
<i>Sphagneticola trilobata</i> (= <i>Wedelia trilobata</i>)	wedelia	II		N, C, S
<i>Stachytarpheta cayennensis</i> (= <i>S. urticifolia</i>)	nettle-leaf porterweed	II		S
<i>Syagrus romanzoffiana</i> (= <i>Arecastrum romanzoffianum</i>)	queen palm	II		C, S
<i>Syzygium jambos</i>	rose-apple	II		C, S
<i>Terminalia catappa</i>	tropical-almond	II		C, S
<i>Terminalia muelleri</i>	Australian-almond	II		C, S
<i>Tradescantia spathacea</i> (= <i>Rhoeo spathacea</i> , <i>Rhoeo discolor</i>)	oyster plant	II		S
<i>Tribulus cistoides</i>	puncture vine, burr-nut	II		N, C, S
<i>Urena lobata</i>	Caesar's weed	II		N, C, S
<i>Vitex trifolia</i>	simple-leaf chaste tree	II		C, S
<i>Washingtonia robusta</i>	Washington fan palm	II		C, S
<i>Wedelia</i> (see <i>Sphagneticola</i> above)				
<i>Wisteria sinensis</i>	Chinese wisteria	II		N, C
<i>Xanthosoma sagittifolium</i>	malanga, elephant ear	II		N, C, S

Citation example:

FLEPPC. 2007. List of Florida's Invasive Plant Species. Florida Exotic Pest Plant Council. Internet: <http://www.fleppc.org/07list.htm> or *Wildland Weeds* Vol. 10(4), Fall 2007.

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FLEPPC Database – The Florida Exotic Pest Plant Database contains over 6,000 sight records of infestations of FLEPPC Category I and Category II species in Florida public lands and waters. 360 species are recorded. Nearly all of the records are from local, state, and federal parks and preserves; a few records document infestations in regularly disturbed public lands such as highway or utility rights-of-way. Natural area managers and other veteran observers of Florida's natural landscapes submit these records, with many supported further by voucher specimens housed in local or regional herbaria for future reference and verification. New and updated observations can be submitted online at www.fleppc.org/EDDMapS/. This database, along with other plant-data resources such as the University of South Florida Atlas of Florida Vascular Plants at www.plantatlas.usf.edu, the Florida Natural Areas Inventory database at www.fnai.org, and The Institute for Regional Conservation Floristic Inventory of South Florida database at www.regionalconservation.org, provides important basic supporting information for the FLEPPC List of Invasive Plant Species.

Images of FLEPPC-listed species may be found at one or more of the following websites: University of South Florida Atlas of Florida Vascular Plants, www.plantatlas.usf.edu; the "Introduced Species" page on the University of Florida Herbarium website, www.flmnh.ufl.edu/herbarium/cat/digitalimagingprojects.htm; at Fairchild Tropical Garden's Virtual Herbarium, www.virtualherbarium.org/vhportal.html; The Robert K. Godfrey Herbarium at FSU, <http://herbarium.bio.fsu.edu/index.php>; and at the University of Florida's Center for Aquatic and Invasive Plants, <http://plants.ifas.ufl.edu>. Please note that greater success and accuracy in searching for plant images is likely if you search by scientific name rather than a common name. Common names often vary in cultivation and across regions. For additional information on plants included in this list, see related links and pages at www.fleppc.org.

APPENDIX 2. DATA ATTRIBUTES, DEFINITIONS, AND VALUES FOR
EXOTIC PLANT POINTS

<u>ATTRIBUTES</u>	<u>VALUES</u>
SITE	Name of the wildlife management area.
SURVEYSITE	Any subunit of the site (e.g. burn unit or management unit)
DATE	Date of data collection.
SURVEYOR	Name of the FNAI field surveyor
FIELD_ID	Number assigned to this point by the FNAI scientist during field work; not necessarily unique.
POINT_ID	Unique number assigned to each point by ArcView
SPECIES	Scientific name of exotic plant occurring at that point
COM_NAME	Common name of exotic plant occurring at that point
DENSITY	Description of the cover or extent of infestation; density values are: single/small clump scattered plants scattered dense patches dominant cover dense monoculture
ACRES_INFE	Approximate area affected by the species: Minimum value = 1 acre; if no data taken, value = -9999.
AREA_OCCUP	Estimated area that the population occupies in hectares. Area occupied values are: <1 square meter 1 - 10 square meters 11 - 100 square meters 101 - 1000 square meters (0.03 acre - 0.25 acre) 1001 - 2500 square meters (0.25 acre - 0.6 acre) 1/4 hectare – 1/2 hectare (0.6 acre - 1.2 acre) >1/2 hectare – 1 hectare (1.2 acre - 2.5 acres) >1 hectare – 10 hectares >10 hectares – 100 hectares >100 hectares

PHENOLOGY	Characteristic phenology of the plants. Phenology values are: flower/bud flower/fruit fruit/spore in leaf dormant
FNAI_NC	FNAI community type affected.
DISTURB_1	Describes the primary disturbance in the vicinity of the rare plant population. If there is more than one type of disturbance, the most prevalent form of disturbance is entered here and the lesser disturbance is entered in Disturb_2. Disturbance values are as follows: not evident agriculture cattle disturbance clearing (includes dove fields, old fields, and food plots that are less than 0.5 acre, i.e. that are not delineated as ruderal polygons) ditch/canal exotics firebreaks fire suppression forestry operations (e.g., logging, loading areas, bedding, equipment rutting, slash piles, and other mechanical disturbances; does not include burning.) hog digging impoundment (e.g. artificial ponds and lakes, borrow pits, dams, dikes) natural ORV trail road trash dumping woody encroachment cause unknown other (details provided in the COMMENTS field)
DISTURB_2	Describes the secondary disturbance, if any, in the vicinity of the rare plant population. Disturbance values are the same as DISTURB_1.
DISTURB_SEV	Severity of the disturbance(s). Disturbance severity values are: none light moderate heavy severe
COMMENTS	Comments is an optional field used by the surveyor to provide additional information about the exotic pest plant population.

EPPC

Category of exotic species as determined by the Exotic Pest Plant Council (EPPC 2003 List of Invasive Species). EPPC categories are:

Category I: Invasive exotics that are altering native plant communities by displacing native species, changing community structures or ecological functions, or hybridizing with natives. *This definition does not relay on the economic severity or geographic range of the problem, but on the documented ecological damage caused.*

Category II: Invasive exotics that have increased in abundance or frequency but have not yet altered Florida plant communities to the extent shown by Category I species.

Not listed: Non-native species not currently listed by EPPC.

APPENDIX 3: Invasive Exotic Plant Descriptions and Additional Information

The 24 of the following 33 accounts were copied from the following publication:

Identification and Biology of Non-Native Plants in Florida's Natural Areas,
Editors : K.A. Langeland and K. Craddock Burks. UF/IFAS

A pdf of the full version of the book is available at the following site:

http://www.fleppc.org/ID_book.htm

Accounts are arranged in alphabetical order by scientific name. Page numbers correspond to the original document from which the accounts were copied. Unnumbered pages were created in the format of the original document by FNAI.

ABRUS PRECATORIUS L.

Fabaceae (Leguminosae)/Pea Family

Common Names: Rosary pea, crab's eyes, precatory pea, licorice vine

Synonymy: *Abrus abrus* (L.) W. F. Wight

Origin: India, and perhaps other parts of tropical Asia

Botanical Description: High-climbing, twining, or trailing woody vine with slender herbaceous branches. Leaves alternate, petioled, 5-13 cm (2-5 in) long, even-pinnately compound with 5-15 pairs of leaflets, these oval to oblong, to 1.8 cm (< 1 in) long, with margins entire. Flowers shaped like pea flowers, white to pink or reddish, small, in short-stalked dense clusters at leaf axils. Fruit a short, oblong pod, splitting before falling to reveal 3-8 shiny hard seeds, 6-7 mm (< 1 in) long, scarlet with black bases.

Ecological Significance: Introduced to Florida for ornament before 1932 (Morton 1976). Noted as abundantly naturalized by Small (1933), Lakela and Craighead (1965), Long and Lakela (1971), Morton (1976), Austin (1978), Wunderlin (1982), and Isely (1990). Described by an early Florida horticulturist as quickly "taking full possession" of a young forest and impossible to remove after several years' effort (Morton 1976). Has invaded undisturbed pinelands and hammocks, including the globally imperiled pine rocklands of Dade County (M. McMahon, Biological and Environmental Consulting, personal observation). Classified as an invasive weed in India, the Caribbean Islands, Belize, west Polynesia, and Hawaii (Holm *et al.* 1979, Wester 1992). Widely introduced and "has run wild in most warm climates" (Morton 1971b). Seeds used as beads in many countries (Isely 1990). Seeds extremely poisonous for humans, cattle, and horses—one ingested seed may prove fatal (Morton 1971b, Isely 1990).

Distribution: Now pantropical (Isely 1990). Common across central and south Florida; herbarium specimens of naturalized populations collected from 27 counties, from Hernando, Marion, Lake, and Volusia counties south to the Keys (Wunderlin *et al.* 1995). Reported from over 40 natural areas in Dade, Broward, Palm Beach, Martin, Indian River, Highlands, Collier, Lee, Sarasota, Manatee, Hillsborough, and Lake counties (EPPC 1996).

✱



Compound leaves

ROSARY PEA

Life History: Roots deeply and tenaciously; difficult to eradicate (R. Moyroud, Mesozoic Landscapes, 1995 personal communication). Increases in population size following fire (Maithani *et al.* 1986). Flowers in summer; fruiting prolifically. Seeds dispersed by birds (Austin 1998). Has been investigated for various types of usable extracts, such as for insecticides (e.g., Khanna *et al.* 1989), antifertility drugs (e.g., Sinha 1990), other medicines (e.g., Wambele and Amosun 1984), and sweetening agents (Jakinovich *et al.* 1990).

KAL



Covering native scrub plants,
Palm Beach County

KAL



Seeds

KAL



Immature pods

ALBIZIA LEBBECK (L.) BENTHAM

Fabaceae (Leguminosae)/Pea Family

Common Names: Woman's tongue, Tibet lebbeck, singer-tree, shack-shack

Synonymy: *Mimosa lebbeck* L., *M. speciosa* (Jacq.) Willd.

Origin: Tropical Asia, northern Australia

Botanical Description: Deciduous, unarmed tree to 20 m (65 ft) tall, with a rounded, spreading crown and pale bark. Leaves alternate, twice compound, with 2-5 pairs of pinnae, each pinna with 3-10 pairs of leaflets (even-pinnate); leaflets elliptic-oblong, 2-4 cm (1-2 in) long, usually asymmetrical at base, dull green above, paler green below; petiole with a sessile, elliptic gland near the base above. Flowers mimosa-like, in showy, rounded clusters near stem tips, 5-6 cm (2-2.5 in) across, cream or yellowish-white, each flower with numerous long stamens. Fruit a flat, linear pod, to 30 cm (1 ft) long, with many seeds; dried pods persistent after leaf-fall, often heard rattling in the wind.

NOTE: In Florida, distinguished from other unarmed leguminous trees with twice-compound leaves by its number of leaflets (usually 20+) and the leaflets' larger size (usually > 2 cm long).

Ecological Significance: Introduced to Florida for ornament in 1880s (Gordon and Thomas 1997). By 1933 (Small 1933), recognized as invading tropical hammocks in the Florida Keys. Known by 1990 (Isely 1990) as a fast-growing colonizer of disturbed areas, becoming common in central and south Florida through the Keys (Nelson 1994). Seedlings now occurring in great numbers throughout Big Cypress National Preserve (T. Pernas, National Park Service, 1996 personal communication). Invading somewhat disturbed pinelands of Everglades National Park (D. Jones, National Park Service, 1996 personal communication). Invading pine rocklands and canopy gaps in rockland hammocks in Dade County (R. Hammer, Miami-Dade Parks Department, 1996 personal communication). Also naturalized on moist and dry coastal hillsides in Puerto Rico, in pastures in the U.S. Virgin Islands, and elsewhere in the Caribbean and Central and South America (Little and Wadsworth 1964, Watkins 1970).



Flower heads

WOMAN'S TONGUE

Distribution: Presently pantropical in occurrence, widely planted and naturalized (Little and Wadsworth 1964). In Florida, now reported from more than 20 natural areas in Monroe, Dade, Collier, Palm Beach, Martin, and Lee counties (EPPC 1996). Naturalized populations documented by herbarium specimens from Broward, Collier, Dade, Indian River, Lee, Marion, Polk, and St. Lucie counties (Wunderlin *et al.* 1996).

Life History: Fast-growing from seed (Morton 1971a). Will not tolerate freezing temperatures, but naturally grows in the Himalayas to altitudes of 1,600 m (5,200 ft) above MSL (Lowry *et al.* 1994). Grows well with average annual rainfalls of 400-2,500 mm (16-98 in), and in soils that are saline or alkaline, but not waterlogged soils (Lowry *et al.* 1994). A nitrogen-fixing, mycorrhizal-associating legume (Osonubi *et al.* 1991). Tolerates coastal salt spray, with some protection (Menninger 1964, Little and Wadsworth 1964). Flowers from April to September, but primarily in spring (or onset of rainy season), with pods held nearly throughout the year (Little and Wadsworth 1964, Wunderlin 1982, Barneby and Grimes 1996). Produces massive quantities of seeds, with seedlings appearing in great numbers (Watkins 1970). Crows and squirrels observed feeding on seeds in India (Natarajan *et al.* 1994).

KAL



In Everglades National Park

KAL



Pods, compound leaf

ALTERNANTHERA PHILOXEROIDES (MART.) GRISEB

Amaranthaceae/Amaranth Family

Common Names: Alligatorweed, pigweed
Synonymy: *Achyranthes philoxeroides* (Mart.) Standl.,
Alternanthera paludosa Bunbury, *Bucholzia philoxeroides* Mart.,
Telanthera philoxeroides (Mart.) Moq.,
Origin: South America

Botanical Description: Aquatic to terrestrial perennial herb with horizontal to ascending stems 1 m long that root at the nodes. Aquatic form has hollow, floating, emergent and submerged stems. Terrestrial plants have solid stems. Stems simple or branched and lacking hairs or with two opposing lengthwise rows of hairs. Leaves opposite, more or less equal at a node, sessile or with narrowly winged petioles (to 1 cm long) that clasp the stem. Leaf blades mostly 4-11 cm long, 1-3 cm wide, narrowly lanceolate (to obovate), with entire margins and a smooth waxy surface. Flowers pleasantly fragrant. Spikes head-like, 12-18 mm in diameter on terminal or axillary stalks 4-9 cm long. Flowers and bracts pearly white, glabrous. Flowers lack petals. Sepals 5, separate 5-7 mm long. Stamens 5, opposite sepals, and alternate with 5 longer sterile stamens (staminodia). Seedlings seldom encountered because viable seed is rarely produced.

Ecological Significance: Alligatorweed was first introduced into the United States around 1900. This plant will root in wet soils or shallow water. It can grow out into waterways, where floating mats expand along the surface. Thick mats can displace native vegetation, restrict oxygen levels in water by shading submersed plants, expand mosquito habitat and reduce water flow, resulting in increase sedimentation. Alligatorweed also disrupts many economic uses of water, such as preventing drainage canals, ditches, streams, and other small waterways from emptying rapidly during periods of heavy water load. This can result in flooding. If mats break loose, they create obstructions by piling up against bridges, dams, and sharp bends in waterways. Navigation of small waterways is obstructed, as is shoreline navigation in large waterways. Efficiency of irrigation systems is decreased. Fishing and swimming can be affected, although a small fringe of alligatorweed probably benefits fishing.

Distribution: Alligatorweed is native along the coast of South America from Venezuela to Buenos Aires Province in Argentina. It also was reported from the upper and middle Amazon River basin and the Paraná River basin. Tolerates saline conditions (to 10% salt by volume). Requires a warm summer growing season. Tolerates cold winters, but cannot survive prolonged freezing temperatures. Alligatorweed occurs in more than one

ALLIGATOR WEED

of half of Florida counties, especially in shallow water or wet soils, in ditches and marshes, the edges of ponds and in slow-moving watercourses.

Life History: Alligatorweed is an emergent or rooted floating invasive that invades aquatic areas throughout the southern portions of the United States. Plants rooted in soil in shallow water form dense, interwoven floating mats that extend over the surface of deeper water. Mats can become dense enough to support the weight of a person. Floating mats can break away and colonize new sites. When the stems break, floating sections are able to establish readily on moist soil. Roots develop at closely spaced nodes along stems. If a waterway draws down or dries completely, alligatorweed changes to a terrestrial form with smaller, tougher leaves and stems.



Photo by Robert H. Mohlenbrock @ USDA-NRCS PLANTS Database / USDA SCS. 1991. *Southern wetland flora: Field office guide to plant species*. South National Technical Center, Fort Worth.

Links to photographs and additional information:

<http://www.invasive.org/eastern/biocontrol/1Alligatorweed.html>

CINNAMOMUM CAMPHORA (L.) J. PRESL

Lauraceae/Laurel Family

Common Name: Camphor tree
Synonymy: *Cinnamomum camphora* (L.) Nees & Eberm., *Camphora camphora* (L.) H. Karst.
Origin: Eastern Asia (China, Taiwan, Korea)

Botanical Description: Evergreen tree potentially to 20 m (65 ft). Twigs green or red-dish green; all vegetative parts glabrous; cut stems and bruised leaves giving off a strong aroma of camphor. Leaves simple, alternate; blades entire but may have wavy margins, mostly ovate, 4-10 cm (1.5-4 in) long and 2-5 cm (0.8-2 in) broad, glossy green above, duller green below, with impressed glands below at major veins. Flowers small, greenish-white to cream, in loose panicles on branchlets of season; 6 petaloid parts; 12 stamen parts, usually 5-9 fertile stamens plus smaller sterile staminodes. Fruits small, subglobose drupes, black, seated on persistent floral tubes.

Ecological Significance: Occurs primarily in drier disturbed areas such as roadsides and fencerows, but has invaded natural areas such as mesic hammocks, upland pine woods, and scrubland (e.g., taking over space in Polk County scrub inhabited by the federally endangered native plant, *Ziziphus celata*, or Florida jujube). Reported by natural-area managers as infesting particular parks in 14 counties (EPPC 1996). Introduced to Florida in 1875 and later established in plantations to promote camphor production, but the venture proved unprofitable (Lakela and Wunderlin 1980). Still sold as a shade tree and for windbreaks.

Distribution: Most commonly naturalized in north and central Florida, but also escapes cultivation in southern peninsula (Godfrey 1988, Long and Lakela 1971, Wunderlin 1982). Naturalized also in Georgia and west to Texas (Small 1933). Cultivated as well in other southern states: Alabama, Mississippi, Georgia, and the Carolinas (Meyer *et al.* 1994), and in southern California (Bailey and Bailey 1976). By 1997, documented as locally common in the flora from Texas to the Carolinas (van der Werff 1997).



Leaf, mature fruit

CAMPBOR TREE

Life History: Main trunk often stout with several secondary trunks arising from it, all supporting a dense evergreen canopy. National co-champion trees found in Florida (in cultivation), in Hardee and Pasco counties, with heights of 22 m (72 ft) and main trunk circumferences of about 9 m (31 ft) (NRBT 1994). Fruits normally abundant on mature trees, with birds often seen to "frolic and feast" on them particularly during late winter (Kurz and Godfrey 1962). For extraction of camphor (an ethereal oil), young shoots distilled; old trees felled, chipped, and the wood steam-distilled (Willis 1973). Wood also used for cabinetwork (Bailey and Bailey 1976).



In hammock, Lake Jessup conservation area



Flowers

CUPANIOPSIS ANACARDIOIDES (A. RICH.) REDKF.

Sapindaceae/Soapberry Family

Common Names: Carrotwood, tuckeroo tree
Synonymy: *Cupania anacardioides* A. Rich.
Origin: Australia

Botanical Description: Slender evergreen tree, usually single trunked, to 10 m (33 ft) tall, with dark gray outer bark and often orange inner bark (hence the common name). Leaves alternate, once compound (usually even-pinnate), with petioles swollen at the base; 4-12 leaflets, stalked, oblong, leathery, shiny yellowish green, to 20 cm (8 in) long and 7.5 cm (3 in) wide, with margins entire and tips rounded or slightly indented. Flowers numerous, white to greenish yellow, up to 0.8 cm (0.4 in) wide, in branched clusters to 35 cm (14 in) long, at leaf axils; 5 petals; 6-8 stamens. Fruit a short-stalked, woody capsule, to 2.2 cm (0.9 in) across, with 3 distinctly ridged segments, yellow-orange when ripe, drying to brown and splitting open to expose 3 shiny oval black seeds covered by a yellow-red crust (aril).

Ecological Significance: Introduced for landscaping in the 1960s, quickly becoming popular in southern Florida for its fast growth, ease of propagation, and adaptability to coastal conditions (Lockhart *et al.* 1997). Even earliest plantings noted as freely seeding (Menninger 1964). By 1990, seedlings found established in various habitats, disturbed and undisturbed, on both coasts (Oliver 1992). Invades spoil islands, beach dunes, marshes, tropical hammocks, pinelands, mangrove and cypress swamps, scrub habitats, and coastal strands (Lockhart *et al.* 1997). Now found in natural areas of 14 coastal counties in central and south Florida, with reproducing wild populations established already in Brevard, Martin, and Sarasota counties (EPPC 1996, Lockhart *et al.* 1997). Appears able to compete well with even other aggressive non-native plants such as Brazilian pepper (Lockhart *et al.* 1997). Greatest densities of seedlings and saplings, to 24 stems per m², found so far in mangrove forests, where they greatly alter the understory habitat (Lockhart *et al.* 1997). In recent years, ornamental use of carrotwood discouraged or restricted by local ordinance in several counties and 1 municipality (G. Jubinsky, Florida Department of Environmental Protection, 1997 personal communication).



Fruits, seeds

CARROTWOOD

Distribution: Occurs naturally along north and east coasts of Australia on rocky beaches, sand dunes, and in hilly scrub and riverine and monsoon forests (Reynolds 1985). Cultivated in various subtropical areas, including California (Oliver 1992). In Florida, naturalized in coastal counties from Brevard and Hillsborough south to Dade and Collier (EPPC 1996).

Life History: Tolerant of salt, full sun, full shade, poor soils, poor drainage, and dry areas (Oliver 1992). Older trees able to withstand cold to about -6°C (22°F) (Stuesau 1986). Flowers in Florida in late winter/early spring, January and February, with fruits maturing in April and May (Lockhart *et al* 1997). Seeds dispersed by birds, including mockingbirds and fish-eating crows (Austin 1996).

KAL



Bird dispersal of seeds

AF



Sapling in mangrove community,
Palm Beach County

d



Flowers

***EICHHORNIA CRASSIPES* (MART.) SOLMS-LAUB.**

Pontederiaceae/Pickerelweed Family

Common Names: Waterhyacinth, water-orchid
Synonymy: *Piaropus crassipes* (Mart.) Britt.
Origin: Amazon basin

Botanical Description: Floating aquatic herb, rooting in mud if stranded, usually in dense mats with new plantlets attached on floating green stolons. Submersed roots blue-black to dark purple, feathery, dense near root crown, tips with long dark root caps. Leaves formed in rosettes; petioles to 30 cm (12 in) or more, spongy, usually inflated or bulbous, especially near base; leaf blades roundish or broadly elliptic, glossy green, to 15 cm (6 in) wide. Inflorescence a showy spike above rosette, to 30 cm (12 in) long. Flowers lavender-blue with a yellow blotch, to 5 cm (2 in) wide, somewhat 2-lipped; 6 petals, 6 stamens. Fruit a 3-celled capsule with many seeds.

NOTE: May be confused with emergent form of the native frog's bit (*Limnobium spongia* (Bosc) Steud.), but its petioles not inflated and its flowers small, white, single in leaf axils.

Ecological Significance: Reported as a weed in 56 countries (Holm *et al.* 1979). Introduced to the United States in 1884 at an exposition in New Orleans, reaching Florida in 1890 (Gopal and Sharma 1981). By late 1950s, occupied about 51,000 ha (126,000 acres) of Florida's waterways (Schmitz *et al.* 1993). Grows at explosive rates exceeding any other tested vascular plant (Wolverton and McDonald 1979); doubles its populations in as little as 6-18 days (Mitchell 1976). In large mats, degrades water quality and dramatically alters native plant and animal communities (Gowanloch 1944, Penfound and Earle 1948).



Leaf rosettes, flowers

WATERHYACINTH

Distribution: Now occurs globally in the tropics and subtropics, and further north and south where it can escape severe cold (Holm *et al.* 1977). Found throughout Florida, north to Virginia (and New York) and west to California and Hawaii, 16 states in all (USDA 1997).

Life History: Reproduces both vegetatively and sexually (Penfound and Earle 1948, Gopal and Sharma 1981). Quickly forms new rosettes on floating stolons, with stolons easily broken; plants and mats transported by wind and water. Leaves killed back by moderate freezes, but quickly regrows from stem tip protected beneath water surface. Flowers year-round in mild climates, producing abundant seeds in developed mats (Penfound and Earle 1948). Numerous seedlings seen in conjunction with lake draw-downs (K. A. Langeland, University of Florida, personal observations).



Crowding out bulrush community

HYDRILLA VERTICILLATA (L.F.) ROYLE

Hydrocharitaceae/Frog's-Bit Family

Common Names:	Hydrilla, water thyme, Florida elodea, waterweed
Synonymy:	None
Origin:	Warmer regions of Old World

Botanical Description: Submersed, usually rooted, aquatic perennial herb with slender ascending stems to 9m (30 ft) long, heavily branched. Stems from slender rhizomes, these often tipped with a small tuber. Leaves whorled, 3-8 per whorl, 2-4 mm (0.1-0.2 in) wide and 6-20 mm (0.2-0.8 in) long, bearing coarse (visible) teeth along the margins and usually 1-4 small conical bumps along underside of midrib, which is often red. Fleshy axillary buds (turions) often formed at leaf axils, to 5 cm (2 in) long, with 3 sepals and 3 petals, each about 4 mm (0.3 in) long, whitish or translucent, floating at water surface. Male flowers detached and free floating at maturity, with 3 sepals and 3 petals, white to reddish brown, about 2mm long, releasing floating pollen from stamens when flower pops open at water surface.

NOTE: May be confused with another invasive non-native submersed aquatic, *Egeria densa* Planch., Brazilian waterweed, which has dense whorls of 3-6 leaves usually 2-3 cm long, with minute teeth on margins and no conical bumps on midrib below.

Ecological Significance: Introduced in Florida waters in 1960 and spreading to all drainage basins in the state by the early 1970's (Langeland 1996). By 1991, found in 41% of Florida's public water bodies (Schmitz *et al.* 1993); by 1994, found in 43% (182), with an estimated coverage of 38,500 ha (95,000 acres) (Schardt 1997). Competitively displaces native submersed plant communities (Haller and Sutton 1975, Bowes *et al.* 1977). In dense stands, alters fisheries populations (Colle and Shireman 1980), causes shifts in zooplankton communities (Schmitz and Osborne 1984), and affects water chemistry (Canfield *et al.* 1983).



Tubers

HYDRILLA

Distribution: Found on every continent except Antarctica (Cook and Lüönd 1982). In the United States, dioecious plants (fortunately just 1 sex, female) found in Florida, Georgia, Alabama, Tennessee, Mississippi, Louisiana, Texas, California, and Connecticut; monoecious plants found in Maryland, Delaware, Washington, and Washington, D.C.; both types found in the Carolinas and Virginia (Netherland 1997).

Life History: Readily dispersed by movement of plant fragments (Langeland and Sutton 1980). Can produce up to 6,000 tubers per m² (Sutton *et al.* 1992). Tubers viable for several days out of water (Basiouny *et al.* 1978), for over 4 years in undisturbed sediment (Van and Steward 1990), and after ingestion and regurgitation by waterfowl (Joyce *et al.* 1980). Can produce nearly 3,000 turions per m² (Thullen 1990). Viable seed produced by monoecious plants, but their importance to dispersal not known (Langeland and Smith 1984). Female dioecious plants from Florida found able to cross with monoecious strains and produce viable seed under laboratory conditions (Steward 1993).

WH



In Lake Trafford, Collier County

TKV



Turions

KAL



Female flowers

***HYMENACHNE AMPLEXICAULIS* (RUDGE) NEES**

Poaceae (Gramineae)/Grass Family

Common Names: West Indian marsh grass, trompetilla
Synonymy: *Panicum amplexicaulis* Rudge
Origin: West Indies, tropical Central and South America

Botanical Description: Robust perennial grass from stolons. Stems floating, creeping, or ascending to 1 m (3 ft) or more in height, sparingly branched, rooting at the lower nodes; stems pithy, not hollow. Leaf sheaths glabrous but with hairs on upper margins; ligule a membrane. Leaf blades flat, to 35 cm (14 in) long and to 4 cm (1.6 in) wide, cordate at the base and clasping the stem (amplexicaul); glabrous but with long hairs on lower margins. Inflorescence a terminal panicle, dense and spike-like, about 8 mm (0.3 in) wide and to 50 cm (20 in) long; spikelets short stalked, 3.3–4.3 mm long, scabrous on the veins, often opened slightly at the apex.

NOTE: May be confused with the native *Sacciolepis striata* (L.) Nash, American cupscale, which has a similar inflorescence, or with other marsh grasses of similar form, but *Hymenachne* stems distinctive in containing white pith (most grass stems are hollow) (Pohl and Lersten 1975).

Ecological Significance: First noted in botanical works for Florida in 1968 (Ward); described by Hall (1978) as “rare” in “low wet pastures” of south Florida. Possibly a natural introduction by migratory birds; can form extensive colonies in its natural habitats (Hill 1996). Has become, along with par  grass, the dominant species in much of the Myakka River basin’s native maidencane marsh, occurring primarily in the deeper water along the river channel while par  grass dominates the shallower zones near the uplands (J. Huffman 1992). Observed in 1993 as “common” in ditches, marshes, and mucky wet areas south of Clewiston, and in “large stands” in nearby detention ponds (E. C. Watson, U.S. Sugar Corp., 1993 personal communication). Dense populations also reported for the Ringling MacArthur tract in Sarasota County and for Mountain Lake in Hernando County (EPPC 1996), and for marsh areas along Fisheating Creek, near Lake Okeechobee, where it is displacing maidencane communities (Jackie Smith, Florida Department of Environmental Protection, 1995 personal communication). Scattered colonies reported for Collier Seminole State Park (EPPC 1996). Colonizing and becoming difficult to control along drainage canals of south central Florida (Mike Bodle, South Florida Water Management District, 1997 personal communication).

Distribution: Now found in tropics of both hemispheres (Howard 1979). In Florida, documented by herbarium specimens from Collier, Hendry, Lee, Palm Beach, and Sarasota counties (Wunderlin *et al.* 1995). Considered a principal agricultural weed in Surinam, a common weed in Indonesia, and present as a weed in Trinidad (Holm *et al.* 1979).

WEST INDIAN MARSH GRASS

Life History: Adapted to fluctuating water levels, i.e., cycles of flooding and drying, which allow massive regeneration by seed and ensure persistence after extensive drought periods (Wildin 1988). Observed as tolerating 40 weeks of flooding and maximum flooding depths of 1.2 m (4 ft) (Tejos 1980). Flowers in the fall (Wunderlin 1982), with observed germination rates variable, 0-86% (Hill 1996). Seed more widely dispersed during periods of high standing water (J. Mullahey, University of Florida, personal observations).

AMF



Along Fisheating Creek, Glades County

KCB



Spike-like panicle

IMPERATA CYLINDRICA (L.) RAEUSCHEL

Poaceae (Gramineae)/Grass Family

Common Name: Cogon grass
Synonymy: *Imperata cylindrica* (L.) Beauv.; *I. brasiliensis* Trinius misapplied
Origin: Southeast Asia

Botanical Description: Perennial grass, growing in loose or compact tufts, from stout, extensively creeping, scaly rhizomes with sharp-pointed tips. Leaf sheaths relatively short, glabrous or pubescent; ligule a membrane, 0.5–1 mm long. Leaf blades erect, narrow and pubescent at base, flat and glabrous above, to 1.2 m (4 ft) tall and to 2 cm (< 1 in) wide, with whitish midvein noticeably off-center; blade margins scabrous, blade tips sharp pointed. Inflorescence a narrow, dense terminal panicle, white silky and plume-like, to 21 cm (8 in) long and 3.5 cm (1.5 in) wide. Spikelets crowded, paired on unequal stalks, with each spikelet surrounded by long white hairs.

Ecological Significance: Considered one of the top 10 worst weeds in the world, reported by 73 countries as a pest in a total of 35 crops (Holm *et al.* 1977). Introduced to the United States in 1911 near Mobile, Alabama as packing material in a shipment of plants from Japan (Dickens 1974, Tabor 1949, Tabor 1952); and into Mississippi as a forage crop from the Philippines before 1920 (Dickens and Buchanan 1971, Patterson *et al.* 1979, Tabor 1949 and 1952, Tanner and Werner 1986). Replanted to Florida from Mississippi for forage and soil stabilization in Gainesville, Brooksville, and Withlacoochee (Hall 1983, Tabor 1949)—these areas now with high densities of naturalized populations (Dickens and Buchanan 1971, Willard 1988). By 1949, more than 405 ha (1,000 acres) of the grass established in central and northwest Florida (Dickens 1974). Now frequent along transportation and utility corridors throughout Florida. Has invaded dry to moist natural areas in over 20 counties (EPPC 1996), including habitats of federally listed endangered and threatened native plant species (K. C. Burks, Florida Department of Environmental Protection, 1997 personal communication).



Leaf blade, off-center midvein

COGON GRASS

Distribution: Commonly found in humid tropics but has spread to warm temperate zones worldwide (Hubbard *et al.* 1944). Currently reported for all of Florida, plus parts of Alabama, Georgia, Louisiana, and Mississippi, along with an adventive (but perhaps not persistent) population in South Carolina (Allen and Thomas 1991, Elmore 1986, Bryson and Carter 1993).

Life History: Fast-growing; thrives in areas of minimal tillage, such as orchards, lawns, and roadsides (Patterson *et al.* 1979). Produces new rhizomes readily, facilitating the plant's spread at newly colonized sites; can propagate by rhizome fragments but does not survive well under regular deep tilling (Wilcut *et al.* 1988). Roots and rhizomes remarkably resistant to fire (Bryson and Carter 1993). Disperses over long distances into a variety of habitats by windborne seeds (Bryson and Carter 1993). Flowers in spring or fall, or year-round in central and south Florida (Willard 1988).



In Everglades National Park (foreground)



Dense panicle

LANTANA CAMARA L.

Verbenaceae/Vervain Family

Common Names: Lantana, shrub verbena
Synonymy: *Lantana aculeata* L.
Origin: West Indies

Botanical Description: Rank-growing, multistemmed, deciduous shrub, to 2 m (6 ft) or more, with stems square, covered with bristly hairs when green, often armed as well with scattered small prickles. Leaves opposite, simple, with petioles to 2 cm (0.8 in) long; blades oval, rough hairy, to 15 cm (6 in) long and 6 cm (2.4 in) wide, with margins blunt-toothed and blade bases broad, squared off (truncate); leaves strongly aromatic. Flowers small, multicolored, in stalked, dense, flat-topped clusters to 4 cm (1.5 in) across; corolla a narrow tube with 4 short spreading lobes; flowers in a single cluster may be white to pink or lavender, yellow to orange or red, changing color over time. Fruit a round, fleshy, 2-seeded drupe, about 5 mm (0.2 in) wide, green turning purple then blue-black.

NOTE: May be confused with the endangered endemic native, Florida lantana (*Lantana depressa* Small), with which it has extensively hybridized, but bases of the native's leaf blades are tapered (cuneate), not truncate. Blade bases of the more common native, wild sage (*L. involucrata* L.), also cuneate, its flowers yellow-centered white, its leaves rounder.

Ecological Significance: A serious to common weed in 25 countries and present as a weed in another 22 countries (Holm *et al.* 1979). A serious, worldwide invader that in some areas has altered habitats and threatens to eliminate populations of native plants and animals (Cronk and Fuller 1995). Can become the dominant understory in open forests (Holm *et al.* 1977). In Florida, often forms thickets in sunny open areas; commonly invades disturbed sites such as roadsides, spoil islands, pastures, citrus groves, and cultivated woodlands. Also frequent in well-drained undisturbed habitats such as native pinelands, hammocks, and beach dunes. Reported from over 40 natural areas from Dade County to Okaloosa County (EPPC 1996). Widely promoted for ornamental cultivation since the early 1800s (Mack 1991), with wild plants in Florida representing tetraploid cultivars (Hammer 1997). Has extensively hybridized with all 3 distinct varieties of *L. depressa* (Sanders 1987), contaminating the endemic gene pool.



Immature and mature fruits

LANTANA

Distribution: Naturalized in tropical and warm regions worldwide (Sanders 1987). Found on the southern Atlantic Coastal Plain from Florida and Georgia to Texas (Small 1933), and in California and Hawaii as a serious pest (Holm *et al.* 1979, Kingsbury 1964). Common throughout Florida, including the Keys. Widely cultivated in Florida, with over 100 forms, cultivars, and hybrids available; some of the newer ones considered sterile (Hammer 1997).

Life History: Long recognized as highly toxic to grazing animals; has caused death in children when a quantity of unripe berries was eaten (Morton 1971b). Produces allelopathic substances in the roots and shoots, increasing its competitive ability (Smith 1985, Sahid and Sugau 1993). Strongly resists herbivory, contributing to its pest-plant status outside its natural range (Janzen *et al.* 1983). Can tolerate fire by regenerating from basal shoots (Smith 1985). Flowers year-round (or May to December in northernmost Florida). Seed dispersed by songbirds (Janzen *et al.* 1983). 'Gold Mound', 'New Gold', 'Alba', and 'Patriot' cultivars not known to produce viable seed in nursery or landscape plantings (S. Kent, Tree of Life Nursery, 1998 personal communication).



In Lake Jessup conservation area



Fruits and multicolored flowers

LEUCAENA LEUCOCEPHALA (Lam.) de Wit

Fabaceae (Leguminosae)/Pea Family

Common Names: white leadtree

Synonymy: *Acacia leucocephala* (Lam.) Link, *Leucaena glauca* Benth.,
Mimosa leucocephala Lam.

Origin: Tropical America, but now virtually pan-tropical.

Botanical Description: Shrub or small tree, up to 5 (rarely 10) m tall, forked when shrubby and branching strongly after coppicing, with greyish bark and prominent lenticels; leaves bipinnate, to 25 cm long; pinnae about 5 (4-9) pairs, up to 8-10 (35) cm long with a large gland (up to 5 mm) at the base of the petiole; leaflets about 12 (11-17 or to 22) pairs, from about (7-) 9-12 (-16) mm long, (1-) 2-3.5 (-4) mm wide, opposite, lanceolate, acute; somewhat dull, grayish-green. Flowers numerous, in globose, pedunculate heads, with a diameter of 2-3 (-5) cm; peduncles to 5-6 cm long; corolla and stamens white; calyx 2.5 mm long; petals linear; stamens (10 per flower) and pistil 10 mm long; anthers pilose, dehiscing at dawn; ovary faintly pubescent at apex; pods clustered, linear, flat, 10-15 (-20) cm long, 1.8-2 cm wide, dark brown, beaked at apex, pendant, brown at maturity, with about 20 (18-25) seeds, these glossy brown, oval-oblong, flat, 6-10 mm long.

Ecological Significance: Probably introduced into Florida for erosion control and cattle fodder. Leadtree is seldom purposely cultivated as a landscape plant but may persist as a "weed" in cultivated areas. Leadtree is a weedy, fast-growing tree that readily invades coastal strand, pine rockland, the margins and canopy gaps of hardwood forests, and open disturbed sites. Population densities can be high if left unchecked. It is a frequent site along roadsides and hammock margins in Miami-Dade and Monroe counties.

"This thornless tree forms dense thickets, excluding all plants. Prolific seed producer. It grows easily from seeds. The seeds are dispersed by rodents and granivorous birds and can also be spread in cattle manure. It is grown for fodder, but unless severely grazed or controlled, it spreads rampantly throughout adjacent areas" (C.W. Smith, 1985; p. 193). Generally favors limestone soils (although seems to do well on volcanic soils on Tahiti) and disturbed areas and is found in dry to mesic habitats up to 700 m. It also grows in severely disturbed wet areas but not as a dominant species. In Fiji, "abundantly naturalized from near sea level to about 800 m along roadsides, in cultivated areas and in pastures, on dry river banks or open gravel banks in forest, often

EARLEAF ACACIA

forming dense thickets" (A.C. Smith, 1985; pp. 63-65). In Hawai'i, "naturalized and very common, sometimes forming the dominant element of the vegetation, in low elevation, dry, disturbed habitats, 0-350m" (Wagner *et al.*, 1999; pp. 679-680).

Distribution: In its native range, grows on shallow limestone soils, coastal sands and seasonally dry, self-mulching vertisol soils of pH 7.0-8.5. In Florida, naturalized in most coastal counties from Volusia and Pasco southward. Also documented in Highlands and Alachua counties.

Life History: In exotic locations requires well-drained soils with pH above 5.5, or above 5.0 where aluminum saturation is very low. Intolerant of soils with low pH, low P, low Ca, high aluminum saturation, high salinity and waterlogging. Tolerant of moderate salinity and alkalinity. Prefers subhumid and humid climates of 650-1,500 mm and up to 3,000 mm annual rainfall and tolerates up to 7 months dry season. Does not tolerate waterlogged soils or extended periods of flooding (>3 weeks). Requires temperatures of 25-30°C for optimum growth. Growth ceases at 15-16°C. Light frosts will kill leaves. Very heavy frosts will kill stems back to ground level but will not kill mature plants. Extremely tolerant of regular defoliation by cutting or grazing once established. Mature plants are tolerant of fire, regrowing readily from burnt stumps. New seedlings often rapidly re-establish stands after fire or other disturbance (C.W. Smith, 1985; p. 193).

Links to photographs and additional information:

http://www.hear.org/pier/species/leucaena_leucocephala.htm

http://www.tropicalforages.info/key/Forages/Media/Html/Leucaena_leucocephala.htm

http://www.miamidade.gov/derm/plant_lead_tree.asp

LUDWIGIA PERUVIANA (L.) H. Hara

Onagraceae/Evening Primrose Family

- Common Names:** peruvian primrose-willow, ludwigia, peruvian primrose, peruvian primrosebush, water-primrose
- Synonymy:** *Jussiaea grandiflora* Ruiz & Pav., *J. hirta* (L.) Sw., *J. macrocarpa* Kunth, *J. peruviana* L. var. *glaberrima* Donn.Sm., *J. peruviana* L., *J. peruviana* L. var. *typica* Munz, *J. peruviana* L. var. *macrocarpa* (Kunth) Bertoni, *J. peruviana* L. forma *hirsuta* Hassl., *J. peruviana* L. forma *tomentosa* Hassl., *J. peruviana* L. var. *australis* Hassl., *J. speciosa* Ridl., *J. sprengeri* L.H.Bailey, *Ludwigia hirta* (L.) M.Gómez, *L. peruviana* (L.) Hara var. *glaberrima* (Donn.Sm.) Alain, *Oenothera hirta* L.
- Origin:** Tropical South America

Botanical Description: A perennial, sometimes deciduous, wetland shrub to 3-4 m. It reproduces by seed and, possibly, by suckers. Stems dark green or brownish green, much branched, hairy when young. Leaves alternate, rarely opposite, ovate, 5 to 10 cm long, 1 to 3 cm wide, hairy. Flowers yellow, bisexual, 2 to 4 cm diameter, solitary in leaf axils on stalks as long as leaves; sepals 4, pale green, 8 to 12 mm long; petals 4, occasionally 5, 1 to 3 cm long and wide. Fruit an erect capsule. Seed light brown, subglobose, 0.6 to 0.8 mm long, numerous. Root: A woody taproot with laterals close to the surface" (Parsons & Cuthbertson, 1992; pp. 525-526). and sometimes with white spongy vertical pneumatophores, especially in water.

Ecological Significance: In fall 2007, the Florida Exotic Pest Plant Council added *Ludwigia peruviana* to the Council's list as a Category I invasive plant species. This category refers to "invasive exotics that are altering native plant communities by displacing native species, changing community structures or ecological functions, or hybridizing with natives. *This definition does not rely on the economic severity or geographic range of the problem, but on the documented ecological damage caused.*"

Peruvian primrose willow (*Ludwigia peruviana*) is known from at least 48 Florida counties, from the Panhandle to the Keys. It is also known in the United States from North Carolina, Georgia, Alabama, Mississippi, and Texas. While always known as an aggressive weed in wetlands in Florida, there has been debate about its nativity. After an evaluation of available data, the Committee now agrees that this species was introduced into Florida, probably from South America, by the late 1800s, and has

PERUVIAN PRIMROSE-WILLOW

subsequently spread throughout the state and to other states. It reproduces by seed and there are many small sand-like seeds in 4 to 5 rows within a capsule and can produce soil seed banks of 1 million seeds per square meter. It can form monospecific stands in both disturbed and undisturbed wetlands, especially river and lake edges, and dramatically change ecosystem structure.

Studies by the University of Florida Center for Wetlands (for the Florida Institute of Phosphate Research, FIPR) of wetlands developing on phosphate mined lands and under controlled greenhouse conditions revealed that Peruvian primrose-willow and Cattail (*Typha* spp.) contributed greater nutrient sequestration than other common herbaceous species. Constructed

wetlands dominated by primrose willow and by Carolina willow (*Salix caroliniana*) had higher microtopographic relief than systems where these species were not present. Another FIPR study found the costly control of primrose willow and cattail is probably not necessary in the reestablishment of forested wetlands in Florida if adapted trees (baldcypress, *Taxodium distichum*, popash, *Fraxinus caroliniana*, water hickory, *Carya aquatica* and red maple, *Acer rubrum*) are planted at sufficient density and site conditions allow vigorous tree growth.

Distribution: Introduced in Asia, Australasia-Pacific Region, and North America.

Life History: The plants may bear conspicuous, bright yellow flowers year-round and are often seen in shallow, wet ditches, in still or slowly flowing streams and drainage canals, and in marshy areas, primarily in central and south Florida, but extending into north Florida as well. In the northern parts of the plant's range, flowers generally bloom in the fall and stems may become winter-killed, during cold snaps.

Links to photographs and additional information:

http://www.hear.org/pier/species/ludwigia_peruviana.htm

http://www.sfrc.ufl.edu/4h/Primrose_willow/primwill.htm

LYGODIUM MICROPHYLLUM (CAV.) R. BROWN

Lygodiaceae/Climbing Fern Family

Common Name:	Old World climbing fern
Synonymy:	<i>Lygodium scandens</i> (L.) Sw., <i>Ugena microphylla</i> Cav. [sometimes placed in Schizaceae, ray fern family]
Origin:	Africa to Southeast Asia, south Pacific islands, Australia

Botanical Description: Fern with dark brown, wiry rhizomes and climbing, twining fronds of indeterminate growth, to 30 m (90 ft) long; main rachis (leaf stalk above petiole) wiry, stemlike. Leafy branches off main rachis (constituting the pinnae) once compound, oblongish in overall outline, 5-12 cm (2-5 in) long. Leaflets (pinnaules) usually unlobed, stalked, articulate (leaving wiry stalks when detached); leaf-blade tissue usually glabrous below; fertile leaflets of similar size, fringed with tiny lobes of enrolled leaf tissue covering the sporangia along the leaf margin.

NOTE: May be confused with *L. japonicum*, whose pinnae are often twice compound (see preceding pages).

Ecological Significance: Considered a principal agricultural weed in Malaysia and present as a weed in Vietnam (Holm *et al.* 1979). Reported from Florida natural areas of Broward, Highlands, Lee, Martin, Palm Beach, and Sarasota counties (EPPC 1996). In 1993, infested 1,233 acres (11% of the area) of Jonathan Dickinson State Park and the Loxahatchee National Wild and Scenic River, including many acres of cypress swamps (Roberts and Richardson 1995). By 1995, infested 17,000 acres (12% of the area) of the Loxahatchee National Wildlife Refuge (Palm Beach County), blanketing entire tree islands and even clambering over sawgrass in standing water (Jewell 1996). Poses management problems for both wildfires and prescribed burns because growth into canopy creates an avenue for fire to spread where swamp waters have usually provided a natural barrier. Has caused loss of some canopy trees with such "crown" fires, as well as loss of native bromeliads residing on tree trunks (S. Farnsworth, Palm Beach County, 1995 personal communication; Roberts 1996).

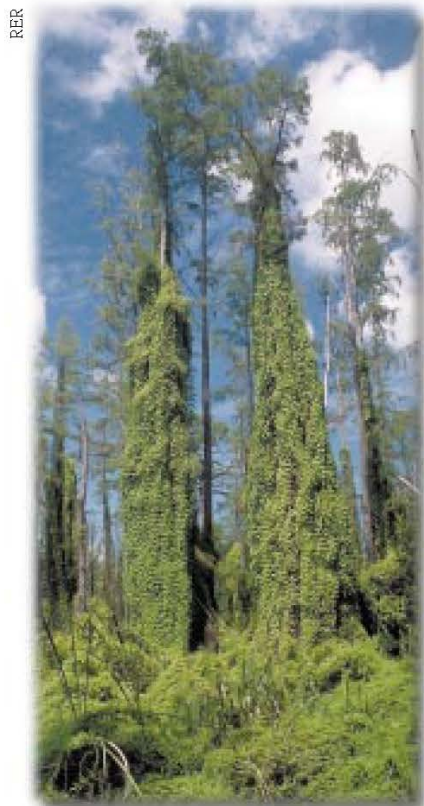


Section of rachis with pinnae

OLD WORLD CLIMBING FERN

Distribution: Center of dispersal in Florida reported by Beckner (1968) and Nauman and Austin (1978) as Loxahatchee River Basin in southern Martin and northern Palm Beach counties. Herbarium specimens now recorded from Broward, Collier, DeSoto, Highlands, Lee, Polk, and Sarasota counties (Wunderlin *et al.* 1996). Widespread in Old World tropics from Africa and India to Malaysia and in Australia from Ryukyu Islands south to New South Wales (Singh and Panigrahi 1984, Tagawa and Iwatsuki 1979).

Life History: Wiry rhizomes able to accumulate into dense mats 1 m (3 ft) or more thick above native soil (J. Street, Palm Beach County, 1996 personal communication). Vegetative growth and production of fertile pinnules continuous throughout year. Can germinate from spores in 6-7 days, with 5-month-old spores still having an 80% germination rate (Brown 1984). Fertile pinnules usually produced where plant receives sunlight, with such exposed locations also aiding windborne dispersal of the spores. Often establishes first at pineland/wetland ecotone. Usually killed back by fire, but not eliminated (Maithani *et al.* 1986).



In natural area, Martin County



Fertile pinnules

MELALEUCA QUINQUENERVIA (CAV.) BLAKE

Myrtaceae/Myrtle family

Common Names: Melaleuca, paper-bark, cajeput, punk tree, white bottlebrush tree

Synonymy: *Melaleuca leucadendron* (L.) L. misapplied

Origin: Australia, New Guinea, and Solomon Islands

Botanical Description: Evergreen tree to 33 m (100 ft) tall, with a slender crown and soft, whitish, many-layered, peeling bark. Leaves alternate, simple, grayish green, narrowly lance shaped, to 10 cm (4 in) long and 2 cm (3/4 in) wide, with a smell of camphor when crushed. Flowers in creamy white “bottle brush” spikes to 16 cm (6 in) long. Fruit a round, woody capsule, about 3 mm (3/8 in) wide, in clusters surrounding young stems, each capsule holding 200-300 tiny seeds.

Ecological Significance: Introduced to Florida for ornament in 1906 (Laroche 1994b). Scattered aerially over the Everglades in the 1930s to create forests (Austin 1978). Widely planted, and recommended as late as 1970 as “one of Florida’s best landscape trees” (Watkins 1970). Now recognized internationally as a threat to the Florida Everglades, a World Heritage Site and International Biosphere Reserve (D. C. Schmitz, 1994 Congressional testimony). Grows extremely fast, producing dense stands that displace native plants, diminish animal habitat, and provide little food for wildlife (Laroche 1994b). Has become abundant in pine flatwoods, sawgrass marshes, and cypress swamps of south Florida (Nelson 1994). By 1994, estimated to infest nearly 200,000 ha (490,000 acres) in south Florida, with extensive stands in the Everglades, Big Cypress, and Loxahatchee Slough (Laroche 1994b). Infested acreage since reduced by an estimated 40,470 ha (100,000 acres) through regional control efforts (F. Laroche, South Florida Water Management District, 1998 personal communication). First insect biological control agent released in Everglades by U.S. Department of Agriculture in 1997 (Cox News Service).

Distribution: Found naturalized in Florida as far north as Hernando, Lake, and Brevard counties (Wunderlin *et al.* 1995, Mason 1997). Reported from natural areas in 16 central and south Florida counties (EPPC 1996).



Old capsules

MELALEUCA

Life History: Prefers seasonally wet sites, but also flourishes in standing water and well-drained uplands (Laroche 1994b). Saplings often killed by fire, but not mature trees. Can survive severe frost damage (Woodall 1981). Grows 1-2 m (3-6 ft) per year; resprouts easily from stumps and roots; capable of flowering within 2 years from seed (Laroche 1994b). Flowers and fruits all year, producing up to 20 million windborne seeds per year per tree, and able to hold viable seed for massive all-at-once release when stressed (Woodall 1983). Releases volatile oils into air, especially when blooming, that cause respiratory irritation, asthma attacks, headaches, and/or rashes in some people (Morton 1971b).



In Big Cypress National Preserve



Flowers, leaves

MELIA AZEDERACH L.

Meliaceae/Mahogany Family

Common Names: Chinaberry, pride-of-India
Synonymy: *M. australis* Sweet; *M. japonica* G. Don; *M. sempervirens* Sw.
Origin: Asia

Botanical Description: Deciduous tree to 15 m (50 ft) tall. Twigs stout with purplish bark, dotted with buff-colored lenticels. Leaves alternate, large, long-petioled, 2 or 3 times compound (odd-pinnate), up to 0.5 m (1.5 ft) long; leaflets pungent when crushed, dark green above, often with sparse pubescence along veins; lighter green below, generally glabrous; margins serrate; blade bases often oblique. Inflorescences showy, loose, stalked panicles from leaf axils. Flowers small, fragrant, with 5 lilac petals; stalks of stamens united into dark purple tube. Fruit a stalked, thinly fleshy, subglobose, single-seeded drupe, yellow or yellowish green at maturity.

Ecological Significance: Introduced around 1830 as an ornamental in South Carolina and Georgia (Gordon and Thomas 1997) and widely planted in southern states. Occurs primarily in disturbed areas such as road right-of-ways and fencerows, but has also invaded floodplain hammocks and marshes and upland woods, particularly in north Florida (Clewett 1985, Godfrey 1988). Reported by land managers as infesting parks in 23 counties (EPPC 1996).

Distribution: Most abundantly naturalized in north and west Florida, but often escaping cultivation in peninsular counties, south to the Keys (Nelson 1994, Wunderlin 1982). Naturalized also in tropical America and planted in temperate and subtemperate areas around the world (Bailey and Bailey 1976). Reported as a prominent roadside and shoreline weed in Cape Province, South Africa (Henderson 1991). In the U.S., naturalized from eastern Virginia, southward to south Florida, and westward to eastern half of Texas and Oklahoma (Godfrey 1988).



Flowers

CHINABERRY

Life History: Often shrubby and root-suckering, forming thickets. Frequently flowers and fruits at shrub size. Produces flowers in spring, usually March and April; its fruits long-maturing, prolific, and commonly persistent after leaf fall. Fruits poisonous to humans and some other mammals, but seeds dispersed by a variety of songbirds, who relish the drupes and sometimes gorge themselves to the point of temporary intoxication (Nelson 1994).



Compound leaf



Fruits

NEYRAUDIA REYNAUDIANA (KUNTH) KENG EX HITCHC.

Poaceae (Gramineae)/Grass Family

Common Names: Silk reed, Burma reed, cane grass
Synonymy: None (*N. arundinacea* (L.) Henr. misapplied)
Origin: South Asia

Botanical Description: Robust, reed-like perennial to 3 m (10 ft) tall, forming clumps from short, coarse rhizomes. Stems often branched and filled with soft pith. Leaf sheaths 10-25 cm (4-10 in) long, smooth, shining, clasping, woolly at the top with a line of collar hairs and ligule of hairs. Leaf blades linear, flat or involute, 20-100 cm (8-39 in) long and 8-25 mm (0.3-1 in) wide, glabrous below, sparsely short-hairy above, with margins smooth or rough and midvein inconspicuous; blades often deciduous from sheaths. Inflorescence a large, feathery, silver-hairy terminal panicle, 30-60 cm (12-24 in) long, densely and finely branched, nodding. Spikelets 6-8 mm (0.2-0.3 in) long, 4- to 8-flowered, with lemmas long-hairy and slender-awned (awns often curved).

NOTE: May be confused with the common reed, *Phragmites australis* (Cav.) Trin. ex Steud., but its rhizomes long, often forming leafy stolons; its leaf sheaths without a hairy collar; and its spikelets without awns.

Ecological Significance: Introduced by USDA to its Plant Introduction Station in Coconut Grove in 1916 (Gordon and Thomas 1997). Reported as escaping in southeastern Florida by several authors (Hitchcock and Chase 1951, Ward 1968, Bailey and Bailey 1976, Morton 1976, Austin 1978, Hall 1978). By 1990, documented as a serious pest in Dade County and as naturalized in Collier County (Guala 1990). Able to colonize marginal and undisturbed habitats once established in an area (Guala 1990). Now well established in the globally rare pine rockland habitats of Dade County and viewed as a threat to rare species there, especially since its high flammability promotes frequent fires, enhancing its spread (Schmitz *et al.* 1997). By 1993, established in nearly 75% of Dade County pine rocklands outside Everglades National Park, with high mortality of the native south Florida slash pine (*Pinus elliottii* var. *densa*) linked to fires involving this grass (Maguire 1993). In its native range, reported to grow gregariously by roadsides and in old clearings, bogs, and agricultural fields, often on infertile and rocky soils (Lazarides 1980).



Hairs at sheath/blade joint

SILK REED

Distribution: Occurs in a wide variety of habitats to 2,000 m (6,500 ft) in elevation in its native range (Bor 1960, Lazarides 1980). Reported as introduced in the Bahamas (Correll and Correll 1982). In Florida, currently found in Collier, Monroe (including the Florida Keys), Dade, Broward, and Palm Beach counties (Schmitz 1994, Wunderlin *et al.* 1996), and possibly in Highlands County, where it was once cultivated (Guala 1990). Has been cultivated as far north as southern Georgia (Schmitz *et al.* 1997, Guala 1990).

Life History: Tolerant of a wide range of soil, light, and water regimes, including marshy areas, but appears to prefer open, sunny, dry sites, usually disturbed ones (Guala 1990). Aerial stems usually killed by freezing temperatures, but observed to vigorously resprout from rhizomes after hard frosts (Guala 1990). Flowers nearly year-round, seeds dispersed by wind.



In natural area, Miami-Dade County



Panicles

PANICUM REPENS L.

Poaceae (Gramineae)/Grass Family

Common Names: Torpedo grass, quack grass, bullet grass

Synonymy: *Panicum littorale* Mohr ex Vasey

Origin: Old World

Botanical Description: Perennial grass to 1 m (3 ft) tall, from sturdy, vigorous, widely creeping or floating rhizomes with overlapping brownish to white scales and rigid sharp-pointed (torpedo-like) growing tips. Aerial stems erect or leaning, lower portions often wrapped in bladeless sheaths. Upper leaf sheaths glabrous or hairy, usually at least with hairs on upper margins; ligule a short-ciliate membrane; leaf blades stiff, linear, flat or folded, to 26 cm (10 in) long and 5.3 mm (0.3 in) wide, glabrous or sparsely hairy below, usually long-hairy above, especially near base behind ligule; blade surfaces often with a whitish waxy coating ("bloom"). Inflorescence a loose open terminal panicle, 7-22 cm (3-9 in) long, with branches erect or ascending. Spikelets 2-3 mm long and about 1 mm wide, glabrous, the first glume (outermost spikelet bract) short, truncate, loose, nearly encircling the base of the other spikelet bracts.

Ecological Significance: Reported as a weed of 17 crops in 27 countries, considered one of the most serious grass weeds (Holm *et al.* 1977). Introduced into Gulf Coast of United States before 1876, being first collected that year near Mobile, Alabama (Beal 1896). Seed introduced for forage crops in the South from 1926 (Tarver 1979). By 1950, planted in nearly every southern Florida county and in a few central and north-central counties (Hodges and Jones 1950). Quickly forms monocultures that displace native vegetation, particularly in or near shallow waters (Shilling and Haller 1989). Occurred in 70% of Florida's public waters by 1992, with the largest infestation in Lake Okeechobee, displacing nearly 5,670 ha (14,000 acres) of native marsh (Schardt 1994). Also reported from parks and preserves throughout Florida (EPPC 1996). Has cost an estimated \$2 million a year for its management in flood control systems (Schardt and Schmitz 1991). Has seriously infested citrus groves and golf courses throughout Florida (Baird *et al.* 1983, Fleming *et al.* 1978).



Rhizome

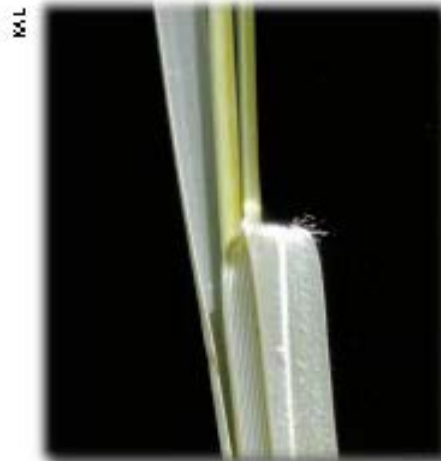
TORPEDO GRASS

Distribution: Now found in the tropics and subtropics from approximately 43° North latitude to 35° South latitude (Holm *et al.* 1977). Occurs from Florida to Texas in the Southeast (Godfrey and Wooten 1979), northward along the Atlantic Coast to North Carolina (C. Jacomo, U.S. Geological Survey, 1998 personal communication), and in California (Small 1933) and Hawaii, where it is a pest in sugarcane (Holm *et al.* 1977). Occurs naturalized in 75% of Florida's 67 counties (Wunderlin *et al.* 1995).

Life History: Tolerant of drought and partial shade, and can grow on heavy upland soils, but thrives in moist to wet sandy or organic soil (Hodges and Jones 1950, Holm *et al.* 1977). Stimulated in its spread by tilling and fertilization (Hodges and Jones 1950). Reproduces principally by rhizome extension and fragmentation (Holm *et al.* 1977). Flowers nearly year-round, but variable in its seed abundance and viability (Whyte *et al.* 1959, Peng and Twu 1979, Wilcut *et al.* 1988).



Panicle



Ligule, hairs on blade



Monoculture in St. Johns Marsh

***PISTIA STRATIOTES* L.**

Araceae/Arum Family

Common Name: Waterlettuce
Synonymy: None
Origin: Africa or South America

Botanical Description: Floating herb in rosettes of gray-green leaves, rosettes occurring singly or connected to others by short stolons. Roots numerous, feathery. Leaves often spongy near base, densely soft pubescent with obvious parallel veins, slightly broader than long, widest at apex, to 15 cm (6 in) long. Flowers inconspicuous, clustered on small fleshy stalk nearly hidden in leaf axils, with single female flower below and whorl of male flowers above. Fruit arising from female flower as a many-seeded green berry.

Ecological Significance: May have been introduced to North America by natural means or by humans (Stoddard 1989). Seen as early as 1774 by William Bartram, in “vast quantities ... several miles in length, and in some places a quarter of a mile in breadth” in the St. Johns River (Van Doren 1928). Has been suggested that trade via St. Augustine, founded in 1565, may have provided an early avenue for introduction into the St. Johns watershed (Stuckey and Les 1984). Capable of forming vast mats that disrupt submersed plant and animal communities and interfere with water movement and navigation (Bruner 1982, Attionu 1976, Sharma 1984, Holm *et al.* 1977); also serves as host for at least 2 genera of mosquitoes (Holm *et al.* 1977). Considered a serious weed in Ceylon, Ghana, Indonesia, and Thailand and at least present as a weed in 40 other countries (Holm *et al.* 1979). A target of management research and control in Florida for at least 2 decades.



Flowering spathe

WATERLETTUCE

Distribution: Now one of the most widely distributed hydrophytes in the tropics (Holm *et al.* 1977). In North America, occurs in peninsular Florida and locally westward to Texas (Godfrey and Wooten 1979). Also found persisting in coastal South Carolina (Nelson 1993). Occurred in 68 public water bodies in Florida by 1982 and in 128 water bodies by 1989, but total abundance reduced by half over same time period as a result of a statewide management program (Schardt and Schmitz 1990).

Life History: Reproduces rapidly by vegetative offshoots formed on short, brittle stolons. Varies seasonally in density of rosettes, from less than 100 to over 1,000 per m² in south Florida (Dewald and Lounibos 1990). Seed production, once thought not to occur in North America, now considered important to reproduction and dispersal (Dray and Center 1989). Not cold tolerant (Holm *et al.* 1977). Can survive for extended periods of time on moist muck, sandbars, and banks (Holm *et al.* 1977).



Leaf rosette

PSIDIUM CATTLEIANUM SABINE

Myrtaceae/Myrtle Family

Common Names: Strawberry guava, Cattley guava
Synonymy: *Psidium littorale* Raddi var. *longipes* (O. Berg) Fosb.
Origin: Brazil

Botanical Description: Evergreen shrub or small tree to 8 m (25 ft) tall, with gray to reddish-brown peeling bark and young branches round, pubescent. Leaves opposite, simple, entire, glabrous, elliptic to oblong, to 8 cm (3 in) long. Flowers to 2.5 cm (1.2 in) wide, borne singly at leaf axils, with white petals and a mass of white and yellow stamens. Fruit a globose berry, 3-6 cm (1.2-2.4 in) long, purple-red, with whitish flesh usually sweet-tasting when ripe; seeds numerous.

NOTE: May be confused with the common guava (*P. guajava*, on following pages), which has 4-angled branches and larger leaves with the veins prominently raised below.

Ecological Significance: Introduced to Florida in the 1880s for ornament and as a fruit crop (Gordon and Thomas 1997), and since planted extensively (Watkins 1970, Broschat and Meerow 1991). Noted as "often growing wild" by 1950s (Barrett 1956). Forms thickets and shades out native vegetation in forests and open woodlands (Cronk and Fuller 1995). Has had catastrophic effect on native habitats of Mauritius, and considered the worst pest plant in Hawaii, where it has invaded a variety of natural areas (Cronk and Fuller 1995). Has become dominant in some native forests of Hawaii, including in 2 national parks, where its clonal spread is enhanced by activities of feral pigs (Huenneke and Vitousek 1990). Reported from Florida parks and preserves in Pinellas, Hillsborough, Martin, and Palm Beach counties (EPPC 1996). Along with the common guava and the Surinam cherry, also serves as a major host for the naturalized Caribbean fruit fly, *Anastrepha suspensa* (Loew), which occasionally spreads to commercial citrus crops (Nguyen *et al.* 1993).



Young stem

STRAWBERRY GUAVA

Distribution: Native to Brazil, naturalized in Florida, Hawaii, tropical Polynesia, Norfolk Island, and Mauritius (Cronk and Fuller 1995). Naturalized across peninsular Florida, with herbarium specimens documented from Seminole, Orange, Osceola, Pinellas, Hillsborough, Indian River, St. Lucie, Martin, Highlands, Glades, Hardee, and DeSoto counties (Wunderlin *et al.* 1995).

Life History: Grows rapidly, tolerates shade, and produces root suckers (Cronk and Fuller 1995). Root-suckering ability important to its dominance in natural habitats (Huenneke and Vitousek 1990). Has good salt tolerance (Maxwell and Maxwell 1961). Flowers and fruits all year (Wunderlin 1982). Has high seed production, early seed maturity, and seed dispersal by both birds and mammals (Cronk and Fuller 1995).



Bark



Immature fruits

PSIDIUM GUAJAVAL

Myrtaceae/Myrtle Family

Common Names: Common guava, apple guava

Synonymy: None

Origin: Tropical America

Botanical Description: Evergreen shrub or small tree to 9 m (30 ft) tall, with scaly greenish-brown bark and young branches 4-angled, pubescent. Leaves opposite, simple, short stalked, entire, oval to oblong-elliptic, to 15 cm (6 in) long, pubescent below, with veins impressed above and conspicuously raised below. Flowers white, fragrant, to 4 cm (1.6 in) wide, borne singly or a few together at leaf axils; many stamens. Fruit an oval or pear-shaped berry, 3-10 cm (1-4 in) long, yellow at maturity, with yellow or dark pink flesh somewhat dull in taste; seeds numerous.

NOTE: May be confused with the strawberry guava (see preceding pages).

Ecological Significance: Introduced early to Florida, naturalized by 1765 (DeBrahm 1773). Planted extensively for edible fruit and ornament; weedy in landscaping (Broschat and Meerow 1991); spreading into hammocks and pinelands (Long and Lakela 1971, Morton 1976). Has become dominant in the understory of some cypress strands (D. F. Austin, Florida Atlantic University, 1997 personal communication). Forms thickets and has a serious impact in native forests and open woodlands (Cronk and Fuller 1995). Present as a weed in 27 countries; a common to serious pest in 9 of these (Holm *et al.* 1979). Now a common element of coastal moist forests in Puerto Rico (Little and Wadsworth 1964). Reported from Florida parks and preserves in Broward, Collier, Dade, Highlands, Lee, Martin, Osceola, Palm Beach, and Sarasota counties (EPPC 1996). Along with the strawberry guava and the Surinam cherry, also serves as a major host for the naturalized Caribbean fruit fly, *Anastrepha suspensa* (Loew), which occasionally spreads to commercial citrus crops (Nguyen *et al.* 1993).



Along roadside,
Indian River County



Leaves

COMMON GUAVA

Distribution: Native to tropical America, probably from southern Mexico south to South America, but its distribution greatly extended through cultivation (Little and Wadsworth 1964). Frequently naturalized (Bailey and Bailey 1976). Naturalized in Old World tropics, in Florida and the West Indies (Cronk and Fuller 1995). Found in Florida from Pinellas and Brevard counties south to the Keys (Nelson 1994).

Life History: Forms dense thickets (Scurlock 1987). Grows rapidly and tolerates shade (Cronk and Fuller 1995). Young plants more tolerant of cold, to -7°C (20°F), if water stressed (Utsunomiya 1988). Flowers and fruits all year (Wunderlin 1982). Has high seed production, early seed maturity, and seed dispersal by both birds and mammals (Cronk and Fuller 1995).

KAL



Bark

KAL



Young stem

PTERIS VITTATA L.

Pteridaceae/Brake Fern Family

Common Names: ladder brake, Chinese ladder brake, Chinese brake fern, Chinese brake

Synonymy: *Polypodium trapezoides* Burm.f., *Pteris acuminatissima* Blume, *P. aequalis* C.Presl, *P. alpinii* Desv., *P. costata* Bory ex Willd., *P. diversifolia* Sw., *P. ensifolia* Poir., *P. guichenotiana* Gaud., *P. inaequilateralis* Poir., *P. lanceolata* Desf., *P. longifolia* L. var. *brevipinna* Domin, *P. microdonta* Gaud., *P. obliqua* Forssk., *P. tenuifolia* Brack, *P. vulcanica* Bertol., *Pycnodoria vittata* (L.) Small

Origin: Asia

Botanical Description: Fern with stout, short-creeping, densely scaly stems; scales pale brown. Leaves clustered, 10-50 (-100) cm. Petiole green to pale brown, 1-30 cm, densely scaly; scales dense proximally, extending to and along rachis. Blade oblanceolate, 1-pinnate, (15-) 25-50 (-80) cm long and (6-) 13-25 cm wide, dark matte green; rachis not winged. Pinnae numerous, linear-lanceolate to linear-attenuate, simple, 2-18 cm × 4-9 mm; base asymmetrically cordate to widened or truncate; margins serrulate, prominently so near apex; apex acuminate, attenuate, or acute; proximal pinnae not divided or lobed; terminal pinna much longer than laterals. Veins free, forked. Sori narrow, blade tissue exposed abaxially.

Note: *Pteris vittata* varies in size, density of scales on the rachis, presence or absence of hairs on the abaxial costae, and overall color and aspect of the leaf. As a result, it may occasionally bear a resemblance to forms of *P. × delchampsii* W. H. Wagner & Nauman, the hybrid between the threatened Bahama ladder brake, *P. bahamensis*, and *P. vittata*. Bahama ladder brake has fronds that are more upright, brighter green, and thinner. The presence of abortive spores is the best distinguishing character of *P. × delchampsii*, although a few spores can be fertile. While the hybrids do not interbreed, back-crosses with the parents are possible.

Ecological Significance: According to the Florida Exotic Pest Plant Council, this Category II species has increased in abundance and/or frequency across the state but has not yet altered Florida plant communities to the extent shown by Category I species.

University of Florida researchers identified this fern as a champion of bioremediation in 2001 when *P. vittata* was found to be highly effective in the uptake of arsenic from contaminated soils. Plants absorb arsenic through their roots and store it in their fronds, which can be clipped or the entire plant can be dug up and disposed of safely. This

LADDER BRAKE

discovery marked the first time a plant had been found to naturally take up arsenic in high concentrations.

Distribution: This exotic escaped from cultivation and is now widely naturalized around the world. It is found in all southeastern states, as well as California, Hawaii, and Puerto Rico (Kartesz, 1999). This fern occurs nearly throughout Florida but is especially common in South Florida. *P. bahamensis* grows in a variety of habitats, but it is usually in pine rockland or fire-suppressed pine rocklands that are transitioning to hammocks. Since both species are often found together in transition habitats and in disturbed areas adjacent to pine rocklands, *P. x delchampsii* may occur in these areas as well.

Life History: Ladder brake is found on almost any calcareous substrate, such as old masonry, sidewalks, building crevices, and nearly every habitat in southern Florida with exposed limestone, notably pinelands. It is scattered throughout Florida and is sporadic, becoming less frequent to rare northward in the coastal plain.

Links to photographs and additional information:

(<http://www.genomenewsnetwork.org/articles/2004/08/06/fern.php>)

Nelson, G. 2000. *The Ferns of Florida*. Pineapple Press Inc., Sarasota, FL.

RHYNCHELYTRUM REPENS (Willd.) C.E. Hubb

Poaceae (Gramineae)/Grass Family

Common Names: rose Natal grass, Natal grass
Synonymy: *Melinis repens* (Willd.) Zizka, *Rhynchelytrum roseum* (Nees) Stapf & C.E. Hubbard ex Bews, *Saccharum repens* Willd., *Tricholaena repens* (Willd.) A.S. Hitchc., *T. rosea* Nees
Origin: South Africa

Botanical Description: Perennial herb, sometimes cespitose. Stems decumbent to erect, 3–10 dm; nodes 4–5. Leaf blade 3–20 cm, 3–6 mm wide, upper surface glabrous; sheath 3–9 cm, glabrous; ligule hairs 0.5–1.5 mm. Inflorescence 8–17 cm; primary branches 2.5–6 cm, glabrous to puberulent; spikelet stalk 0.5–5 mm, more or less wiry. Spikelet 3–5.5 mm, 1–2 mm wide, ovate to elliptic; lower glume less than 1.5 mm, 0–1-veined, upper glume about equaling the spikelet, silky hairs white to purplish; lower floret staminate, lemma more or less like the upper glume, 5-veined, tip minutely lobed, palea about equaling the lemma; upper floret about two thirds the length of the lower floret, lemma firm, white, shiny.

Ecological Significance: Natal grass invades Florida scrub vegetation, which harbors many state and federally listed species. Rose Natal grass was introduced in Florida for hay production but was abandoned when more productive grasses were discovered, although the species had already escaped into natural areas. It was also popular as landscape plant for its plumes of pink, long-lasting flowers. The Florida Nurserymen and Growers Association (FNGA) agreed to phase this species out of horticultural trade in 2001. In Miami-Dade County, rose natal grass can be a persistent problem in disturbed pine rocklands.

Few plants have invaded xeric habitat of the Southern Lake Wales Ridge, but some species have slowly invaded communities such as scrub and sandhill. Invasive plants occurring in xeric habitats of the Lake Wales Ridge are dominated primarily by grasses including natal grass (*Rhynchelytrum repens*) and the following: torpedo grass (*Panicum repens*), cogon grass (*Imperata cylindrical*), para grass (*Urochloa mutica*), Guinea grass (*Panicum maximum*), smutgrass (*Sporobolus indicus*), vaseygrass (*Paspalum urvillei*), and stargrass (*Cynodon spp.*).

ROSE NATAL GRASS

Distribution: Disturbed places, fields, slopes, from California to southern United States; occurs in nearly all Florida counties.

Life History: Grows well in arid or semiarid areas on poor sandy soils. This grass is usually stemmy and rather low in palatability for livestock. In the northern part of its U.S. geographic range, this grass is a short-lived perennial or annual, but becomes stouter in warmer areas to the south.

Links to photographs and additional information:

http://www.archbold-station.org/abs/landmanage/ExoticsGrant03/ExoticsMain/natal_grass1.htm

RUELLIA TWEEDIANA GRISEB

Acanthaceae/Acanthus Family

Common Names: Britton's wild petunia; Mexican bluebell
Synonymy: *Ruellia brittoniana* Leonard, *R. caerulea* Morong, *R. malacosperma* sensu Small, *non* Greenm.
Origin: Mexico

Botanical Description: Erect perennial herb to 1m tall. Leaves opposite, linear to linear-elliptic, 10-30 cm long, 1 cm wide, narrowed at base to a short petiole. Calyx and uppermost inflorescence branches sparsely stipitate-glandular or eglandular. Flowers distinctly pedunculate; peduncles terminated by inconspicuous, linear or narrowly lanceolate, nonfoliose bracts. Corolla to 5 cm across with five, fused, petals, violet to purple, white or pink. Capsule elongate, to 2.5 cm long with brown seeds, 2 mm (0.8 in) wide.

Ecological Significance: Frequently found in disturbed sites throughout the state, as well as drainage ditches, shores of ponds or lakes and moist to wet wooded areas. Observed on roadside ditch banks and around road culverts in the Big Cypress National Preserve and Fakahatchee Strand Preserve State Park, both in Collier County. Large, spreading populations also observed within the Big Cypress National Preserve. Large, naturalized populations occur in Gainesville (Alachua County) and Lake Wales (Polk County) and plants extend westward into the panhandle.

Distribution: Native to central Mexico. Widely cultivated in the United States for ornament. Sporadically naturalized across coastal plain, from South Carolina to Florida, west to Texas. Florida is the only state which currently recognizes this plant as invasive. The Florida Exotic Pest Plant Council lists *R. tweediana* as a Category I invasive plant species. This category refers to "invasive exotics that are altering native plant communities by displacing native species, changing community structures or ecological functions, or hybridizing with natives.

Life History: Prefers wet, disturbed sites. Adapts to sun or part shade. Moderately drought tolerant; proliferating in areas with abundant soil moisture.

Links to photographs and additional information:

<http://www.floridata.com/ref/R/ruellia.cfm>

Hammer, Roger L. Mexican Bluebell(*Ruellia tweediana* Griseb.), A Pretty Invasive Weed. Wildland Weeds, SPRING 2002, Volume 5, Number 2.

SAPIUM SEBIFERUM (L.) ROXB.

Euphorbiaceae/Spurge Family

Common Names: Chinese tallow tree, popcorn tree
Synonymy: *Croton sebiferus* L., *Stillingia sebifera* Michx., *Triadica sebifera* (L.) Small
Origin: Eastern Asia

Botanical Description: Deciduous tree to 16 m (52 ft), commonly to 10 m (33 ft). Sap milky. Leaves simple, alternate; blades entire, broadly ovate, 3-6 cm (1-2.5 in) wide, with broadly rounded bases and abruptly acuminate (tapering to a slender point) tips; petioles slender, 2-5 cm (1-2 in) long. Flowers small, yellow, borne on spikes to 20 cm (8 in) long, with 2-3 sepals (petals absent), 2-3 stamens or 3 styles (plants monoecious). Fruit a 3-lobed capsule, 1 cm (0.5 in) wide, turning brown and splitting open at maturity to reveal 3 dull white seeds, which remain attached for a time.

Ecological Significance: Considered a common agricultural weed in Taiwan, requiring constant effort and expense to hold at bay (Holm *et al.* 1979). Introduced repeatedly to the United States as an ornamental and potential oil crop species (Jones and McLeod 1989). Considered an invasive pest plant in the Carolinas since the 1970s. Has expanded its range on the United States Gulf Coast in low-lying areas, becoming dominant and spreading along roadside ditches and into areas where the soil stays wet (Cameron and LaPoint 1978). Also thrives in upland, well-drained areas near human habitation and in undisturbed areas such as closed canopy forests, in bottomland hardwood forests, shores of waterbodies, and sometimes on floating islands (Godfrey 1988). Survives in both poorly drained freshwater and saline soils as well (Scheld and Cowles 1981). Tends to take over large areas (Bonner 1974).



Flowers

CHINESE TALLOW TREE

Distribution: Naturalized in outer coastal plain of South Carolina and adjacent North Carolina, also in Richmond County, North Carolina (Radford *et al.* 1968), south through Florida, and west to eastern Texas (Godfrey 1988). Found throughout Florida south to Manatee County on the Gulf coast and St. Lucie County on the Atlantic coast (Jubinsky 1993). Has potential range through southern Florida to the upper Florida Keys (Broschat and Meerow 1991). Recently found naturalized in Dade County (Wunderlin *et al.* 1995), and by 1996 (Jubinsky and Anderson), recorded as naturalized in 57% of Florida's counties.

Life History: Early growth rate very rapid with flowering and fruiting from the time the tree is about 1 m (3.3 ft) tall. Also suckers from stumps. Flowers in spring (Broschat and Meerow 1991), with fruit ripening August to November. Seeds primarily dispersed by birds and water (Jubinsky 1993).



Persisting white seeds



In Lake Jessup conservation area

SCHINUS TEREBINTHIFOLIUS RADDI

Anacardiaceae/Cashew Family

Common Names: Brazilian pepper, Florida holly, Christmas berry, pepper tree

Synonymy: None

Origin: Brazil, Argentina, Paraguay

Botanical Description: Evergreen shrub or tree to 13 m (43 ft) tall, often with multi-stemmed trunks and branches arching and crossing, forming tangled masses. Leaves alternate, odd-pinnately compound with 3-11 (usually 7-9) leaflets, these elliptic-oblong, 2.5-5 cm (1-2 in) long, with upper surfaces dark green (lateral veins obvious, lighter in color), lower surfaces paler, and leaflet margins often somewhat toothed. Leaves aromatic when crushed, smelling peppery or like turpentine. Flowers unisexual (dioecious), small, in short-branched clusters at leaf axils of current-season stems; 5 petals, white to 2 mm long. Fruit a small, bright-red spherical drupe.

Ecological Significance: Imported as an ornamental in the 1840s (Barkley 1944). Has invaded a variety of areas including, but not limited to, fallow farmland, pinelands, hardwood hammocks, roadsides, and mangrove forests, in areas with a high degree of disturbance and natural areas with little disturbance (Woodall 1982, Laroche 1994a). Forms dense thickets of tangled woody stems that completely shade out and displace native vegetation. Has displaced some populations of rare listed species, such as the Beach Jacquemontia (*Jacquemontia reclinata* House, U.S. and Fla. Endangered), and Beach Star (*Remirea maritima* Aubl., Fla. Endangered) (D. F. Austin, Florida Atlantic University, personal observations). Produces certain allelopathic agents, which appear to suppress other plants' growth (Mahendra *et al.* 1995). Seeds spread by consumption and deposition of the fruit by wildlife; spread enhanced by decorative use of branches and fruit (Morton 1978). Now estimated to occupy over 283,400 ha (700,000 acres) in central and south Florida (Ferriter 1997, Wunderlin *et al.* 1995).



Flowers

BRAZILIAN PEPPER

Distribution: Naturalized in most tropical and subtropical regions, including other South American countries, parts of Central America, Bermuda, the Bahama islands, the West Indies, Guam, Mediterranean Europe, North Africa, southern Asia, and South Africa. In the United States, occurs in Hawaii, California, southern Arizona, and Florida—in Florida as far north as Levy and St. Johns counties and as far west as Santa Rosa County (EPPC 1996).

Life History: Sprouts easily from the trunk and roots, even if the plant is undamaged. Seen in flower in every month of the year in Florida, with the most intense period of flowering in the fall season, September through November. Fruits profusely in southern and central Florida, with wildlife consumption of fruits contributing in large part to the spread of seeds (Ewel *et al.* 1982). Produces chemicals in leaves, flowers, and fruits that irritate human skin and respiratory passages (Ewel *et al.* 1982, Morton 1978).



In coastal strand, Sarasota County



Compound leaves, mature fruit

SENNA PENDULA (WILLD.) IRWIN & BARN. VAR. GLABRATA
Fabaceae (Leguminosae)/Pea Family (VOGEL) IRWIN & BARN.

Common Names: Climbing cassia, Christmas cassia, Christmas senna, cassia shrub
Synonymy: *Cassia coluteoides* Coll.; *C. bicapsularis* L. and *C. surattensis* Burm. f. misapplied
Origin: South America

Botanical Description: Sprawling evergreen shrub to 4 m (13 ft) tall (or wide), with somewhat zigzag, sparsely hairy stems. Leaves alternate, stalked, even-pinnately compound, with 3-6 pairs of leaflets, larger ones at leaf tip; leaflets to 4 cm (1.6 in) long, oblong with rounded tips; petioles with gland above, between lowermost leaflets (and occasionally between others). Flowers yellow or yellow-green, 3-4 cm (1.2-1.6 in) across, in 3- to 12-flowered racemes near stem tips; stamens with prominent, curved filaments. Fruit a brown slender pod, cylindric, glabrous, 7-12 cm (3-5 in) long.

Ecological Significance: Briefly noted by Small (1933) as seen in south Florida. Commonly cultivated for ornament in Florida at least since the 1940s (Bailey and Bailey 1947). Described as fast and rank in its growth (Maxwell and Maxwell 1961). Observed in the wild in south Florida since the early 1970s (D. F. Austin, Florida Atlantic University, 1995 personal communication). Noted as naturalized in south Florida, and becoming weedy in the Bahamas and disturbed areas in South America (Irwin and Barneby 1982) and as moderately established outside cultivation in Florida by 1990 (Isely). Displaces native vegetation in disturbed and undisturbed areas of Florida's tropical hammocks, coastal strands, and canal banks (M. Renda, The Nature Conservancy, 1996 personal communication). Often becomes established in sunny openings and then clambers over adjacent canopy (Austin 1998). Reported from scrub and forest natural areas in Palm Beach County and from the edge of Lake Okeechobee in Hendry County (EPPC 1996).

Distribution: Native to Brazil, Peru, through Bolivia and south to Paraguay and Argentina; naturalized in the Bahamas and Florida, and probably also in southern Alabama, Louisiana, and Mississippi (Isely 1990). Cultivated in all regions of Florida (Hunt 1977, Nelson 1996). Often sold as *C. bicapsularis* (Isely 1990). Documented by herbarium records from peninsular Florida, from Hillsborough and Brevard south to Dade and Collier counties (Wunderlin *et al.* 1995).



In Lake Jessup conservation area

CLIMBING CASSIA

Life History: Hardy north of the frost line; will come back if tops killed by freezing (Maxwell and Maxwell 1961). Grows easily once established (Nelson 1996). Quite salt tolerant; does well in sandy soil; needs pruning regularly to contain sprawl (Maxwell and Maxwell 1961). Flowers in late fall to early winter, producing numerous seeds in each pod (Isely 1990).



Immature pod



Flower



In Blowing Rock Preserve

SESBANIA PUNICEA (Cav.) Benth

Fabaceae (Leguminosae)/Pea Family

Common Names: rattlebox; scarlet wisteria

Synonymy: *Aeschynomene miniata* Ortega,
Daubentonia punicea (Cav.) DC., *D. tripetii* Poit.,
Emerus puniceus (Cav.) Kuntze, *Ormocarpum elegans* G. Don,
Piscidia punicea Cav., *Sesbania tripetii* (Poit.) F. T. Hubb.

Origin: Argentina, Brazil, Paraguay, and Uruguay

Botanical Description: *Sesbania punicea* is a deciduous shrub or small tree, up to 4 meters tall. It has 10-20 cm long compound leaves each with 10-40 small dark-green leaflets in opposite pairs. Each leaflet is oblong and ends in a tiny pointed tip. The showy coral or red flowers appear in spring and early summer in dense sprays (up to 25 cm long) that droop or project outwards. The 2-3 cm long flowers are shaped like pea flowers. A characteristic feature are the seed pods, which are longitudinally 4-winged, oblong, 6-8 cm long, 1 cm broad, borne on short 1.5 cm stalks and may be dispersed by water. The tip of the pod is sharply pointed. The 4-10 seeds are separated by partitions and are freed only when the pod eventually breaks open.

Ecological Significance: *Sesbania punicea* is an invader of wetlands. It produces abundant seed, can reproduce rapidly, and since it may grow along watercourses its buoyant pods may spread great distances. It can survive a hard freeze,

Distribution: Found throughout most of the southeastern U.S. Occurs over most of Florida, from the panhandle east and southward to Indian River and Lee counties.

Life History: Can be found in a variety of wetlands including brackish marshes. Frost tolerant. Flowers in spring to early summer and produces abundant seeds that are dispersed by water. Can grow to produce dense thickets that shade herbaceous plants.

Links to photographs and additional information:

<http://www.fw.vt.edu/dendro/dendrology/Syllabus2/factsheet.cfm?ID=572>

***SOLANUM VIARUM* DUNAL**

Solanaceae/Nightshade Family

Common Names: Tropical soda apple, Sodom apple
Synonymy: *Solanum khasianum* var. *chatterjeeanum* Sen Gupta
Origin: Brazil, Paraguay, Argentina

Botanical Description: Bushy, prickly herbaceous perennial, to 2 m (6 ft) tall, more commonly 1 m (3 ft) tall; stems armed with broad-based, straight or downward-pointing prickles and clothed in a mixture of stellate and simple glandular or nonglandular hairs (viscid-pubescent). Leaves alternate, simple, clearly petioled (these also prickly); blades oval-triangular, nearly as broad as long, to 20 cm (8 in) long and 15 cm (6 in) wide, angular-lobed; surfaces dense with fine soft hairs giving blades a velvety sheen (hairs a mix of types as on stems); veins prickly. Flowers white, in small terminal clusters; 5 petals white, recurved; stamens with prominent cream-colored anthers. Fruit a globose berry, 2-3 cm (0.8-1.2 in) wide, green with dark veining, like a tiny watermelon, when immature, dull medium yellow when ripe; seeds about 400 per berry.

NOTE: Distinguished in Florida from other prickly *Solanum* spp. by its straight prickles, mixture of stellate and simple hairs with and without glands, clearly petioled leaves with a velvety sheen, terminal flower clusters, and yellow berries that are dark-veined when young.

Ecological Significance: A recent accidental introduction, exact means unknown; first collected in Florida in 1988; found in pastures and other open disturbed sites of Glades, Okeechobee, and Polk counties (Wunderlin *et al.* 1993). From 1990 to 1996, Florida's infestation estimated to have increased from 10,000 ha (25,000 acres) to 200,000 ha (500,000 acres), becoming a major concern of agriculture and a serious threat to Florida natural areas (J. Mullahey, University of Florida, 1997 personal communication). Reported from over 20 natural areas, including local, state, and federal preserves, from as far north as Alachua County (EPPC 1996). Outcompetes native plants, crowding or shading them out (observations of several natural-area managers).



Flower

TROPICAL SODA APPLE

Distribution: Has spread north in Florida to the Panhandle, with herbarium specimens recorded for 17 counties (Wunderlin *et al.* 1995). Now a common weed in fields and groves, a frequent one along roadsides, and turning up more often at pineland and hammock edges. Also present now in adjoining states (Mullahey *et al.* 1996). Naturalized also in the West Indies, Mexico, Africa, and India (Wunderlin *et al.* 1993).

Life History: Reaches maturity from seed within 105 days (Mullahey and Cornell 1994). Green stems persist in mild winter temperatures (Coile 1993). Less productive or may die in summer when standing in water (Mullahey and Colvin 1993). Can regenerate shoots from extensive root system; difficult to eradicate (Akanda *et al.* 1996). Flowers and fruits primarily from September through May, with few fruits produced in summer. Produces 40,000 to 50,000 seeds per plant, with a tested germination rate of 30-100% (Mullahey *et al.* 1993). Seeds dispersed by birds and other animals, including cattle, deer, feral pigs, and raccoons (Akanda *et al.* 1996). Also spread by seed-contaminated hay, sod, and machinery.



In rangeland



Leaves



Fruit

SYAGRUS ROMANZOFFIANA (Cham.) Glassman

Arecaceae (Palmae)/Palm Family

Common Names: queen palm

Synonymy: *Arecastrum romanzoffianum* (Cham.) Becc.,
Calappa acrocomioides (Drude) Kuntze, *C.*
australis (Mart.) Kuntze, *C. datil* (Griseb. & Drude ex
Griseb.) Kuntze, *C. martiana* (Drude & Glaziou ex
Drude) Kuntze, *C. plumosa* (Hook.) Kuntze, *C.*
romanzoffiana (Cham.) Kuntze, *Cocos acrocomioides* Drude, *C.*
arechvaletana Barb. Rodr., *C. australis* Mart.,

Origin: Brazil, Paraguay and northern Argentina

Botanical Description: Stems solitary, smooth, with conspicuous nodal rings, to 25-50 feet tall. Petiole unarmed; sheath not forming crownshaft; blade pinnate, unarmed, about 5m. Inflorescences axillary within crown of leaves, paniculate, ascending, becoming pendulous in fruit; flowering throughout the year. Fruits drupes, 3.0-3.5 cm, ovoid, yellowish orange; endocarp ovoid, brown, with 3 germination pores. Fruits ripen in late summer to early winter.

Ecological Significance: Widely planted throughout much of southern and central Florida. Seedlings easily volunteer in natural areas and mature plants persist after cultivation. Weak roots, combined with a prodigious sail-like canopy, makes it prone to topple in strong winds.

Distribution: Disturbed hammocks and woodlands.

Life History: Prefers full sun and acidic, well-drained soils. Shows severe mineral deficiencies on alkaline soil, ultimately disfiguring the palm by stunting young leaves. Requires regular applications of manganese and/or iron to help keep fronds green. Potassium deficiency is also displayed on older fronds in well-drained soils. Quick-growing, responding well to ample moisture and fertilizer. Slightly salt-tolerant. Rapid growth rate once established. Not affected by lethal yellowing disease. Cold damage appears at 25°F; may freeze and die at about 20° F. Fruits may be produced in quantity and are sometimes considered messy in landscape situations.

Links to photographs and additional information:

http://www.floridata.com/ref/S/syag_rom.cfm

<http://hort.ufl.edu/trees/SYAROMA.pdf>

SYZYGium CUMINI (L.) SKEELS

Myrtaceae/Myrtle Family

- Common Names:** Java plum, jambolan, jamun, duhat
Synonymy: *Syzygium jambolana* (Lam.) DC., *Eugenia cumini* (L.) Druce, *E. jambolana* Lam.
Origin: Southeast Asia, India

Botanical Description: Evergreen tree to 25 m (80 ft) tall, with young stems grayish white and lower bark coarse and discolored. Leaves opposite, simple, entire, elliptic to broadly oblong, smooth, glossy, somewhat leathery, 5-10 cm (2-5 in) long, short pointed at tips; petioles to 3 cm (1.2 in) long; leaf midrib prominent, yellowish; blades with many lateral veins closely parallel. Flowers white to pinkish, about 1 cm (0.5 in) across, in branched clusters at stem tips; calyx cuplike; 4 petals, fused into a cap; many stamens. Fruit an ovoid, 1-seeded berry to 2 cm (0.8 in) long, dark purplish red, shiny, with white to lavender flesh.

NOTE: May be confused with another naturalized non-native, the rose apple, *Syzygium jambos* Alston, but its habit smaller, to 15 m (50 ft) in height; its leaves longer, to 25 cm (10 in) long; its petals free, not fused into a cap; and its fruits cream-yellow.

Ecological Significance: Introduced into Florida for ornament and edible fruit by the U.S. Department of Agriculture, with seeds from the Philippines in 1911 and 1920, and from Java and Zanzibar in 1912 (Popenoe 1939). Long recommended as a shade tree but considered messy (Broschat and Meerow 1991). Noted as naturalized in southern Florida by 1982 (Wunderlin). Now one of the more rapidly spreading non-native species, forming dense canopies that shade out young native trees in wet pinelands, hammocks, and well drained uplands (Duever *et al.* 1986). Reported from 17 natural areas in Pinellas, Lee, Collier, Dade, Palm Beach, and Martin counties (EPPC 1996). Naturalized on all islands of Hawaii, where it excludes native as well as introduced plants, such as *Schinus terebinthifolius* (Wagner *et al.* 1990).



Leaves

JAVA PLUM

Distribution: Found in peninsular Florida, mostly in southernmost counties; documented by herbarium specimens from Palm Beach, Collier, and Lee counties (Wunderlin *et al.* 1995). Native from India to Myanmar and East Indies, but widely cultivated in tropics (Bailey and Bailey 1976). Naturalized in Hawaii (Wagner *et al.* 1990), Australia (Commachan 1977, Morton 1987), the Philippines, Zanzibar, Pemba, Mombassa, and Kenya (Morton 1987).

Life History: Restricted to areas with minimum temperatures above 1.7°C (35°F) (Broschat and Meerow 1991). Thrives in low wet areas as well as higher well-drained land, including loam, sand, or oolitic limestone (Morton 1987). Observed most often in Big Cypress National Preserve on damp pineland sites but also on regularly inundated but relatively high spots in cypress strands and sawgrass marshes (Dueter *et al.* 1986). Does well in its native range in areas with as much as 1,000 cm (400 in) of annual rainfall and withstands prolonged flooding (Morton 1987). Common in the dry zone of its native range, in all forms of forest but especially along margins of streams and ponds (Dassanayake and Forsberg 1981). Resistant to coastal high winds, but not to heavy salt spray and overwash (Menninger 1964). Does not do well in highly saline, or sodic, soils (Gill and Abrol 1991). Produces fruit in 5-6 years when grown from seeds (Burkill 1935). Flowers year-round (Wunderlin 1982), but mostly in the spring. Seeds dispersed by birds and mammals, including raccoons and wild hogs. Dispersed in Hawaii primarily by myna birds (Morton 1987). Used in fruit preserves, but fruit considered "rarely worth eating" by some (Menninger 1964). Closely related to *S. aromaticum* (L.) Merr., the dried flower buds of which form the spice known as "cloves" (Willis 1973).



Fruits



Flowers, fruits, and leaves

TRADESCANTIA FLUMINENSIS VELL.

Commelinaceae/Dayflower Family

Common Names: Green, or white-flowered, wandering Jew

Synonymy: *T. albiflora* Kunth

Origin: Tropical South America

Botanical Description: Creeping, trailing, subsucculent perennial herb, much branched, with branch tips erect; often forming dense ground cover; prostrate stems rooting freely at nodes. Leaves parallel-veined, alternate, simple, all glossy green or tinged with purple below; leaf blades arising from short, closed sheaths (tops often ciliate); blades to 5 cm (2 in) long and 2 cm (0.75 in) wide, oblong to ovate, with tips pointed; glabrous or with ciliate margins. Flowers white, in small clusters at stem tips, subtended by 1-3 leaflike bracts similar in size and form to stem leaves; 3 sepals and petals, separate; sepals usually with a line of hairs; 6 stamens, white bearded (pilose); ovary 3-celled, 6-seeded. Fruits small, 3-parted capsules; seeds black, pitted.

Ecological Significance: Occurs most densely in partial or full shade of disturbed and undisturbed hammocks, particularly in moist or wet areas but also in well-drained woodlands and shady residential yards. Forms dense monocultural ground cover that can be 60 cm (2 ft) deep in overlapping leafy stems (Kelly and Skipworth 1984). Smothers native ground cover and seedlings of overstory species (K. C. Burks, Florida DEP, personal observation; Godfrey and Wooten 1979); acts similarly in remnant lowland forests of New Zealand (Kelly and Skipworth 1984), where it has become an important natural-area pest. Also a weed of disturbed areas in New South Wales, Australia (Reed 1977), and an agricultural weed in its native range, particularly Brazil (Kelly and Skipworth 1984). Recognized in 1947 (Bailey and Bailey 1947) as a common weed under benches in commercial greenhouses, and as naturalized in the Southeast (Bailey and Bailey 1976). Noted as naturalized in sandy woods and waste places from Florida to North Carolina (Small 1933), but in later works shown only for Florida (e.g., Radford *et al.* 1968, Godfrey and Wooten 1979). Still cultivated, most often as a house or patio plant. Once established, difficult to control without nontarget damage (J. Weimer, Paynes Prairie Preserve, 1996 personal communication).



Leaves

GREEN WANDERING JEW

Distribution: Found most abundantly naturalized in north central Florida, from Gainesville to Orlando, but documented by herbarium specimens for 10 counties, including Leon and Calhoun in the Panhandle, Flagler on the east coast, and Hillsborough on the west (Wunderlin *et al.* 1995). Reported by conservation-area managers primarily for Alachua and Marion counties (EPPC 1996), with several dense populations noted in bottomland forests.

Life History: Spreads successfully by vegetative means; stem fragments with just 1 node remaining viable and rooting freely (Kelly and Skipworth 1984). May have main stems averaging 1.5 m (5 ft) long, with an additional 1.5 m of branches; a dense square meter of cover potentially supporting a standing crop of 900 m (2,880 ft) of plant (Kelly and Skipworth 1984). Flowers in spring and fall in north Florida; level of seed viability not known. Resists cold to -4°C (25°F) in laboratory experiments (Bannister 1986). Cultivars with variegated leaves apparently revert to full green in shade (IMP 1985). Can be used as larval host for native noctuid moth, *Mauralis tinctorides* (Guerè), a species related to cabbage and soybean loopers but not reported as a pest itself (Landolt 1993).



Flowers



In Greenway natural area, Alachua County

URENA LOBATA L.

Malvaceae/Mallow Family

Common Names: Caesarweed
Synonymy: *Urena trilobata* Vell.
Origin: probably of Asiatic origin

Botanical Description: Erect subshrub, 0.6 to 3 m. Usually has a single stem emerging from the ground but normally produces several stems or major branches low on the stem and many branches throughout. The nearly smooth bark is tough and fibrous, brown on the outside and green within. Its pale yellow wood is of medium density. Plants are supported by a tap and lateral root system of tan or ivory-colored, tough and flexible roots. Leaves grayish-green, discolorous, alternate, stellate pubescent both above and below, ovate, angulate or shallowly lobbed, serrate, 4-8 cm long. Axillary flowers are usually solitary and have five pink petals. The flowers are about 1 cm broad. Fruits are 8-10 mm, globose capsules that break into five, fine-barbed (glochidate) mericarps.

Ecological Significance: Caesarweed readily invades disturbed areas or infrequently burned natural areas. Tolerates a wide range of soils and varying fertility levels. Tolerates salt spray and a moderate amount of salt in the soil. Generally intolerant of saturated soils. The plant is infrequently browsed by cattle and can become a severe weed in pastures and plantations. Burs that collect on clothing and in animal fur are a nuisance. In Florida, cattle aid the spread of caesarweed both by carrying the seeds and by disturbing the soil, which, in turn, reduces competing native plants.

Distribution: Pantropical, but probably of Asiatic origin. Widespread in peninsular Florida. Largely absent from northern peninsula and panhandle counties.

Life History: Caesar weed grows rapidly and can reach 0.5 to 2 m by the end of the first year. Because of the aggressive nature of the species, wildland plantings are not recommended. This is a qualitative short-day plant with a critical dark period of about 12 hr. A minimum of 12 short days are required for floral initiation.

Links to photographs and additional information:

http://www.alabamaplants.com/Pinkalt/Urena_lobata_page.html
http://www.hear.org/pier/species/urena_lobata.htm
<http://www.fs.fed.us/global/iitf/pdf/shrubs/Urena%20lobata.pdf>
<http://plants.usda.gov/java/profile?symbol=URLQ>
<http://www.killerplants.com/plant-of-the-week/20041025.asp>

UROCHLOA MUTICA (FORSK.) NGUYEN

Poaceae (Gramineae)/Grass Family

Common Names: Pará grass, California grass, buffalo grass, water grass, Scotch grass, Carib grass

Synonymy: *Brachiaria mutica* (Forsk.) Stapf, *Brachiaria purpurescens* (Raddi) Henr., *Panicum muticum* Forsk., *Panicum purpurescens* Raddi

Origin: Africa

Botanical Description: Perennial grass from widely creeping stolons. Stems reclining at base, rooting at the lower nodes, to 1 m (3 ft) tall when erect, to 3 m (15 ft) long when creeping; nodes swollen, densely hairy. Leaf sheaths with dense stiff hairs below, slightly hairy above; ligule a densely ciliate membrane; leaf blades flat, 10-15 mm (0.4-0.6 in) wide and 25-30 cm (10-12 in) long, glabrous but often with small fine hairs at base above and below. Inflorescence a terminal panicle to 20 cm (8 in) long, with 8-20 ascending, alternate branches; spikelets (reduced flowers) dense on the branches, paired, each about 3 mm long, glabrous, often purple tinged.

Ecological Significance: Introduced in most tropical and subtropical regions of the world as a fodder grass, but also considered one of the world's worst weeds; reported as an agricultural pest in 23 crops in 34 countries, including the United States (Holm *et al.* 1977). Competes aggressively with other plants, with fast growth, high productivity, and allelopathic abilities that allow it to form dense monocultural stands (Chang-Hung 1977, Handley *et al.* 1989). Probably introduced into the Americas via Brazil "at an early date" (Hitchcock and Chase 1951); may have been introduced into Florida as early as the late 1870s (Austin 1978); recommended for pasturage here in 1919 (Thompson 1919b). Invades disturbed low areas such as canals, but also displaces native vegetation along river and lake shorelines and in marshes and swamps. Found in 51 public water bodies in 1982 and 183 water bodies by 1994—down from a 1986 high of 207, or 52% of Florida's public waters (Schardt and Schmitz 1991, Schardt 1997).

KAL



In Myakka River basin, Sarasota County

PARÁ GRASS

Distribution: Now commonly escaped from cultivation in central and south Florida. Documented by herbarium specimens from 15 counties, from Pinellas on the west to Brevard on the east and south to the Florida Keys (Wunderlin *et al.* 1995). Also reported from wetland natural areas in Sarasota, Hillsborough, Martin, and Palm Beach counties (EPPC 1996).

Life History: Flourishes in wet conditions, able to form a stolon mat 1 m (3 ft) or more in depth (Holm *et al.* 1977) and send floating stems of 6 m (18 ft) or more in length across slow-moving water (Handley and Ekern 1981). Also tolerant of drought and of brackish water, but susceptible to frost (Holm *et al.* 1977). Reproduces and spreads primarily by stem fragments (Sainty and Jacobs 1981). Flowers from September through December in Florida (Hall 1978), but production of fertile seeds apparently low (Thompson 1919b).

KAL



Panicle

KAL



Hairy node and sheath

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GLOSSARY

- Abaxial.** Facing away from the axis, such as the underside of a leaf.
- Adaxial.** Facing toward the axis, such as the upper side of a leaf.
- Acuminate.** Tapering gradually to a slender point; sharply acute.
- Adventitious.** Said of buds and roots that grow in irregular or unusual places.
- Allelopathic.** Able to suppress growth of nearby plants by secretion of toxic substances.
- Alternate.** Borne one at a node, as in leaves, appearing on one side of the axis and then the other.
- Anther.** Pollen-bearing portion of stamen (at apex of filament).
- Aril.** A fleshy expansion of the seed stalk, partially or wholly enveloping the seed.
- Auricle.** Earlobe shaped; a margin or surface that bulges in the shape of an earlobe.
- Awn.** A stiff, bristlelike appendage at the end of a structure.
- Axil.** Angle formed where two parts join, as a leaf and stem or branch and stem.
- Axillary.** In the axil.
- Basiscopic.** Pointing downward.
- Berry.** A fleshy fruit with at least 2 seeds (no stone, usually many seeds) and with a skin not splitting along regular suture lines (i.e., indehiscent).
- Bilabiate.** Two lipped, often applied to a corolla or calyx.
- Bisexual.** An individual flower that has both male and female parts.
- Bract.** A scalelike, leaflike, or petallike structure, often of a different size and color, associated with a flower head or flower.
- Bulbil.** Small bulb (enlarged, shortened stem), borne on a stem or in an inflorescence.
- Calyx.** The sepals of a flower; the outermost whorl of flower parts, usually green, or at least a different size and shape from the petals.
- Capsule.** A dry fruit formed from 2 or more fused ovaries, splitting along regular sutures lines when mature (i.e., dehiscent).
- Ciliate.** Bearing cilia, often said of leaf or petal margins that bear more or less short, stiff hairs.
- Cladophyll.** A branch modified to function as a leaf.
- Claw.** The narrowed base of a sepal or petal.
- Collar.** Outer side of a grass leaf where the blade joins the sheath.
- Compound.** Composed of 2 or more similar and united parts, as a leaf with 2 leaflets.
- Cordate.** With an indentation and rounded lobes at the base; heart shaped.
- Corm.** Shortened, enlarged underground stem, often globe or cone shaped.
- Corolla.** The petals of a flower; the inner, usually colorful whorl of flower parts.
- Crenate.** Shallowly round toothed; scalloped.
- Cuneate.** Wedge shaped, tapering, said of leaf-blade bases.
- Deciduous.** Falling after completion of their normal function.
- Decumbent.** Prostrate, but with branches ascending at the ends.
- Dehiscent.** Splitting open along definite regions or suture zones.
- Dioecious.** Said of plants bearing only male or only female flowers; bearing unisexual flowers, with male and female on separate plants.



Drupe. A more or less fleshy, indehiscent fruit, with a stone, a hard inner layer enclosing a seed.

Elliptic. An outline narrowed to rounded at the ends and widest at about the middle.

Entire. A margin, as a leaf's, without teeth, lobes, or divisions.

Epilithic. Growing on rocks.

Epiphytic. Growing on another plant, but not parasitic.

Even-pinnate. Said of pinnately compound leaves with no terminal leaflet, so the total number of leaflets is even.

Evergreen. Said of species that retain their leaves for more than a single growing season, hence are never without leaves.

Filament. The stalk bearing the anther (filament and anther together form the stamen).

Glabrous. Without hairs.

Gland. A depression or protuberance, usually small, that secretes a substance from a plant surface.

Glandular hairs. Hairs with glands at the tips.

Glaucous. Covered with a whitish bloom that rubs off.

Globose. Spherical or rounded.

Glume. One of the outermost bracts of a grass spikelet.

Hirsute. Covered with short, erect hairs.

Indehiscent. Said of fruits that do not open along regular, preformed suture lines.

Indusium. A papery, thin covering of the sorus in some ferns. (False indusium: a covering derived from the leaf margin rather than from midleaf epidermis.)

Inflorescence. The characteristic cluster of flowers of a plant.

Internode. The interval or part between 2 nodes of a stem or other axis.

Involute. Said of margins that are rolled upward and inward from the edges.

Keel. A projected longitudinal ridge, such as that made by a folded leaf, bract, sepal, or petal. In some legume flowers, the 2 lower petals are fused and folded into the "keel."

Lanceolate. An outline longer than broad, widest below the middle and tapered above to a point.

Lemma. An inner bract enclosing reproductive parts in the spikelet of grasses.

Lenticels. Pits, slits, or corky openings on young bark.

Ligule. In grasses and sedges, an outgrowth (membrane or hairs) at the adaxial junction of leaf blade and sheath.

Linear. Long and narrow, with sides more or less parallel.

Monoecious. Said of plants bearing unisexual flowers with both male and female flowers occurring on the same plant.

Node. Place on a stem or other axis where a leaf, branch, or other organ arises.

Oblanceolate. An outline broadest above the middle, long tapered to the base.

Oblique. Slanting or unequal sided, such as a leaf base unequal in size on either side of midvein.

Oblong. Longer than broad, with more or less parallel sides.



Obtuse. Bluntly pointed.

Odd-pinnate. Said of pinnately compound leaves with a terminal leaflet; thus the total number of leaflets is odd.

Opposite. With 2 leaves (or other parts) at the same node, one on each side.

Ovate. An outline broadest near the base, not greatly longer than broad; egg shaped.

Ovoid. A 3-dimensional object with an ovate outline.

Palmate. Arising or radiating from a common point, as with veins, lobes, or segments; hand shaped (with fingers held apart).

Panicle. An inflorescence that is a compound (further-branched) raceme.

Pedicel. Stalk of a single flower.

Peltate. Said of leaf blades or other structures that have stalks attached interior to the structure's margin, as in a thumbtack (i.e., not at the edge of the blade, scale, etc).

Perfect. Said of flowers that have both male and female parts; bisexual.

Petal. A lobe or segment of a flower's corolla, often colored and showy.

Petiolate. Having a petiole.

Petiole. Stalk of a leaf (not always present).

Phyllode. A flattened, expanded petiole that functions as a whole leaf (no blade present).

Pilose. With long, soft, somewhat shaggy hairs.

Pinna. Leaflet in a once-compound leaf; a primary division of a twice-compound leaf, the branch axis with its leaflets.

Pinnate. Divided into more or less similar units (e.g., leaflets) along an elongated axis (rachis).

Pinnule. Secondary axis or leaflet in a twice-compound leaf.

Pistil. The female part of a flower, consisting of ovary, style, and stigma.

Pith. Storage tissue, often whitish and soft, filling the center of stems and some roots.

Plumose. Resembling a feather.

Prickle. A sharp-pointed, usually stiff and hard, protuberance from the epidermis of a plant.

Pubescent. Hairy (noun: pubescence—the hairs of a plant).

Raceme. An inflorescence with stalked flowers arranged along an elongate axis (lower flowers opening first).

Rachis. The main axis above the petiole of a pinnately compound leaf.

Raphide. A needle-shaped crystal, usually of calcium oxalate, occurring in bundles in some stems and leaves, often irritating to mucous membranes of animals.

Receptacle. More or less enlarged end of a stalk bearing a flower or specialized flower cluster.

Recurved. Bent or curved downward or backward.

Reticulate. Netlike, often referring to leaf vein patterns with complex branching.

Revolute. Bent under and inward from the edge, often said of leaf margins.

Rhizome. Elongate, prostrate stem, typically underground, but may be at surface as in some epiphytes.

Samara. A winged, 1-seeded, dry fruit.

Scabrous. Rough and harsh to the touch, like a cat's tongue.

Semievergreen (semideciduous). With leaves persisting through part or most of the winter; if dropping leaves in a mass, quickly replacing them.

Sepal. A lobe or segment of a flower's calyx.

Serrate. Toothed with the teeth pointing toward the blade tip; saw toothed.

Sessile. Without a stalk, attached directly.

Simple. Not compound, as in leaves not divided into leaflets.

Sorus. A discrete, usually dense, cluster of sporangia in ferns. (Plural: sori.)

Spathe. A usually conspicuous, leaflike bract enclosing an inflorescence.

Spike. A raceme with the flowers sessile on the main axis.

Sporangium. Spore case; a sac or body in which reproductive spores are borne. (Plural: sporangia.)

Spikelet. In grasses and sedges, the basic unit of an inflorescence—a short axis bearing 1 or more flowers (florets) with their sepals/petals usually reduced in number and size to specialized bracts.

Stamen. The male part of a flower, consisting of a filament (sometimes absent) and a pollen-bearing anther.

Staminode. A sterile stamen, sometimes petallike and showy.

Stellate. Star shaped, as in plant hairs with radiating branches.

Stigma. Part of a pistil receptive to pollen, usually located at tip of the style.

Stipule. Basal appendage of a leaf on some species, usually small; may be leaflike, spine-like, membranous, hairlike, or scalelike.

Stolon. Prostrate stem growing at the surface of the ground, often giving rise to new growth. (Adjective: stoloniferous—having stolons.)

Style. The part of the pistil connecting the ovary and the stigma.

Subglobose. Nearly spherical in shape.

Tendril. Thread or cordlike process that clasps or twines around other objects; may represent a modified (specialized) branch, leaf, leaflet, stipule, or petiole.

Tomentose. Covered densely with soft, matted, woolly hairs.

Trichome. Any hairlike outgrowth of the epidermis.

Trifoliolate. Said of a compound leaf having 3 leaflets.

Truncate. Appearing cut off; a squarish end or base of a leaf or other structure.

Tuber. A swollen, starch-storing portion of an underground stem, as in the potato, or less often of an aerial stem, as in the air potato.

Turion. An enlarged, short lateral bud, a “winter bud” able to break off from the parent plant and elongate into a new plant, as in hydrilla.

Unarmed. Having no thorns, spines, or prickles.

Unifoliolate. Said of a compound leaf reduced to a single leaflet, appearing simple.

Unisexual. Said of a flower having only male or only female parts, not both.

Viscid. Sticky.

Whorl. With 3 or more leaves (or other parts) at a node.

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APPENDIX 4. Control of Non-native Plants in Natural Areas of Florida

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Control of Non-native Plants in Natural Areas of Florida¹

K.A. Langeland and R.K. Stocker²

Introduction

Forty-three percent of Florida's land area is currently in agricultural or urban land uses and over one third of its native habitats have been lost (1987 census). While continued urbanization is an inevitable consequence of increasing population, and food production by agriculture is essential, it is also important to preserve and protect Florida's native habitats for historical significance and to protect species, water quality, and water quantity. Setting aside certain lands to be managed for conservation is a method to protect them. According to the Florida Natural Areas Inventory, 6.3 million acres of state and federal public lands are currently managed for conservation. Natural areas are conservation lands that have been set aside for the purpose of preserving (or restoring) native plant and animal communities. Natural areas are also maintained by counties and cities in Florida and by private land owners.

Non-native plants, carried here by humans since Florida's discovery by Columbus, now threaten the state's remaining natural areas. Of the 4,012 plant species now growing on their own without cultivation in Florida, 29% are non-native (Atlas of Florida Flora, R. P. Wunderlin). Many of these

non-native plants were originally introduced as garden ornamentals or agricultural crops. Other non-native plants were accidentally introduced. Regardless of how they arrived, these 1,200 or so non-native plants grew so well in Florida that they naturalized, that is, spread on their own without cultivation into managed and natural areas. While some of these naturalized non-native plants are not a problem, many became weeds, or undesirable plants, in agricultural, forestry, yards, and roadways. When these naturalized non-native plants spread extensively into natural areas and dominate by displacing native plants and disrupting natural processes such as fire or water flow, they are called invasive. Invasive non-native plants can be thought of as weeds in natural areas.

Familiar examples of invasive non-native plants that have already replaced native Florida plant communities and drastically changed the landscape both visually and ecologically include Brazilian pepper (*Schinus terebinthifolius*), and melaleuca (*Melaleuca quinquenervia*) in south Florida, and cogongrass (*Imperata cylindrica*) and Chinese tallow (*Sapium sebiferum*) in north Florida.

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Currently there is no information source that describes all invasive species for each particular part of Florida, and most invasive species are weed problems in some areas, but not in others. Until more information is developed, the best strategy for land managers is to become familiar with the most invasive species, and be watchful for their appearance. Listing of a species in this publication does not necessarily suggest that it should be regulated. It does indicate that it has warranted control measures in at least one natural area in the state and should be viewed as potentially invasive in other natural areas if it appears. Several invasive plants in Florida are regulated by statutory authority of the Florida Department of Agriculture and Consumer Services (DACS) and the Florida Department of Environmental Protection (DEP). The list of plants regulated by DACS, the Florida Noxious Weed List, includes plants that are federally regulated by the Federal Noxious Weed Act of 1974. The Florida Exotic Pest Plant Council (EPPC) maintains a current list of plants that are considered to be invasive or have invasive potential. While the EPPC list contains some plants that are also regulated by DACS and DEP, the list does not have statutory authority. These lists can be obtained from the University of Florida, Institute of Food and Agricultural Sciences Center for Aquatic Plants at 352/392-9613.

Management of invasive vegetation in natural areas requires methods that will minimize damage to nontarget vegetation and soil. Often this need for caution necessitates more time and effort than weed management in agricultural, industrial, or right-of-way settings. Some particular types of vegetation, for instance woody or sprawling vegetation, may require removal of standing plant material even after it has been killed if its presence increases fire hazard, reduces aesthetic appeal, or could cause harm as it decays and falls. Control methods include manual removal, mechanical removal, physical controls, herbicides, and biological control alone or in combination.

The purpose of this publication is to provide land managers in Florida with current methods being used to manage non-native plants by other land managers in the state.

Regulatory Agencies

Removal of vegetation in certain areas such as public waters and wetlands is regulated by state and local agencies and a permit may be required. For questions regarding permits to control vegetation in public waters, contact one of the following Department of Environmental Protection regional offices:

Bartow (941) 534-7143
Floral City (352) 726-8622
Lake City (904) 758-0464
Orlando (407) 275-4004
Upland Weed Office (904) 487-2600
Tampa (813) 744-6163
West Palm Beach (561) 791-4720

For regulatory questions regarding vegetation control in wetlands contact the Water Management District (WMD) in which you are located:

Northwest Florida WMD (850) 482-9522
Suwannee River WMD (904) 362-1001
St. Johns River WMD (904) 329-4500
Southwest Florida WMD (813) 796-7211
South Florida WMD (561) 682-6201

Control Methods

Prevention

The importation and spread of invasive vegetation can be significantly reduced by public education. It is the responsibility of those who are aware of the problems caused by invasive non-native plants to educate others about their identity, impacts, and control so that further ecological degradation of native ecosystems can be reduced.

Biological Control

In Florida, classical biological control (introduction of reproducing populations of foreign insects or diseases) of invasive non-native plants in non-agricultural areas has focused on aquatic weeds. The first biocontrol agent introduced was the alligatorweed flea beetle (*Agasicles hygrophila*) in 1964 for control of alligatorweed (*Alternanthera philoxeroides*). Subsequently, the alligatorweed

thrips (*Aminothrips andersoni*) was released in 1967 and the alligatorweed stem borer (*Vogtia malloi*) in 1971. The flea beetle and stem borer proved to be fairly effective for suppressing growth of alligatorweed, although harsh winters can reduce their populations. Less effective have been introductions of the waterhyacinth weevils (*Neochotina eichhorniae* and *N. bruchi*), released in 1972 and 1974, and the waterhyacinth borer, released in 1977 (*Sameodes albigutalis*) for waterhyacinth (*Eichhornia crassipes*) control. Likewise, effectiveness of a weevil (*Neohydronomus affinis*) and a moth (*Namangama pectinicornis*) released for control of water lettuce (*Pistia stratiotes*) has been unpredictable. Waterhyacinth and water lettuce continue to be problems that require management by other methods. Current biological control research is focused on hydrilla (*Hydrilla verticillata*), waterhyacinth (*Eichhornia crassipes*), melaleuca, and Brazilian pepper.

While classical biological controls are currently under study and will be implemented in the future, their development takes years and they cannot be expected to solve all invasive plant problems. Biological control programs are typically implemented by state and federal agencies, and the potential role of individual resource managers and the public will depend on the particular action being implemented.

Introduction of animals such as cattle, sheep, goats, or weed-eating fish may also be used to control certain invasive plants. However, environmental impacts of using such nonselective herbivores in natural areas should be carefully considered before implementation.

Manual Removal

Manual removal is very time-consuming but often a major component of effective invasive plant control. Seedlings and small saplings can sometimes be pulled from the ground, but even small seedlings of some plants have tenacious roots that will prevent extraction or cause them to break at the root collar. Plants that break off at the ground will often resprout, and even small root fragments left in the ground may sprout. Therefore, repeated hand-pulling or

follow-up with herbicide applications is often necessary.

Removal of uprooted plant material is important. Stems and branches of certain species (e.g. ligustrum and melaleuca) that are laid on the ground can sprout roots, and attached seeds can germinate. If material cannot be destroyed by methods such as burning, it should be piled in a secure area that can be monitored and new plants killed as they appear.

Pulling plants from the ground may cause unwanted soil disturbance in some natural areas, especially pine rockland habitat. This soil disturbance may result in further invasion by invasive non-native plant species, again requiring follow-up control measures.

Mechanical Removal

Mechanical removal involves the use of bulldozers, or specialized logging equipment to remove woody plants. Intense follow-up with other control methods is essential after the use of heavy equipment because disturbance of the soil creates favorable conditions for regrowth from seeds and root fragments, and recolonization by invasive non-native plants. Plans for management or replanting of sites with native vegetation following mechanical removal should be carefully developed prior to implementation of mechanical removal. Mechanical removal may not be appropriate in natural areas because of disturbance to soils and nontarget vegetation caused by heavy equipment.

Cultural Practices

Prescribed burning and water level manipulation are cultural practices that are used in management of pastures, rangeland, and commercial forests and may be appropriate for vegetation management in natural areas in some situations. One important consideration is the degree of degradation for the area in question. Cultural practices may have impacts to all parts of the habitat, native species included. If the habitat is so badly degraded that the need to reduce invasives strongly outweighs consideration of remaining native species, more aggressive control strategies can be considered. In

less degraded areas, more careful use of integrated methods may be appropriate.

Land use history is critical in understanding the effects of fire and flooding on the resulting plant species composition. Past practices affect soil structure, organic content, seed bank (both native and invasive non-native species), and species composition. While there is evidence that past farming and timber management practices will greatly influence the outcome of cultural management, very little is known about effects of specific historical practices. Similar management practices conducted in areas with dissimilar histories may achieve very different results. Even less is known about the effects of invasives entering these communities, and the subsequent management effects of fire on the altered communities.

Understanding the reproductive biology of the target and nontarget plant species is critical to effective use of any control methods, but particularly so with methods, such as fire management, that often require significant preparation time. Important opportunities exist when management tools can be applied to habitats when non-native invasive species flower or set seed at different times than the native species.

Prescribed Burning

Fire is a very normal part of most of Florida's many ecosystems, and native species have evolved varying degrees of fire tolerance. Throughout much of Florida, suppression of fire during this century has altered historical plant communities, such as flatwood and oak scrub communities, enhancing fire-intolerant species, and reducing the coverage of species that possess fire adaptations. Within these communities, the fire-tolerant woody species have lingered in smaller numbers, and less fire-tolerant species have replaced ephemeral herbs. Little is known about the amount, frequency, timing, and intensity of fire that would best enhance the historically fire-tolerant plant species, and less is known about how such a fire management regime could be best used to suppress invasive species. Single fires in areas with many years of fire suppression are unlikely to restore historical species

composition. Periodic fires in frequently burned areas do little to alter native species composition.

In a special case, invasion of tree stands by exotic vines and other climbing plants has greatly increased the danger of canopy (crown) fires and the resulting death to mature trees.

Added biomass by invasive plants can result in hotter fires, and can greatly increase the risk of fires spreading to inhabited areas. In these situations, use of fire to reduce standing biomass of invasive species may better protect the remaining plant populations than doing nothing, even though impacts to non-target native species will occur. Under these conditions, the expense of reducing standing biomass of invasive plant species might be justified by the savings on subsequent fire suppression.

In general, fire can be used to suppress plant growth, and even kill certain plants that are not fire tolerant. Most often, woody species are reduced while effects are less noticeable on herbaceous species. Some information has been published on responses of individual Florida plant species, but very little is known about the vast majority of native plant species, and less about invasive exotic species. Tolerance to fire can sometimes be predicted in species with thick bark, seeds, either in the soil or held in the canopy, that are adapted to fire (either tolerant of high temperature, or requiring fire for seed release or germination), and seeds that are disbursed over a wide area.

Effects of a single burn are hard to predict, but under some conditions a single fire effect can persist for several growing seasons. The length of effect is due to intensity of fire, time of year of fire (fire during the growing season can be more destructive than during dormant seasons), and the plant species involved. Smoke is now recognized as a germination triggering mechanism for fire-dependent as well as non-fire-dependent species, so plant species composition following a burn is due, in part, to the type of fire and the distribution of the smoke from that fire. A single burn may or may not start a replacement sequence (succession) with its own effects on species composition.

Whether fire can play a logical role in suppression or elimination of invasive exotic plant species depends on many factors. In addition to the principal factors described above, the resource manager must consider potential fire effects on soil loss and water quality, historical and economic impacts to buildings, possible harm to human life, and the potential for escape of a fire to nontarget areas.

Fire has been very successfully used to manage plant species in grasslands, to maintain open savannahs (scattered trees in herbaceous species dominated habitats), and to promote seral (fire-induced or fire-tolerant) stages of forest succession. Very little is known about the use of fire to enhance natives while reducing invasive exotic plant species. As a final caution in the use of fire to manage invasive plant species, too frequent burning has been shown to reduce plant diversity under many conditions, and it appears possible that increased fire frequency could provide opportunities for invasive plants to enter new areas.

Water Level Manipulation

Some success has been achieved regulating water levels to reduce invasive plant species in aquatic and wetland habitats. Dewatering aquatic sites reduces standing biomass, but little else is usually achieved unless the site is rendered less susceptible to repeated invasion when rewatered. Planting native species may reduce the susceptibility of aquatic and wetland sites in some cases.

In most situations, water level manipulation in reservoirs has not provided the level of invasive plant control that was once thought achievable. Ponds and reservoirs can be constructed with steep sides to reduce invadable habitat, and levels can be avoided that promote invasive species, but rarely are these management options adaptable to natural areas.

Carefully timed water level increases following mechanical removal or fire management of invasive species can provide effective control of subsequent germination, and, with some species, resprouting. Specific methods applicable to natural areas have not been described.

Re-establishment of Native Plant Species

Planting native species can be an effective, though expensive, way to reduce the likelihood of exotic species reinvasion following removal of non-native species. Commercial plant nurseries currently provide seed and plants of several wetland and upland species. Since some species cover a wide range of habitats and latitudes, care should be taken to obtain plant material suitable to the habitat under consideration. Seed collected from plants growing in more northern latitudes may do very poorly in Florida. Introduction of seeds, plant parts, or whole plants should include thorough screening for any unwanted pests, plant or animal.

It often takes several years for plantings to become thoroughly established, and extra care (water, nutrients) and protection (from fire and pests) may be necessary for a while. Also during this establishment phase, past management practices may have to be altered to avoid injury to the plantings. If periodic burning or flooding, for example, is part of the current management practice, it may be necessary to reduce the intensity or duration until the plantings are able to exhibit their typical resistance to injury, whatever that may be. Unfortunately, little is known about requirements for successful establishment of many native species, and less is known about their tolerances to cultural invasive plant management techniques. Even when tolerances are better known, responses may be affected by historical site effects, traits of particular genetic strains, site specific nutrition and light conditions, and interactions of soil type, hydroperiod, and microclimate.

Herbicides

Training and Certification

Anyone who applies herbicides in natural areas should have basic training in herbicide application technology. Only topics specifically important to herbicide use in natural areas are emphasized in this circular and the reader is expected to have prior knowledge of basic herbicide application technology.

A pesticide, or some of its uses, is classified as restricted if it could cause harm to humans or to the environment unless it is applied by certified applicators who have the knowledge to use these pesticides safely and effectively. Although none of the herbicides or uses listed in this publication, or commonly used for invasive plant control in natural areas, are classified as restricted-use, the basic knowledge of herbicide technology and application techniques that is needed for safe handling and effective use of any herbicides can be obtained from restricted-use pesticide certification training. This training can be obtained through the University of Florida Institute of Food and Agricultural Sciences. Certification requirements are met by successfully completing testing to ensure that the individual is knowledgeable in the use and supervision of restricted use pesticide application. Once certified, applicators may obtain a license from the Florida Department of Agriculture and Consumer Services as either public applicators or commercial applicators. The fees for a four-year license are \$35 for a public applicator and \$90 for a commercial applicator. Workshops on use of herbicides for invasive plant control in natural areas can also be arranged. For additional information regarding pesticide applicator training contact the Cooperative Extension Service in your county or the IFAS Pesticide Information Office (352) 392-4721. The EPPC can provide information on training opportunities and assist with organization of workshops for natural area managers through its education committee.

Active Ingredients and Formulations

A herbicide formulation, or product, consists of the herbicide active ingredient dissolved in a solvent (e.g., oil, water, or alcohol), or adsorbed to a solid such as clay. Formulations often include an adjuvant that facilitates spreading, sticking, wetting, and other modifying characteristics of the spray solution. Special ingredients may also improve the safety, handling, measuring, and application of the herbicide. Products mentioned in this publication contain the active ingredients 2,4-D, fluzifop, glyphosate, imazapyr, triclopyr (amine or ester), and hexazinone in varying concentrations (Table 1).

The active ingredients 2,4-D amine, triclopyr amine, imazapyr, and hexazinone are formulated as water-soluble liquids (L). They are not compatible with oil-based diluents and are diluted in water for foliar applications and diluted in water or applied in their concentrated form for cut stump applications. They are not normally used for basal bark applications.

Triclopyr ester, imazapyr, and fluzifop are formulated as emulsifiable concentrates (EC). Emulsifiable concentrates are compatible with oil-based diluents and also contain emulsifiers that allow the formulation to mix with water. Agitation is used to mix the EC in water. They may be diluted in water for foliar applications or mixed with oil based diluents for low volume applications (e.g., basal bark).

Hexazinone is also formulated as an ultra-low-weight soluble granule (ULW) formulation. This formulation is broadcast with specialized ground or aerial equipment.

Where Herbicides Can Be Used

No pesticide may be sold in the United States until the U.S. Environmental Protection Agency (EPA) has reviewed the manufacturer's application for registration and determined that the use of the product will not present unreasonable risk to humans or the environment. **Pesticide users are required by law to comply with all the instructions and directions for use in pesticide labeling.**

EPA approves use of pesticides on specific sites, i.e., for use on individual crops, terrestrial non-crop or aquatic areas. Only those herbicides registered by EPA specifically for use in aquatic sites can be applied to plants growing in lakes, rivers, canals, etc. For terrestrial uses, EPA requires herbicide labels to have the statement: "Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean highmark." Rodeo® is the only product mentioned in this publication that is registered for aquatic use and can be applied directly to water (Table 1). Certain but not all products that contain 2,4-D can also be applied directly to water. The state supplemental special local need label for the imazapyr-containing product,

Arsenal® (EPA SLN NO. FL-940004) allows government agencies and their contractors to use it for injection, frill/girdle or cut stump applications to control melaleuca and Brazilian pepper (addition of Chinese tallow to label applied for) growing in water. Other products mentioned can be used in noncropland areas and variously described low lying areas, including wetlands, but cannot be applied directly to water (Table 1).

Absorption Characteristics

Herbicides recommended in this publication for invasive plant control are systemic. They move within the plant to the site where they are active after being absorbed by foliage, roots, or bark. Triclopyr, 2,4-D imazapyr, and glyphosate can be absorbed by plant leaves and are effective for foliar applications. Addition of an appropriate surfactant, as recommended on the herbicide label, is essential. Triclopyr, 2,4-D and glyphosate are absorbed by soils or broken down quickly in soil and are not absorbed effectively by plant roots, whereas imazapyr and hexazinone are readily absorbed by plant roots (Table 2). Only oil-soluble herbicide formulations, i.e. emulsifiable concentrates, are absorbed readily through tree bark.

Behavior in Soils

Herbicides used for invasive plant control vary in their persistence and sorption to soils (Table 2). The most important factor is the ability of various soil types to chemically bind herbicides. Soil-applied herbicides, such as hexazinone, have label recommendations that vary the application rate for different types of soils. In general, soils with more organic matter and/or clay have greater capacities for binding herbicides than coarse, sandy soils and require higher application rates. Because woody plants are a problem on a range of Florida soils including highly organic muck, sand, and very thin soil layers over limestone, a broad range of herbicide behavior in different soils can be expected.

Selectivity

The ability to selectively control target vegetation with herbicides without harming nontarget plants is related to the relative sensitivities

of target and nontarget plants, absorption and chemical characteristics of the herbicides, and placement.

Herbicides vary in their potential to damage nontarget vegetation, and unwanted results can be prevented or minimized by making the best choice of herbicides in conjunction with careful application. Fluazifop, which kills many grasses, can be used to selectively manage invasive grass species among nontarget broadplant species. Formulations that contain the active ingredients 2,4-D or triclopyr can often be used selectively because many broadleaf species are more sensitive to them than to perennial grasses.

Because 2,4-D, triclopyr and glyphosate have negligible root activity and break down quickly (Table 2), they have little potential for causing nontarget damage, due to root absorption, when carefully applied to target vegetation. In contrast, caution must be used with root active herbicides (i.e. hexazinone and imazapyr) to minimize damage to nontarget vegetation by root absorption.

Care must be taken to avoid unwanted contact of herbicide spray (drift) to foliage of nontarget plants when broadcast applications of the foliar active herbicides, 2,4-D, triclopyr, glyphosate, or imazapyr are made. Particulate drift can be minimized by avoiding windy conditions when spraying and using low pressures and large nozzle orifices. Volatile compounds such as ester formulations may cause nontarget damage due to vapor drift when applied on very hot days. This damage, which may be observed as wilting or curling leaves, has been minimal and has not caused permanent harm to woody nontarget plants.

Wildlife Toxicity

Invasive plant management is often conducted in natural areas with the purpose of maintaining or restoring wildlife habitat. Therefore, it is essential that the herbicides themselves are not toxic to wildlife. Risk assessment to wildlife is conducted as part of the registration procedure for herbicides and is determined as the product of hazard and exposure. Hazard is measured as the toxicity of the herbicide to test animals and exposure depends on the use and

persistence of the compound. Herbicides recommended in this publication have shown very low toxicity to wildlife that they have been tested on, with the exception of the relatively low LC_{50} (0.87 ppm) of triclopyr ester and fluzifop (0.57 ppm) for fish, neither of which can be applied directly to water (Table 3). Ester formulations are toxic to fish because of irritation to fishes' gill surfaces. However, because triclopyr ester and fluzifop are not applied directly to water, are absorbed by soil particles, and have low persistence, exposure is low, which results in low risk when properly used.

Herbicide Application Methods

Foliar applications. Herbicide is diluted in water and applied to the leaves with aerial or ground equipment. Dilution is usually about 20 parts water to 1 part herbicide concentrate for aerial applications, and 50 to 400 parts water to 1 part herbicide concentrate when making ground applications for woody plant control. Adjuvants, such as surfactants, drift control agents or other spray modifiers, are often added to the spray mix, as specified on the herbicide label. Ground equipment ranges from handspray bottles for applications to small individual plants, to large high pressure vehicle or boat-mounted sprayers for larger areas. Foliar applications can either be directed, to minimize damage to nontarget vegetation, or broadcast. Broadcast applications are used where damage to nontarget vegetation is not a concern or where a selective herbicide is used.

For directed spray, selective applications, backpack sprayers such as the Solo Model 475 with diaphragm pump or Swissmex SPI are effective and commonly used. A spray tip such as a TP 2503 or TP 2504 produces large spray droplets to reduce spray drift. The 2503 spray tips may be installed in the spray wand that comes with the backpack sprayer, or a Model 30 Gunjet with the 2503 or 2504 spray tip may be attached to any backpack spray unit. If an adjustable tip is used, a Tee-Jet 5500-X8 or equivalent is recommended. All backpack sprayers and spray guns should have chemical-resistant seals for the herbicides being used.

Power-driven ground equipment is commonly used to spray large/tall plants or large areas. Properly adjusted equipment should deliver a uniform spray with nozzle pressures of about 30 to 80 psi and should generate large spray droplets to reduce potential for spray drift. Higher spray pressures produce many small spray particles, which may drift onto sensitive desirable plants adjacent to the treated area. Application is made by directing the spray on the target foliage, being sure to spray the growing tips and terminal leader. Techniques must be employed to prevent the spray from contacting foliage of desirable plants.

Commonly used power equipment consists of portable power driven spray units mounted on a truck or all-terrain vehicle. A wide variety of pumps, tanks, and accessories are used. The most common and maintenance-free pump is a diaphragm pump driven by a gasoline engine, or a self-contained 12-volt pump unit. Routinely used spray guns are Spraying Systems Model 2 and 2A Gunjets. These are adjustable spray guns which produce patterns ranging from a solid stream to a wide cone spray. These spray guns may produce small spray particles at the cone spray setting, resulting in spray drift. Also, a Model 30 Gunjet with a Tee-Jet 5500-X10 adjustable tip is very effective for power sprayers. Dual spray Gunjets that accommodate two flat spray tips with different volumes and patterns are available. The spray gun can immediately be switched from one spray tip to the other by rotating the spray head. The two most commonly used spray tips for the spray gun are TP 0512, TP 4010 or TP 4020. These tips produce few fine spray particles so spray drift potential is reduced.

Basal bark applications. Herbicide is applied, commonly with a backpack sprayer, directly to the bark around the circumference of each stem/tree up to 15 inches above the ground. The herbicide must be in an oil-soluble formulation (EC) and if not in a ready-to-use form it may be mixed with a specially formulated penetrating oil. The spray tip should be a narrow angle (15-25 degrees) flat fan-tip nozzle such as a TP 1502 or TP 1503 or TP 2502/TP 2503, a solid cone nozzle, or an adjustable conejet such as a Tee-Jet 5500-X4 or 5500-X5 or equivalent. Any of these tips may be installed in the spray wand that

comes with the spray unit. A good alternative is a brass tip shut-off wand such as a Spraying Systems Model 31 with brass extension and tip shut-off or a Spraying Systems Model 30 Gunjet. A TP-0001/TP-0002 tip or DE-1/DE-2 disc should be used with the Model 30 Gunjet. The Gunjet may be attached to most backpack spray units that produce pressures between 20 and 50 psi. All backpack sprayers and spray guns should have chemical resistant seals for the herbicides and carriers being used.

Frill or girdle (sometimes called hack-and-squirt) applications. Cuts into the cambium are made completely around the circumference of the tree with no more than 3-inch intervals between cut edges. Continuous cuts (girdle) are sometimes used for difficult-to-control species and large trees. Do not make multiple cuts directly above or below each other because this will inhibit movement of the herbicide. Incisions should be angled downward to hold herbicide and must be deep enough to penetrate the bark and cambium layer. Herbicide (concentrated or diluted) is applied to each cut until the exposed area is thoroughly wet. Frill or girdle treatments are slow and labor intensive but sometimes necessary in mixed communities to kill target vegetation and minimize impact to desirable vegetation. To further minimize potential impact to desirable vegetation, cuts can be wrapped with tape to prevent rainfall from washing herbicide to the soil. Water- or oil-soluble formulations can be used for frill or girdle applications.

Backpack sprayers such as described above or 1- to 2-gallon pump-up sprayers can be suitable for frill or girdle herbicide mixtures as long as they contain chemically resistant seals such as Viton. Hand-held, chemical resistant spray bottles, such as the 1-quart Delta Industries "Spraymaster" are commonly used for applying herbicide for frill and girdle applications.

Stump treatments. After cutting and removing large trees or brush, herbicide (concentrated or diluted) is sprayed or painted on to the cut surface. The cut surface should be as level as possible so that herbicide solution does not run off. Sweep off dirt and sawdust that may prevent the herbicide solution

from being taken up by the stump. The herbicide is usually concentrated on the cambium layer on large stumps, especially when using concentrated herbicide solutions. The cambium is next to the bark around the entire circumference of the stump. When using dilute solutions the entire stump is sometimes flooded (depending on label instructions) with herbicide solution. Water- or oil-soluble formulations can be used. Spray equipment previously described can be used as long as they contain chemical resistant seals for the herbicides and carriers being used. Best results are obtained if the herbicide is applied immediately after cutting and with no more than one hour between cutting and applying herbicide, especially when using a water-soluble formulation (seconds can count with less susceptible species). Oil-soluble formulations can be effective when applied after some time has passed and should then be applied to the bark as well. The procedure must ensure that cut stems, branches, or seeds do not take root and produce additional plants.

Soil applications. Granular herbicide formulations can be applied by hand held spreaders, by specially designed blowers, or aerially. Soil-applied water-soluble or water-dispersible formulations can be applied with the same type of application equipment described for foliar applications or spotguns that can accurately deliver a measured amount of herbicide.

Marker Dyes. Marker dyes are very useful for keeping track of what vegetation has been treated when making applications to large numbers of individual trees or stumps. Dyes are also a useful indicator of the applicator's efficiency of limiting herbicide contact with nontarget vegetation and personal contact.

Methods Currently Used by Land Managers in Florida

Control methods being used for invasive non-native plants by land managers in Florida are listed in Table 4. All methods listed have been found effective under certain circumstances. However, many factors can affect the performance of a herbicide application and results can vary. Choice of application method, herbicide, and rate for individual

species depend on environmental conditions and personal experience. Experience has shown that treatment success may vary from site to site and on the same site.

Pesticide product labeling is the primary method of communication between a herbicide manufacturer and the herbicide users and provides instructions on how to use the product safely and correctly. Changes in herbicide label directions may occur that are not concurrently updated in this publication. Because pesticide users are required by law to comply with all the instructions and directions for use contained in the pesticide label, no herbicide applications should be made based solely on information presented in this publication. Pesticide users must review and comply with all conditions set forth in the pesticide label.

Table 1. Herbicides commonly used in natural areas of Florida. (Alphabetical by active ingredient. All concentrations are a.i.)

PRODUCT	FORMULATION	COMMENTS
Several	2,4-D various	Some products can be applied directly to water.
Fusilade	Fluazifop 24.5% EC	Post emergence, grass specific. Cannot be applied directly to water.
Rodeo, Aquamaster, Aquaneat, Eagre, AquaPro, GlyPro, Accord	Glyphosate 53.8% L	Can be applied directly to water.
Roundup Pro, Roundup Super Concentrate, Credit, Glyphos, GloPro Plus, Rattler, Honcho, Touchdown Pro, Dupont Glyphosate, Roundup Pro Dry, Gly Gran	Glyphosate 41.0% L	May be applied to ditch banks, dry ditches, dry canals. May not be applied directly to water.
Velpar L	Hexazinone 25% L	May cause ground-water contamination if applied to areas where soils are permeable, especially where the water table is shallow. Nontarget plants can be damaged by root absorption.
Velpar ULW	Hexazinone 75% ULW	Same comments as Velpar L.
Arsenal	Imazapyr 28.7% L	May be applied to non-irrigation ditches and low lying areas when water has drained but may be isolated in pockets due to uneven or unlevel conditions. Otherwise, may not be applied directly to water. May be applied by government agencies or their contractors in Florida, under SLN, by injection, frill and girdle, or cut stump to melaleuca and Brazilian pepper when growing in water. Nontarget plants can be damaged by root absorption.
Stalker	Imazapyr 28.7% L	Can be applied to non-irrigation ditch banks. Nontarget plants can be damaged by root absorption.
Brush-B-Gon	Triclopyr amine 8.0% L	Homeowner packaging readily available in retail stores. Lower concentration than Garlon 3A may require follow-up applications.
Brush Killer	Triclopyr amine 8.8% L	Homeowner packaging readily available in retail stores. Lower concentration than Garlon 3A may require follow-up applications.
Garlon 3A	Triclopyr amine 44.4% L	May be applied to non-irrigation ditch banks, seasonally dry wetlands, flood plains, deltas, marshes, swamps, bogs, and transitional areas between upland and lowland sites. May not be applied directly to water.

Table 1. Herbicides commonly used in natural areas of Florida. (Alphabetical by active ingredient. All concentrations are a.i.)

PRODUCT	FORMULATION	COMMENTS
Garlon 4	Triclopyr ester 61.6% L	Same comments as Garlon 3A.
Pathfinder II	Triclopyr ester 13.6% L	Same comments as Garlon 3A. Ready to use.

Table 2. Soil behavior of herbicides commonly used in natural areas of Florida.

	HALF-LIFE (DAYS)	MOBILITY IN SOIL	ABSORPTION BY PLANT ROOTS
Glyphosate	~47	Little	Negligible
Fluazifop	15	Little	Negligible
Triclopyr	10-46	Moderate	Slight
2,4-D amine	10	Moderate	Slight
Imazapyr	25-142	Mobile	Strong
Hexazinone	~90	Mobile	Strong

Table 3. Toxicity of herbicides commonly used in natural areas of Florida.

	BOBWHITE QUAIL 8-DAY DIETARY LC ₅₀ *	LABORATORY RAT 96-HR ORAL LD ₅₀ **	BLUEGILL SUNFISH 96-HR LC ₅₀ *
2,4-D amine	>5,620	>1000	524
Fluazifop	>4659 (5-day)	2721 (Female)	0.53
Triclopyr amine	>10,000	2574	891
Triclopyr ester	9,026	1581	0.87
Imazapyr	> 5,000	>5000	>100
Glyphosate	> 4,640	>5000	120
Hexazinone	>10,000	1690	420

*LC₅₀ is the concentration in food (mg/kg) or water (mg/l) required to kill 50% of the population of test animals.
 **LD₅₀ is the quantity of herbicide in food that is lethal to 50% of test animals expressed as mg of herbicide per kg body wt.

Table 4. Control methods for non-native plants in use by land managers in Florida.

The development and testing of many of these techniques was made possible through the Post-Hurricane Natural Areas Recovery Program supported by the Knight Foundation and a Florida state legislative appropriation to the Metro-Dade Park and Recreation Department. The following individuals contributed to recommendations listed in this table: Rodell Collins, Laura Flynn, Roger Hammer, Dallas Hazelton, Linda McDonald, Laurie McHargue, Jose Prieto, Robert Stewart, Sandra Vardaman Wells - Metro-Dade Park and Recreation Department; Jim Duquesnel, Mark Ludlow, Greg Jubinsky - Florida Department of Environmental Protection; Doria Gordon - The Nature Conservancy; Brian Nelson - Southwest Florida Water Management District; Wayne Corbin, Johnny Drew, Shawn Moore, Jerry Glance - St. Johns River Water Management District; Ross Hakes, Monsanto; Joe Visaggio, American Cyanamid; Bill Kline, DowElanco; Doug DeVries - National Park Service; Alison Fox, Ken Langeland, Jeff Mullahey, Donn Shilling, Brian Smith - University of Florida Institute of Food and Agricultural Sciences. Deborah Shelley, Jim Burney NOTE! All dilutions of Garlon 4 applications (except foliar) are made with oil. All dilutions of Arsenal, Garlon 3A, Rodeo, Roundup Pro, or Roundup Super Concentrate are made with water.	
AGAVACEAE	
<i>Sansevieria hyacinthoides</i>	Bowstring hemp, Mother-in-law's tongue
	Treatment: Foliar apply 5%-10% Garlon 4 in oil or water. Addition of 3% stalker may increase consistency where non-target vegetation will not be endangered. In sandy soils where a greater potential exists for non-target damage plants can be cut and 15%-25% Roundup applied to the cut surfaces. Comments: Plants often take six to twelve months to die and follow-up applications are necessary.
ANACARDIACEAE (Cashew Family)	
<i>Schinus terebinthifolius</i>	Brazilian pepper; Florida holly
	Treatment: Cut-stump treatment with 50% Garlon 3A, 10% Garlon 4 or a basal bark application of 10% Garlon 4. Foliar application of Garlon 4, Garlon 3A, Roundup Pro, Roundup Super Concentrate, or Rodeo, according label directions may be used where appropriate. Glyphosate products are less effective when used alone in spring and early summer. Use Rodeo or cut stump application of 50% Arsenal where plants are growing in aquatic sites. Comments: Dioecious; female trees produce enormous quantities of bird-dispersed fruit; seed germinate readily; some people experience allergic reactions to the sap; target only female trees if time, funds or herbicide limitations are a factor.
APOCYNACEAE (Oleander Family)	
<i>Alstonia macrophylla</i>	Devil tree
<i>Alstonia scholaris</i>	Scholar tree
	Treatment: Basal bark application of 10% Garlon 4 or cut stump application of 50% Garlon 3A. Comments: Both species Invade hammocks, pinelands and disturbed sites; leaves are reportedly toxic to eat; <i>A. macrophylla</i> is becoming widespread in Dade county.
<i>Ochrosia elliptica</i>	Ochrosia; Kopsia
	Treatment: Cut-stump treatment with 50% Garlon 3A. Comments: Fruits are bright red, paired and reportedly poisonous to eat; often used in coastal landscaping.

Table 4. Control methods for non-native plants in use by land managers in Florida.

ARACEAE (Arum Family)	
<i>Colocasia esculenta</i>	Wild Taro
Treatment:	Foliar application of 1% Weedar 64 (3lb a.e./gal 2,4-D amine) + 1% Rodeo + 0.5% 1% Kammo (D-limonene) + silicone surfactant.
Comments:	Usually found in aquatic habitats so only herbicides labeled for aquatic sites can be used. Large corms make control very difficult and repeat applications will be necessary.
<i>Syngonium podophyllum</i>	Nepthytis
Treatment:	Hand pull vegetation, remove from site, spray resprouts with 3% Roundup or apply 10% Garlon 4 to stems. Foliar application of 3% Garlon 4 in water with surfactant has also achieved reasonable success. Multiple treatments are required.
Comments:	Breaks readily when pulled; roots from nodes; difficult to control; sap is a skin, mouth, and eye irritant; only spreads vegetatively; many populations are the result of discarded landscape material.
<i>Epipremnum pinnatum</i> cv. 'aureum'	
Treatment:	Hand pull vegetation, remove from site or place in plastic in plastic bags and leave on-site until decomposed. After it has resprouted from broken stems, treat with 3% Roundup and surfactant. If non-target damage is not a concern, 3% roundup is very effective on large intact patches. Repeated cuttings of climbing vines 4-6' above ground and removal of the lower portion.
Comment:	Roots at nodes; sap is skin, mouth, and eye irritant; may form extensive groundcover; leaves enlarge considerably when plants climb trees or other support; spreads vegetatively, apparently does not set seed in Florida.
ARALIACEAE (Aralia Family)	
<i>Schefflera actinophylla</i>	Queensland umbrella; Umbrella tree
Treatment:	Large individuals (>10 inches dbh) have proven extremely difficult to eradicate. A cut-stump treatment with 50% Garlon 3A or 10% Garlon 4 is recommended. If a cut-stump treatment is not possible, application of a wide band of 10% Garlon 4 may be used on smaller individuals and 20% Garlon 4 may be used on larger individuals. It may take up to 9 months to kill large trees.
Comments:	Grows terrestrially or as an epiphyte; invasive in hammocks, particularly wet, rocky sites; bird-dispersed fruits.
ARECACEAE (Palm Family)	
<i>Caryota mitis</i>	Fishtail palm (clumping species)
<i>Caryota urens</i>	Fishtail palm (solitary-trunked species)
Treatment:	Cut palm below growing point and treat with 50% Garlon 3A or 10% Garlon 4. Alternatively, Garlon 4 can be applied to the apical bud.
Comments:	Unlike any other palm genus, the leaves are twice compound; on multiple-trunked (clumping) species, when one trunk is cut the plant will resprout; fruits abundantly and is a common invasive plant in hammocks; fruit and sap are a skin, mouth, and eye irritant.
<i>Chamaedorea seifrizii</i>	Bamboo palm
Treatment:	Treat as fishtail palm, above.
Comments:	Pinnate-leaved, narrow-trunked, clustering species; invades hammocks.

Table 4. Control methods for non-native plants in use by land managers in Florida.

<i>Livistona chinensis</i>	Chinese fan palm
	Treatment: Hand pull seedlings; cut young specimens at ground level or spray Garlon 4 into the apical bud.
	Comments: Costapalmate leaves; green, curved, sharp spines along petiole; can be mistaken for <i>Sabal</i> and <i>Thrinax</i> species, but neither of the latter have spines on the petioles; differs from <i>Washingtonia</i> by having green, not brown, spines and lacking threadlike fiber on the leaves.
<i>Phoenix reclinata</i>	Senegal date palm
	Treatment: Cut stems near ground level and treat with 50% Garlon 3A or 10% Garlon 4 or apply 10% Garlon 4 to meristem.
	Comments: Common non-native palm in hammocks, especially near coast; pinnate leaves with straight, sharp spines on petiole.
<i>Ptychosperma elegans</i>	Solitaire palm
	Treatment: Hand pull seedlings; cut mature trees down at ground level; remove fruiting stems from site.
	Comments: Pinnate leaves, solitary trunk; commonly invades hammocks; high seed germination; fruit dispersed by birds, raccoons and opossums; very common in the landscape.
<i>Roystonea regia</i>	Royal palm
	Treatment: Hand pull seedlings; chainsaw mature trees down near the base.
	Comments: Commonly escapes into hammocks from landscape trees; best controlled in the seedling stage; Florida royal palm, <i>Roystonea elata</i> is similar and some taxonomists lump these two species together as synonyms; royal palms should only be treated as exotics if it is known that they are invading areas outside of their native Florida range; Florida royal palm still occurs as a wild plant in Everglades National park (Royal Palm Hammock), Fakahatchee Strand State Preserve, and Royal Palm Hammock in Collier Seminole State Park in Collier County.
<i>Syagrus romanzoffianum</i> (= <i>Arecastrum romanzoffianum</i>)	Queen palm
	Treatment: Treat the same as Royal palm, above.
	Comments: Pinnate leaves, single trunk; common in the landscape; invasive in hammocks.
<i>Washingtonia robusta</i>	Mexican fan palm, Washingtonia palm
	Treatment: Hand pull seedlings; cut young specimens at ground level or spray Garlon 4 into apical bud. Large, mature trees in natural areas will need to be cut down.
	Comments: Palmate leaves with brown, curved, sharp spines along the petioles; mature trees may retain dead leaves along the trunk; leaves characteristically have brown, threadlike fibers attached; can be mistaken for Chinese fan palm, <i>Livistona chinensis</i> , but the latter has green petiole spines and costapalmate leaves; invades pinelands and disturbed sites.
ASTERACEAE (Aster Family)	
<i>Wedelia trilobata</i>	Wedelia; Dune sunflower
	Treatment: Treat small patches with 2% Roundup; large, dense populations may be treated by broadcast-spraying 5% Roundup (with follow-up treatments as needed). Or 1/4-1.0% Garlon 4 in water.

Table 4. Control methods for non-native plants in use by land managers in Florida.

Comments: Trailing species, forming dense groundcover; yellow, daisy-like flowers produced all year; invades a variety of open, sunny habitats, including beaches; often becomes established from discarded landscape material.	
BERBERIDACEAE (Barberry family)	
<i>Nandina domestica</i>	Nandina, Heavenly bamboo
Treatment: Basal bark application of 15% Garlon 4 in mineral oil. Collect and destroy attached fruits.	
Comments: Naturalized in Gadsden, Jackson, Leon, Wakulla, and perhaps other Counties.	
CACTACEAE (Cactus Family)	
<i>Hylocereus undatus</i> (= <i>Cereus undatus</i>)	Night-blooming cereus
Treatment: Hand pull and remove from site if possible; if removal is not feasible, lay the plants out on a plastic tarp and spray them with 10% Garlon 4; 15% Roundup has been successful but it takes much longer for the plants to die.	
Comments: Vining cactus that climbs and roots to tree trunks; sometimes epiphytic; very showy, fragrant flowers open at night in summertime.	
CAPRIFOLIACEAE	
<i>Lonicera japonica</i>	Japanese honeysuckle
Treatment: Foliar application of 3%-5% Garlon 3A or 1%-3% Roundup Pro or equivalent concentration of other glyphosate containing product.	
Comments: Twining or trailing woody vine with young stems pubescent. Interrupts succession in once-forested areas by overtopping and smothering young trees, preventing their recruitment to the overstory and can disrupt understory structure in mature forests. May be confused with native honeysuckle, <i>Lonicera sempervirens</i> , leaves and stems of which are not hairy and flowers red with yellow within.	
CASUARINACEAE (Beefwood Family)	
<i>Casuarina equisetifolia</i>	Australian pine
<i>Casuarina glauca</i>	Beefwood, Brazilian oak
Treatment: Basal bark treatment with 10% Garlon 4 is very effective, as is a cut-stump treatment with 50% Garlon 3A or 10% Garlon 4. When basal bark treatment is used on trees greater than 1 foot in diameter it may be necessary to slough off loose bark in the application area to prevent the bark from trapping the herbicide. Addition of 3% Stalker will increase consistency on older trees. Broadcut of 4-6 lb Velpar ULW may be used when appropriate.	
Comments: <i>C. equisetifolia</i> has a single trunk and produces viable seeds which are wind- and bird-dispersed; <i>C. glauca</i> produces suckers at the base of the trunk, rarely sets seed in Florida, and has a weeping growth habit.	
CLUSIACEAE (Pitch-apple Family)	
<i>Calophyllum antillanum</i> (= <i>C. Calaba</i> ; <i>C. brasiliense</i> var. <i>antillanum</i>)	Brazilian beauty-leaf
Treatment: Basal bark treatment with 10% Garlon 4. Follow-up herbicide applications may be necessary.	
Comments: Medium-sized tree with glossy, leathery leaves; has been found principally invading coastal areas, including mangrove fringe.	

Table 4. Control methods for non-native plants in use by land managers in Florida.

COMBRETACEAE (Combretum Family)	
<i>Terminalia arjuna</i>	Arjun tree
<i>Terminalia catappa</i>	Indian almond
<i>Terminalia muelleri</i>	Mueller's almond
Treatment: Basal bark application of 10% Garlon 4 or cut-stump treatment with 50% Garlon 3A.	
Comments: The Indian almond is deciduous and invades coastal habitats, hammocks, and disturbed sites; Arjun tree and Mueller's almond invade hammock interiors and margins.	
COMMELINACEAE (Spiderwort Family)	
<i>Tradescantia spathacea</i> (= <i>Rhoeo spathacea</i>)	Oyster plant
Treatment: Hand pull and remove from site.	
Comments: Succulent with sword-shaped rosettes of leaves, green on upper surface, bright purple on lower surface; highly invasive, forming extensive colonies.	
CONVOLVULACEAE (Morning-glory Family)	
<i>Merremia tuberosa</i>	Wood rose
Treatment: Cut stem at ground level and treat with 50% Garlon 3A or 10% Garlon 4. A basal bark treatment with 10% Garlon 4 also works. The cut-stem treatment is preferred because it is evident within one week which stems were treated and which were missed.	
Comments: Individual plants can cover extensive areas; rarely roots at nodes; bright yellow morning-glory-like flowers produced in late fall, fruits profusely in early winter; later December and early January die backs occur; seeds germinate readily.	
CRASSULACEAE (Orpine Family)	
<i>Kalanchoe pinnata</i>	Life plant, Live leaf
Treatment: Hand pull or treat with direct application of 3% Roundup and surfactant. Roundup is an effective treatment because it kills individual leaves that otherwise may produce new plants along leaf margins. Follow-up hand removal of leaves is necessary to prevent leaves from producing new plants. Basal stem treatments with 10% Garlon 4 is NOT recommended. This causes the leaves to drop, resulting in hundreds of new plantlets.	
Comments: Often found along edges of natural areas, generally as a result of discarded landscape material.	
DIOSCOREACEAE (Yam Family)	
<i>Dioscorea alata</i>	Water yam
<i>Dioscorea bulbifera</i>	Air-potato; Air yam
<i>Dioscorea sansibarensis</i>	West African yam
Treatment: Cut and remove as much of the vines as possible and collect bulbils and remove from site. Apply foliar application of 1.25%-2.0% Garlon 3A or 0.5%-2.0% Garlon 4 to remaining vegetation. Several follow-up applications will be necessary through the growing season and perhaps successive years to control growth.	

Table 4. Control methods for non-native plants in use by land managers in Florida.

Comments: Monocot with heart-shaped leaves; dies back to tubers in winter in response to shortened day length, resprouts in spring from tubers; all three species produce aerial bulbils in late summer, early fall.	
EBENACEAE (Ebony Family)	
<i>Diospyros digyna</i> (= <i>D. ebenaster</i>)	Black sapote
Treatment: Large individuals are difficult to kill. Applying 50% Garlon 3A to a freshly cut stump is recommended. Basal bark treatments with Garlon 4 does not work.	
Comments: Black bark, shiny alternate leaves; scattered throughout a few hammocks in South Florida; fruits large, edible; green when ripe.	
ELAEAGNACEAE (Oleaster family)	
<i>Elaeagnus pungens</i>	Silverthorn
Treatment: Basal bark application of 15% Garlon 4 in mineral oil.	
Comments: Naturalized and targeted for removal in Florida Caverns State Park (Jackson County).	
EUPHORBIACEAE (Spurge Family)	
<i>Aleurites fordii</i>	Tungoil tree
Treatment: Basal bark applications with 20% Garlon 4.	
Comments: Found mainly in northern counties to Citrus County.	
<i>Bischofia javanica</i>	Bishopwood; toog
Treatment: Basal bark treatment with 10% Garlon 4 is effective. Large trees require applying a wider band of herbicide on the trunk, or increasing the concentration of Garlon 4 to 20%.	
Comments: Dioecious; compound leaves with three large leaflets; herbicide treatment may cause adventitious roots to form along trunk; female trees produce massive numbers of bird-dispersed fruits that hang in grape-like clusters; target only female trees if time, funds, or herbicide limitations are a factor.	
<i>Ricinus communis</i>	Castor bean
Treatment: Basal bark or cut-stump treatment with 10% Garlon 4. Site must be revisited several times to pull up seedlings.	
Comments: High seed germination: seeds extremely poisonous to eat.	
<i>Sapium sebiferum</i>	Chinese tallow, popcorn tree
Treatment: Cut stump treatment of 20% Garlon 4; or basal bark application of 15% Garlon 4 to trees <10 in dbh or 20% Garlon 4 to trees >10 in dbh (non-aquatic sites only). Addition of 3% Stalker will reduce resprouting on older trees. Experimental cut stump and frill applications of 2-3% Arsenal have proven effective in aquatic sites and an application has been made to add to the label. Low volume foliar application with 0.5%-0.75% Arsenal can be used where appropriate.	
Comments: Use basal bark method when seeds are present on tree to reduce seed spread, apply to run-off. Seedlings up to 10 in tall can be hand pulled.	
FABACEAE (Pea Family)	
<i>Abrus precatorius</i>	Rosary pea
Treatment: Treat base of vine with 10% Garlon 4. Site must be revisited several times to pull seedlings.	

Table 4. Control methods for non-native plants in use by land managers in Florida.

	Comments: Seeds black and red, highly poisonous.
<i>Acacia auriculiformis</i>	Earleaf acacia
	Treatment: Basal bark application of 10% Garlon 4 or cut-stump treatment with 50% Garlon 3A. Addition of 3% Stalker will increase consistency.
	Comments: A frequent invader of pinelands and disturbed sites.
<i>Adenanthera pavonina</i>	Red sandalwood
	Treatment: Basal bark treatment with 10% Garlon 4. Cut-stump treatments are also effective with 50% Garlon 3A or 10% Garlon 4. Small seedlings can be hand-pulled.
	Comments: Can be easily confused with <i>Albizia lebbbeck</i> , which has larger leaflets; bark of red sandalwood is typically reddish; produces hard red seeds which seem to persist in soil.
<i>Albizia lebbbeck</i>	Woman's tongue; Rattle pod
	Treatment: Basal bark treatment with 10% Garlon 4. Cut stump treatments are also effective with 50% Garlon 3A or 10% Garlon 4. Small seedlings can be hand-pulled.
	Comments: Large, dry, brown pods with few large seeds, mature principally in winter; common in pinelands and hammocks.
<i>Albizia julibrissin</i>	Mimosa
	Treatment: Basal bark application of 15% Garlon 4.
	Comments: Apply to 1-2 ft of trunk on larger trees. Trees >3 in dbh may require retreatment.
<i>Bauhinia forficata</i>	Spiny orchid tree
<i>Bauhinia purpurea</i>	Orchid tree
<i>Bauhinia variegata</i>	Orchid tree
	Treatment: Basal bark application of 10% Garlon 4 or application of 50% Garlon 3A to cut stump.
	Comments: All three species invade disturbed sites and the edges of natural areas in Dade County.
<i>Dalbergia sissoo</i>	Indian rosewood
	Treatment: Basal bark treatment with 10% Garlon 4.
	Comments: Medium to large tree with compound leaves bearing 3 to 5 leaflets; papery seed pods wind-dispersed; invasive along hammock margin, canopy gaps and disturbed sites.
<i>Delonix regia</i>	Royal poinciana
	Treatment: Cut stump application of 50% Garlon 3A.
	Comments: Large spreading tree with bi-pinnately compound leaves; very popular flowering tree in the landscape; invades hammock margin, canopy gaps and disturbed sites; seeds commonly sprout beneath parent trees.
<i>Leucaena leucocephala</i>	Lead tree, jumble bean
	Treatment: Difficult to control and variable results have been reported. Basal bark or cut-stem treatment with 10%-20% Garlon 4 has been reported to be effective while others report only partial success with 40% Garlon 4. 25% has been effective on trees <3" DBH, while larger trees were not killed. Large trees must be completely girdled for frill/girdle applications.

Table 4. Control methods for non-native plants in use by land managers in Florida.

<i>Mimosa pigra</i> (=M. <i>pelita</i>)	Comments: Usually found on edges of natural areas; can be mistaken for native wild tamarind, <i>Lysiloma latisiliquum</i> . A larger band of Garlon 4 is applied to larger trees or those growing in sandy soils.
	Catclaw mimosa
	Treatment: Basal bark or cut stump application of Pathfinder or 30%-50% Garlon 4 and oil. Repeat foliar applications of 1.5% Rodeo or 2%-3% Garlon 3A.
<i>Mucuna pruriens</i>	Comments: Repeated site visits are necessary to control seedlings and prevent further seed production. An estimated ten years are estimated to be needed for seed bank eradication.
	Cow itch
	Treatment: Basal bark application of 10% Garlon 4, or hand pull mature vines and seedlings; does not resprout from roots. It is important to continue pulling seedlings until seed bank is exhausted.
	Comments: Hairs on seed pods cause intense itching.
<i>Pueraria montana</i> (=P. <i>lobata</i>)	Kudzu
	When actively growing at or beyond bloom stage of growth apply 2% Roundup Pro (or equivalent) diluted in water with hand held equipment. During early to mid growing season apply 2% Garlon 3A. Use sufficient spray volume to thoroughly wet foliage.
	Comments: Follow up treatments are necessary as resprouting occurs from root crowns and tubers.
<i>Wisteria sinensis</i>	Chinese wisteria
	Treatment: Cut vine and treat stump with 20%-30% Garlon 4 or 100% Garlon 3A.
	Comments: High climbing woody vine with showy lavender flowers in spring. Can top and kill mature trees. Legume densely, velvety pubescent compared to the native <i>Wisteria frutescens</i> with glabrous fruits.
GOODENIACEAE (Goodenia Family)	
<i>Scaevola sericea</i> (=S. <i>frutescens</i> ; S. <i>taccada</i>)	Beach naupaka; Half-flower; Scaevola
	Treatment: Hand pull and remove, at least fruit, from site whenever possible; basal treatment with 10% Garlon 4 or treat cut stump with 50% Garlon 3A or 10% garlon 4 if removal is not feasible. Monocultures can be treated foliarly with 4% Garlon 4 in water, using care not to allow drift to non-target vegetation.
	Comments: Semi-woody shrub with either glabrous or pubescent, somewhat succulent leaves; flowers fan-shaped, white or blushed with purple; fruit are white, which helps distinguish it from the black-fruited, native Inkberry, <i>Scaevola plumieri</i> ; seeds of the exotic scaevola are carried by ocean currents where they sprout and colonize beaches and other shoreline habitats. Branches in contact with ground may root.
LYGODIACEAE (Climbing fern family)	
<i>Lygodium microphyllum</i>	Old World climbing fern
	Treatment: Thoroughly spray foliage to wet with 1.25% Garlon 4 (4 pt per acre), 0.6% Roundup Pro (maximum 5 pt/acre), 1.0%-3.0% Rodeo (maximum 7 pt per acre). Only Rodeo can be used if plants are growing in aquatic site. Plants growing high into trees cut vines and treat lower portions. Do not apply when plants are under environmental stress.

Table 4. Control methods for non-native plants in use by land managers in Florida.

<i>Lygodium japonicum</i>	Comments:	Fern with twining, climbing fronds, leaflets unlobed. The most serious natural area weed in Florida. Land managers should be on constant lookout for it and take immediate steps to control it when encountered.
		Japanese climbing fern
	Treatment:	Foliar application of 1.5% Rodeo or equivalent glyphosate containing product at proportional glyphosate concentration.
	Comments:	Fern with twining, climbing fronds, leaflets lobed. Occurs throughout west and north Florida into central Florida. Smothers seedlings of overstory tree species.
MALVACEAE (Mallow Family)		
<i>Hibiscus tiliaceus</i>		Sea hibiscus; Mahoe
	Treatment:	Hand pull seedlings; basal bark treatment with 10% Garlon 4 or cut stump treatment with 50% Garlon 3A.
	Comments:	Multi-trunked, large, spreading tree with long-petioled, rounded cordate leaves, hibiscus-like yellow flowers turn pink or red with age; seeds float and drift to new coastal habitats; erroneously considered native by some people.
<i>Thespesia populnea</i>		Seaside mahoe; Portia tree
	Treatment:	Seedlings can be hand pulled. 50% Garlon 3A for cut stump applications. Basal bark applications of 10% Garlon 4 have killed trees <2' DBH after 8 weeks. Larger trees with thick corky bark require up to 25% Garlon 4.
	Comments:	Multi-trunked, large, spreading tree; heart-shaped leaves with a pronounced drip-tip; hibiscus-like yellow flowers turn pink or red with age; seeds float and drift to new coastal habitats; erroneously considered native by some people.
MELIACEAE (Mahogany family)		
<i>Melia azedarach</i>		Chinaberry, Pride of India
	Treatment:	Basal bark application of 15% to 30% Garlon 4. Treat 1-2 ft of trunk for larger trees. Trees > 3" dbh may require retreatment. Fell trees over 6" DBH and treat stumps with up to 30% Garlon 4. Addition of 3% Stalker may increase consistency. Apply low volume foliar application of 1% Arsenal covering 50% of the foliage.
	Comments:	Often shrubby and root-suckering, forming thickets. Fruits poisonous to humans and some other mammals. Most abundantly found in north and west Florida but often escaping cultivation in peninsular counties, south to the Keys.
MORACEAE (Mulberry Family)		
<i>Broussonetia papyrifera</i>		Paper mulberry
	Treatment:	Basal bark application of 10%-30% Garlon 4. Addition of 3% Stalker will increase consistency.
	Comments:	Large tree with scabrous leaves and reddish-orange balls of flowers. Invades hammocks and disturbed sites; young trees can be mistaken for the native red mulberry, <i>Morus rubra</i> .
<i>Ficus altissima</i>		Lofty fig
<i>Ficus benghalensis</i>		Banyan fig
<i>Ficus microcarpa</i>		Laurel fig

Table 4. Control methods for non-native plants in use by land managers in Florida.

Treatment: Basal bark application of 10% Garlon 4 is effective.	
Comments: All three species invade the interior and edges of hammocks; often found growing as epiphytes (on trees) or epiliths (on rocks or stone structures); exercise care when treating epiphytic figs to ensure that herbicide does not come in contact with the host tree; members of this genus are very sensitive to Garlon 4; extreme care must be taken when treating any vegetation near the native strangler fig and shortleaf fig; spray that contacts surface roots can kill a large tree	
MYRSINACEAE (Myrsine Family)	
<i>Ardisia elliptica</i> (= <i>Ardisia solanacea</i>)	Shoe-button Ardisia
Treatment: Basal bark treatment with 10% Garlon 4 or cut stump application of 50% Garlon 3A. Hand pull seedlings.	
Comments: Often found in wetter areas; prolific reproduction; closely resembles the native <i>Ardisia escallonioides</i> (Marlberry) but differs in that new growth, petioles, and stem tips are pink to red, and fruit are produced in axillary, not terminal, clusters.	
<i>Ardisia crenata</i>	Coral ardisia
Treatment: Foliar application of 5% Garlon 4 or basal bark application of 10% Garlon 4. Thorough coverage is essential for foliar application.	
Comments: Small shrub, easily recognized by bright shiny leaves, with crenate (scalloped) margins and calluses in the margin notches and persistent bright red (sometimes white) fruits.	
MYRTACEAE (Myrtle Family)	
<i>Eugenia uniflora</i>	Surinam cherry
Treatment: For seedlings and small plants up to 1/2 inch diameter, use a basal bark treatment with 10% Garlon 4. This species takes a long time to die, and may require a subsequent herbicide application. For larger stems, use a cut-stump treatment with either 50% Garlon 3A or 10% Garlon 4. Seedlings should be hand pulled.	
Comments: Looks quite similar to native species of <i>Eugenia</i> ; leaves have a distinct odor when crushed.	
<i>Melaleuca quinquenervia</i>	Cajeput; Punk tree; Melaleuca
Treatment: For seedlings and saplings: (1) hand pull, being sure not to break plant off of root system and remove or place in piles to help reduce the chance that they will re-root or; (2) Treat with foliar, low volume spot application of 5% Rodeo. For mature trees: (1) Fell large trees with chain saw leaving a level surface, or fell small trees with machete and treat with 20% to 40% Arsenal according to directions on SLN; (2) if trees are to be left standing, make girdle application of 20% to 50% Arsenal or mixture of 25% Arsenal and 25% Rodeo according to frill and girdle directions on Arsenal SLN. Monitor for resprouting and retreat as necessary. (3) Mature trees are very difficult to control with foliar applications. Experimental aerial applications of 3 qt Rodeo + 3 qt Arsenal + 4 qt methylated seed oil surfactant have been somewhat successful. Contact manufacturer representatives when planning such large-scale treatments.	
Comments: Tall, highly invasive tree in freshwater wetlands; thick, papery bark; extremely high seed production; seeds dispersed by wind following natural or mechanical disturbance.	

Table 4. Control methods for non-native plants in use by land managers in Florida.

<i>Psidium guajava</i>	Guava
	Treatment: Basal bark application of 10% Garlon 4.
	Comments: Yellow, edible fruits; common invader in disturbed areas, hammock margins and wetlands.
<i>Rhodomyrtus tomentosa</i>	Downy rosemyrtle
	Treatment: Basal bark application of 10%-20% Garlon 4.
	Comments: A very aggressive evergreen shrub to 6 ft tall found as far north as Pasco County on the West Coast. Action should be taken immediately to remove it when found in natural areas. Identified by opposite, simple entire leaves, which are glossy green above, densely soft-hairy below, with three main veins form blade base; round, dark purple fruit with sweet aromatic flesh.
<i>Syzygium cumini</i>	Jambolan plum; Java plum
<i>Syzygium jambos</i>	Rose apple
	Treatment: Cut-stump treatment with 50% Garlon 3A or 10% Garlon 4, or use a basal bark treatment with 10% Garlon 4.
	Comments: Large trees, bird- and mammal-dispersed fruits. Mature trees may take up to 9 months to die.
OLEACEAE (Olive Family)	
<i>Jasminum dichotomum</i>	Gold coast jasmine
<i>Jasminum fluminense</i>	Brazilian jasmine
	Treatment: Individual vines of any size can receive a cut-stump treatment with 50% Garlon 3A or 10% Garlon 4, or a basal bark application of 10% Garlon 4. Because basally-applied Garlon 4 does not translocate beyond a few rooted nodes it is often necessary to pull runners back to the main stem, cut and apply Garlon 3A or Garlon 4 to the cut stem. Re-treatment of areas is usually necessary. Newly emerged seedlings can be hand pulled.
	Comments: Jasmines produce a large number of bird- and mammal-dispersed seeds with very high germination; highly invasive.
<i>Ligustrum lucidum</i>	Glossy privet
<i>Ligustrum sinense</i>	Chinese privet
	Treatment: Basal Bark application of 15% Garlon 4. Apply to 1-2 ft of trunk on larger trees.
	<i>L. sinense</i> widespread in northern Florida mesic woods, road shoulders, and farmlands. Invades logged areas, dispersed by mammals, birds, and floodwaters.
PASSIFLORACEAE (Passion-flower Family)	
<i>Passiflora edulis</i>	Passion-flower
	Treatment: Treat stems with a basal application of 10% Garlon 4 or use 10% Garlon 4 in a cut-stem application.
	Comments: Large attractive flower; fruit purple, edible; invasive in hammocks.
PIPERACEAE (Pepper Family)	
<i>Lepianthes peltata</i>	Lepianthes
<i>Piper aduncum</i>	Bamboo piper
<i>Piper auritum</i>	Makulan

Table 4. Control methods for non-native plants in use by land managers in Florida.

Treatment: Hand pull when possible (broken roots may resprout); remove entire plant from site; if hand pulling is not possible or feasible, use basal bark application of 20% Garlon 4, or cut stems off at ground level and treat stumps with 50% Garlon 3A; remove cut stems from the site to avoid resprouting from nodes. Comments: All three of the above species invade hardwood hammocks, especially margins and canopy gaps.	
POACEAE (Grass Family)	
<i>Imperata cylindrica</i>	Cogongrass
Treatment: 3-4 qt. Roundup Pro, 2-3 qt. Arsenal, or 0.5 qt Fusulade per acre. For high volume, spot treatment use 3%-5% Roundup Pro or 0.25%-0.5% Arsenal. Herbicides should be used in combination with burning or tillage for optimum control. See IFAS Publication SS-AGR-52 for additional information. Comments: If not controlled, cogongrass will spread along roadways and into pastures, mining areas, forest land, parks, and other recreation areas. Extensive rhizomes must be eliminated for long term control.	
<i>Neyraudia reynaudiana</i>	Burma reed
Treatment: Where non-target damage is not a concern, the entire culm can be sprayed with 1-3% Roundup Pro. In areas with surrounding desirable vegetation, the culms can be cut to ground level and sprayed with 5% Roundup Pro when the plant reaches a height of approximately 12 to 18 inches (cut stems should be removed from the site). Removing seedheads before treatment will reduce need for follow-up. Responds quickly after fire and should be targeted as soon as new growth reaches 12 to 18 inches. Most native plants will not have resprouted from the fire by the time Burma reed has reached this height, and it can be easily treated with little concern about non-target damage. Comments: Tall cane grass; extremely invasive in pine rockland habitat and open dry habitats, as well as roadsides, vacant lots and other disturbed sites; fire tolerant.	
<i>Panicum repens</i>	Torpedograss
Treatment: Foliar application of 0.75 - 1.5% Rodeo and surfactant solution. Re-apply as necessary when plants regrow to with 4 - 6 inches in height; or foliar application of 0.5% spot treatment or 4 pints per acre broadcast treatment of Arsenal. Comments: Numerous dormant buds associated with extensive rhizomes make this plant extremely difficult to control. Several years of re-application may be necessary to completely eliminate a population.	
<i>Pennisetum purpureum</i>	Napier grass
Treatment: Foliar application of 1%-3% Roundup Pro. If non-target damage is a concern, cut stems to ground level and allow sprouts to reach 8-12 inches and treat the same as <i>Neyraudia</i> above. Broadcast 3-5 quart/acre Roundup Pro, 2 quart/acre Arsenal, or 1 quart Arsenal and 2 quart Roundup Pro. Comments: Tall cane grass with white stripe down the center of the leaf blade and a foxtail-like inflorescence; prefers wetter substrates.	
<i>Phyllostachys aurea</i>	Golden Bamboo

Table 4. Control methods for non-native plants in use by land managers in Florida.

Treatment: Foliar application of 3% Roundup Pro (equivalent formulations should be effective). Application of 5% Roundup Pro to cut culms will reduce resprouting but results are inconsistent. Comments: Not a common problem but once established can spread extensively. Populations should be controlled immediately. Can become established by dumping of yard waste.	
RHAMNACEAE (Buckthorn Family)	
<i>Colubrina asiatica</i>	Latherleaf; Asian colubrina
Treatment: Basal bark application of 20% Garlon 4, cut-stump treatment with 50% Garlon 3A, or foliar application with 3% Garlon 3A or Garlon 4 in water with surfactant. Follow up for 3 to 4 weeks Hand pull seedlings. Comments: Sprawling shrub commonly invading coastal habitats; has become a serious pest plant in mangrove/buttonwood habitat and in coastal hardwood forests. Capsules spread by tides and currents. Seeds resemble small pebbles and may be used as crop stones by seed eating birds, such as doves, and dispersed.	
ROSACEAE (Rose Family)	
<i>Rubus albescens</i>	Mysore raspberry
Treatment: Cut stem near ground and spray with 50% Garlon 3A or 10% Garlon 4. This species has not been observed resprouting from cut stem segments lying on the ground. Comments: Sharp thorns on stems and leaves; arching stems and branches of intact plants root where they touch the ground; seeds bird and mammal dispersed.	
<i>Eriobotrya japonica</i>	Loquat
Treatment: Tree can be cut-stump treated with 50% Garlon 3A or Garlon 4 or with a basal bark application of 10% Garlon 4. Comments: Invasive in hammocks; commonly cultivated for its yellow, fuzzy, edible fruit; seeds spread into natural areas by mammals; exotic, free-flying parrots are known to feed on the fruit as well, and may also be vectors of seeds.	
RUBIACEAE (Madder Family)	
<i>Paederia cruddasiana</i>	Sewer vine; skunk vine; Chinese fever vine
Treatment: Low volume foliar applications of 3% RoundupPro where non-target damage is not a concern. Where there are desirable plants, basal bark applications of 10% Garlon 4. Within 2-4 weeks retreat the area with basal applications of 10% Garlon 4. This second treatment can be time-consuming because many underground runners sprout. The area should continue to be monitored for follow-up treatments. Comments: Climbing vine; related to <i>Paederia foetida</i>, which is established in central Florida; flowers profusely; produces viable seeds.	
<i>Paederia foetida</i>	Skunk vine
Treatment: Apply 0.5% Garlon 3A to thoroughly wet foliage (4-8 pt./acre) or 10% to 6-inch band chest high to foliage of vertically climbing vines. Or apply 0.2%-0.6% Garlon 4 to thoroughly wet foliage or 1.0%-10% to 6 to 20-inch band chest high. Or thoroughly wet foliage with 1.0%-1.5% Plateau. Homeowners can use Brush-B-Gon at maximum label rates.	

Table 4. Control methods for non-native plants in use by land managers in Florida.

<i>Paederia foetida</i>	Comments: Perennial twining vine from woody rootstock having leaves and stems with disagreeable odor, especially when crushed. Most common in west central Florida, documented northward to Gadsen County and southward to Broward County. Skunk vine Treatment: Limited information available. Foliar application of 3% (4 oz/gal) Brush-B-Gone or 1-2% Roundup has been effective. Preliminary data suggests successful control with fire when invading a pyric community. Comments: Extremely aggressive, draping, foul smelling vine. Common in West Central Florida and expanding its range.
RUTACEAE (Rue Family)	
<i>Murraya paniculata</i>	Orange jessamine Treatment: Hand pull seedlings; basal bark treatment with 10% Garlon 4. Comments: Shrub or small tree with small, glossy, compound leaves that are fragrant when crushed; white, citrus-like, heavily perfumed flowers produced in summertime; small orange fruit are bird-dispersed; invasive in hammocks, especially when bordered by residential areas that use this plant in the landscape.
SAPINDACEAE (Soapberry Family)	
<i>Cupaniopsis anacardioides</i>	Carrotwood Treatment: Basal bark application of 100% Pathfinder II, or 10%-20% Garlon 4 diluted with oil; or cut stump application of 10% Garlon 3A, 100% Brush-B-Gon, 100% Roundup Pro, 100% Rodeo, or equivalent glyphosate containing product, or 100% Pathfinder II. Comments: Invades interior of hammocks; added to Florida Noxious List in 1999; bird dispersed. Note label restrictions with respect to high tide mark and use extra caution near mangroves.
SAPOTACEAE (Sapodilla Family)	
<i>Manilkara zapota</i>	Sapodilla Treatment: Hand pull seedlings; basal bark application of 10% Garlon 4, larger trees may require several applications or increasing the Garlon 4 to 20%; or cut stump application with 50% Garlon 3A. Comments: Large, spreading tree; edible fruit; seeds dispersed by raccoons and opossums; invades hammock interiors.
<i>Pouteria campechiana</i>	Egg fruit; Canistel Treatment: Hand pull seedlings; basal bark application of 10% Garlon 4. Comments: Small to medium tree; yellow, edible fruit; prolific invader of hammocks but local in distribution; fruit eaten by raccoons and opossums.
SOLANACEAE (Nightshade Family)	
<i>Cestrum diurnum</i>	Day jessamine Treatment: Hand pull when possible (if soil disturbance is not an issue); cut stump treatment with 50% Garlon 3A is effective. Comments: Shrub or small tree with small, tubular, very fragrant flowers (in daytime) small purple fruit dispersed by birds.
<i>Solanum tampicense</i>	Wetland nightshade, misleadingly called aquatic soda apple

Table 4. Control methods for non-native plants in use by land managers in Florida.

<i>Solanum viarum</i>	Treatment: Preliminary research results suggest foliar applications of 1.5% Garlon 3A is most effective while similar application rates of Rodeo or Weedar 64 may be somewhat less effective. Aggressive follow-up treatments will probably be necessary to control seedlings.
	Comments: An aggressive invader of wetlands and floodplains. Should be eliminated whenever located.
	Tropical soda apple
	Treatment: Foliar application of 1% Garlon 4, 3% Roundup or 0.5% Arsenal solution in water with surfactant.
	Comments: Destroy fruit and treat plants immediately after detection. Spreads extremely fast. Livestock and wild animals eat fruits and readily disperse seed. For additional information see IFAS publication SS-AGR-58.
VERBENACEAE (Verbena Family)	
<i>Lantana camara</i>	Shrub verbena; Lantana
	Treatment: Basal application with 10% Garlon 4 or cut stump treatment with 50% Garlon 3A or 10% Garlon 4.
	Comments: Shrub with prickly stems and branches; multi-colored flower heads; ripe fruit blue; green unripe fruit highly toxic if eaten; this exotic species should be controlled to help avoid hybridization with the endemic <i>Lantana depressa</i> ; typically a plant of roadsides and other disturbed sites but also invades pineland as well as hammock margins; numerous cultivars exist in the nursery trade.

Index of Common Names.

COMMON NAME	REFER TO PLANT FAMILY
Air-potato	Dioscoreaceae
Air yam	Dioscoreaceae
Ardisia	Myrsinaceae
Arjun tree	Combretaceae
Asian colubrina	Rhamnaceae
Australian pine	Casuarinaceae
Bamboo palm	Arecaceae
Bamboo piper	Piperaceae
Banyan fig	Moraceae
Beach naupaka	Goodeniaceae
Beefwood	Casuarinaceae
Bishopwood	Euphorbiaceae
Black sapote	Ebenaceae

Index of Common Names.

COMMON NAME	REFER TO PLANT FAMILY
Bowstring hemp	Agavaceae
Brazilian beauty-leaf	Clusiaceae
Brazilian jasmine	Oleaceae
Brazilian oak	Casuarinaceae
Brazilian pepper	Anacardiaceae
Burma reed	Poaceae
Cajeput	Myrtaceae
Canistel	Sapotaceae
Carrotwood	Sapindaceae
Castor bean	Euphorbiaceae
Catclaw mimosa	Fabaceae
Chinaberry	Meliaceae
Chinese fan palm	Arecaceae
Chinese privet	Oleaceae
Chinese tallow	Euphorbiaceae
Chinese wisteria	Fabaceae
Cogongrass	Poaceae
Coral ardisia	Myrsinaceae
Cow itch	Fabaceae
Day jessamine	Solanaceae
Devil tree	Apocynaceae
Downy rosemyrtle	Myrtaceae
Dune sunflower	Asteraceae
Earleaf acacia	Fabaceae
Egg fruit	Sapotaceae
Ficus	Moraceae
Fishtail palm	Arecaceae
Florida holly	Anacardiaceae
Glossy privet	Oleaceae

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COMMON NAME	REFER TO PLANT FAMILY
Gold coast jasmine	Oleaceae
Golden bamboo	Poaceae
Guava	Myrtaceae
Half-flower	Goodeniaceae
Heavenly bamboo	Berberidaceae
Hunter's robe	Araceae
Indian almond	Combretaceae
Indian rosewood	Fabaceae
Jambolan plum	Myrtaceae
Japanese climbing fern	Lygodiaceae
Japanese honeysuckle	Caprifoliaceae
Jasmine	Oleaceae
Java plum	Myrtaceae
Kopsia	Apocynaceae
Lantana	Verbenaceae
Latherleaf	Rhamnaceae
Laurel fig	Moraceae
Lead-tree	Fabaceae
Lepianthes	Piperaceae
Life plant	Crassulaceae
Live leaf	Crassulaceae
Lofty fig	Moraceae
Loquat	Rosaceae
Mahoe	Malvaceae
Makulan	Piperaceae
Melaleuca	Myrtaceae
Mexican fan palm	Arecaceae
Mimosa	Fabaceae
Mother-in-law's tongue	Agavaceae

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COMMON NAME	REFER TO PLANT FAMILY
Mueller's almond	Combretaceae
Mysore raspberry	Rosaceae
Nandina	Berberidaceae
Napier grass	Poaceae
Nephthytis	Araceae
Night-blooming cereus	Cactaceae
Ochrosia	Apocynaceae
Old World climbing fern	Lygodiaceae
Orange jessamine	Rutaceae
Orchid tree	Fabaceae
Oyster plant	Commelinaceae
Palms	Arecaceae
Paper mulberry	Moraceae
Passion-flower	Passifloraceae
Piper	Piperaceae
Popcorn tree	Euphorbiaceae
Portia tree	Malvaceae
Possum grape	Vitaceae
Pothos	Araceae
Punk tree	Myrtaceae
Queen palm	Arecaceae
Queensland umbrella	Araliaceae
Raspberry	Rosaceae
Red sandalwood	Fabaceae
Rosary pea	Fabaceae
Rose apple	Myrtaceae
Rosewood	Fabaceae
Royal poinciana	Fabaceae
Royal palm	Arecaceae

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COMMON NAME	REFER TO PLANT FAMILY
Sapodilla	Sapotaceae
Scaevola	Goodeniaceae
Schefflera	Araliaceae
Scholar tree	Apocynaceae
Sea hibiscus	Malvaceae
Seaside mahoe	Malvaceae
Senegal date palm	Arecaceae
Sewer vine	Rubiaceae
Shoebutton ardisia	Myrsinaceae
Silverthorn	Elaeagnaceae
Skunk vine	Rubiaceae
Solitaire palm	Arecaceae
Surinam cherry	Myrtaceae
Toog	Euphorbiaceae
Torpedograss	Poaceae
Tropical soda apple	Solanaceae
Tungoil tree	Euphorbiaceae
Umbrella tree	Araliaceae
Washingtonia palm	Arecaceae
Water yam	Dioscoreaceae
Wedelia	Asteraceae
West African yam	Dioscoreaceae
Wild taro	Araceae
Woman's tongue	Fabaceae
Wood rose	Convolvulaceae

Index of Botanical Names.

GENUS NAME	REFER TO PLANT FAMILY
Abrus	Fabaceae

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GENUS NAME	REFER TO PLANT FAMILY
Acacia	Fabaceae
Adenanthera	Fabaceae
Albizia	Fabaceae
Aleurites	Euphorbiaceae
Alstonia	Apocynaceae
Ardisia	Mysinaceae
Bauhinia	Fabaceae
Bischofia	Euphorbiaceae
Broussonetia	Moraceae
Calophyllum	Clusiaceae
Caryota	Arecaceae
Casuarina	Casuarinaceae
Cereus	Cactaceae
Cestrum	Solanaceae
Chamaedorea	Arecaceae
Colocasia	Araceae
Colubrina	Rhamnaceae
Cupaniopsis	Sapindaceae
Dalbergia	Fabaceae
Delonix	Fabaceae
Dioscorea	Dioscoreaceae
Diospyros	Ebenaceae
Elaeagnus	Elaeagnaceae
Epipremnum	Araceae
Eriobotrya	Rosaceae
Eugenia	Myrtaceae
Ficus	Moraceae
Hibiscus	Malvaceae
Hylocereus	Cactaceae

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GENUS NAME	REFER TO PLANT FAMILY
Imperata	Poaceae
Jasminum	Oleaceae
Kalanchoe	Crassulaceae
Lantana	Verbenaceae
Lepianthes	Piperaceae
Leucaena	Fabaceae
Ligustrum	Oleaceae
Livistona	Arecaceae
Lonicera	Caprifoliaceae
Lygodium	Lygodiaceae
Manilkara	Sapotaceae
Melaleuca	Myrtaceae
Melia	Meliaceae
Merremia	Convolvulaceae
Mimosa	Fabaceae
Mucuna	Fabaceae
Murraya	Rutaceae
Nandina	Berberidaceae
Ochosia	Apocynaceae
Neyraudia	Poaceae
Paederia	Rubiaceae
Panicum	Poaceae
Passiflora	Passifloraceae
Pennisetum	Poaceae
Phoenix	Arecaceae
Phyllostachis	Poaceae
Piper	Piperaceae
Pouteria	Sapotaceae
Ptychosperma	Arecaceae

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GENUS NAME	REFER TO PLANT FAMILY
Psidium	Myrtaceae
Rhaphidophora	Araceae
Rhodomyrtus	Myrtaceae
Rhoeo	Commelinaceae
Ricinus	Euphorbiaceae
Roystonea	Arecaceae
Rubus	Rosaceae
Sansevieria	Agavaceae
Sapium	Euphorbiaceae
Scaevola	Goodeniaceae
Schefflera	Araliaceae
Schinus	Anacardiaceae
Solanum	Solanaceae
Sphagneticola	Asteraceae
Syagrus	Arecaceae
Syngonium	Araceae
Syzygium	Myrtaceae
Terminalia	Combretaceae
Thespesia	Malvaceae
Tradescantia	Commelinaceae
Washingtonia	Arecaceae
Wedelia	Asteraceae
Wisteria	Fabaceae

Exhibit W

Arthropod Control Plans

- Charlotte County
 - Lee County



ADAM H. PUTNAM
COMMISSIONER

Florida Department of Agriculture and Consumer Services
Division of Agricultural Environmental Services

ARTHROPOD MANAGEMENT PLAN - PUBLIC LANDS

Section 388.4111, F.S.
Telephone: (850) 617-7997

Return to:
Bureau of Entomology and Pest
Control
3125 Conner Blvd, Suite N,
MS C-41
Tallahassee, Florida 32399-1650

For use in documenting an Arthropod Control Plan for lands designated by the State of Florida or any political subdivision thereof as being environmentally sensitive and biologically highly productive therein. Fill this form out if control work is necessary or planned.

Name of Designated Land:

Babcock Ranch Preserve

Is Control Work Necessary:

☐ Yes ☒ No

Location:

8000 State Road 31, Punta Gorda, FL 33982, Charlotte County

Land Management Agency:

Florida Forest Service

Are Arthropod Surveillance Activities Necessary?

☐ Yes ☒ No

If "Yes", please explain:

Which Surveillance Techniques Are Proposed?

Please Check All That Apply:

☐ Landing Rate Counts

☐ Light Traps

☐ Sentinel Chickens

☐ Citizen Complaints

☐ Larval Dips

☐ Other

If "Other", please explain:

None at this time

Arthropod Species for Which Control is Proposed:

None

Proposed Larval Control:

None

Proposed larval monitoring procedure:

Are post treatment counts being obtained:

☐ Yes

☒ No

Biological Control of Larvae: None

Might predacious fish be stocked:

☐ Yes

☒ No

Other biological controls that might be used:

Material to be Used for Larvaciding Applications:

(Please Check All That Apply:)

☐ Bti

☐ Bs

☐ Methoprene

☐ Non-Petroleum Surface Film

☐ Other, please specify:

Please specify the following for each larvicide:

Chemical or Common name:

☐ Ground

☐ Aerial

Rate of application:

Method of application:

Proposed Adult Mosquito Control:

Aerial adulticiding ☐ Yes ☒ No

Ground adulticiding ☐ Yes ☒ No

Please specify the following for each adulticide:

Chemical or common name:

Rate of application:

Method of application:

Proposed Modifications for Public Health Emergency Control: Arthropod control agency may request special exception to this plan during a threat to public or animal health declared by State Health Officer or Commissioner of Agriculture.

Proposed Notification Procedure for Control Activities:

None

Records:

Are records being kept in accordance with Chapter 388, F.S.:

☐ Yes ☐ No

Records Location:

How long are records maintained:

(Place-holder for Lee County ACP)