Department of Defense
Legacy Resource Management Program

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Utilizing Cooperative Invasive Species Management Areas (CISMAs) to Effectively Reduce Re-infestation of Invaders on Six (6) Military Bases and Adjacent Lands in Florida

Apalachicola Regional Stewardship Alliance CISMA
(Includes Tyndall Air Force Base)
Invasive Species Management Plan

Kristina Serbesoff-King and Perrin Penniman
The Nature Conservancy: Florida Chapter

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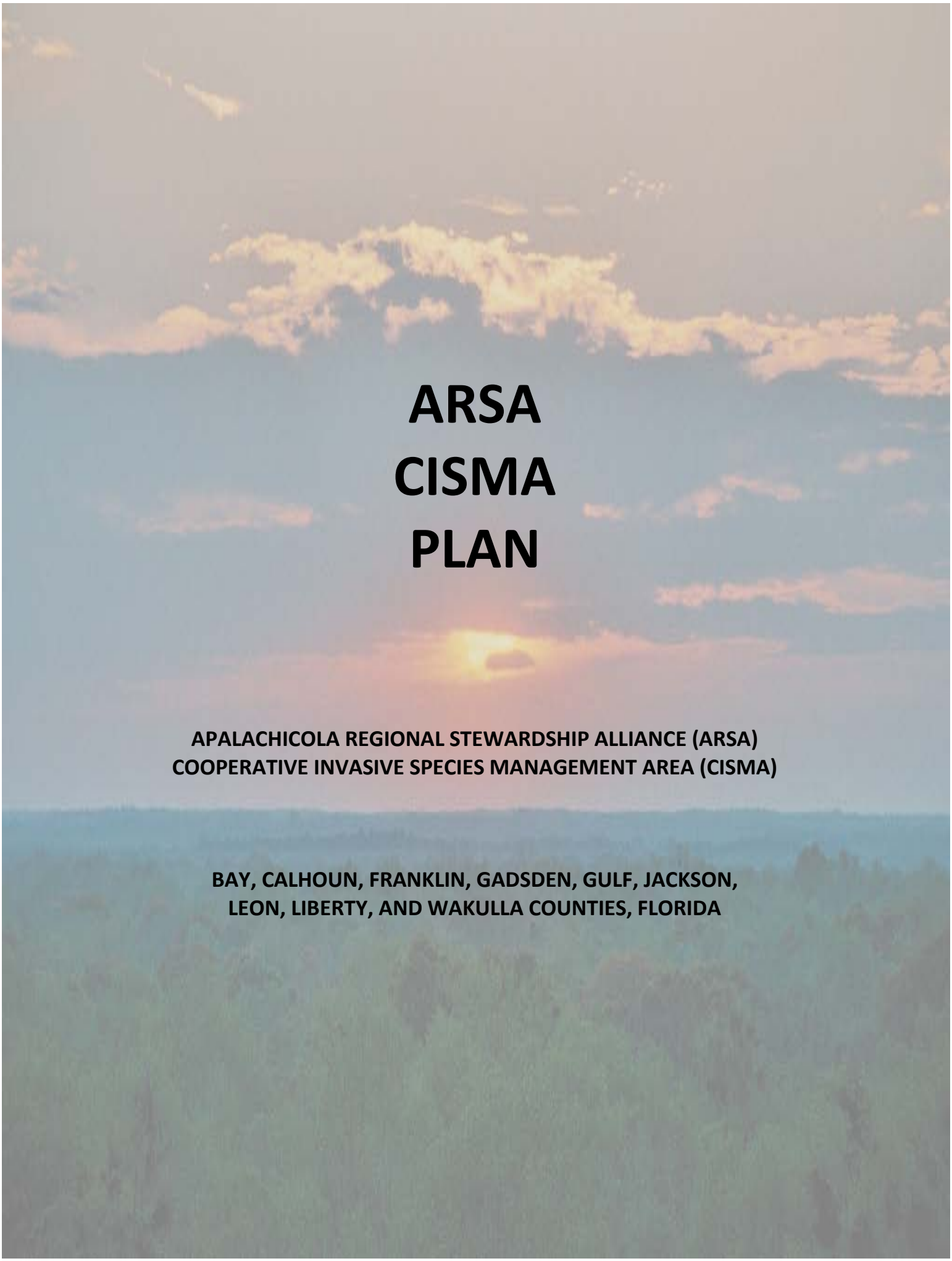

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APALACHICOLA REGIONAL STEWARDSHIP ALLIANCE (ARSA)
COOPERATIVE INVASIVE SPECIES MANAGEMENT AREA (CISMA)

BAY, CALHOUN, FRANKLIN, GADSDEN, GULF, JACKSON,
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EXECUTIVE SUMMARY

In June of 2003 the Apalachicola Regional Stewardship Alliance (ARSA) Cooperative Invasive Species Management Area (CISMA) was founded by stakeholders in the Apalachicola River region. This plan was originally created in June of 2007 by The Nature Conservancy (TNC) with support from U.S. Fish and Wildlife Service (FWS) and Florida Department of Environmental Protection (DEP). TNC updated and expanded this document in June of 2011 with support from U.S. Department of Defense (DOD) Legacy Resource Management Program. The general objective of this project is to reduce the threats posed to natural communities by non-native invasive species.

After habitat loss and degradation, non-native invasive species are the most serious threat to biodiversity in the U.S. These species interfere with ecosystem processes, such as hydrology and fire, and out-compete native flora and fauna for critical habitat. Non-native invasive species do not adhere to political boundaries, making collaboration between conservation cooperators essential for the continued preservation of native plant and animal communities.

The effectiveness of efforts to manage current non-native invasive species infestations and stem future establishments in the Apalachicola River region are dependent upon a collaborative strategy adopted by partnering agencies. This plan offers information necessary to implement such a strategy. The first step of this approach is the prevention of new introductions, accompanied by eradication of incipient populations and finally, the management of well-established species. The philosophy behind this approach is to maximize limited financial and personnel resources throughout the region, prioritize highly valued sites, and reduce threats on a landscape scale.

ARSA cooperators will utilize this plan to determine strategic actions for the CISMA. Individual land managers are encouraged to use this document as a guide to implement strategies on their own sites. This method will be used as a management tool to protect the native flora and fauna of the Apalachicola River region and serve as a model for other regions.

ACKNOWLEDGEMENTS

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We also thank Kristina Serbesoff-King and Mike Renda for their expertise and input throughout the drafting of this document.

Florida Natural Areas Inventory (FNAI) and Florida Fish & Wildlife Conservation Commission (FWC) provided the maps for this document. We are grateful for their support. These maps were updated with data from the FNAI Invasive Plant Database, EDDMapS, and CISMA cooperators.

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INTRODUCTION

PLAN DESCRIPTION

The three principal purposes of this document are to: 1) provide a current report of all known populations of non-native invasive species in the Apalachicola River region for the benefit of all CISMA cooperators, 2) provide descriptions of the region's non-native invasive species and associated management options, and 3) provide a management approach that will plan CISMA actions and guide individual land managers.

The management approach and prioritization method used in this document were adapted from a management plan created by The Nature Conservancy Global Invasive Species Initiative (Meyers-Rice and Tu 2001). The CISMA strategic plan template was modified from a document created by The Nature Conservancy Florida Chapter in 2009.

The Individual Species Account section is arranged into four sections: terrestrial plants, aquatic plants, vertebrates, and invertebrates. Species were selected for inclusion in this document by CISMA cooperators that included land managers, botanists, and biologists. The selected species are present in the Apalachicola River region. Within each of the four sections, species are listed alphabetically by scientific name. Phenology, impacts to natural communities, goals, objectives, management options, and distributional data maps are included for each species. Each species account may be updated as land managers initiate control projects, increase distributional datasets, and reassess threats.

The information presented in this document will additionally be used to assess non-native invasive species on private lands, particularly those adjacent to public conservation lands. We will use documented infestations on public lands to identify sources (e.g. seed banks) on private lands and, as resources allow, conduct control projects. Florida Natural Areas Inventory (FNAI) element occurrence data for rare, threatened, and endangered species will be used to prioritize sensitive areas threatened by non-native invasive on private and public lands.

THE ARSA CISMA

History

The Apalachicola Regional Stewardship Alliance (ARSA) Cooperative Invasive Species Management Area (CISMA) was established in 2003 by The Nature Conservancy (TNC) Northwest Florida Program and other stakeholders in the Apalachicola River region with concerns related to non-native invasive species. The primary reason for the creation of the CISMA was to facilitate a network for land managers to address the growing threat of non-native invasive species in the region. Since its inception the CISMA has conducted semiannual meetings, implemented control projects on private lands, assisted land managers with grant writing, compiled and shared data, performed cooperative outreach and education, and participated in other activities related to non-native invasive species. Our goals for the future include the continuation and expansion of these activities, with increased focus on private land control and public education programs. CISMA cooperators as of June 2011 include the following:

1. BASF Corporation
2. City of Chattahoochee
3. Florida Department of Agriculture and Consumer Services, Division of Forestry
4. Florida Department of Environmental Protection
5. Florida Department of Transportation
6. Florida Fish and Wildlife Conservation Commission
7. Florida Natural Areas Inventory
8. Florida State University- Florida Resources Environmental Analysis Center
9. Franklin County Recreation and Parks
10. Leon County Growth and Environmental Management
11. Liberty County Road and Bridge
12. National Interagency Prescribed Fire Training Center
13. Northwest Florida Water Management District
14. St. Joe Timberland Company of Delaware, LLC
15. The Nature Conservancy
16. United States Army Corps of Engineers
17. University of Florida, IFAS Extension
18. United States Department of Agriculture, Agricultural Research Service
19. United States Department of Agriculture, Animal and Plant Health Inspection Service
20. United States Department of Agriculture, Forest Service
21. United States Department of Agriculture, Natural Resources Conservation Service
22. United States Department of Defense, Tyndall Air Force Base
23. United States Department of the Interior, Bureau of Land Management
24. United States Department of the Interior, Fish and Wildlife Service

Mission

The mission of the ARSA CISMA is to implement a comprehensive, region-wide approach to address the threats invasive aquatic and terrestrial non-native invasive species pose to native ecosystems within the Apalachicola River region (adopted January 2004).

Specific goals of the ARSA CISMA are:

1. Maintain the functional landscape community of the Apalachicola River region.
2. Preserve and restore the native biodiversity of the Apalachicola River region.
3. Maintain the Apalachicola River region's natural processes, such as hydrology and fire that sustain native species and natural communities.
4. Protect species designated by the State of Florida or the U. S. Fish and Wildlife Service (FWS) as rare, threatened, or endangered.

PROJECT AREA DESCRIPTION

Location

The Apalachicola River region is located in Northwest Florida directly south of the border between Alabama and Georgia. The ARSA CISMA project area includes Bay, Calhoun, Franklin, Gadsden, Gulf, Jackson, Leon, Liberty, and Wakulla Counties in Florida.

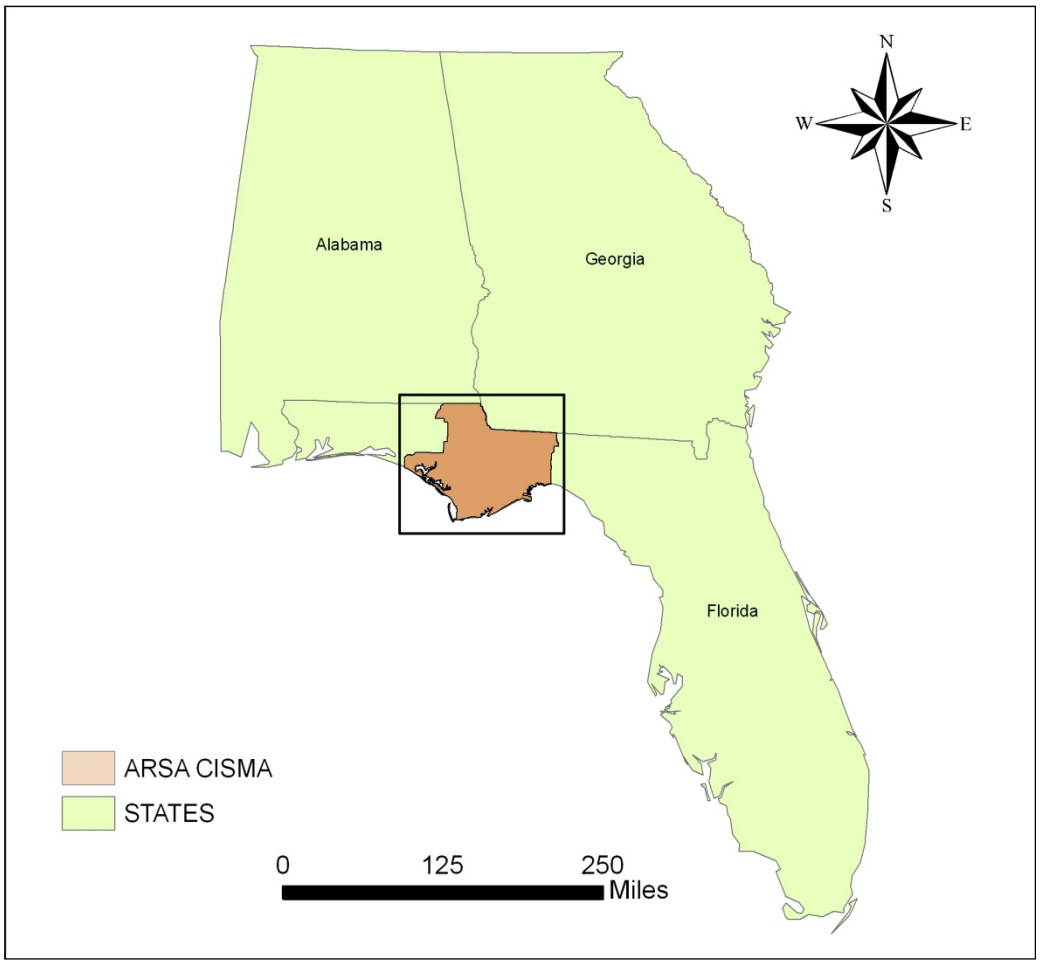


Figure 1. The Apalachicola River region

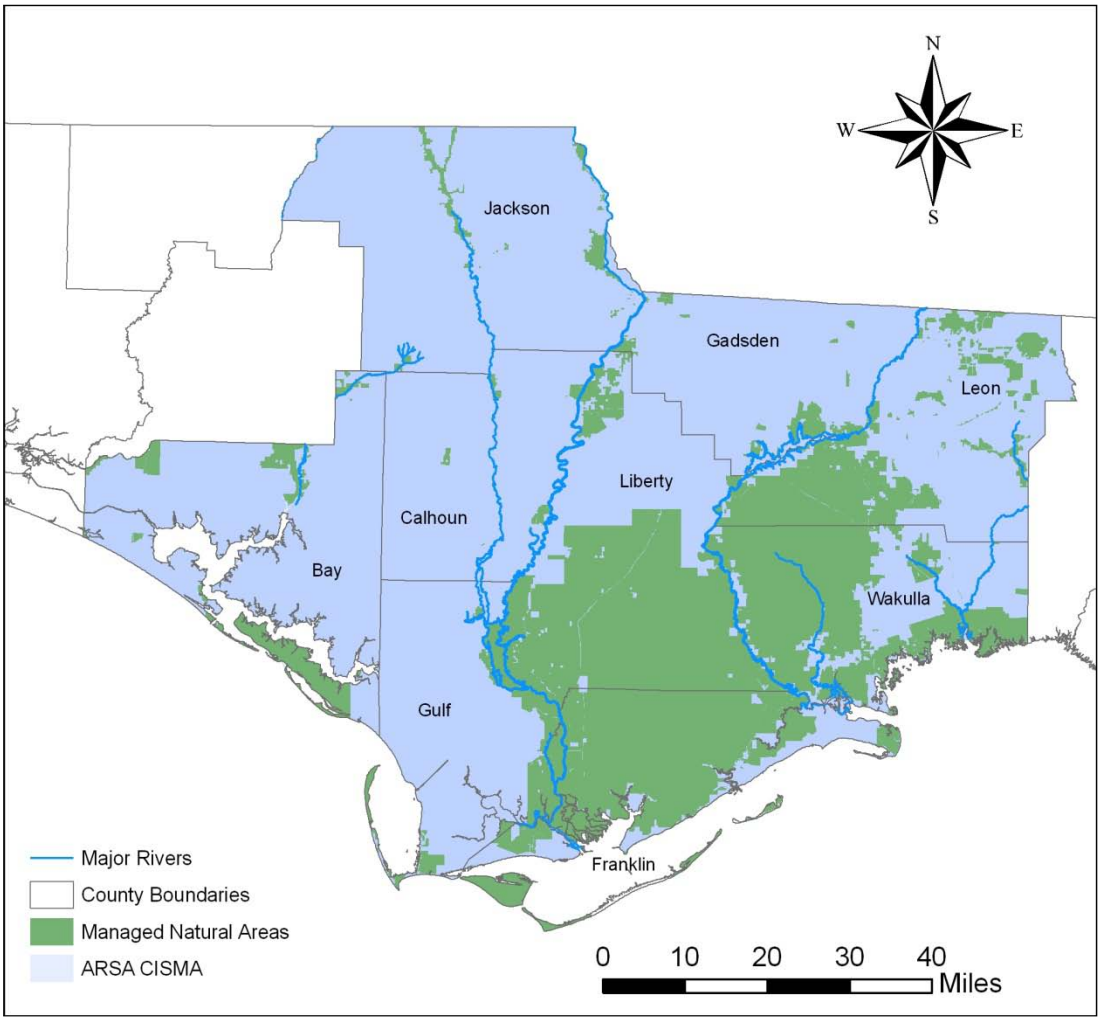


Figure 2. The ARSA CISMA

Biogeophraphical History

The ARSA CISMA Plan was produced to help protect the Apalachicola River region and associated natural communities. The confluence of the Chattahoochee and Flint Rivers, north of Jim Woodruff Dam in the City of Chattahoochee, forms the Apalachicola. The Apalachicola River then flows uninhibited through the Florida panhandle for 106 miles before emptying into the Gulf of Mexico. Periodic inundation of the surrounding floodplain wetlands is essential for maintaining the largest forest floodplain in Florida, which covers over 112,000 acres (Light et al. 1998). This alluvial river pours freshwater and nutrients into the Apalachicola Bay, one of the most productive bays in the country.

The Apalachicola River region is home to a variety of endemic and rare species (see Appendix), making the region one of the five "biological hotspots" in the continental United States (Stein et al. 2000). For example, the greatest density of reptiles and amphibians of any North American region north of Mexico is found in this region (Abell et al. 2000).

The biodiversity of the region is a result of a unique geological history. Clay, sand, silt, and gravel sediments brought down from the lower Appalachian Mountains and Piedmont Plateau were deposited in the region by the Apalachicola River via the Chattahoochee and Flint rivers, resulting in varied soil types throughout the region (Whitney et al. 2004). Periodic rise and fall of ocean levels over millions of years also left deposits of sand and limestone, creating rare geological features. These factors, along with a temperate climate, have fostered a variety of natural communities, including coastal uplands, estuarine, floodplain wetlands, mesic uplands, mesic/wet flatlands, riverine, and xeric uplands (Florida Natural Areas Inventory and Florida Department of Natural Resources 1990).

Existing public and private conservation lands help to protect the natural communities and biodiversity of the region. The Apalachicola National Forest, for example, encompasses over 500,000 acres and contains rare natural communities such as wet prairies and pine flatwoods. The acreage of the entire region totals over 3 million acres including over 1.1 million acres of public and private conservation lands (Florida Natural Areas Inventory 2011).

In order to maintain the natural integrity of the Apalachicola River region, the threats posed to the region must be identified, assessed, and managed. One of the greatest and most insidious threats to the region is non-native invasive species. The monitoring and management of non-native invasive species will help sustain the natural communities found in the region and protect the myriad species that make the Apalachicola River region one of the most biologically diverse areas in the United States.

NON-NATIVE INVASIVE SPECIES

Non-Native Invasive Species in the U.S. and Florida

Relative to other states, Florida has a high number of documented species introductions, many of which have been found in natural areas. For example, over 1,351 non-native plants have been recorded as naturalized in Florida (B. Hansen, pers. comm.). Of these species, 147 are considered by the Florida Exotic Pest Plant Council (FLEPPC) to be Category I and Category II invasive plants (Florida Exotic Pest Plant Council 2009). State agencies have also reported over 300 non-native vertebrate and invertebrate species (Florida Fish and Wildlife Conservation Commission 2004 and Fuller 2005). Florida's varying climates, soil types and habitats, as well as anthropogenic factors (e.g. the number of shipping ports), cause the state to be susceptible to introductions from many parts of the world. Although not all non-native species are considered invasive, managing and preventing introductions from non-native species has become a priority for land managers throughout the state.

The impacts of non-native invasive species are significant. Second only to habitat loss and degradation, non-native invasive species are the most serious threat to biodiversity in the United States (Stein et al. 2000). Non-native invasive species can alter ecosystem function, such as hydrology, and community structure, such as plant diversity, which are crucial for the maintenance of native flora and fauna (Gordon 1998).

Non-native invasive species also have a significant impact on Florida's economy. Estimates of federal funds spent throughout the entire United States total over $120 billion annually to manage its 800 non-native invasive plant and animal species (Pimental et al. 2004). Funding for non-native invasive species management is primarily used for control, though significant portions are spent for prevention, education, and research.

Non-Native Invasive Species in the Apalachicola River Region

Natural community designations in this section are taken from the Guide to Natural Communities of Florida (Florida Natural Areas Inventory and Florida Department of Natural Resources 1990). For a more comprehensive list of the region's rare, threatened, and endangered species and their associated natural communities see the Appendix.

Coastal Uplands

Coastal uplands include natural communities such as Beach Dunes and Barrier Islands. Coastal areas are important to rare species such as St. Andrew's beach mouse (*Peromyscus polionotus peninsularis*), large-leaved jointweed (*Polygonella macrophylla*) and federally listed species such as piping plover (*Charadrius melodus*), and green sea turtle (*Chelonia mydas*) (Florida Natural Areas Inventory 2006). Barrier islands in the northern Gulf of Mexico are especially important during neotropical migratory bird migrations. It is at this critical 'stopover habitat' where migrants can access water, cover, and food before continuing with migration (Duncan et al. 2001).

Non-native invasive mammals that threaten Coastal Uplands communities are red fox (*Vulpes vulpes*), coyote (*Canis latrans*), and feral dog (*Canis familiaris*), all of which may consume eggs of sea turtles and ground nesting birds (Main et al. 2004). The cactoblastis moth (*Cactoblastis cactorum*) has also been documented on barrier islands in the region and is known to negatively affect native prickly pear species (*Opuntia* spp.) buy consuming leaf pads (Hight et al. 2002). Non-native invasive plants documented in these natural communities include Chinese tallow (*Sapium sebiferum*), Mexican petunia (*Ruellia tweediana*), and others.

Estuarine

The Apalachicola bay and estuary serve as a nursery for many species, including commercially important species such as mullet, shrimp, oyster, and blue crab. Recreational species such as black drum, flounder, redfish, sea trout, sheepshead, and tarpon also use the bay and estuary as a nursery (Apalachicola National Estuarine Research Reserve 2005). These and other species are crucial elements of the Gulf of Mexico economy, in which many people are involved in the fishing, oyster, and shrimp industries. The bay is also important for rare species such as Florida manatee (*Trichechus manatus*), Scott's seaside sparrow (*Ammodramus maritimus peninsulae*), and others (Hipes et al. 2001). The bay and estuary are both nationally and internationally recognized as important biological areas because of diversity of species found there. The United Nations Educational, Scientific, and Cultural Organization (UNESCO), for example, designated over 16,000 acres of the bay, estuary, and floodplain as an international Biosphere Reserve (United Nations Educational, Scientific, and Cultural Organization 2006).

Non-native invasive plants documented in the estuary and bay of the watershed include torpedo grass (*Panicum repens*), water hyacinth (*Eichhornia crassipes*), wild taro (*Colocasia esculenta*), and rattlebox (*Sesbania punicea*). Torpedo grass, for example, can be particularly troublesome in the shallow waters of tidal marshes because it displaces native vegetation

(Langeland and Craddock Burks 1998). Non-native invasive fishes or invertebrates may also be found in the estuary and bay.

Floodplain wetlands

Floodplain wetlands surrounding riverine habitats are rich with species diversity. This category includes the following natural communities: Bottomland Hardwood Forest, Freshwater Tidal Swamp, Floodplain Marsh, Floodplain Swamp and Floodplain Forest (Florida Natural Areas Inventory and Florida Department of Natural Resources 1990). The floodplain is home to over 40 species of trees whose leaf litter forms a nutrient base important to the food chain of the floodplain and main stem river (Myers and Ewel, 1990). Rare trees include corkwood (*Leitneria floridana*) and Apalachicola and Thorne's buckthorn (*Sideroxylon* sp.) (Florida Natural Areas Inventory 2006). These wet communities host other rare plants such as little club-spur orchid (*Platanthera clavellata*), Canada honewort (*Cryptotaenia canadensis*), and Florida bellwort (*Uvularia floridana*) (Florida Natural Areas Inventory 2006). As water inundates the floodplain fish can be found using this immense habitat for spawning and feeding. The nutrients carried from the floodplain's receding waters are of vital importance to the Apalachicola Bay.

Two of the most deleterious non-native invasive species, Japanese climbing fern (*Lygodium japonicum*) and feral hog (*Sus scrofa*), have been documented in floodplain wetland communities of the region. Japanese climbing fern is the most prevalent non-native invasive plant species in the CISMA. It can form dense mats, completely covering native flora and reducing regeneration of natives (Langeland and Craddock Burks 1998). Japanese climbing fern spreads by spores, making it extremely difficult to control. Feral hogs may exacerbate the populations of Japanese climbing fern and other non-native invasive plants when soil is disturbed by their rooting and wallowing habits. Feral hog behavior can also cause erosion and increased sedimentation of water sources (Giuliano and Tanner 2005).

Mesic Uplands

Mesic Uplands are some of the rarest communities in the state, fostering many different species. Mesic upland natural communities include Bluff, Slope Forest, Upland Glade, Upland Hardwood Forest and Mixed Upland Forest, and Upland Pine Forest (Florida Natural Areas Inventory and Florida Department of Natural Resources 1990).

Slope Forests, found in Torreya State Park and TNC Apalachicola Bluffs and Ravines Preserve, are unique mesic upland habitats. Significant topographical relief and shade from the hardwood canopy create microclimates similar to that of the lower Appalachian Mountains and the Piedmont Plateau in Georgia (Whitney et al. 2004). High species diversity in these communities is a result of the climate that allows cool temperate and warm temperate species, including many rare and endemic elements (Florida Natural Areas Inventory and Florida Department of Natural Resources 1990). Slope forests and associated Seepage Streams harbor species such as Apalachicola dusky salamander (*Desmoganthus apalachicolae*), fireback crayfish (*Cambarus pyronotus*), Say's spiketail (*Cordulegaster sayi*), Alabama shiny-pod (*Matalea alabamensis*) and Florida spiny-pod (*M. floridana*), and the federally listed Florida torreya (*Torreya taxifolia*) (Chaffin 2000, and Hipes et al. 2001).

The Upland Glade communities of Jackson and Gadsden counties are also rare mesic upland habitats. The presence of limestone in the northern areas of the region creates a distinctive structure for terrestrial, subterranean and aquatic species. Rare species associated with subterranean and aquatic karst features are Georgia blind salamander (*Haideotriton wallacei*) and gray bat (*Myotis grisescens*). Rare terrestrial species include Marianna columbine (*Aquilegia canadensis* var. *australis*), single-sorus spleenwort (*Asplenium monanthes*) and cream-flowered tick-trefoil (*Desmodium orchroleucum*) (Chaffin 2000, and Hipes et al. 2001).

Non-native invasive species found in mesic upland habitats include Japanese climbing fern, Chinese tallow, coral ardisia (*Ardisia crenata*), feral hog and nandina (*Nandina domestica*). The presence of many rare, state and federally listed species warrants protection against non-native invasive species in these natural communities.

Mesic and Wet Flatlands

Mesic and wet flatlands include natural communities such as mesic flatwoods, wet prairies, wet pine flatwoods, seepage slopes, and depression marshes. Most of these communities are maintained by the frequent disturbance of fire. Ephemeral wetlands in the flatwoods provide breeding sites for many amphibians including the federally threatened flatwoods salamander (*Ambystoma cingulatum*). These wetlands are also significant food sources for the surrounding terrestrial ecosystems (LaClaire and Franz 1991). Other species supported by mesic flatwoods and wet prairies are red-cockaded woodpecker (*Picoides borealis*), Harper's beauty (*Harperocallis flava*), Florida skullcap (*Scutellaria floridana*), and wiregrass gentian (*Gentiana pennelliana*).

Non-native invasive species documented in these habitats include Chinese tallow, Japanese climbing fern, feral hog, and others. Like in the sandhills, species that alter fire patterns are of special concern. Species that create dense monocultures are also of concern because they out-compete native species.

Riverine

The riverine habitats of the region support a wide variety of species, including federally listed and commercially important species. Over 130 freshwater and estuarine fish species have been documented in the Apalachicola watershed (Abell et al. 2000) including diadromous fishes such as the federally threatened Gulf sturgeon (*Acipenser oxyrinchus desotoi*) and federal species of concern Alabama shad (*Alosa alabamae*). In addition, this drainage is a regional center of mussel diversity with over 26 species (Brim Box and Williams 2000), including the endemic and federally threatened Chipola slabshell (*Elliptio chipolaensis*) and other federally listed species, such as fat threeridge (*Amblema neislerii*) and purple bankclimber (*Elliptoideus sloatianus*) (Hipes et al. 2001). Species with commercial and recreational value such basses and catfish are also found in the Apalachicola watershed's riverine natural communities.

Several aquatic non-native invasive plant species, such as water hyacinth and parrot feather (*Myriophyllum aquaticum*), have been documented in the watershed's riverine natural

communities and could negatively impact its native flora and fauna. Of the non-native invasive aquatic plant species documented in the region, water hyacinth is especially noxious. This aquatic plant reproduces quickly, creating dense mats of solid vegetation, which can affect fisheries dynamics (Herrington et al. 2005). The dense mats restrict light and change dissolved oxygen levels, which alters the composition of vertebrate and invertebrate communities (United States Department of Agriculture Forest Service et al. 2006). Changes in sediment composition have also been recorded where water hyacinth is present because the decaying plant material significantly increases organic matter, resulting in eutrophication (Batcher 2000a).

Non-native invasive vertebrate and invertebrate species have also been documented in riverine communities and could also affect these natural communities. The CISMA has identified one mollusk and 12 fish species non-native to the watershed. The mollusk, Asian clam (*Corbicula fluminea*), has been reported to compete with native mollusks for food and habitat especially during drought conditions (Light et al. 2006). The high diversity of mussel species in the Apalachicola and Chipola rivers may be threatened by Asian clams, especially federally listed species. The impacts of some introduced fish species, such as common carp (*Cyprinus carpio*), include predation of native fish and fish eggs (Fuller et al. 1999).

Xeric Uplands

Xeric upland natural communities in the Apalachicola region are characterized by Sandhills, an increasingly rare habitat requiring fire to avoid succession to Xeric Hammock. Rare species found in sandhills include scare-weed (*Baptisia simplicifolia*), toothed savory (*Calamintha dentata*), striped newt (*Notophthalmus perstriatus*), gopher frog (*Rana capito*), gopher tortoise (*Gopherus polyphemus*), and federally listed species such as Apalachicola rosemary (*Conradina glabra*) and red-cockaded woodpecker (Florida Natural Areas Inventory 2006).

Non-native invasive species such as Chinese tallow and cogongrass (*Imperata cylindrica*), are problematic in the sandhills because they can alter fire function. Chinese tallow, for example, may inhibit the spread of fire by reducing fuel loads (McCormick 2005). Cogongrass is extremely flammable and burns very hot, which can change fire behavior (United States Department of Agriculture Forest Service et al. 2006). Longleaf pine (*Pinus palustris*) and wiregrass (*Aristida stricta*), key species in the sandhill community, cannot reproduce within the dense growth of cogongrass.

MANAGEMENT APPROACH

ADAPTIVE MANAGEMENT

The management approach described in this section was adopted by the CISMA. Individual land managers are encouraged to utilize this management approach for species located on their respective sites.

The first step in non-native invasive species management focuses not on unwanted species, but management for desired native species and natural communities. The preservation of these elements via practices such as prescribed fire, erosion control, or restored hydrological regimes will reduce the chances of invasions and help maintain integrity of the region's natural communities.

The next step is prevention of new invasions, especially of those species documented in adjacent regions. It is far less costly to prevent an infestation than to implement control or eradication efforts, therefore, prevention is considered a top priority. If new species are found, a rapid response approach is advisable to reduce future workloads and preserve natural communities.

The third step is to assign priorities for species already established using the prioritization criteria described in the following section. The control of non-native invasive species is recommended when it is clear that leaving the species unchecked will result in more damage than control of the species using known control methods and available resources.

In summary, the following adaptive management strategy is advised:

1. Establish and record goals for the site (e.g. prioritization of sensitive areas).
2. Identify the species, including watch species, inhibiting land managers from reaching these goals.
3. Assign rankings based on the prioritization criteria in the following section.
4. Determine methods of control based upon the evaluation of how control methods may impact target and non-target species.
5. Develop control plans for each species based upon available information. Develop annual action plan based upon data gathered up to this point.
6. If control is implemented, monitor to assess results of actions taken.
7. Evaluate the effectiveness of the management strategy, keeping in mind conservation targets and management goals. This information can be used to modify or improve management practices.
8. Continue the cycle of the management plan by establishing new and/or modified goals for the site.

PRIORITIZATION

The following process was developed by CISMA cooperators as a recommended method to prioritize species for management. CISMA cooperators will use the criteria for ranking species on collaborative projects. Individual land managers may use the criteria for ranking species on their respective sites. This ranking system was modified by TNC-Global Invasive Species Initiative staff (Meyers-Rice and Tu 2001) from the United States Geological Survey (USGS) Northern Prairie Wildlife Research Center's Alien Plants Ranking System (Alien Plants Ranking System Implementation Team 2000). Each species will be assigned a number (i.e. its "score") for each of the four categories: 1) current extent of the species, 2) current and potential impacts of the species, 3) value of the habitats/areas the species infests or could infest, and 4) difficulty of control and reestablishment of native species. The scores for each category will be added together to indicate its rank for that project or area. The rankings and prioritization are as follows:

Table 1. Prioritization and corresponding rank for non-native invasive species

Priority	Rank
High priority	4–7
Medium priority	8–11
Low priority	12–15

Ranking and Scoring Protocol for Plant Species

1) Current extent of the species

Under this category, priorities are assigned to species in order to prevent the establishment of new weed species, eliminate small, rapidly-growing infestations, prevent large infestations from expanding, and reduce or eliminate large infestations.

1. Species not yet on the site but which are present nearby. Pay special attention to species known to be pests elsewhere in the region.
2. Species present as new populations or outliers of larger infestations, especially if they are expanding rapidly.
3. Species present has large, expanding populations in localized areas.
4. Species present in large, widespread infestations that continue to expand.
5. Species present in large infestations that are not expanding because it occupies all available/suitable habitats.

There may be infestations that are presently not controllable with available technology and resources. The CISMA will share information when innovations in control methods are identified.

2) Current and potential impacts of the species

Priorities under this category based on the management goals for site.

1. Species that alter ecosystem processes such as fire frequency, sedimentation, nutrient cycling, or other ecosystem processes. These are species that largely disturb important ecological processes, often altering conditions so radically that few native plants and animals can persist.
2. Species that out-compete natives and dominate otherwise undisturbed native communities.
3. Species that do not out-compete dominant natives but:
    A. prevent or depress recruitment or regeneration of native species; OR
    B. reduce or eliminate resources (e.g., food, cover, nesting sites) used by native animals; OR
    C. promote populations of non-native invasive plants.
4. Species that overtake and exclude natives following natural disturbances such as fires, floods, or hurricanes, thereby altering succession, or that hinder restoration of natural communities. Note that species of this type should be assigned higher priority in areas subject to repeated disturbances.

3) Value of the habitats/areas the species infests or could infest

1. Infestations that occur in the most highly valued habitats or areas of the site - especially areas that contain rare or highly valued species or communities and areas providing vital resources.
2. Infestations that occur in less highly valued portions of the site. Areas already badly infested with other weeds may be given lower priority unless the species in question will make the situation significantly worse.

4) Difficulty of control and reestablishment of native species

1. Species likely to be controlled or eliminated with available technology and resources and which desirable native species will replace with little further input.
2. Species likely be controlled but will not be replaced by desirable natives without an active restoration program requiring substantial resources.
3. Species difficult to control with available technology and resources and/or whose control will likely result in substantial damage to other, desirable species.
4. Species is unlikely to be controlled with available technology and resources.

CISMA STRATEGIC PLAN TEMPLATE

This template was modified from another document produced by The Nature Conservancy Florida Chapter in 2009. This strategic plan template consists of six goals for the CISMA. There are a series of potential action items associated with each of these goals. CISMA cooperators will use this strategic plan template as a guide to create an annual action plan each calendar year. Annual action plans will be short documents that include a brief summary of accomplishments from the previous year, which action items are to be implemented during the current year, and why action items are being continued, added, or removed.

Acronyms

ASLA = American Society of Landscape Architects
BMP = best management practices
CISMA = cooperative invasive species management area
CWMA = cooperative weed management area
FDACS = Florida Department of Agricultural and Consumer Services
FDOT = Florida Department of Transportation
EDDMapS = Early Detection and Distribution Mapping System (http://www.eddmaps.org/)
EDRR = early detection and rapid response
FISP = Florida Invasive Species Partnership (http://www.floridainvasives.org/)
FDOF = Florida Department of Forestry
FFWCC = Florida Fish and Wildlife Conservation Commission
FFWCC IPMS = Florida Fish and Wildlife Conservation Commission Invasive Plant Management Section
FLEPPC = Florida Exotic Pest Plant Council
FNAI = Florida Natural Areas Inventory
FNGLA = Florida Nursery, Growers & Landscape Associations (http://www.fngla.org/)
FNPS = Florida Native Plant Society (http://www.fnps.org/)
IFAS = Institute of Food and Agricultural Sciences
MOU = memorandum of understanding
NIWAW = National Invasive Weeds Awareness Week
ROW = right of way
SOP = standard operating procedures
USDA ARS = United States Department of Agriculture, Agricultural Research Service
USGS NAS = United States Geological Services Non-indigenous aquatic species (http://nas.er.usgs.gov/)
VCC = voluntary code of conduct (http://www.centerforplantconservation.org/invasives/codesN.html)
WEEDDAR = Weed Data and Reporting (database program)
WIMS = Weed Information Management System
WRA = weed risk assessment (that is - the predictive tool) (http://plants.ifas.ufl.edu/assessment/)

Goal 1: Create, strengthen and sustain a CISMA.

1.1. Develop basic organizational structure for CISMA.

1.1.1. Use CWMA cookbooks and current CISMA examples to help form and sustain CISMA.
1.1.2. Coordinate a meeting with enthusiastic regional cooperators to form a new CISMA.
1.1.3. Establish geographic boundaries, a steering committee and a chair.
1.1.4. Create standing subcommittees and ad hoc committees to assist with project specific CISMA efforts.

1.2. Sustain and strengthen CISMA.
1.2.1. Schedule CISMA meetings at least twice per year.
1.2.2. Recruit new, and maintain current membership in the CISMA.
1.2.3. Review steering committee and subcommittees and revise as appropriate.
1.2.4. Develop Annual Action Plan with CISMA cooperators.
1.2.5. Create short annual report.
1.2.6. Update strategic plan.
1.2.7. Seek liaison to CISMA from private industries.
1.2.8. Hire a part time staff person to coordinate CISMA activities.

1.3. Submit cooperative funding proposals.
1.3.1. Encourage public land conservation managers to submit FFWCC IPMS cost reimbursement program applications.
1.3.2. Identify lead partner or organization to serve as the recipient and administrator for grants.
1.3.3. Submit CISMA grants; consider utilizing less common approaches like landowner incentive programs, staff time as in-kind matches, and shared field staff.
1.3.4. Develop a list of funding programs with due dates for control, EDRR, education and other projects.

1.4. Generate legal documents to strengthen CISMA.
1.4.1. Sign a MOU or other document allowing public agency staff to work on other agency/NGO/private lands (if required to allow agencies to work on partner lands).
1.4.2. Create or use existing liability releases (for example - TNC or FDOF) for cooperators to work on private lands.
1.4.3. Write or find and modify an existing CISMA partner MOU, or other document, or use future FISP CISMA MOU, to facilitate partner agency participation and support of CISMA goals and objectives.

Goal 2: Prevention - Develop and/or implement techniques and practices to prevent establishment and spread of new invasions near the CISMA boundaries.

Plants

2.1. Develop and/or find and use an existing alert system to identify new terrestrial and aquatic non-native plant invasions near, or at the boundaries of, CISMA lands and waters.

2.1.1. Review EDDMapS database and/or other alert system databases for new terrestrial invasive plants adjacent to CISMA. If new plant species is found, include in EDRR prioritization.

2.1.2. Review EDDMapS and/or USGS NAS for new aquatic invasive plants adjacent to CISMA waters. If new plant species is found adjacent to CISMA, include in EDRR prioritization.

2.2. Reduce potential pathways of introduction for terrestrial and aquatic (marine and freshwater), non-native invasive plant species into the CISMA.

2.2.1. Develop and/or find and use existing guidelines for vehicle, boats, equipment, personal protective equipment and personnel disinfection program/protocol(s) to address the unintentional movement of terrestrial and aquatic invasive plants. Consider using FFWCC IPMS or other decontamination standards.

2.2.2. Implement vehicle, boat, equipment and personnel disinfection program/protocol(s) for use by CISMA cooperators (researchers, fire crews, public works, FDOT, FDOF, and others).

2.2.3. Encourage use of decontamination guidelines by all contractors (for example - invasive plant management contractors, wildlife services contractors, etc.).

2.2.4. Encourage use of decontamination guidelines by landscapers, lawn companies and other outdoor service contractors.

2.2.5. All CISMA cooperators will actively push for purchase of only weed-free mulch, pine-straw, hay, sod, etc.(that is - create the demand)

2.2.6. CISMA cooperators will develop and/or use existing preventative guidelines for conducting ground disturbing activities (for example - timber harvest/transport, prescribed fire, fire suppression, off-road vehicle use, or contracted activities on partner lands).

2.3. Incorporate IFAS WRA into CISMA invasive plant ranking and planning process.

2.3.1. Review results of WRA for plant species to be watched. If new plant species is listed as invasive, include in EDRR prioritization.

2.3.2. If a new non-native plant is found in the CISMA or surrounding geography, request IFAS run this incipient species through the WRA.

2.3.3. Engage local botanical gardens or similar to use the WRA or other predictive tool to assess the invasive threat of new and existing garden collection plants. If new/existing garden collection plant is listed as invasive, stop planting and remove from botanical garden and include in EDRR prioritization (if it has escaped).

2.3.4. Explore the feasibility of restricting the highest threat new invasive plant species through state and local ordinances. (Note – as of March 2002, per FDACS CHAPTER 581 (4), local ordinances cannot prohibit plants that are not already listed by FDACS as a noxious weed or invasive plant).

Animals

2.4. Develop and/or find and use existing alert type system to identify new animal invasions near, or at the boundaries of, CISMA lands.

2.4.1. Review EDDMapS database and other sources of new species alerts (for example - USGS NAS database, shell collecting groups, bird boards, etc.) for new invasive animals adjacent to CISMA. If new animal species is found adjacent to CISMA, include in EDRR prioritization.

2.5. Reduce potential pathways of introduction for invasive animal species into the CISMA.

2.5.1. Assist and participate in FFWCC or other Pet Amnesty Days.

2.5.2. Work with cooperators to identify pathways and modes of transport for invasive animals to move into the CISMA.

2.5.3. Develop and/or find and use decontamination guidelines to restrict movement of invasive animals.

2.5.4. Explore avenues of reducing pathways for potentially new highest threat invasive animal species through state/local ordinances (for example - ownership restrictions, caging requirements, gender restrictions, etc.).

Pest and Pathogens

2.6. Reduce potential pathways of introduction for invasive pest/pathogens species into the CISMA.

2.6.1. Implement a vehicle, equipment and personnel disinfection program/protocol to address the unintentional movement of invasive pest/pathogens for use by CISMA cooperators (researchers, fire crews, public works, FDOT, FDOF, and others). (Note: This will likely already be addressed in plant objective above)

2.6.2. Encourage use of decontamination guidelines by all contractors (for example - invasive plant management contractors, wildlife services contractors, etc.).

2.6.3. Encourage use of decontamination guidelines by landscapers, lawn companies and other outdoor service contractors.

2.6.4. All CISMA will actively push for purchase of only pest/pathogen-free mulch, pine-straw, hay, sod, firewood, etc.

2.7. Develop or find and use an existing alert type system to identify new invasive pest/pathogen invasions near CISMA lands and waters.

2.7.1. Review EDDMapS database for new invasive species adjacent to CISMA. If new pest or pathogen is found adjacent to CISMA, include in EDRR prioritization.

Goal 3: Early Detection and Rapid Response (EDRR) - Develop and implement techniques and practices to promote early detection and rapid response of newly established invasive species within the CISMA boundaries.

Plants

3.1. Use existing alert type systems and partner communications to identify new plant invasions within CISMA lands and waters.
   - 3.1.1. Have CISMA cooperators discuss new plant species that they have observed during the regularly scheduled meeting.
   - 3.1.2. Review EDDMapS database and/or other alert system databases for new terrestrial invasive plants within CISMA. If new plant species is found in CISMA, include in EDRR prioritization.
   - 3.1.3. Review EDDMapS and/or USGS NAS for new aquatic invasive plants within CISMA waters. If new plant species is found in CISMA, include in EDRR prioritization.
   - 3.1.4. Develop early detection guidelines for cooperators to insert in contract language for contractors and researchers requiring them to alert land managers when they observe unknown or EDRR plant species.

3.2. Prioritize EDRR plant species on CISMA lands and/or waters.
   - 3.2.1. Create a list of possible EDRR terrestrial and/or aquatic plant species from best available information from CISMA cooperators, adjacent CISMAs, CISMA prevention alert system, FLEPPC, FISP, FNAI, IFAS and EDDMapS.
   - 3.2.2. Use a ranking system (USGS, others) to prioritize top [insert #] EDRR plant species.
   - 3.2.3. As needed, reassess EDRR plant list.

3.3. Eradicate high ranking EDRR plant species on CISMA lands and/or waters.
   - 3.3.1. Conduct cooperative workdays to eradicate high priority EDRR and prevention plant species (newly in or adjacent to CISMA).
   - 3.3.2. Hire contractors to eradicate high priority EDRR plant species.
   - 3.3.3. Create a Rapid Response Team(s) and if necessary, response protocol, to eradicate high priority EDRR plant species.

Animals

3.4. Use existing alert type systems and partner communications to identify new animal invasions within CISMA lands and waters.
   - 3.4.1. Have CISMA cooperators discuss new animal species that they have observed during the regularly scheduled meeting.
   - 3.4.2. Review EDDMapS database and/or other alert system databases for new terrestrial invasive animals within CISMA. If new species is found in CISMA, include in EDRR prioritization.
   - 3.4.3. Review EDDMapS and/or databases for new aquatic invasive animals within CISMA waters. If new species is found in CISMA, include in EDRR prioritization.
   - 3.4.4. Develop early detection guidelines for cooperators to insert in contract language for contractors and researchers requiring them to alert land managers when they observe unknown or EDRR species.

3.5. Prioritize EDRR animal species on CISMA lands and/or waters.

3.5.1. Create a list of possible EDRR species from best available information from CISMA cooperators, wildlife hospitals, adjacent CISMAs, CISMA prevention alert system, FISP, FNAI, IFAS and EDDMapS.
3.5.2. Use a ranking system to prioritize top [insert #] EDRR animal species.
3.5.3. As needed, reassess EDRR animal list.
3.5.4. Eradicate highest ranking EDRR animal species on CISMA lands and/or waters.
3.5.5. Create a Rapid Response Team(s) and if necessary, response protocol, to eradicate high priority EDRR animal species.

Pest/pathogens - See Goal 4: Control; Pest/pathogens

Goal 4: Control (Prioritized Management) - Develop and implement techniques and practices to control known infestations of priority non-native invasive species and maintain them at the lowest feasible level in the CISMA boundaries.

Plants

4.1. Prioritize known CISMA non-native invasive plants (that is - plants that have spread beyond ability to eradicate) using a ranking system that considers the impact of imperiled species and/or habitats and if necessary, other criteria.
- 4.1.1. Develop a list of known invasive plants within CISMA boundaries.
- 4.1.2. Prioritize invasive plant control species using a ranking system (USGS, local expert opinion, other) and best available information from CISMA cooperators, FLEPPC, FISP, FNAI, IFAS and EDDMapS.
- 4.1.3. Assess and update prioritized list of invasive plant control species.

4.2. Implement coordinated CISMA management of the top 2 priority invasive plant control species to reduce infestations to maintenance level.
- 4.2.1. Emphasize top 2 priority invasive plant control species by focusing CISMA partner efforts.
- 4.2.2. Increase acres of priority invasive plant control species being treated and acres under maintenance level control on public conservation lands (for example - using FFWCC IPMS and other funds).
- 4.2.3. Increase acres of priority invasive plant control species being treated and acres under maintenance level control on private conservation lands (for example - non-profit conservation lands, conservation easement lands, etc.).
- 4.2.4. Coordinate a cooperative workday focusing on priority invasive plant control species.
- 4.2.5. Determine invasive plant free buffer areas within CISMA boundaries and annually increase the size of invasive plant free buffer areas around conservation lands.
- 4.2.6. Increase treatment of prioritized, invasive plants on public non-conservation lands (for example - ROWs, spoil mounds, recreational parks).
- 4.2.7. Increase net acreage of invasive plant control species treated on prioritized private lands.

4.3. Cease sale, planting or other modes of spread of invasive plant species we are controlling.
- 4.3.1. Submit petitions to FDACS to request listing of high priority EDRR and control invasive plants as noxious weeds.
- 4.3.2. Identify and engage sellers to voluntarily stop selling known invasive plants.
- 4.3.3. Identify and engage appropriate local regulatory and enforcement agencies for local ordinances, comprehensive plans, landscape rules that limit the planting and encourage control of known invasive plants.

Animals

4.4. Prioritize known CISMA invasive animals (that is - animals that have spread beyond ability to eradicate) using a ranking system that considers the impact of imperiled species and/or habitats and if necessary, other criteria.
- 4.4.1. Develop a list of known invasive animals on CISMA lands (for example - feral hogs).
- 4.4.2. Prioritize invasive animal control species using a ranking system and best available information from CISMA cooperators, FFWCC, FNAI, EDDMapS and others.

4.4.3. Assess and update prioritized list of invasive animal control species.

4.5. Manage the high priority invasive animal control species in order to reduce damage and/or population size.
   4.5.1. Emphasize the top 2 priority invasive animal control species by focusing CISMA partner efforts on these at all opportunities.
   4.5.2. Increase the level of effort and number of public conservation lands that are treating and maintaining low densities of priority invasive animal control species.
   4.5.3. Increase the level of effort and number of private conservation lands that are treating and maintaining low densities of priority invasive animal control species.
   4.5.4. Increase treatment of priority invasive animal control species on public non-conservation lands (for example - ROWs, spoil mounds, recreational parks).
   4.5.5. Increase the size of priority invasive animal-free buffer areas around conservation lands, including private lands.

4.6. Cease the sale, importation or other modes of spread of invasive animal species that we are controlling.
   4.6.1. Submit requests to FFWCC to include priority invasive animal control species to restrictive lists (for example - Reptiles of Concern, conditional species, prohibitive species, etc.).

Pest/Pathogens

4.7. Prioritize, communicate and coordinate management activities designed to protect native species (plants and animals) and/or economically important species that are impacted by invasive pest/pathogens.
   4.7.1. Research and prioritize known and potential invasive pest /pathogen species.
   4.7.2. Investigate tested and potential control methods for invasive pests and pathogens (for example - biological, chemical and mechanical) and determine if identified control methods are critical and effective actions for land managers to utilize.
   4.7.3. Research and apply methods other than invasive pest/pathogen control to protect native species (for example - collect seeds).

Goal 5: Monitoring, Mapping and Applied Research - Promote locating and documenting occurrences, and supporting applied research, prevention, EDRR and control to inform CISMA decisions.

5.1. Coordinate monitoring and mapping of invasive plants, animals, pests/pathogens (terrestrial, freshwater and marine.)
   5.1.1. Record invasive species from field observations and mapping projects into CISMA EDDMapS and/or FNAI's invasive databases. Encourage use of EDDMapS for EDRR species and single occurrence entry and FNAI for large census/polygon data.
   5.1.2. Recruit and assign plant verifier(s) to oversee CISMA plant record entries into EDDMapS.
   5.1.3. Recruit and assign animal verifiers to oversee CISMA animal record entries into EDDMapS.
   5.1.4. Use EDDMapS database, FNAI's invasive maps, and information from land managers and private landowners to create CISMA prioritized invasive management maps of top ranked EDRR and control species.
   5.1.5. Conduct partner workdays to survey targeted locations for new invasions focusing on high priority EDRR and prevention species (newly in or adjacent to CISMA).Use monitoring results to inform management decisions and updates of priority lists as necessary.
   5.1.6. Coordinate an update meeting to produce a standardized report of CISMA-coordinated invasive species treatments.
   5.1.7. Assist cooperators to complete transition to all digital reporting of invasive species treatment efforts for updates and/or standardized reporting (for example - WEEDDAR, WIMS, etc).
   5.1.8. Assist in information gathering to document the impact of high priority control species (this helps with prioritizing control, listing on regulated lists (state/local), getting assessments completed by IFAS).

5.2. Encourage research on invasive plants, animals, pests/pathogens (terrestrial, freshwater and marine).
   5.2.1. Submit a list of questions to research institutions that would be useful to your CISMA on invasive species biology, impacts, and/or management (e.g. university and college biology departments, FLEPPC, FISP, chemical company representatives, or other research entities).
   5.2.2. Inform USDA ARS, IFAS/University of Florida, and/or others of CISMA members that are willing to participate in biological control trials (in other words, allow biological control trials to be conducted on lands that they manage).

Goal 6: Outreach, Training and Strategic Collaboration- Implement outreach and training to support invasive species prevention, EDRR and control efforts in the CISMA boundaries.

6.1. Implement invasive species outreach, training and strategic collaboration efforts with CISMA cooperators to increase CISMA community knowledge as well as statewide profile.
   - 6.1.1. Work with FISP to develop CISMA website.
   - 6.1.2. As needed, maintain and improve CISMA website.
   - 6.1.3. Participate in statewide CISMA monthly calls and FLEPPC annual CISMA meeting (both coordinated by FISP).
   - 6.1.4. Contact the media through press/photo releases and radio to highlight CISMA efforts on invasive species. Consider doing this during National Invasive Species Awareness Week (held annually in spring).
   - 6.1.5. Hold trainings for CISMA cooperators and targeted audiences on how to use the EDDMapS online database to report occurrences of invasive species (with priority placed on reporting EDRR and prevention species).
   - 6.1.6. Maintain and improve CISMA knowledge by communicating with experts (for example - invite experts to present information at CISMA meetings).
   - 6.1.7. Conduct at least one invasive terrestrial plant identification and treatment training focusing on priority prevention, EDRR and control species (if possible, coordinate with IFAS Extension Agent).
   - 6.1.8. Compile a communication network contact list in order to establish alert system for cooperators both within and adjacent to CISMA boundary (for example - adjacent CISMAs). Assign a CISMA member to send emails to this network when new threat/emerging issue is identified. Also, encourage CISMA members to sign up for EDDMapS alerts (on EDDMapS website).
   - 6.1.9. Conduct at least one invasive aquatic plant identification and treatment training focusing on priority prevention, EDRR and control species (if possible, coordinate with Florida Sea Grant).
   - 6.1.10. Create or find existing materials to distribute to CISMA cooperators to increase knowledge of current invasive species laws and distribute to CISMA cooperators (for example - FFWCC fact sheet on Reptiles of Concern rules, FDACS poster on rule restricting the movement of unprocessed wood).
   - 6.1.11. Develop and pilot a workshop focused on identification and treatment of invasive animals (terrestrial, aquatic and/or marine).

6.2. Implement invasive species outreach and training efforts with academic/education infrastructure.
   - 6.2.1. Develop a list of extension offices and environmental education centers within CISMA boundaries and provide them with materials about invasive species prevention and control (for example - put together packet of information on CISMA, CISMA priorities and relevant fact sheets/educational information and assign members to distribute this information to offices/centers).
   - 6.2.2. Work with Cooperative Extension Master Gardener Program and local garden clubs to include programming that promotes the removal of invasive plants and encourages the use of non-invasive plants.
   - 6.2.3. Work with Florida Sea Grant and other coastal stakeholders to implement a “Stop Aquatic Hitchhikers” program and distribute outreach materials to large local marinas and at large fishing tournaments (http://www.protectyourwaters.net/).

6.2.4. Develop list of schools, scout groups, community festivals, environmental festivals and others who could help with education about invasive species prevention, EDRR and control. Annually, conduct at least one group presentation and have at least one event display/booth.

6.2.5. Develop and implement at least one priority education volunteer program for CISMA that simultaneously builds up volunteer programs and raises invasive species awareness (for example -, student workdays, invasive survey recruitment/training programs, Pepper Busters creation, etc.)

6.3. Increase invasive species outreach efforts to private industries and organizations, utilities and rights-of-way agencies.

6.3.1. Work with retailers to reduce the sale and release of invasive animals. Encourage retailers to display and distribute the "Don't Release Unwanted Pets" poster and cards (statewide effort organized through UF-IFAS and Seagrant, find at http://stjohns.ifas.ufl.edu/sea/DontRelease.html).

6.3.2. Create a communication network contact list for private industries and organizations, utilities and rights-of-way agencies (for example - railroads, utilities, ranges, nurseries, botanical gardens, pet stores, animal rehabilitation centers, landscapers, architects, foresters, county animal control, FDOT, and other ROW agencies).

6.3.3. Ask private companies and organizations, utilities and rights-of-way agencies to help raise awareness about invasive species best management practices and alternatives to widely used invasive species through their internal communications (for example - FL ASLA and FNGLA Chapter electronic updates, large growers' publications, agency newsletters)

6.3.4. Work with retailers to reduce the sale of invasive plants (for example - GreenThumb Program http://www.keysgreenthumb.net/).

6.3.5. Encourage at least one relevant industry, organization or agency to endorse and sign the voluntary code of conduct pledge committing to curb the use and distribution of invasive plant species (find codes at http://www.centerforplantconservation.org/invasives/codesN.html). Publicize signees of voluntary code of conducts lists (for example - post on website, news articles).

6.3.6. Ask your local prominent botanical garden or ASLA Chapter to take a lead role in educating the public and the nursery industry about preventing the introduction and spread of invasive species.

6.3.7. Encourage interpretive signage at botanical gardens explaining threat of invasive species and alternatives to their use in the landscape (could include demonstration garden).

6.3.8. Develop or find existing landscape architect certification course that promotes CISMA invasive species priorities.

6.4. Implement outreach and training efforts to private landowners and landowner associations.

6.4.1. Encourage all CISMA cooperators to place "Do Not Move Firewood" poster at all public conservation lands, public and private campgrounds and other high-use recreational areas.

6.4.2. Develop landowner 'outreach' packets to send priority landowners (include CISMA information, priority invasive species information, training courses, etc.).

6.4.3. Implement at least one training effort to specific private landowners and landowner associations focused on high priority prevention, EDRR and control invasive species.

Include instruction on use the EDDMapS online database to report occurrences of invasive species.

6.4.4. Develop, or acquire existing materials about native or non-invasive plants that can be used as alternatives to invasive species for erosion control, wildlife forage, landscaping, etc. Include this information in private landowner packets and trainings.

6.4.5. Use/adapt existing materials (fact sheets /posters) to increase knowledge of funding opportunities and current laws and distribute to individuals with goal of enrolling private landowners in funding programs that assist with invasive species control (FISP website). Include this in private landowner packets and trainings.

6.4.6. Begin annual conservation champion award to private landowner.

6.5. Increase outreach and awareness efforts to policy makers.

6.5.1. Share CISMA Annual Reports with elected officials during National Invasive Species Awareness Week (held annually in spring).

6.5.2. Get county(s) proclamations supporting CISMA goals and invasive species control. Coordinate press releases upon/after signing. Consider doing this during National Invasive Species Awareness Week (held annually in spring).

6.5.3. Visit with newly elected local government officials to support invasive species funding, EDRR, prevention and other CISMA goals.

INDIVIDUAL SPECIES ACCOUNTS

The following includes specific control plans for each non-native invasive species selected by the CISMA for consideration in this document. The use of trade names in this section does not imply endorsement of a particular product or manufacturer. Federal law requires that all users of herbicides read the entire label and follow label instructions.

PLANTS

Terrestrial Plants

Table 2. Terrestrial non-native invasive plants of the Apalachicola River region

Scientific Name	Common Name
Albizia julibrissin	mimosa
Aleurites fordii	tungoil
Ardisia crenata	coral ardisia
Arundo donax	giant reed
Cinnamomum camphora	camphor tree
Colocasia esculenta	wild taro
Dioscorea alata	winged yam
Dioscorea bulbifera	air potato
Elaeagnus pungens	silverthorn
Elaeagnus umbellata	autumn olive
Imperata cylindrica	cogongrass
Lantana camara	lantana
Ligustrum lucidum	glossy privet
Ligustrum sinense	Chinese privet
Lonicera japonica	Japanese honeysuckle
Lygodium japonicum	Japanese climbing fern
Melia azerderach	chinaberry
Nandina domestica	heavenly bamboo
Paederia foetida	skunkvine
Panicum repens	torpedo grass
Phragmites australis	common reed
Phyllostachys aurea	golden bamboo
Pueraria montana	kudzu
Ruellia tweediana	Mexican petunia
Sapium sebiferum	Chinese tallow
Sesbania punicea	rattlebox
Solanum viarum	tropical soda apple
Tradescantia fluminesis	wandering jew
Wisteria sinensis	Chinese wisteria

Mimosa

Scientific name: *Albizia julibrissin*

Description

Mimosa is a small to medium sized tree with a native range from the Middle East to Asia. It was introduced as an ornamental to the U. S. in 1945 and continues to be used and sold as such (Miller 2003). Distribution in the U. S. extends across the southern states from Florida to California and as far north as Massachusetts. Mimosa is commonly found on disturbed sites especially old fields, stream banks, home sites, and roadsides and also in natural areas, especially sites adjacent to disturbed areas. It is a FLEPPC Category I pest plant. Another common name for mimosa is silktree.

Impacts

Mimosa is highly adaptable and can grow in a variety of soils and can resprout when damaged. It is a strong competitor to native trees and dense stands of the species may block sunlight to understory vegetation. It reproduces both vegetatively and by seeds, which may remain viable for up to five years (Remaley 2005).

Goals and Objectives

Goal: Eradicate mimosa from natural areas.

Objectives:

1. Identify populations within managed area and conduct annual monitoring.
2. Reduce population by managing infestations.
3. Prevent spread of the plant to other natural areas. Encourage private land owners to manage mimosas on their property to limit its spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.

Management Options

Chemical:

Treatments for smaller trees and seedlings:

A. *Foliar*: 2% solution of glyphosate with water and 0.5% surfactant. Thoroughly wet all leaves (United States Department of Agriculture Forest Service et al., 2006).
B. *Foliar*: 2% solution of triclopyr amine with water and 0.5% surfactant. Thoroughly wet all leaves (United States Department of Agriculture Forest Service et al., 2006).

Treatments for larger trees:

A. *Basal bark*: Use a solution of 25% triclopyr ester and 75% horticultural oil. Spray from base of the tree up to 12–15 inches from the ground level. Use when the ground is not frozen (United States Department of Agriculture Forest Service et al., 2006).

B. *Cut stump*: Spray felled trees immediately after cutting with Arsenal AC© (imazapyr) or Garlon 3A© (triclopyr amine) in recommended dilutions on the herbicide label. Use when the ground is not frozen (Miller 2003).
C. *Stem injections*: with the same herbicides as above (Miller 2003).

Mechanical or Manual:

- Cutting: large trees may be cut at the base with either manual or power saws. Resprouts will have to be cut after initial felling. Cut trees during flowering stage before seeds are produced (Remaley 2005).
- Hand Removal: Seedlings may be pulled from the ground before the plant has had the chance to flower and produce seeds. All roots must be extracted from the soil; pull after a rain when the soil is wet.
- Girdling: With a hatchet, cut into the bark about six inches above the ground. Make sure that the cuts penetrate all the way through the bark. It will take several years and additional cuttings until roots are exhausted (United States Department of Agriculture Forest Service et al., 2006). Resprouts can also be treated with a foliar spray of herbicides.

<u>Distribution in the Region</u>

Distributional data for mimosa has been collected by the CISMA in various locations throughout the region (Figure 3).

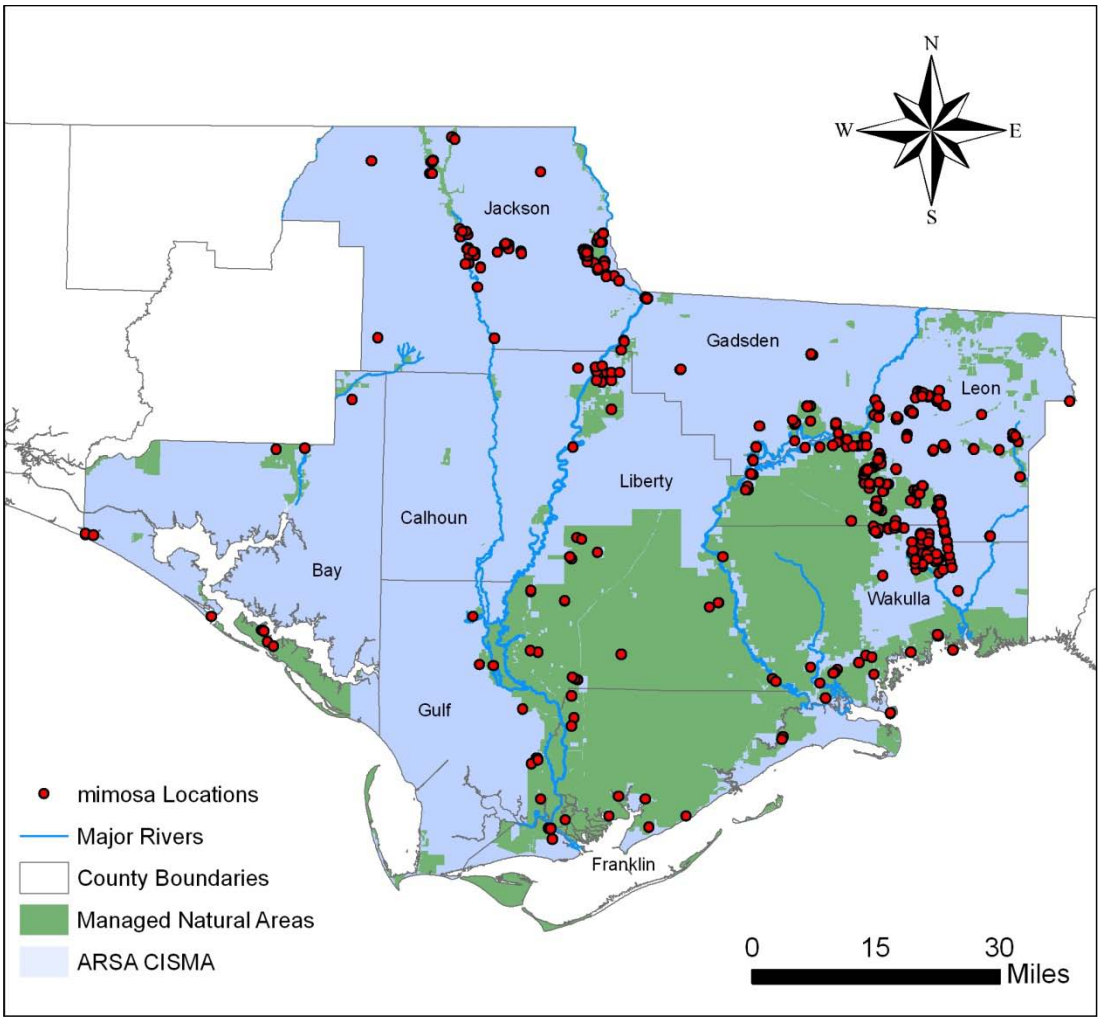


Figure 3. Mimosa locations in the Apalachicola River region

Tungoil

Scientific name: *Aleurites fordii* (synonym: *Vernicia fordii*)

Description

Tungoil is a small to medium sized tree native to central and western China, where it is cultivated for seed oil. Tungoil trees can be found across the southeastern U. S. from Florida to Louisiana (NatureServe 2006). Range in Florida extends across the Panhandle to the central part of the state (Wunderlin and Hansen 2004). Flowers appear in February and March; fruit appears from September to November (Duke 1983). Tungoil is a FLEPPC Category II pest plant.

Impacts

Information about tungoil is lacking and more research is needed to assess impacts posed to natural communities.

Goals and Objectives

Goal: Eradicate tungoil from natural areas.

Objectives:

1. Collect more information on the plant. Encourage research.
2. Eradicate populations in natural areas. This will require active management, because the seed bank will reinfest an area if it is not controlled before seeds are released.
3. Prevent spread of the plant to other natural areas.
   A. Encourage private land owners to manage tungoil trees on their property to limit its spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.
   B. Educate land managers, staff, volunteers, etc. to identify it.

Management Options

Chemical:

- *Basal bark*: Langeland and Stocker (1997) recommend applications of 20% Garlon 4© (triclopyr ester) in oil.

Distribution in the Region

Distributional data for tungoil has been collected by the CISMA in various locations throughout the region (Figure 4).

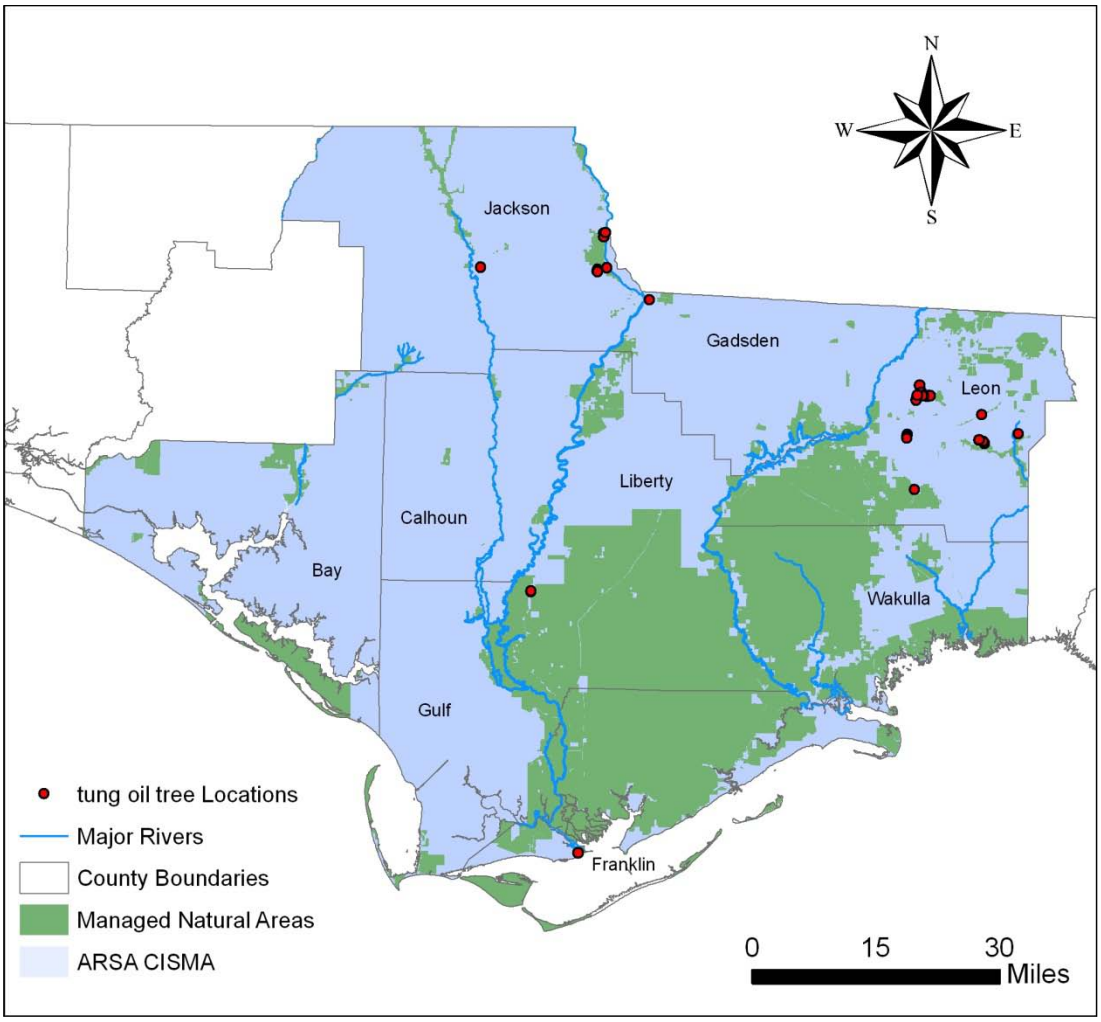


Figure 4. Tungoil locations in the Apalachicola River region

Coral ardisia
Scientific name: *Ardisia crenata*

Description
Coral ardisia is an evergreen shrub with a native range extending from Japan to northern India. It has been documented in Florida, Louisiana, Texas and Hawaii (United States Department of Agriculture Natural Resources Conservation Service 2006). It was most likely introduced to Florida as an ornamental in the early 1900s. Coral ardisia is an understory plant and can be found in moist soils (Langeland and Craddock Burks 1998). Coral ardisia is a FLEPPC Category I pest plant.

Impacts
Coral ardisia forms dense colonies, out-competing native understory plants. Coral ardisia located in areas such as the Angus Gholson Jr. Nature Park of Chattahoochee may negatively impact rare species such as the federally endangered fringed campion by competing for understory habitat space (Figure 5).

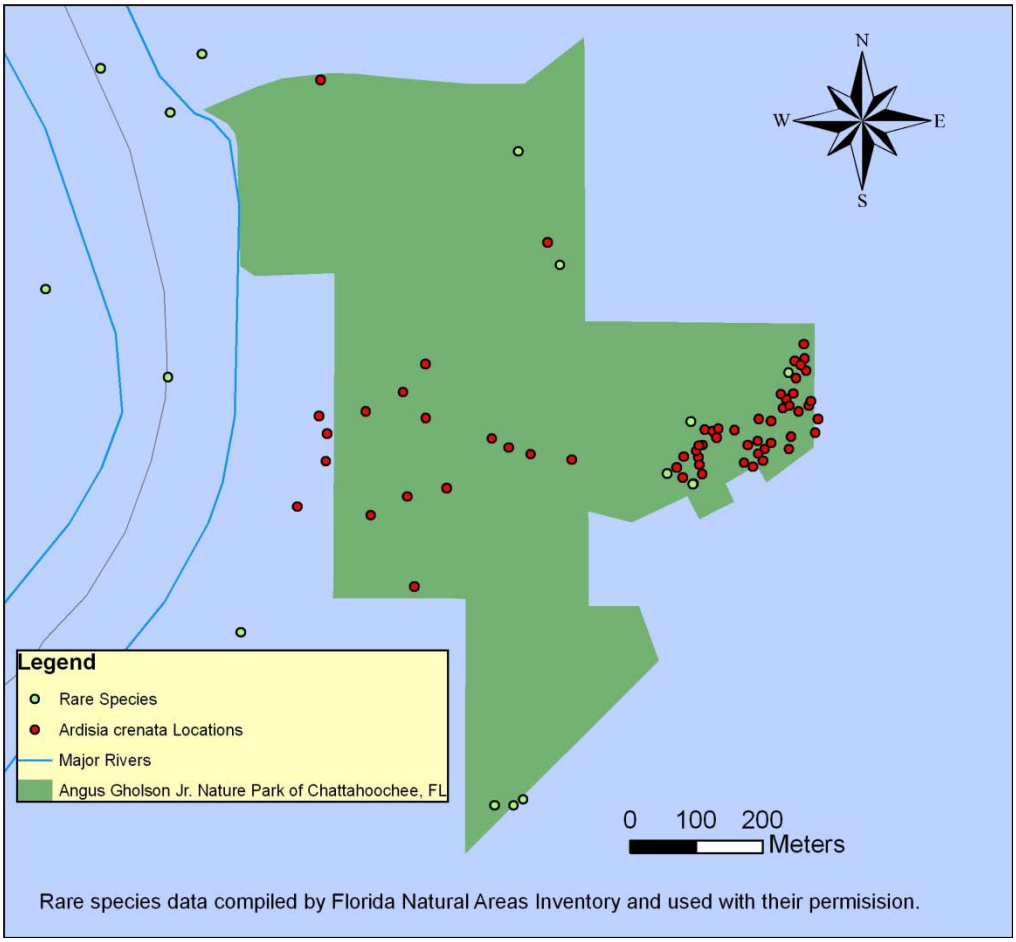


Figure 5. Coral ardisia and rare species in Angus Gholson Jr. Nature Park of Chattahoochee

Goals and Objectives

Goal: Maintenance and prevention.

Objectives:

1. Monitor treated infestations of the sites highlighted in Figure 4 below. All of these sights are of high value because presence of threatened and endangered species.
2. Prevent spread of the species to other natural areas.
    A. Survey private lands sites adjacent to highly valued areas. Coral ardisia is widely used as an ornamental in yards and should be monitored for that reason.
    B. Encourage private land owners to manage coral ardisia on their property to limit its spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.

Management Options

Chemical: Langeland and Stocker (1997) recommend:

- *Basal bark*: 10% Garlon 4© in oil.
- *Foliar*: 5% solution of Garlon 4© (triclopyr ester) in water.

Distribution in the Region

Distributional data for coral ardisia has been collected by the CISMA at various locations in the Apalachicola region (Figure 6).

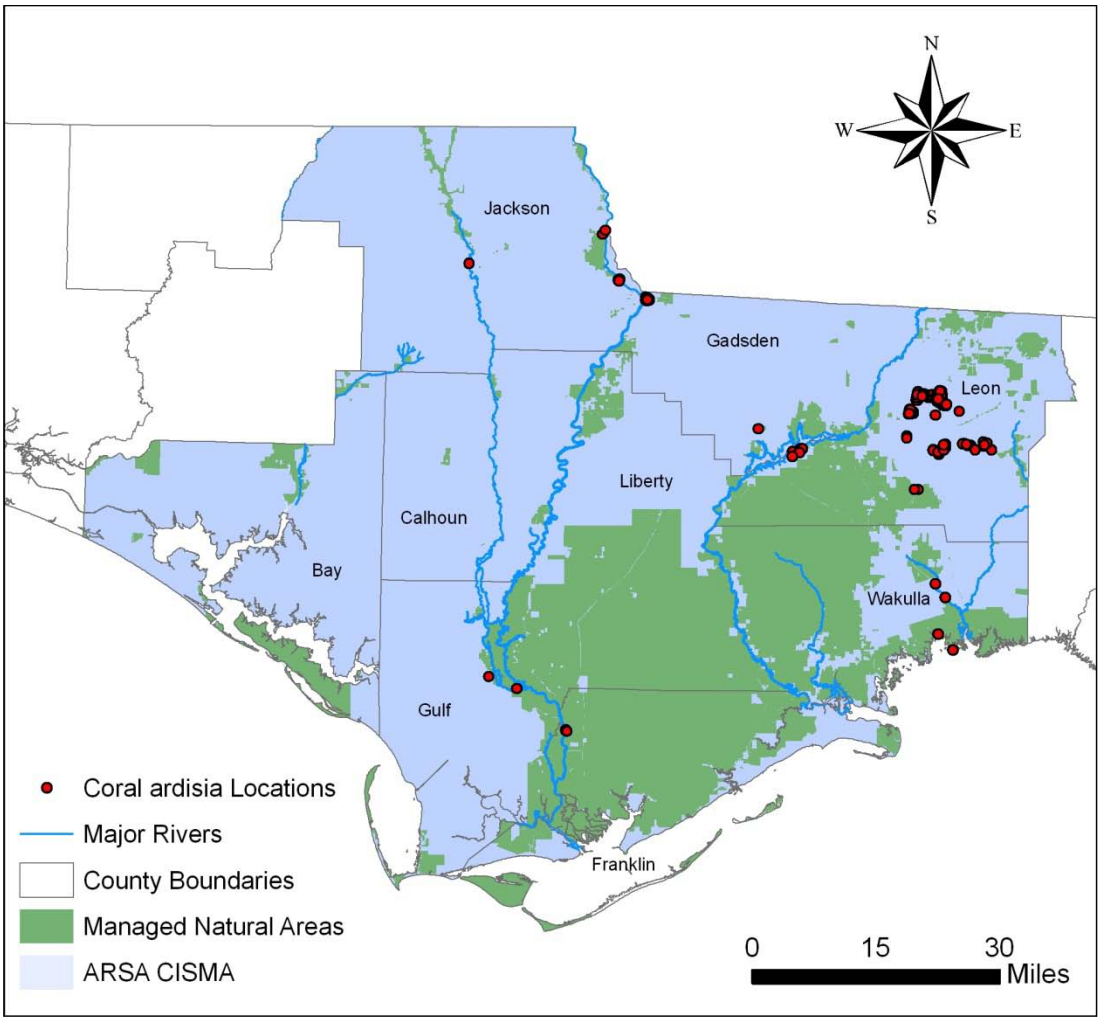


Figure 6. Coral ardisia locations in the Apalachicola River region

Giant reed
Scientific name: *Arundo donax*

Description
Giant reed is a tall perennial grass that can reach heights of 20 feet and is native to coastal areas of the Mediterranean Sea and India. It is believed to have been introduced to the U. S. in the early 1800s as an ornamental and has been found in temperate climates in the southern U. S. from Florida to California and north to West Virginia and Illinois. Giant reed grows in riparian habitats including streams, ditches, and lake shores and in disturbed sites. It can tolerate high levels of salinity (Swearingen et al. 2002).

Impacts
Giant reed can rapidly invade riparian habitats, out-competing native species. When established the plant forms dense monocultures. Giant reed is highly flammable and has been found to alter fire behavior (McWilliams 2004).

Goals and Objectives

Goal: Prevention from introduction to natural areas.

Objectives:

1. Work with City of Apalachicola to allow control. The infestation is in the city's waterfront district, which has a ban on herbicide use.
2. Survey for infestations on private lands, especially those adjacent to natural areas. Eradicate known infestations with landowner's permission.
3. Support efforts to prevent its use as a biofuel.

Management Options
Chemical:

- *Foliar*: spray all leaves with a 2 % glyphosate solution or 1% imazapyr with surfactant in September/October. Multiple applications may be necessary (Miller 2003).

Mechanical or Manual: Giant reed can be mowed or removed mechanically but, because it reproduces vegetatively by its rhizomes, herbicide may be needed. Hand pulling may be effective on plants less than six feet tall if all rhizomes are extracted from the soil.

Distribution in the Region
Distributional data for giant reed has been collected by the CISMA in the city of Apalachicola on a site adjacent to the ANERR (Figure 7). It has also been documented in adjacent areas (Wunderlin and Hansen 2004).

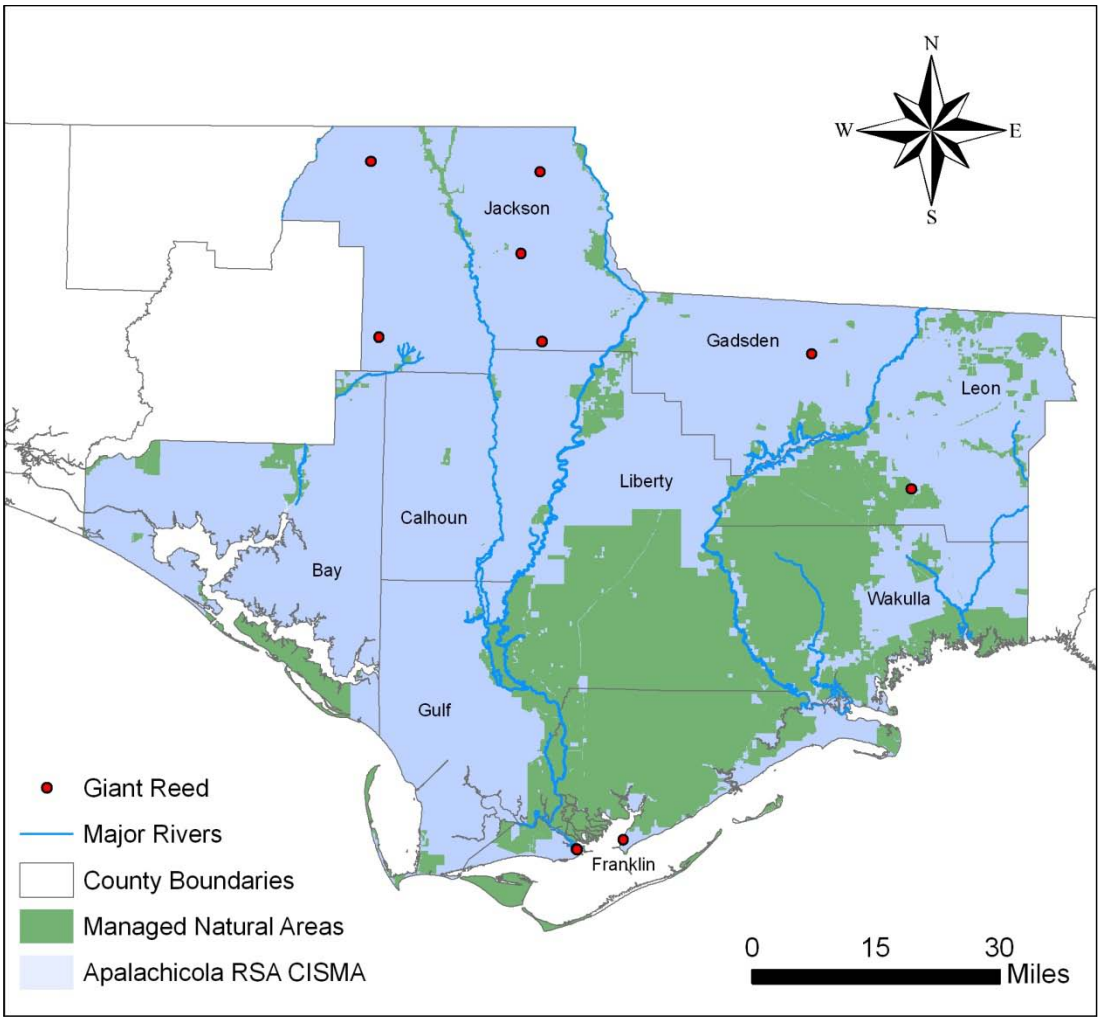


Figure 7. Giant reed locations in the Apalachicola River region

Camphor tree
Scientific name: *Cinnamomum camphora*

Description
Camphor tree is an evergreen species native to China and East Asia and was introduced to the U. S. in 1875 as an agricultural venture to produce camphor oil. It is no longer planted commercially for oil, but is sold as an ornamental. It has been documented in the southern states from Florida to Texas, north to North Carolina, and in California and Hawaii. Camphor tree can be found in disturbed areas, especially roadsides and fencerows, and has also been located in natural upland habitats such as hammocks and pine flatwoods (Langeland and Craddock Burks 1998). It has been documented in moist soils, such as the floodplain forest in the ANERR. It is a FLEPPC Category I pest plant.

Impacts
Camphor tree can form dense monocultures, inhibiting regeneration of native trees and shrubs. Birds are wide distributors of the seeds.

Goals and Objectives

Goal: Eradicate camphor tree from natural areas.

Objectives:

1. Identify populations within managed area and conduct annual monitoring.
2. Reduce population by managing infestations.
3. Prevent spread of the plant to other natural areas.
    A. Encourage private land owners to manage camphor trees on their property to limit its spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.
    B. Educate land managers, staff, volunteers, etc. on identification.

Management Options
Chemical: Basal bark treatments of 30% Garlon 4© (triclopyr ester) in oil; this mixture should not be used near water (Ramey 2001).

Mechanical or Manual: Seedlings can be pulled by hand if all roots are extracted from the soil.

Distribution in the Region
Distributional data has been collected for camphor tree throughout the Apalachicola region (Figure 8). There are many home sites in Apalachicola and Bristol where the tree is an ornamental.

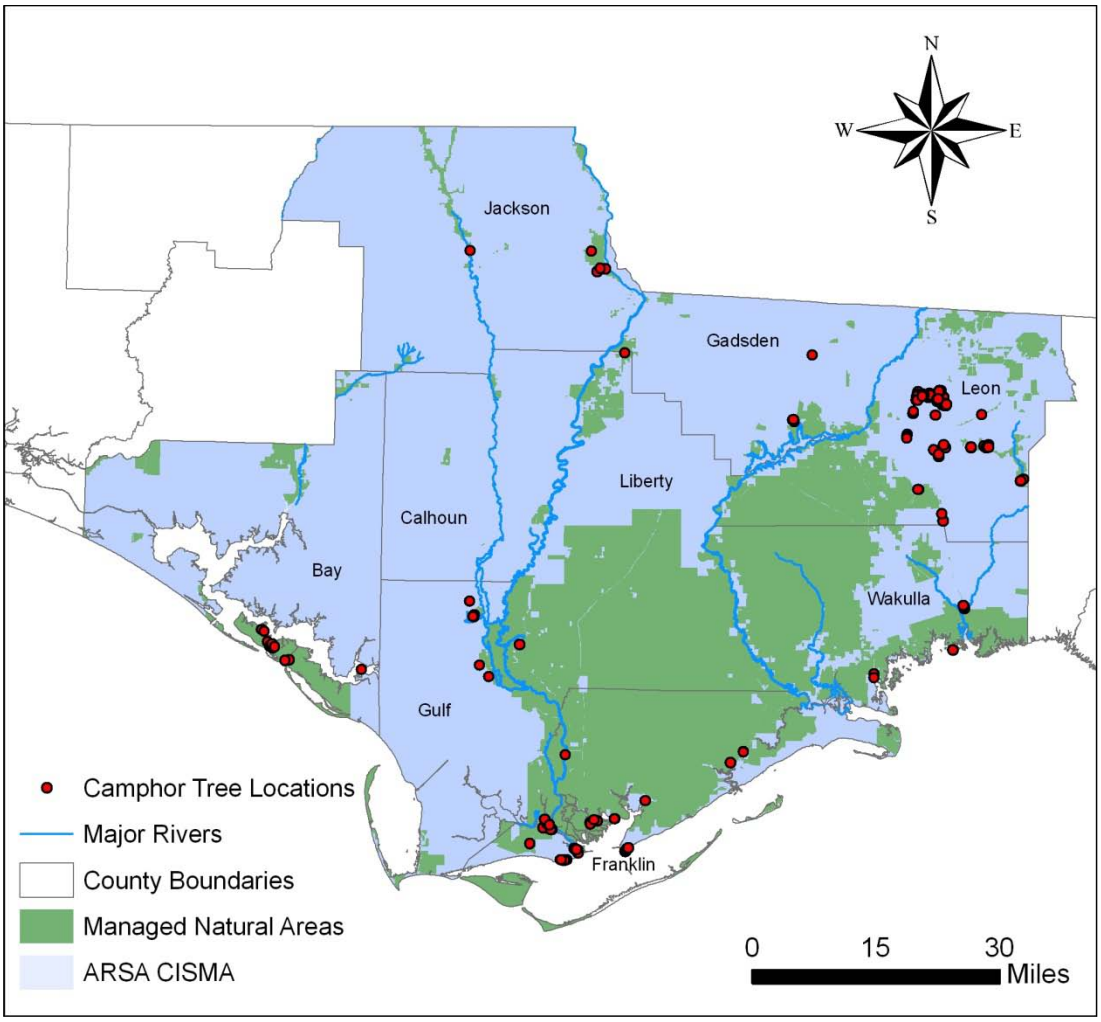


Figure 8. Camphor tree locations in the Apalachicola River region

Wild taro
Scientific name: *Colocasia esculenta*

Description
Wild taro is a perennial herb native to India and Southeastern Asia. It was introduced to Florida in 1910 by the USDA as a substitute crop for potatoes. Its current range in the U. S. extends west from Florida to Texas and north to North Carolina, and Hawaii (NatureServe 2006). It has established itself along streams, rivers, canals, ditches and marshy shorelines throughout Florida. Wild taro is a FLEPPC Category I pest plant.

Impacts
Wild taro grows in dense patches along edges of water sources, crowding out native plants that are important food sources for wildlife. The presence of wild taro increased from 32% in 1983 to 62% in 2002 in Florida's public rivers and lakes (Florida Department of Environmental Protection 2003).

Goals and Objectives
Goal: Maintenance control.
Objectives:
1. Identify populations within managed areas. Identify high priority sites and prioritize for management.
2. Reduce population by managing infestations on less valued sites.
3. Prevent spread of the plant to other natural areas.

Management Options
Chemical:
- *Foliar*:
    1. 1% solutions of triclopyr amine, 2-4,D, or glyphosate in water with a 0.25% non-ionic surfactant were effective in killing taro in a controlled study performed in Mississippi (Nelson and Getsinger 2000).
    2. Langeland and Stocker (1997) recommend foliar application of 1% Weedar 64© (2,4-D) + 1% Rodeo© (glyphosate) + 0.5-1.0% Kammo© (D-limonene)+ silicone surfactant. Applications will most likely require retreatment and monitoring is necessary for treated infestations.

Distribution in the Region
Distributional data for wild taro has been collected by the CISMA in various locations in the region (Figure 9).

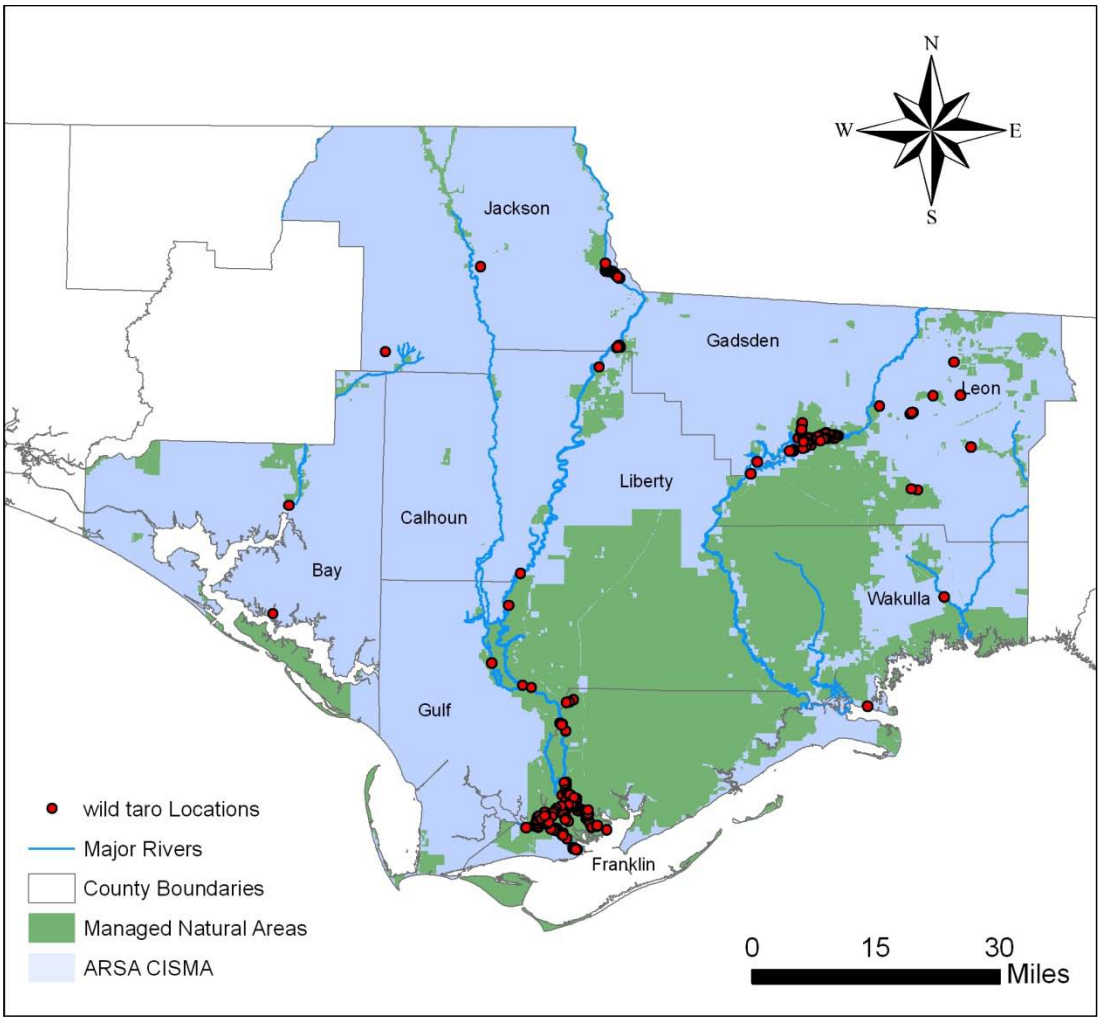


Figure 9. Wild taro locations in the Apalachicola River region

Winged yam
Scientific name: *Dioscorea alata*

Description
Winged yam is an herbaceous perennial vine native to Africa and Asia where it is widely cultivated as a food crop. This species was introduced to the U. S. during the slave trade and to Florida in the early 1900s; it has since then been recorded in Florida, Georgia, and Louisiana (United States Department of Agriculture Natural Resources Conservation Service 2006). It is listed as a FLEPPC Category I pest plant and a Florida Noxious Weed.

Winged yam may be confused with the non-native air potato (*D. bulbifera*), or either of the two natives, Florida yam (*D. floridana*) and fourleaf yam (*D. quaternata*); all of these species are documented in the Apalachicola region (Langeland and Craddock Burks 1998; NatureServe 2006; Wunderlin and Hansen 2004). Aerial tubers are present on winged yam and air potato, but are absent on Florida yam and fourleaf yam (Clewell 1988).

Impacts
Winged yam reproduces rapidly and has the ability to cover and smother native vegetation, including trees and understory species (Miller 2003).

Goals and Objectives
Goal: Prevention.
Objectives:
1. Conduct surveys for winged yam. Initiate rapid response and control measures if found.
2. Locate populations in the Ocklockonee River watershed (Wunderlin and Hansen 2004) and encourage control.
3. Educate land managers, staff, volunteers, etc. on identification, especially for the eastern region of the CISMA.

Management Options
Winged yam is difficult to manage because of prolific tubers present both aerially and underground. The above ground bulbils will become new plants when they fall off the host plant. The plants can also reproduce vegetatively, thus mechanical efforts may spread the species to previously uninfested areas.

Remove both aerial bulbils and underground tubers (place in a heavy duty garbage bag and bury in landfill) and dispose of properly before implementing any of the following treatments. Aerial bulbils can be hand removed in winter before they sprout. Underground tubers may also be dug up but requires substantial time and effort.

Chemical:
- *Cut stump*: Apply undiluted Garlon 3A (triclopyr amine) to freshly stems cut just above the ground (Miller 2003).

- *Foliar*: apply from June to October; thoroughly wet all leaves (Miller, 2003).
    1. 1-2% solution of Garlon 3A© (triclopyr amine) or 2-4, D amine (Langeland and Stocker 1997).
    2. 2% Garlon 4© (triclopyr ester) or Garlon 3A (triclopyr amine) in water with a surfactant (Miller 2003).

Cultural: Prescribed fire may help to defoliate the vines enough to make herbicide treatment more effective and less costly, but fire alone will not eradicate the plants as they will resprout from underground tubers (Schultz 1993).

Distribution in the Region

Distributional data has been collected by the CISMA for winged yam in Wakulla County (Figure 10).

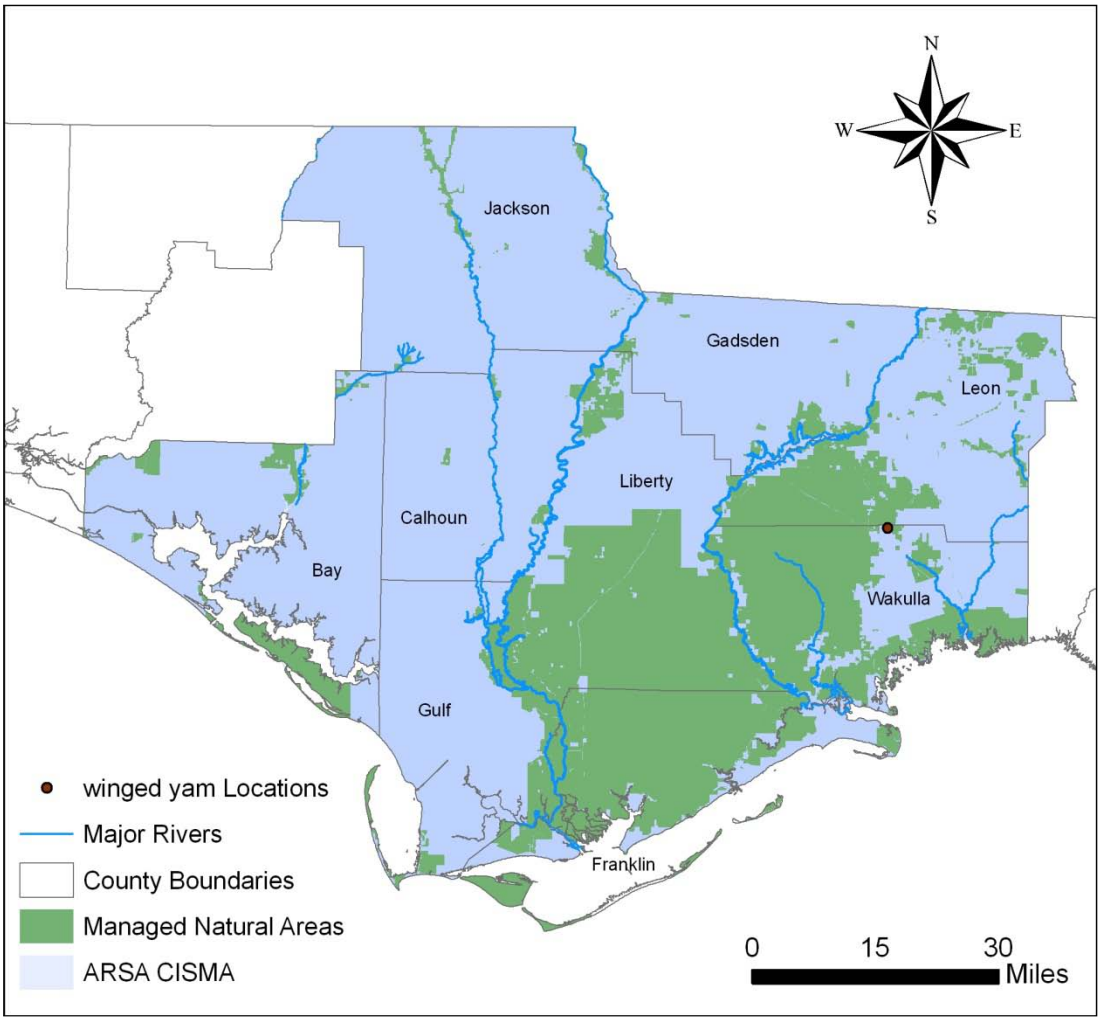


Figure 10. Winged yam locations in the Apalachicola River region

Air potato
Scientific name: *Dioscorea bulbifera*

Description
Air potato is an herbaceous perennial vine native to Africa and Asia, where it is widely cultivated as a food crop. It was first recorded in Florida in the early 1900s (Langeland and Craddock Burks 1998). Air potato has been documented in Florida, Illinois (Schultz 1993), Texas, Mississippi, and Louisiana. In Florida, air potato is often found in pinelands and hammocks (Langeland and Craddock Burks 1998) and various disturbed areas. Air potato does not tolerate salinity (Schultz 1993). It is a FLEPPC Category I pest plant and a Florida Noxious Weed.

Air potato may be confused with non-native winged yam (*D. alata*), and the two natives Florida yam (*D. floridana*) or fourleaf yam (*D. quaternata*), which are all documented in the Apalachicola region (Langeland and Craddock Burks 1998; Wunderlin and Hansen 2004). Aerial tubers are present on winged yam and air potato, but are absent on Florida yam and fourleaf yam (Clewell 1988). Another common name for air potato is air yam.

Impacts
Air potato reproduces rapidly and has the ability to cover and smother native vegetation. It has also been found climbing into tree canopies.

Goals and Objectives
Goal: Prevent spread to natural areas.
Objectives:
1. Identify populations on private lands adjacent to natural areas, especially in coastal regions because of its abundance in cities such as Apalachicola, where the climate is slightly warmer than other parts of the region.
2. Prevent spread of the plant to other natural areas. Encourage private land owners to manage air potatoes on their property to limit spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.

Management Options
Air potato infestations are difficult to manage because of prolific aerial and underground tubers. The above ground bulbils will become new plants when they fall off the host plant. It can also reproduce vegetatively, meaning that mechanical efforts may further spread the plants.

Remove all aerial bulbils before implementing any of the following treatments. Dispose of bulbils by placing them in a tight garbage bag and burying it in the landfill.

Chemical:
- *Cut stump*: Apply to freshly cut stems.

1. 50% Garlon 3A© (triclopyr amine) or 10% Garlon 4© (triclopyr ester) (Langeland and Stocker 1997).

- *Foliar*: Apply from June to October; thoroughly wet all leaves (Miller, 2003).
    1. 1–2% solution of Garlon 3A© (triclopyr amine) or 2-4, D amine (Langeland and Stocker 1997).
    2. 2% Garlon 4© (triclopyr ester) in water with a surfactant (Miller 2003).

Cultural: Prescribed fire may help to defoliate the vines enough to make herbicide treatment more effective and less costly, but fire alone will not eradicate the plants as they will resprout from underground tubers (Schultz 1993).

Distribution in the Region

Distributional data for air potato has been collected by the CISMA in various locations in the region (Figure 11). The plant is also located on many home sites in Apalachicola and other cities on the coast.

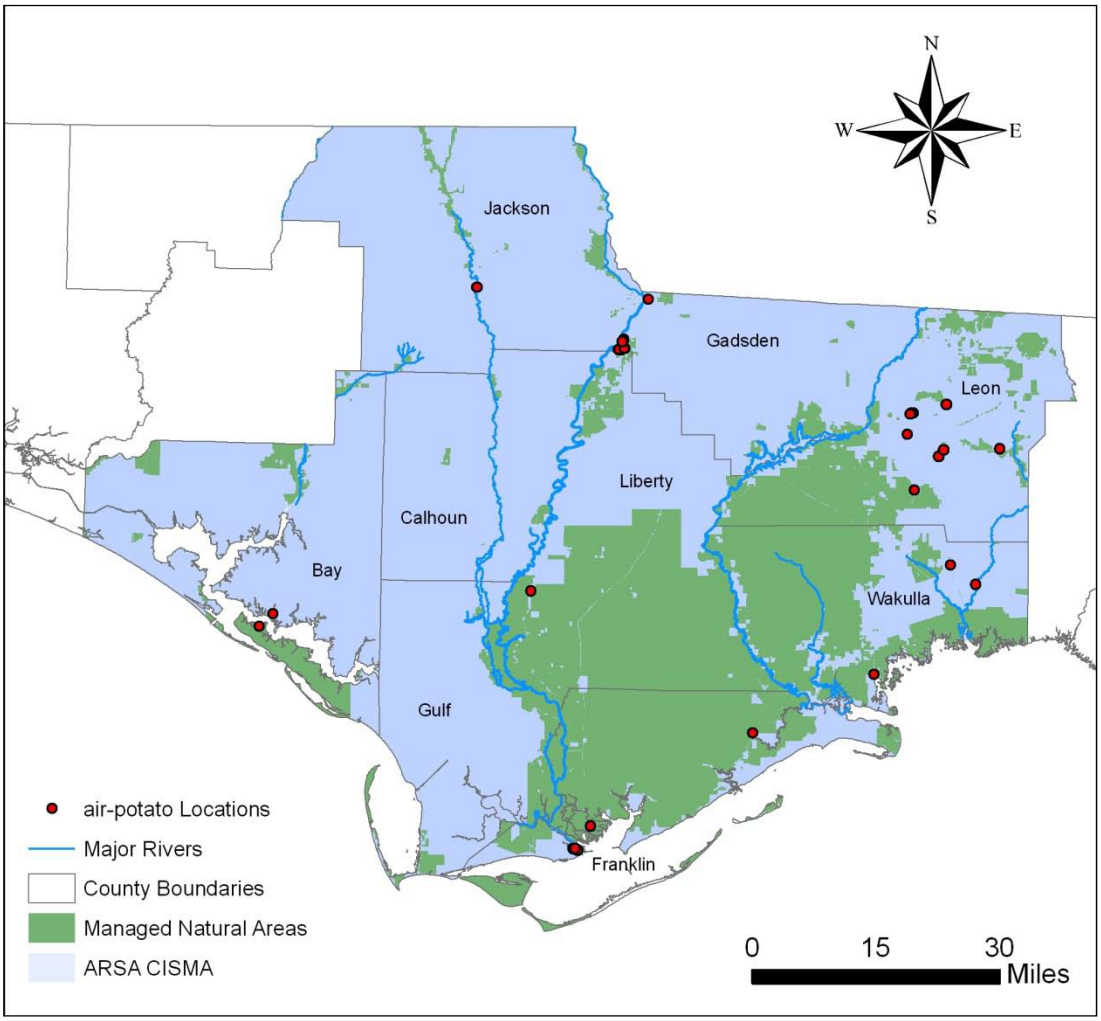


Figure 11. Air potato locations in the Apalachicola River region

Silverthorn
Scientific name: *Elaeagnus pungens*

Description
Silverthorn is an evergreen shrub native to East Asia and was introduced to the U. S. in the 1930s as an ornamental; it continues to be used as such. Current range in the U. S. extends across the Southeastern states (Miller 2003). This shrub is shade tolerant and can be found on disturbed sites and in natural areas. It is a FLEPPC Category II pest plant.

In addition to silverthorn and autumn olive (*E. umbellata*), there is another non-native invasive olive, Russian olive (*E. angustifolia*), documented in the Southeastern U. S. It has not yet been documented in the Apalachicola River region (Wunderlin and Hansen 2004), but is considered invasive and has been recorded in 35 other states (NatureServe 2006). Another common name for silverthorn is thorny olive.

Impacts
Silverthorn is capable of spreading into a variety of natural areas because it is tolerant of many soil types. Seed dispersal by animals makes their spread even more prolific. This shrub is capable of creating dense thickets, out-competing native species for habitat and dominating natural open areas (United States Department of Agriculture Forest Service et al. 2006).

Goals and Objectives
Goal: Eradicate.
Objectives:
1. Identify populations within managed area and conduct annual monitoring.
2. Reduce population by managing infestations.
3. Prevent spread of the plant to other natural areas. Encourage private land owners to manage plant on their property to limit its spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.

Management Options
Chemical:
- *Basal bark*: 20% solution of Garlon4© (triclopyr ester) with penetrant. Apply to young stems in January and February or from May to October. This treatment is effective throughout the year as long as the ground is not frozen (Miller 2003).
- *Cut stump*: Cut stems and immediately apply herbicide:
  1. Solution of 50% glyphosate in water (United States Department of Agriculture Forest Service et al. 2006). Miller (2003) recommends using glyphosate as a 20% solution in water with a surfactant.
  2. Solution of 10 % Arsenal AC© in water with a surfactant (Miller 2003).
- *Foliar*: Thoroughly wet all leaves. Apply when air temperature is above 65°F.
  1. Solution of 2% glyphosate in water with a 0.5% non-ionic surfactant (United States Department of Agriculture Forest Service et al. 2006).

2. 1% solution of Arsenal AC© (imazapyr) or Vanquish© (dicambia) and water with a surfactant. Apply April-September (Miller 2003).

Distribution in the Region

Distributional data for silverthorn has been collected by the CISMA in various locations in the Apalachicola region (Figure 12).

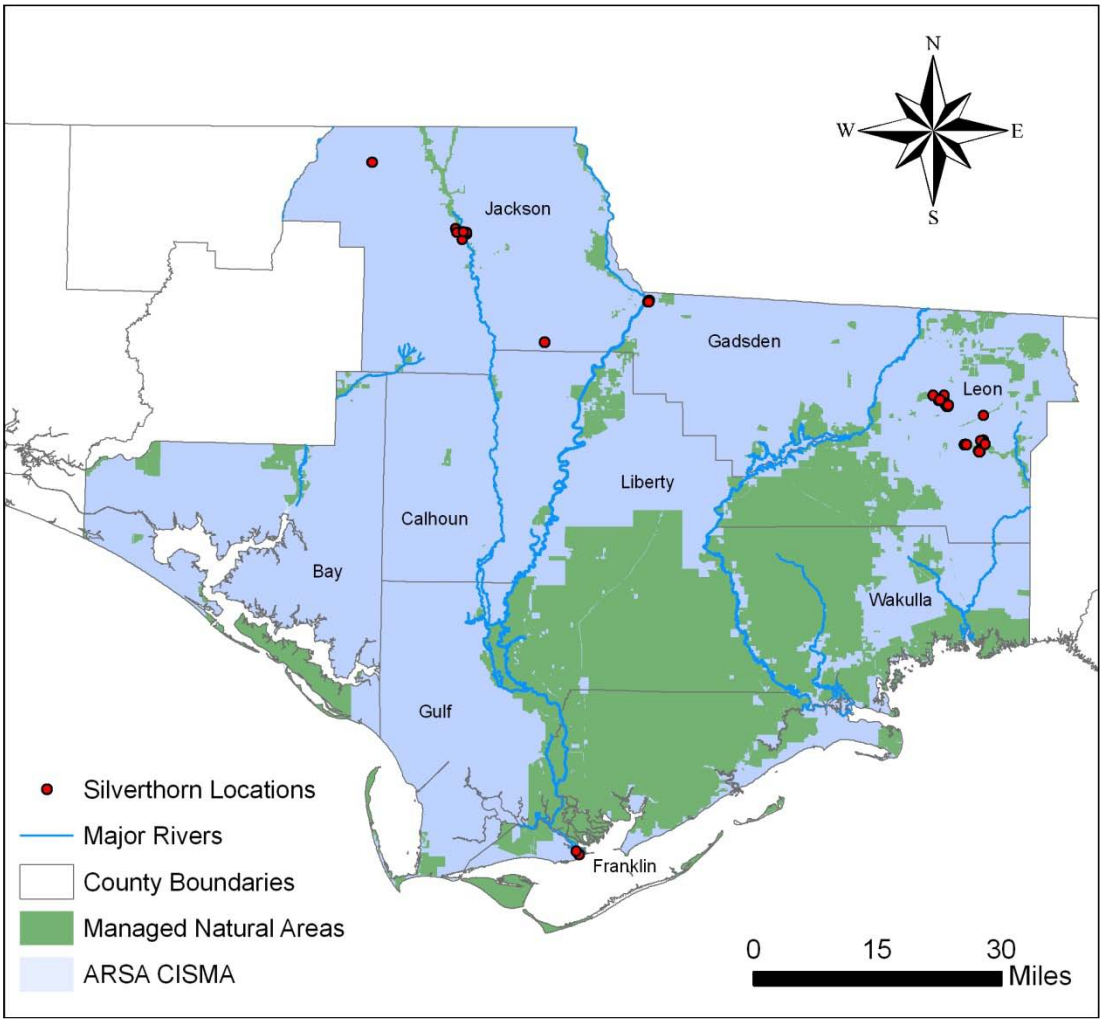


Figure 12. Silverthorn locations in the Apalachicola River region

Autumn olive
Scientific name: *Elaeagnus umbellata*

Description
Autumn olive is a deciduous shrub native to China and Japan and was introduced to the U. S. in the 1930s as an ornamental. Autumn olive can be found as far north as Maine and Wisconsin and throughout the mid-western states. This shrub is drought tolerant and can be found in a variety of soil types (United States Department of Agriculture Forest Service et al. 2006).

In addition to autumn olive, there are two other non-native invasive olives documented in the Southeastern U. S., thorny olive (*E. pungens*) and Russian olive (*E. angustifolia*). Thorny olive is included in this document. Russian olive is not included in this document and has not been recorded in the Apalachicola River region (Wunderlin and Hansen 2004). However, Russian olive has been documented in over 35 states and is invasive when it becomes established (NatureServe 2006) and may be included as a watch species for the Apalachicola region in the future.

Impacts
Autumn olive is capable of spreading into a variety of natural areas because it is tolerant of many soil types. This shrub is capable of creating dense thickets, out-competing native species for habitat and dominating natural open areas (United States Department of Agriculture Forest Service et al. 2006). Seed dispersal by animals makes spread of this species even more prolific.

Goals and Objectives
Goal: Prevent introduction from adjacent regions.
Objectives:
1. Conduct surveys for autumn olive. If found, then initiate rapid response and control measures.
2. Locate populations in the Ocklockonee River watershed (Wunderlin and Hansen 2004) and encourage control.
3. Educate land managers, staff, volunteers, etc on identification, especially for the eastern region of the CISMA.

Management Options
Chemical:
- *Basal bark*: Effective throughout the year as long as the ground is not frozen.
    1. Apply solution of 25% solution of triclopyr ester product and 75% horticultural oil. Apply around base up to 15 inches from the ground (United States Department of Agriculture Forest Service et al. 2006).
    2. 20% solution of Garlon4© (triclopyr ester) with penetrant. Apply to young stems in January and February or from May to October (Miller 2003).
- *Cut stump*: Cut stems and immediately apply herbicide.
    1. Miller (2003) recommends using glyphosate as a 20% solution in water with a surfactant.

2. Solution of 10 % Arsenal AC© (imazapyr) in water with a surfactant (Miller 2003).

- *Foliar*: Thoroughly wet all leaves. Apply when air temperature is above 65°F.
    1. Solution of 2% glyphosate in water with a 0.5% non-ionic surfactant (United States Department of Agriculture Forest Service et al. 2006).
    2. 1% solution of Arsenal AC© (imazapyr) or Vanquish© (dicambia) and water with a surfactant. Apply April-September (Miller 2003).

Distribution in the Region

No distributional data has been collected by the CISMA for autumn olive to date.

Cogongrass
Scientific name: *Imperata cylindrica*

Description
Cogongrass is a perennial grass believed to be native to Southeast Asia and Africa. It was probably introduced to the U. S. in the early 1900s in ship ballast (Faircloth et al. 2005). In Florida it was cultivated for soil erosion control and as livestock forage (Langeland and Craddock Burks 1998). The current range of cogongrass in the U. S. extends as far north as Virginia and west to Oregon (NatureServe 2006). It can be found in disturbed areas including roadsides, fields, and fencerows, as well as in natural areas such as sandhills and pine flatwoods. Cogongrass is a FLEPPC Category I pest plant, a Florida Noxious Weed, and a Federal Noxious Weed. It has also been called one of the world's ten worst weeds (Tu 2002).

Impacts
Cogongrass forms dense monocultures that out-compete native plants and diminish habitats for species such as gopher tortoise and Eastern indigo snake. Most native wildlife species will not use cogongrass as a food source (Florida Department of Environmental Protection 2003). Fire regimes can be altered by the weed as it is highly flammable and burns extremely hot (United States Department of Agriculture Forest Service et al. 2006). Federally listed species such as flatwoods salamander, red-cockaded woodpecker, Harper's beauty, and Florida skullcap located in habitats requiring fire may be impacted by the altered fire behavior created by cogongrass.

Goals and Objectives
Goal: Maintenance control.
Objectives:
1. Identify populations within managed areas and conduct annual monitoring.
2. Reduce population by managing infestations.
3. Prevent spread of the plant to other natural areas.
    A. Encourage private land owners to manage cogongrass on their property to limit its spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.
    B. Work with DOT and private contractors to limit spread in road right-of-ways. Encourage DACS-Division of Plant Industry to survey dirt fill piles.
    C. Manage populations in northern counties to limit spread to Georgia, which at this time has fewer infestations and has reported introductions from Florida.

Management Options
An integrated pest management approach is the most advisable management option for cogongrass infestations (MacDonald et al. 2006).

Biological: Laboratory studies at the University of Florida identified 30–50% foliar lesions and spotting with two pathogens, *Bipolaris sacchari* and *Drechslera gigantean*. The pathogens were more effective when applied in oil (University of Florida Department of Plant Pathology 2002).

Integrated pest management: The size and location of a cogongrass infestation is a determining factor in selecting a treatment. The following recommendations are adapted from MacDonald et al. (2006):

1. Small infestations in natural areas where desirable natives are present (i.e., small clumps of plants scattered throughout an area or a low number of individual plants scattered in an area): use a foliar application of a 2% solution of glyphosate product in areas that will be immediately revegetated. In areas where immediate revegetation is not planned, and non-target plant damage is not a concern, use a foliar application of a 1–1.5% solution of imazapyr product. The addition of a non-ionic surfactant is recommended to increase herbicide uptake. A tank mix of imazapyr and glyphosate can also be used. For a 1 gallon tank mix, use 2.5 oz glyphosate product and 0.25 oz. imazapyr product. The best time to apply herbicides is in the early fall before first frost. IMPORTANT: Imazapyr is highly active in soil. Nearby plants may be damaged by root uptake or improper application of this herbicide.
2. Dense stands: effective management combines a mechanical and chemical protocol.
    A. Mow or burn infestation in late spring to remove old growth and thatch layer.
    B. Six to eight weeks later, when grass has resprouted to a height of 6–12 inches, disc site as deeply as possible. [*Discing should not be used in sensitive natural areas*, but is allowable on road shoulders and similar disturbed areas. Clean equipment of contaminated dirt prior to moving from site].
    C. When adequate regrowth of the cogongrass has occurred use the herbicide treatment described above.

Revegetation of native species in the treated area is necessary in areas with large infestations of cogongrass, but it will recolonize (though perhaps less densely) and retreatment is required with close monitoring afterwards.

The following treatment is also recommended (adapted from Faircloth et al. 2005):
Large infestations may take several years of application. Most of the biomass of cogongrass is located in underground rhizomes, so treatments with both foliar and soil active herbicides are required to kill the plant. Research shows that only two herbicides, glyphosate and imazapyr, have effectively controlled the plant. A minimum of two applications is required each year. Treat in the spring with a foliar application of glyphosate and follow with an application of imazapyr in the fall to kill remaining regrowth and underground rhizomes. Follow instructions on the herbicide labels because application rates vary depending on the size of the stand and presence of desirable species nearby.

Mechanical: Mechanical efforts to remove the plant may result in its spread if equipment is not completely cleaned of all plant fragments and seeds before leaving the site. However, tillage methods that penetrate more than six inches into the soil, breaking up the rhizomes, have shown to slow its spread, or eliminate small infestations if it is done several times (every 6–8 weeks) during the growing season (Faircloth et al. 2005, MacDonald et al. 2006). The site may

need spot herbicide treatments if the infestation is recurring (Faircloth et al. 2005). This method is recommended for sites where cogongrass has formed a dense monoculture and crowded out all natives.

Distribution in the Region

Distributional data for cogongrass has been collected by the CISMA throughout the region (Figure 13). It is especially prevalent along road right-of-ways.

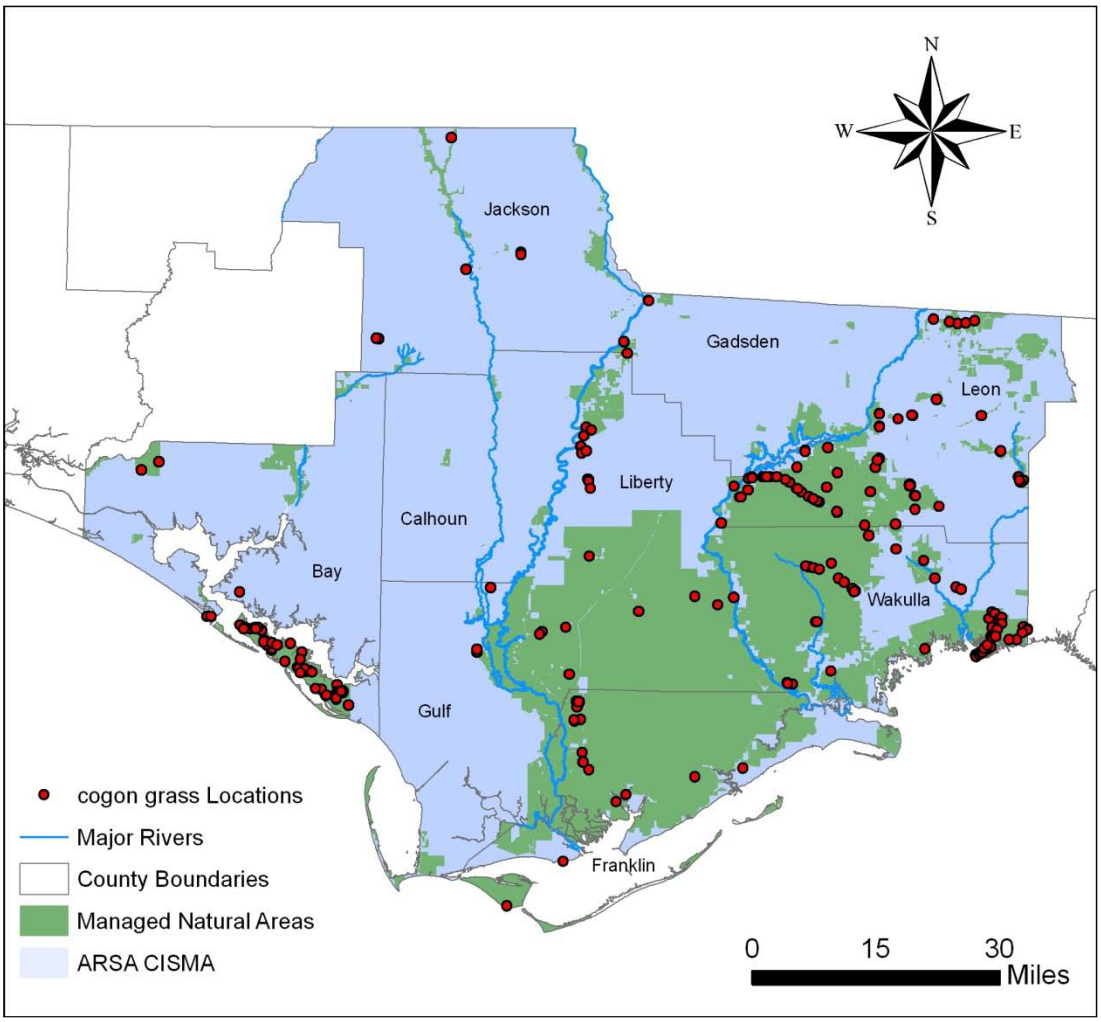


Figure 13. Cogongrass locations in the Apalachicola River region

The map in Figure 14 shows where infestations have spread along state and county roads on the Apalachicola National Forest Wakulla District (in the Ocklockonee River drainage). The infestation on Forest Highway 13 has been spread from the use of mowers and graders by road workers.

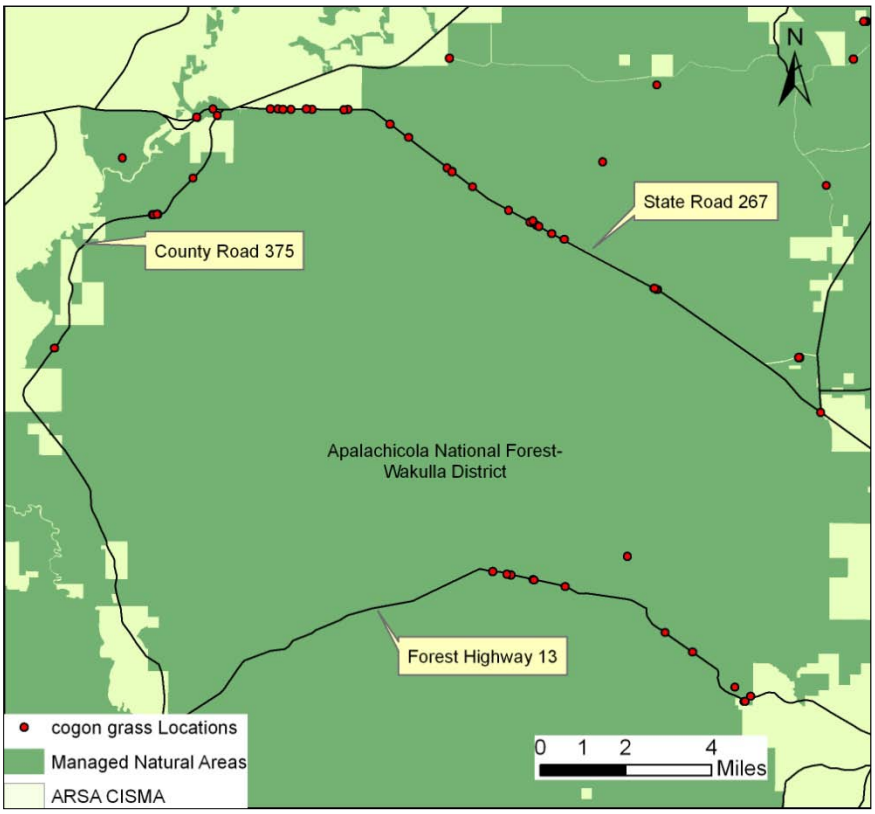


Figure 14. Spread of cogongrass in Apalachicola National Forest, Florida

Lantana
Scientific name: *Lantana camara*

Description
Lantana is a deciduous shrub native to Central and South America. It was probably introduced to the U. S. in the late 1800s as an ornamental. Its distribution in the U. S. extends north to North Carolina, across the southern states from Florida to California, and Hawaii. Lantana can be found in many disturbed sites, especially roadsides and pastures, but it has been documented in natural areas as well (Langeland and Craddock-Burks 1998). It grows best in moist soils and can tolerate some shade. It is a FLEPPC Category I pest plant. It is also considered one of the world's 100 worst weeds (Walton 2006).
Another common name for lantana is shrub verbena.

Impacts
Lantana can form dense monocultures, out-competing native plants. Disturbed areas are highly subject to invasion once it has been introduced (Walton 2006). Lantana's allelopathic qualities give it a competitive advantage over native species by reducing habitat (Langeland and Craddock-Burks 1998). Seeds are widely dispersed by birds.

It has been documented to hybridize with the native pineland lantana (*L. depressa*), resulting in gene contamination (Langeland and Craddock-Burks 1998). Pineland lantana and hammock shrub verbena (*L. canescens*) are native to south Florida, but there is not a native *Lantana* in the Apalachicola region (Wunderlin and Hansen 2004).

Goals and Objectives

Goal: Prevent lantana from introduction into natural areas.

Objectives:

1. Identify populations on private lands, especially in coastal counties where the plant has been seen or documented in towns such as Apalachicola and Port St. Joe.
2. Prevent spread of the plant to natural areas.
    A. Encourage private land owners to manage lantana on their property to limit spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.
    B. Educate land managers, staff, volunteers, etc on identification.

Management Options
Biological: Extensive biological research has been conducted in Australia and Hawaii, where it is a major pest. Twelve biocontrol agents have been released in Hawaii, with varying effectiveness (Pacific Islands Ecosystems at Risk 2005).

Chemical: glyphosate, 2,4-D, imazapyr, and triclopyr have been effectively used against lantana (Vandiver 2002).

Langeland and Stocker (1997) recommend:

- *Basal bark:* 10% Garlon 4© (triclopyr ester) in oil.
- *Cut stump*:
    1. 50% Garlon 3A© (triclopyr amine) in water.
    2. 10% Garlon 4© in oil.

Cultural: Fire has been reported to reduce above ground plant mass, but lantana will regenerate from basal stems (Langeland and Craddock-Burks 1998).

Mechanical: Hand pulling is effective in small patches. Revegetation of native plants is recommended after pulling. The use of machinery has been ineffective because the disturbance results in higher germination rates (Walton 2006).

Distribution in the Region

Distributional data for lantana has been collected by the CISMA in various locations in the region (Figure 15).

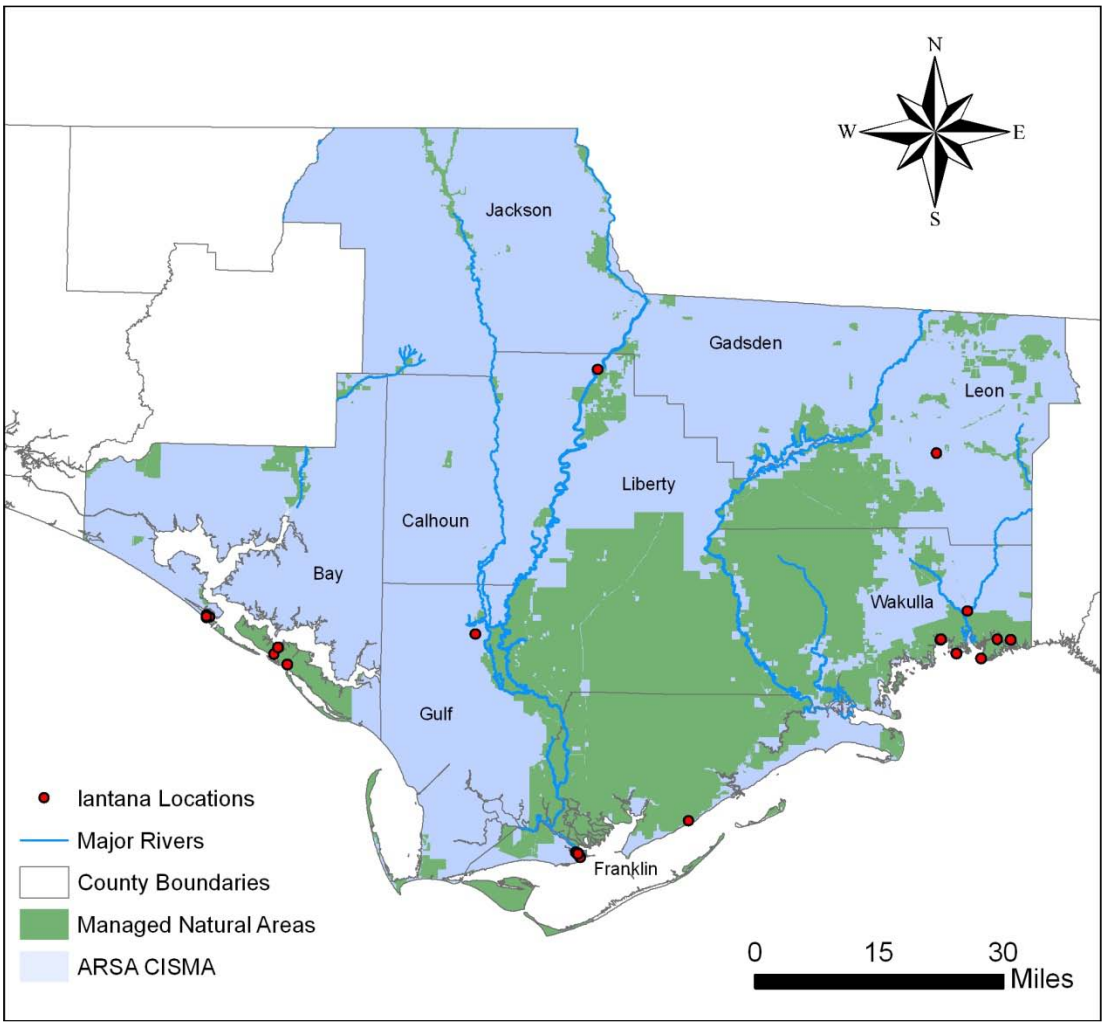


Figure 15. Lantana locations in Apalachicola River region

Glossy privet
Scientific name: *Ligustrum lucidum* (Thunb./ *L. lucidum*)

Description
Glossy privet is a semi-deciduous shrub and small tree native to Asia. It was introduced to the U. S. as an ornamental hedge around the 1850s (Miller 2003, Langeland and Craddock Burks 1998). Its range in the U. S. extends north from Florida to North Carolina and west to Texas. It can be found predominantly on disturbed sites, but can be found in natural areas, especially on sites adjacent to disturbed areas. It is a FLEPPC Category I pest plant.

Also included in this document is Chinese privet (L. sinense), which is more prevalent in the Apalachicola region. There are 50 known *Ligustrum* species worldwide and a number of them have been introduced to the U. S. (Batcher 2000c). Another common name for glossy privet is Japanese privet.

Impacts
Glossy privet can form dense thickets, out-competing native vegetation. Seeds are widely distributed by birds, enhancing its potential colonization range.

Goals and Objectives

Goal: Maintenance control.

Objectives:

1. Identify populations within managed area and conduct annual monitoring.
2. Reduce population by managing infestations.
3. Prevent spread of the plant to other natural areas. Encourage private land owners to manage glossy privet on their property to limit its spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.

Management Options
Biological: In 1998 the ligustrum weevil (*Ochyromera ligustri*) was found eating privet seeds in Tallahassee. The ligustrum weevil can be present on several *Ligustrum* species, but prefers glossy privet. Further research is needed to assess capabilities of the weevil to control *Ligustrum* in natural areas (Cuda et al. 2005).

Chemical:

- *Basal bark*: Apply a solution of 25% triclopyr ester and 75% horticultural oil. Apply 12–15 inches from the ground (Batcher 2000c).
- *Cut stump*: Treat immediately after cutting with a 20–25% solution of glyphosate or triclopyr amine and water with a surfactant. Make sure to cover entire surface of stump (Batcher 2000c, Miller 2003).
- *Foliar*: This method is effective in dense thickets where run off to non-target species is less likely. Treat in late fall or early spring when privet is showing leaves but many other natives are dormant.

1. 2% Glyphosate and water plus 0.5% non-ionic surfactant. (Batcher 2000c).
2. 2% Triclopyr amine and water plus 0.5% non-ionic surfactant. (Batcher 2000c).
3. 1% solution of imazapyr (Arsenal AC©) in water with a surfactant. (Miller 2003)

Mechanical or Manual: Hand pulling is effective on seedlings if all of the roots are extracted from the soil. Cutting larger plants to reduce seed dispersal is effective, but may require a cut stump treatment of herbicides to suppress regrowth.

Distribution in the Region

Distributional data for glossy privet has been collected by the CISMA in various locations in the region (Figure 16).

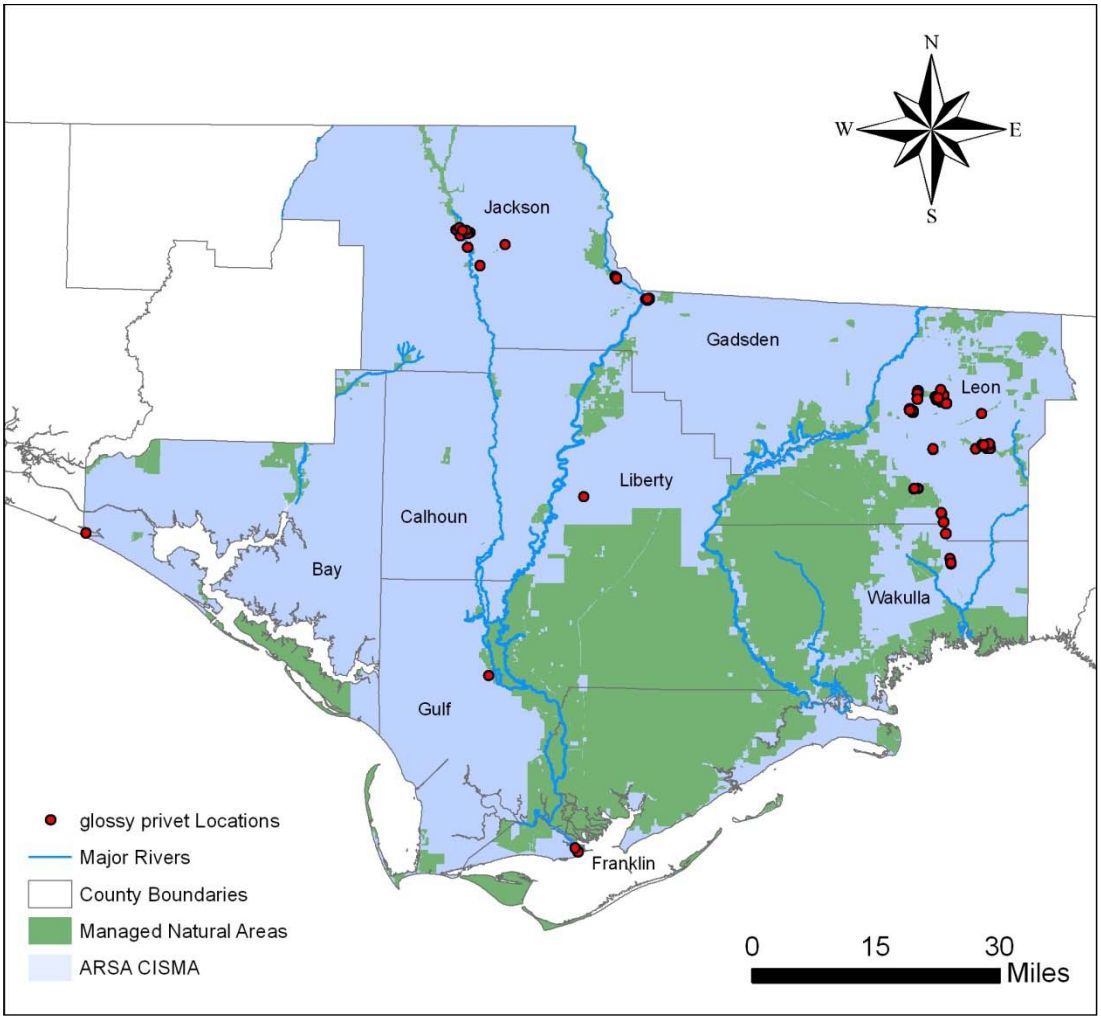


Figure 16. Glossy privet locations in the Apalachicola River region

Chinese privet
Scientific name: *Ligustrum sinense*

Description
Chinese privet is a semi-deciduous shrub and small tree native to Asia. Current range in the U. S. extends north from Florida to North Carolina and west to Texas. It was introduced to the U. S. as an ornamental hedge around the 1850s (Miller 2003, Langeland and Craddock Burks 1998). It can be found in disturbed areas and in natural areas such as hardwood forests, longleaf pine-turkey oak forests, floodplains, woodland edges, etc. (Batcher 2000c). It is a FLEPPC Category I pest plant.

There are 50 known *Ligustrum* species worldwide and a number of them have been introduced to the U. S. (Batcher 2000*c*); Chinese privet is the most prevalent species in the Apalachicola region. Glossy privet (*L. lucidum*) is included in this document.

Impacts
Chinese privet can form dense thickets, out-competing native vegetation. Seeds are widely distributed by birds.

Goals and Objectives

Goal: Maintenance control.

Objectives:

1. Identify populations within managed area and conduct annual monitoring.
2. Reduce population by managing infestations.
3. Prevent spread of the plant to other natural areas. Encourage private land owners to manage Chinese privet on their property to limit its spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.

Management Options
Biological: In 1998 the ligustrum weevil (*Ochyromera ligustri*), was found eating privet seeds in Tallahassee. The ligustrum weevil can be found on several *Ligustrum* spp. but prefers glossy privet. Further research is needed to assess capabilities of the weevil to control *Ligustrum* spp. in natural areas (Cuda et al. 2005).

Chemical:

- *Basal bark*: Apply a solution of 25% triclopyr ester and 75% horticultural oil. Apply 12–15 inches from the ground (Batcher 2000c).
- *Cut stump*: Treat immediately after cutting with a 20–25% solution of glyphosate or triclopyr amine and water with a surfactant. Make sure to cover entire surface of stump (Batcher 2000c, Miller 2003).
- *Foliar*: This method is effective in dense thickets where run off to non-target species is less likely. Treat in late fall or early spring when privet is showing leaves but many other natives are dormant.

1. 2% Glyphosate and water plus 0.5% non-ionic surfactant (Batcher 2000c).
2. 2% Triclopyr amine and water plus 0.5% non-ionic surfactant (Batcher 2000c).
3. 1% solution of imazapyr (Arsenal AC©) in water with a surfactant (Miller 2003).

Cultural: Fire has been reported to reduce above ground plant mass of Chinese privet, maintaining it at low densities (Batcher 2000c) but it will require monitoring and possibly chemical treatment.

Mechanical or Manual: Hand pulling is effective on seedlings if all of the root system is extracted from the soil. Cutting larger plants to reduce seed dispersal is effective but may require a cut stump treatment of herbicide to suppress regrowth.

Distribution in the Region

Distributional data for Chinese privet has been collected by the CISMA throughout the region (Figure 17). It is especially prevalent along road right-of-ways.

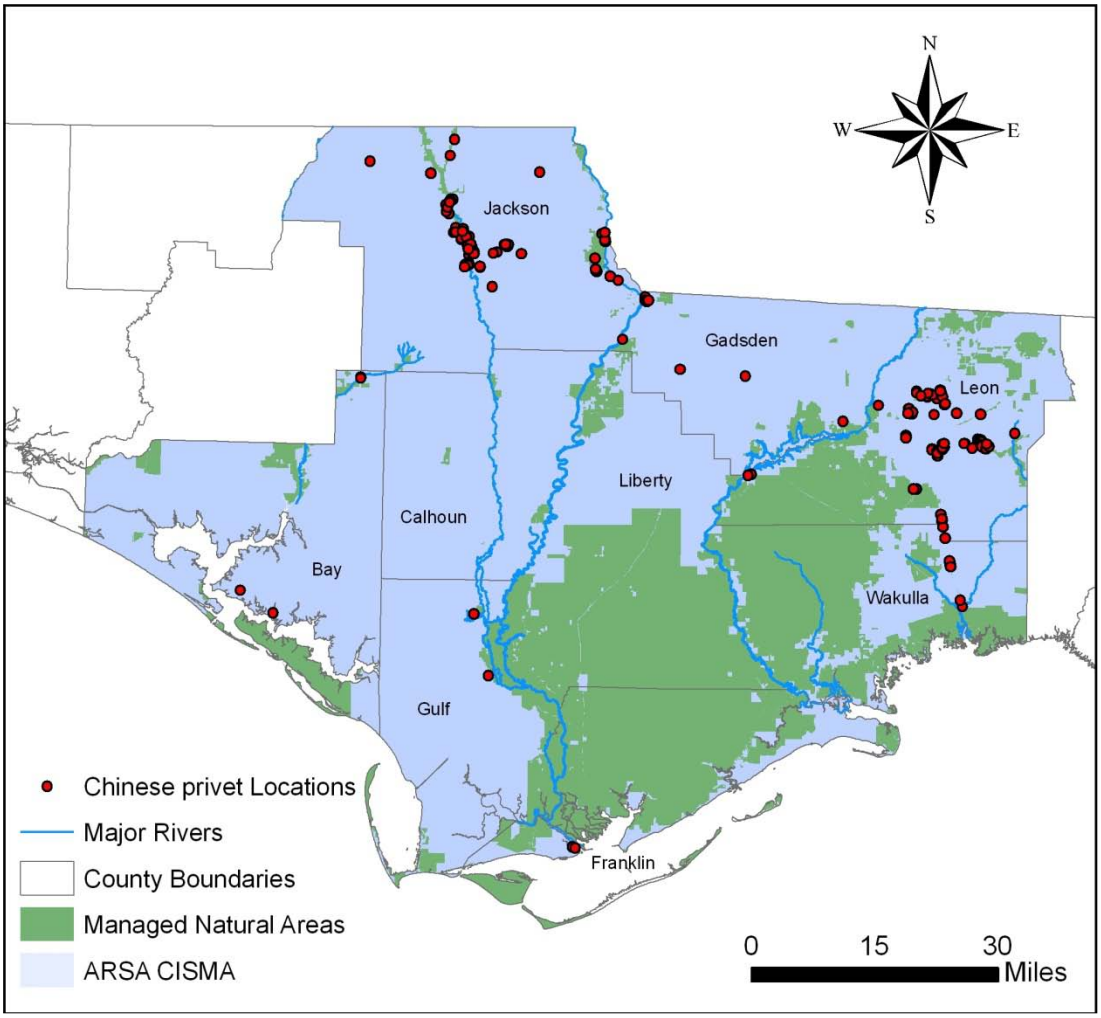


Figure 17. Chinese privet locations in the Apalachicola River region

Japanese honeysuckle
Scientific name: *Lonicera japonica*

Description
Japanese honeysuckle is an evergreen vine native to Eastern Asia. It was introduced to the U. S. in the 1800s as an ornamental, potential livestock forage species, and for erosion control (Swearingen et al. 2002). It has been documented in at least 38 states from Florida north to New Hampshire, through the Great Lakes region and west to California. Japanese honeysuckle can grow in disturbed sites such as fence rows and roadsides, and in natural areas such as open woodlands, prairies, thickets, and dry or moist forests (Langeland and Craddock Burks 1998). It is a FLEPPC Category I pest plant.

Impacts
Japanese honeysuckle grows rapidly, covering native plants and killing them as they out-compete for light. It can girdle trees and shrubs as it reaches towards sunlight. As an evergreen, honeysuckle has the advantage of growing while native deciduous species stay dormant (Alien Plant Invaders of Natural Areas 2005).

Goals and Objectives
Goal: Prevent encroachment into natural areas.
Objectives:
1. Survey for populations within managed area and conduct annual monitoring.
2. Reduce found populations by managing infestations.
3. Prevent spread of the plant to other natural areas. Encourage private land owners to manage honeysuckle on their property to limit its spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.

Management Options
Chemical: Miller (2003) recommends:
- *Cut stump*: Treat any time when ground is not frozen. Cut vines just above ground and immediately treat stumps with 20% glyphosate or triclopyr amine in water with a surfactant.
- *Foliar*: Spray in spring to fall. It is best to spray when native species are dormant, but Japanese honeysuckle still has foliage to minimize overspray to non-target species.
    1. 2.5% glyphosate with water and surfactant.
    2. 3-5% triclopyr amine or ester and water and surfactant.

Cultural: Prescribed burning will lower above ground foliage, but will not kill root system; regrowth can be treated with a foliar spray (see chemical management options) (Miller 2003).

Mechanical or Manual: Discing may be effective, but is destructive and will harm all surrounding plants (Nuzzo, 1997). Hand pulling is effective for small patches, and removal of

the entire root system is necessary. Vines must be cut and pulled from shrubs and trees to prevent girdling by Japanese honeysuckle.

Distribution in the Region

Distributional data for Japanese honeysuckle has been collected by the CISMA in various locations throughout the region (Figure 18).

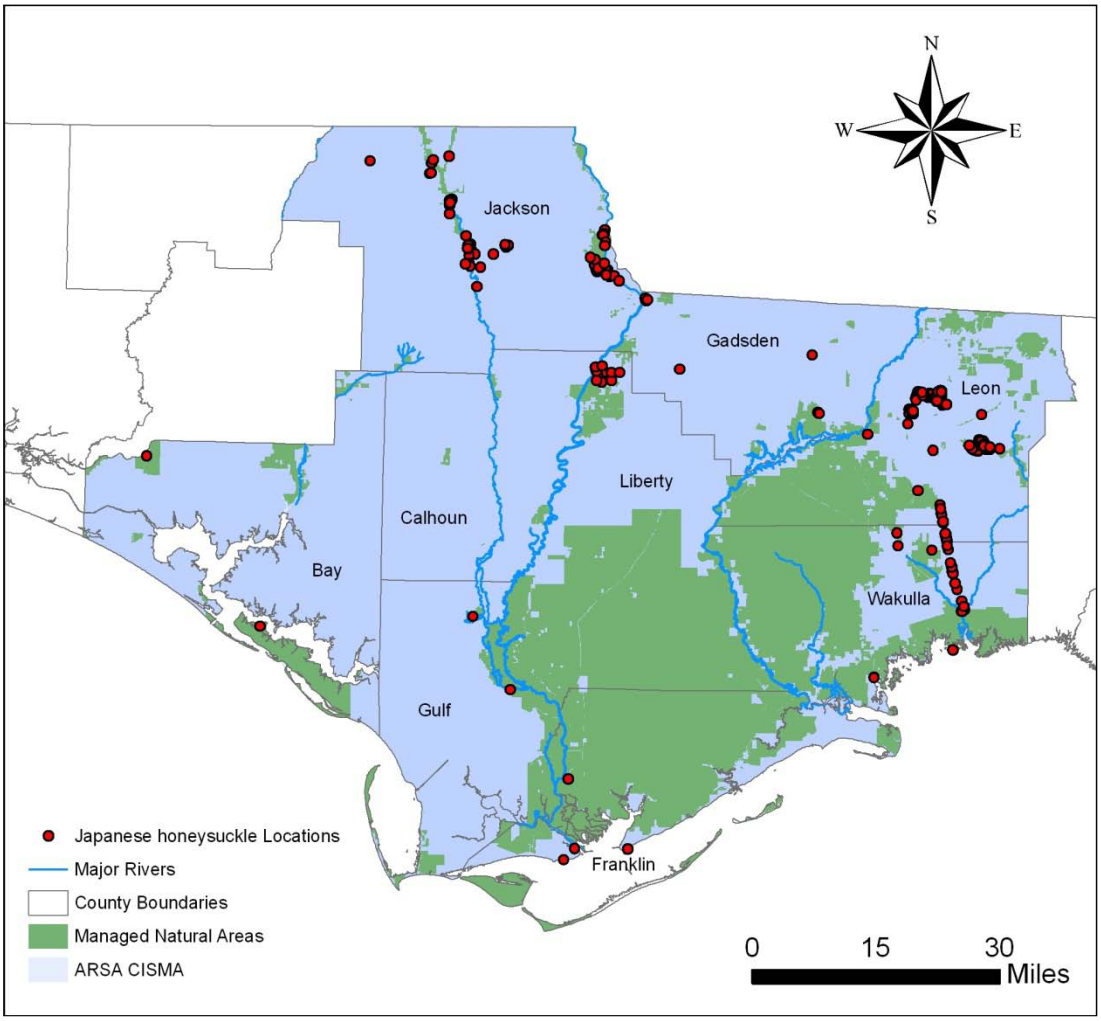


Figure 18. Japanese honeysuckle locations in the Apalachicola River region

Japanese climbing fern
Scientific name: *Lygodium japonicum*

Description
Japanese climbing fern is native to Eastern Asia and was most likely introduced to the U. S. in 1932 as an ornamental (United States Department of Agriculture Natural Resources Conservation Service 2006). Its current range in the U. S. extends from Florida west to Texas and north to North Carolina (Langeland and Craddock Burks 1998). It can be found in disturbed sites, including roadsides, ditches, and pine plantations and in natural areas such as floodplains and other riparian and upland sites. It is a FLEPPC Category I pest plant and a Florida Noxious Weed.

Impacts
Japanese climbing fern grows rapidly, dominating understory plants and reducing regeneration from native seedlings (Langeland and Craddock Burks 1998). Spores can be transferred easily on human clothing, vehicles, and by feral hogs and other wildlife. High winds and rainfall from hurricanes are also vectors of spore dispersal. There have been numerous reports of Japanese climbing fern in pine straw bales that are collected on pine plantations and sold as landscaping mulch (Zeller and Leslie 2004), which is another cause of its wide distribution in north Florida. It is illegal in Florida to transport or sell pine straw that has Japanese climbing fern in the bale.

Goals and Objectives
Goal: Maintenance control.
Objectives:
1. Identify priority areas and prevent encroachment or initiate control, especially in the floodplain.
2. Reduce population by managing infestations as resources allow.
3. Prevent spread of the plant to other natural areas.
   A. Encourage private land owners to manage climbing fern on their property to limit its spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.
   B. Encourage DOT and private contractors to treat Japanese climbing fern along roadways, refrain from mowing when spores are present, and clean equipment properly.
   C. Reduce transport of the plant from commercial pine straw operations. It is illegal to transport pine straw if Japanese climbing fern is present in the plantation. However, some pine straw operations do not comply and sell bales in other states. Please report any such occurrences to the appropriate Florida Department of Agricultural and Consumer Services-Division of Plant Industry district inspectors at the following website: http://www.doacs.state.fl.us/pi/plantinsp/pi_inspectordirectory/r1a1.html
   D. If working in an area where sporing leaves are present, clean equipment and clothing before leaving the site and do not drive vehicles directly onto the site (Hutchinson and Langeland 2006).

4. Encourage research for biological control agents.
5. Encourage listing as a Federal Noxious Weed.

Management Options

Recent studies suggest that herbicide treatments are the most effective control method for Japanese climbing fern (Van Loan 2006b).

Biological: The fungus *Punninia lygodii,* identified from Louisiana and Central and North Florida and has been reported to attack Japanese climbing fern in North Florida in November and December, but is not a significant predator (Van Loan 2006a).

Researchers at the USDA Agricultural Research Service in Fort Lauderdale, Florida are currently conducting research on biological controls for old world climbing fern (*L. microphyllum*). However, because of risks to the native American climbing fern (*L*. *palmatum*), the potential for biological controls specific to Japanese climbing fern is limited and researchers are focusing on tropical biological control agents specific to old world climbing fern (R. Pemberton pers. comm.).

Chemical: Recent studies by Van Loan (2006b) concluded that treatments with glyphosate and imazapyr are the most effective and less costly than other chemicals. Herbicides were applied using a CO2 pressurized hand-held boom sprayer at 20-gallons per acre. The treatments concluded to be most effective (i.e. those with at least 70% foliar damage for up to 12 months after treatment) were studied at the following concentrations:

Glyphosate -2.5%
Glyphosate- 5%
Glyphosate + imazapyr-2.5% + 0.94%
Glyphosate + metsulfuron- 2.5% + 0.075 oz/gal
Imazapyr- 0.94%
Metsulfuron + imazapyr- 0.075 oz/gal + 0.94%

Van Loan recommends checking treated sites after six months (or 12 months if resources do not allow earlier visits) to monitor efficacy. Multiple treatments may be necessary, depending on surrounding areas that may have the plant and serve as a spore bank. Effective treatments may leave an opening for new infestations of climbing fern or other non-native invasive species, so restoration may be required. Van Loan also notes that glyphosate and imazapyr may negatively impact non-target vegetation, which may affect management goals for land managers.

Another study performed by Zeller and Leslie (2004) showed that foliar sprays with the brand name Escort© (metsulfuron methyl 60%) with 0.5% surfactant at 1–2 ounces per acre were effective long term with little harm to surrounding native plants. The same study found the brand name Accord© (glyphosate 41.5%) with 0.5% surfactant at 2–6 quarts per acre to be effective, but with much harm to surrounding native plant systems.

Distribution in the Region

Distributional data for Japanese climbing fern has been collected by the CISMA throughout the region (Figure 19). There are locations in the Apalachicola floodplain where the understory is blanketed by this species.

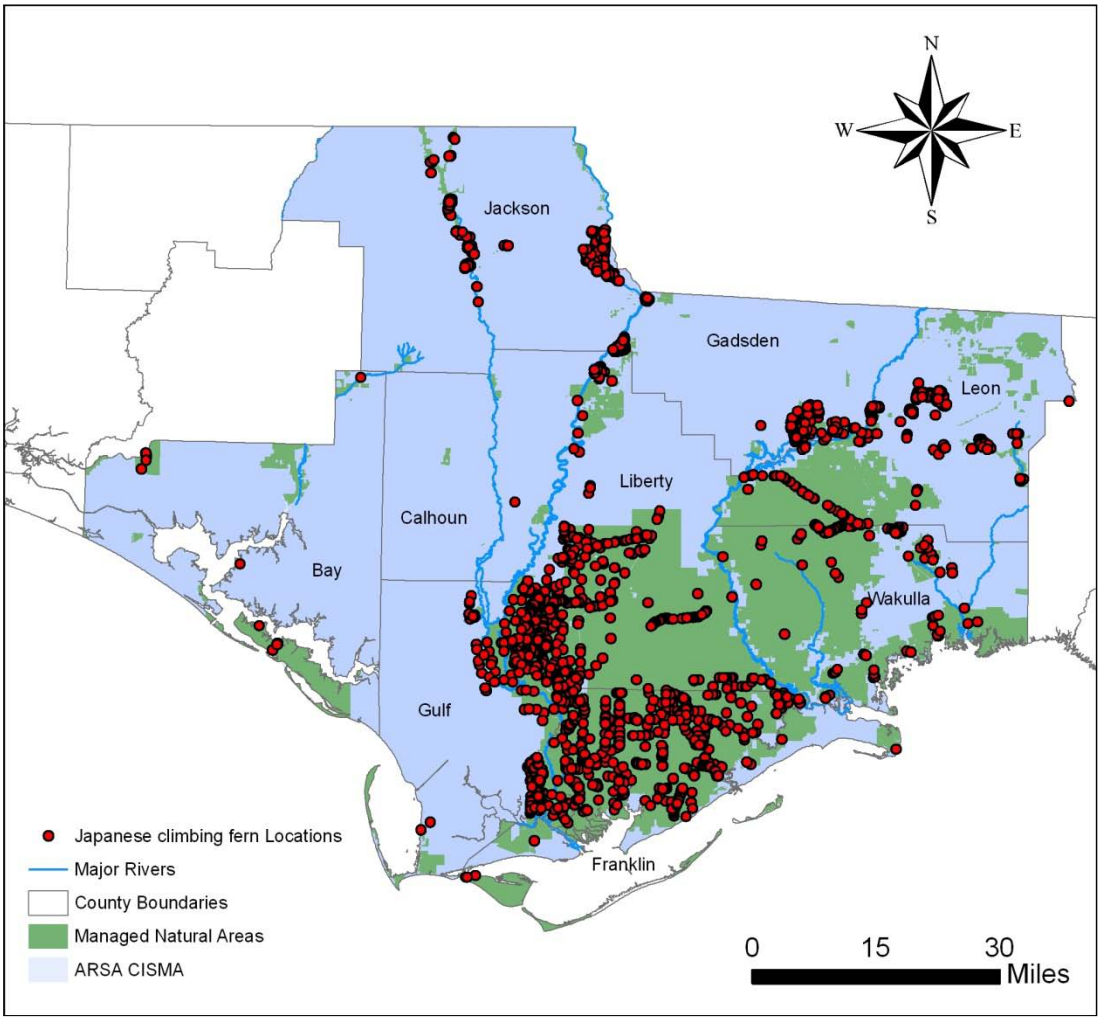


Figure 19. Japanese climbing fern locations in the Apalachicola River region

Chinaberry
Scientific name: *Melia azederach*

Description
Chinaberry is a perennial tree that can reach heights of 50 feet and is native to Southeast Asia and Australia. It was introduced to the U. S. as an ornamental in the mid 1800s (United States Department of Agriculture Natural Resources Conservation Service 2006). Its current range in the U. S. extends from Florida across the southern states to California and as far north as Maine (Batcher 2000d). It can be found in disturbed areas such as roadsides and forest edges, and has also been located in natural areas such as floodplains, hammocks, marshes, and various upland habitats. It is a FLEPPC Category II pest plant.

Impacts
Chinaberry can form dense monocultures, out-competing native species. It reproduces vegetatively and via seeds, which are widely dispersed by birds. Its leaf litter has been shown to change soil chemistry by increasing pH and nitrogen levels (Batcher 2000d). Chinaberry has also been reported to be highly tolerant of insects and plant pathogens, giving it an advantage over native species (Batcher 2000d). The berries are toxic to humans and other mammals.

Goals and Objectives
Goal: Eradicate chinaberry from natural areas.
Objectives:
1. Identify populations within managed areas and conduct annual monitoring, especially in the floodplain.
2. Reduce population by managing infestations.
3. Prevent spread of the plant to other natural areas. Encourage private land owners to manage Chinaberry on their property to limit its spread to natural areas. Refer landowners to Environmental Quality Incentive Program (EQIP), Wildlife Habitat Incentive Program (WHIP), Landowners Incentive Program (LIP), and Forest Stewardship for invasive management funding opportunities.

Management Options
Chemical: Foliar sprays require more herbicide, especially for larger infestations. Stem injections reduce cost and non-target damage. Basal bark and cut-stump methods have been reported to be very effective but can be time consuming.

- *Basal bark*:
    1. Trees: Apply a 10% solution of Garlon 4© (triclopyr ester) in an 8 inch band from the ground. A 4 inch band of Pathfinder II© (triclopyr ester) applied to the trunk base has also been effective (Batcher 2000d).
    2. Saplings: Apply a 20% solution of Garlon 4© in basal oil, diesel fuel, or kerosene with a penetrant (Miller 2003).
- *Cut stump*: Apply 8% solution of triclopyr ester immediately after cutting (Batcher 2000d).
- *Foliar*: Thoroughly wet leaves. Miller 2003 suggests:

1. Saplings: 20% solution of Garlon 4© in basal oil, diesel fuel, or kerosene with a penetrant.
2. Seedlings: 2% solution of Garlon 3A© (triclopyr amine) or Garlon 4© in water with a surfactant. 1% solution of Arsenal AC© (imazapyr) in water with a surfactant.

- *Stem injection*: Arsenal AC©, Pathway© (2,4-D and picloram), Pathfinder II©, or Garlon 3A© in dilutions are recommended (Miller 2003).

Distribution in the Region

Distributional data for chinaberry has been collected by the CISMA in various locations in the region (Figure 20). It is especially common along roads, though data has not been collected on all sites where the species has been reported. The floodplain forest located below the bridge between Bristol and Blountstown (SR 20) is heavily infested.

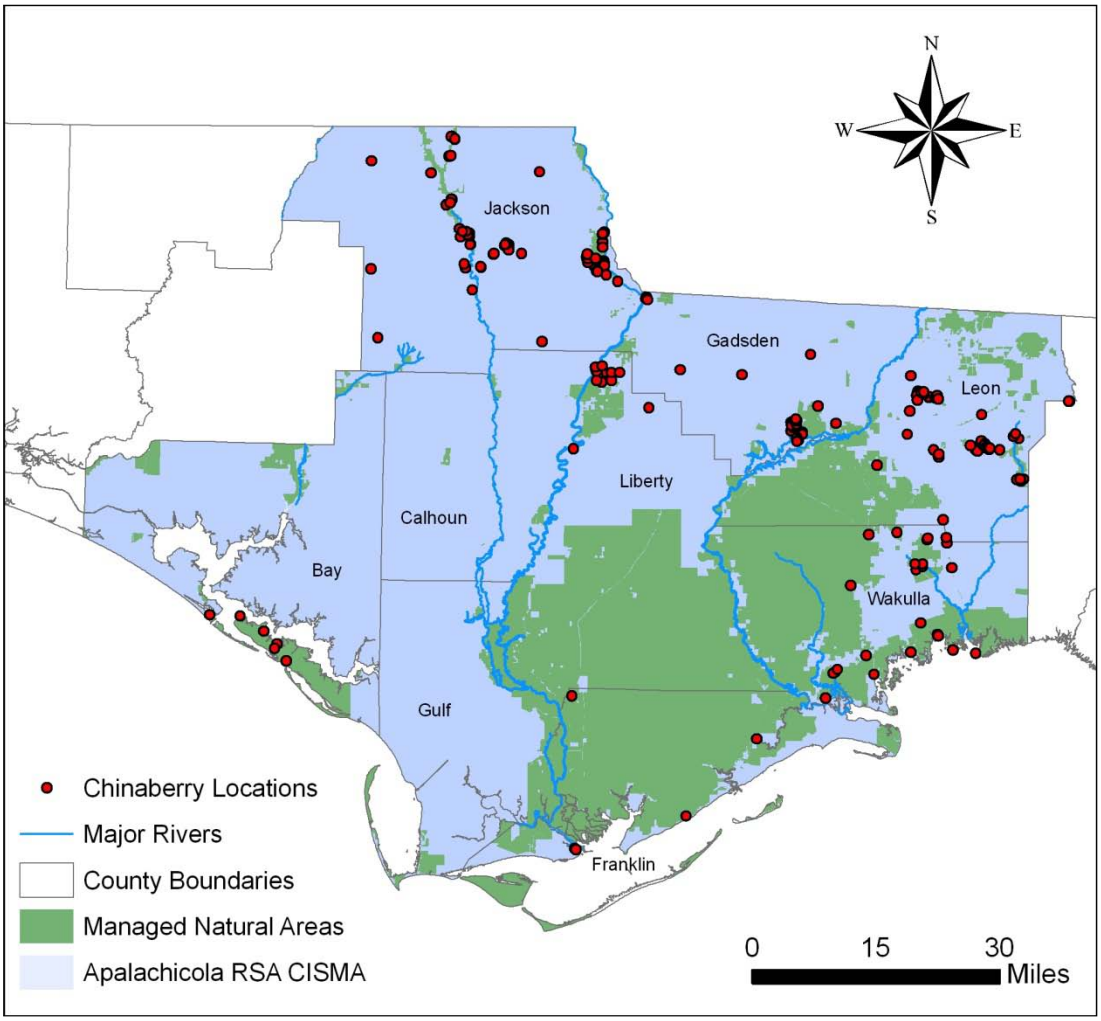


Figure 20. Chinaberry locations in the Apalachicola River region

Nandina
Scientific name: *Nandina domestica*

Description
Nandina is an evergreen shrub native to Eastern Asia and India. It was introduced to the United States in the 1800s as an ornamental (Langeland and Craddock Burks 1998). Its current range in the U. S. extends from Florida to Texas and north to Virginia (United States Department of Agriculture Natural Resources Conservation Service 2006). It can be found along forest edges, floodplains, and woodland habitats. It is a FLEPPC Category I pest plant. Another common name for nandina is heavenly bamboo.

Impacts
Nandina can form dense groves in the understory of forests, displacing native vegetation. Seeds are dispersed widely by birds (Langeland and Craddock Burks 1998).

Goals and Objectives
Goal: Eradicate nandina from natural areas.
Objectives:
1. Monitor populations in Angus Gholson Jr. Nature Park of Chattahoochee, Three Rivers State Park, and Florida Caverns State Park, all which have been treated. Re-treat as necessary and possibly initiate restoration projects.
2. Survey in natural areas within proximity to urban areas because of its retail as an ornamental.
3. Prevent spread of the plant to other natural areas. Encourage private land owners to manage nandina on their property to limit its spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.
4. Encourage nurseries not sell it as an ornamental.

Management Options
Chemical: Miller 2003 recommends:
- *Basal bark*: 20% solution of Garlon 4© (triclopyr ester) in basal oil, diesel fuel, or kerosene with a penetrant.
- *Cut-stump*: Apply the following immediately after cutting:
    1. 10% solution Arsenal AC© (imazapyr) in water with a surfactant.
    2. 20% glyphosate in water with a surfactant.
- *Foliar*: 1% glyphosate solution in water with a surfactant applied from August to October.

Mechanical: Fruit can be collected and destroyed (Miller 2003). Nandina fruits in the fall and winter (Langeland and Craddock Burks 1998). Hand pulling of this plant is difficult because of long tap root (NatureServe 2006).

Distribution in the Region

Distributional data for nandina has been collected by the CISMA in various locations in the region (Figure 21). There are sizeable populations of nandina in Angus Gholson Jr. Nature Park of Chattahoochee, Florida Caverns State Park, and Three Rivers State Park.

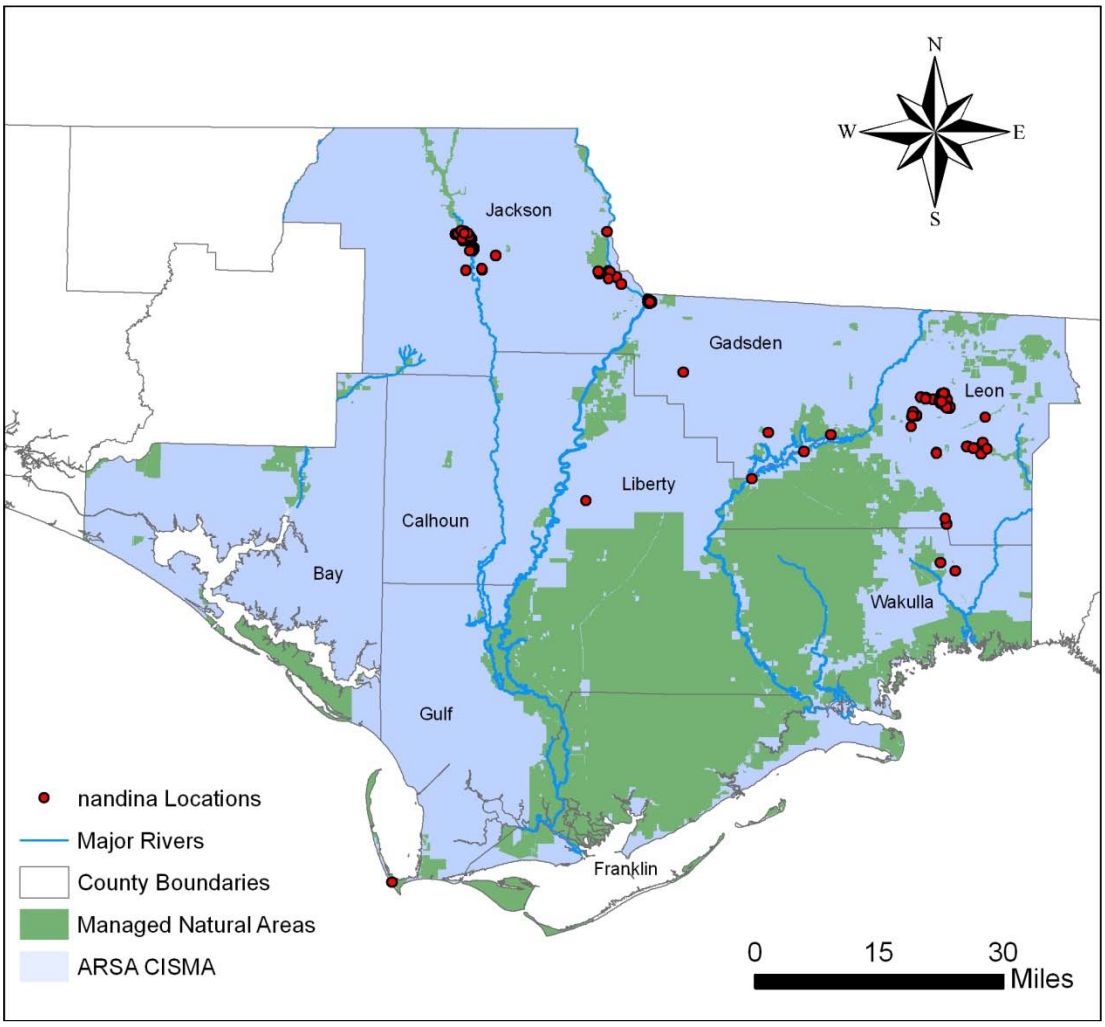


Figure 21. Nandina locations in the Apalachicola River region

Skunk vine
Scientific name: *Paederia foetida*

Description
Skunk vine is a climbing perennial vine native to Asia. It was introduced to the U. S. in the late 1800s by the U. S. Department of Agriculture (USDA) as a fiber plant (Langeland and Craddock Burks 1998). Current distribution in the U. S. is limited to the southeastern states and Hawaii. Skunk vine can be found in a variety of natural, disturbed, and agricultural sites and in various soils types and climactic conditions (VanDriesche et al. 2002). It is a FLEPPC Category I pest plant and a Florida Noxious Weed.

Impacts
Skunk vine can form dense monocultures, covering native vegetation. It can also grow into the canopy of trees, reducing their ability to reach sunlight (United States Department of Agriculture Forest Service et al. 2006).

Goals and Objectives
Goal: Prevention.
Objective:
1. Identify infestations from Wunderlin and Hansen (2004) and initiate rapid response.
2. Conduct surveys for skunk vine and initiate rapid response if found in other natural areas.
3. Prevention measures.
   A. Address private landowners who may have the plant on their property. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.
   B. Educate land managers and staff on identification and potential impacts.

Management Options
Biological: Research has not been conducted (VanDriesche et al. 2002).

Chemical: The following applications are recommended by Langeland et al. (2000); post treatment monitoring is necessary and reapplications may be needed:

- Garlon 3A© (triclopyr amine)
  1. Foliar spray of 4–8 pints per acre in water.
  2. Foliar spray of a 0.5% solution.
  3. Apply a 10% solution, 6-inch band chest high to leaves of vertically climbing vines.
- Garlon 4© (triclopyr ester)
  1. Foliar spray of 1.5–4.5 pints per acre in water.
  2. Foliar spray of a 0.2–0.6% solution.
  3. Apply a 1.0-10% solution, 6–20 inch band chest high to leaves of vertically climbing vines,.
- Brush-B-Gon© (triclopyr amine)

1. Foliar spray of 4 ounces per gallon of water.

- Plateau© (Imazapic)
    1. Foliar spray of 1.0–1.5% solution.

Mechanical: Hand pulling is appropriate for small infestations if all roots are extracted from the soil.

Distribution in the Region

Distributional data for skunk vine has been collected by the CISMA in Gadsden and Leon Counties (Figure 22).

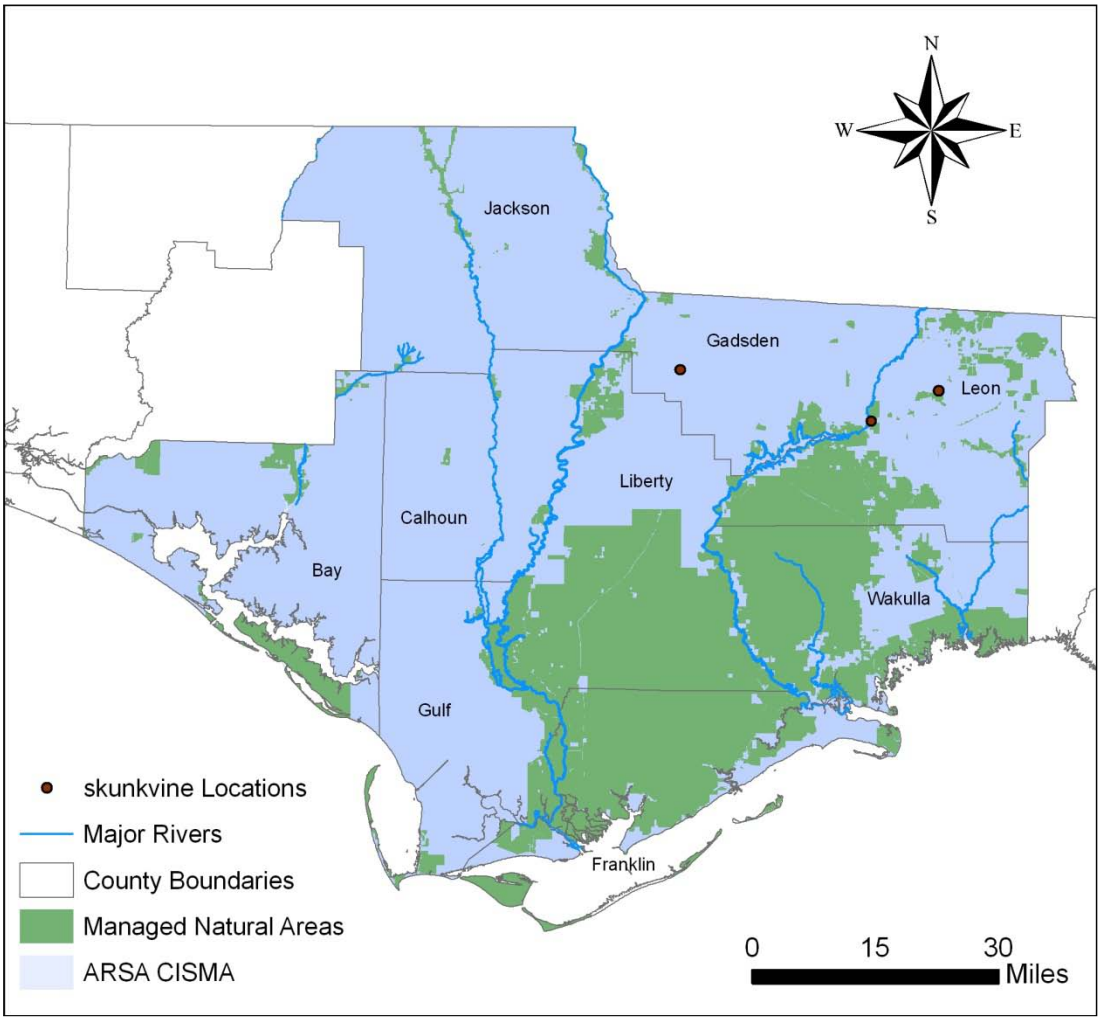


Figure 22. Skunk vine locations in the Apalachicola River region

Torpedo grass
Scientific name: *Panicum repens*

Description
Torpedo grass is a perennial grass native to Australia, Africa, and Asia. It was introduced in Florida as a forage crop around the 1950s (Langeland and Craddock Burks 1998). Its current range in the U. S. extends from Florida north to North Carolina and west to California. Torpedo grass can be found along ditches, canals, and lakes in sandy soils and can form large dense floating mats. It has also been found terrestrially in the U. S. It is a FLEPPC Category I pest plant.

Impacts
Torpedo grass has been particularly damaging to native marsh habitats because it spreads rapidly once established, out-competing native vegetation. Areas managed for flood control have also been affected by infestations of torpedo grass. Some agricultural areas have noted problems in crop systems (Langeland and Craddock Burks 1998).

Goals and Objectives
Goal: Maintenance control.
Objectives:
1. Initiate control measures on and adjacent to highly valued sites.
2. Prevent spread of the plant to other natural areas, especially reducing spread from fragments on construction equipment.

Management Options
Chemical: Herbicides containing the following active ingredients have been used against torpedo grass: glyphosate, imazapyr, and fluridone, (Vandiver 2002). Reports have shown that in order for herbicides to be effective against torpedo grass they must be absorbed completely by rhizomes located under the soil's surface (National Biological Infrastructure and Invasive Species Specialist Group 2005). Torpedo grass' extensive rhizome base makes it hard to control and several treatments are likely to be needed.

- *Foliar*: 0.75–1.5% Rodeo© with a surfactant have been reported as effective (Langeland and Stocker 1997).

Integrated pest management: Studies performed at Lake Okeechobee have shown that prescribed burning followed by chemical treatments are effective in controlling torpedo grass (Bodle and Hanlon 2001). The fire reduces biomass and the new growth after the fire is more susceptible to herbicide, improving the efficacy of the application. Bodle and Hanlon recommend the brand Arsenal© (imazapyr) as a chemical treatment following a prescribed burn.

Land managers at TNC's Disney Wilderness Preserve in Kissimmee have found that an integrative management approach is effective. Large infestations of torpedo grass were treated with Habitat© (aquatic labeled imazapyr) and smaller ones with glyphosate.

Maidencane stems were transplanted onto the site by hand after the herbicide treatment. The native maidencane was able to reestablish and the torpedo grass effectively controlled (C. Matson pers. comm.).

Mechanical: Mechanical efforts have been widely ineffective because fragmented rhizomes create new plants and it is difficult to remove all roots (National Biological Infrastructure and Invasive Species Specialist Group 2005).

Distribution in the Region

Distributional data for torpedo grass has been collected by the CISMA in various locations in the Apalachicola River region (Figure 23).

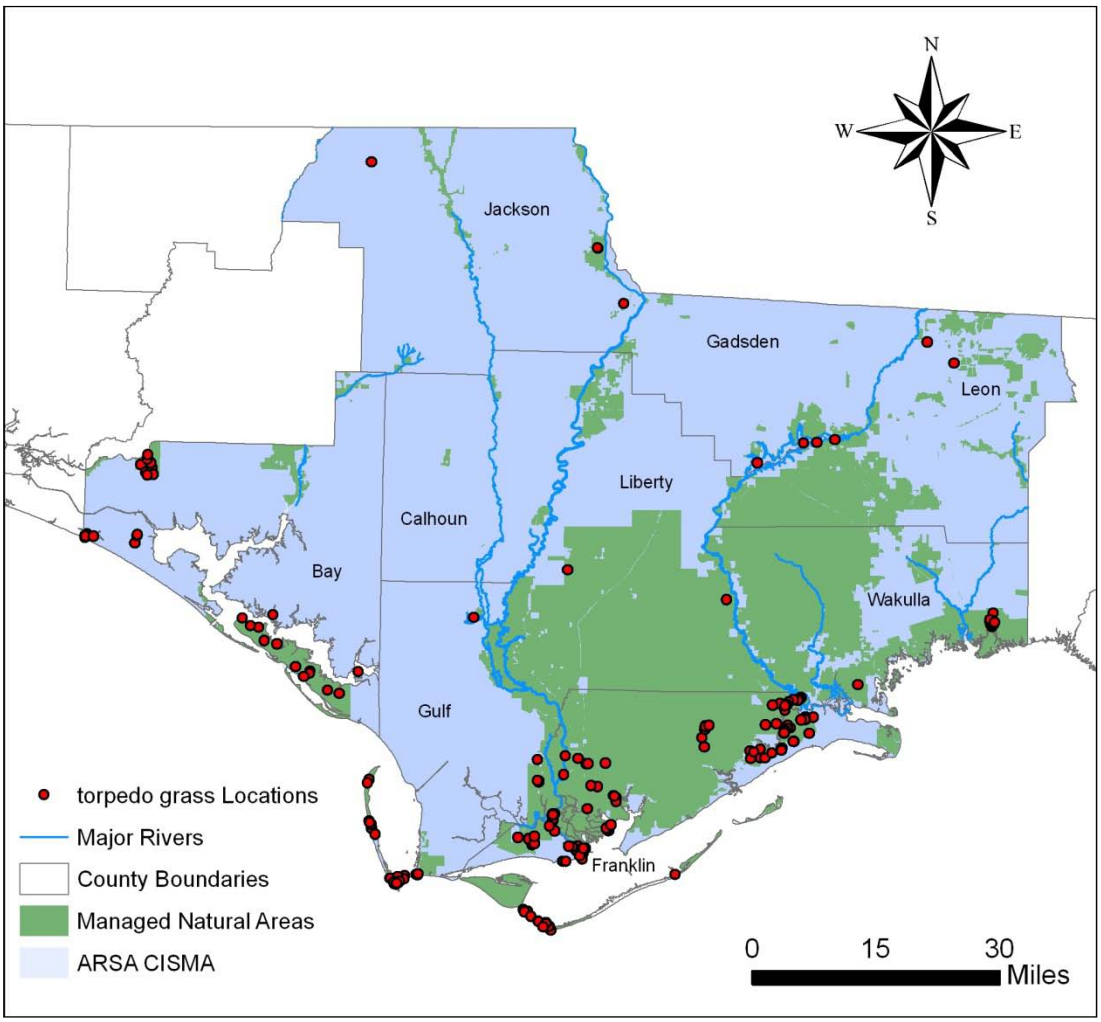


Figure 23. Torpedo grass locations in the Apalachicola River region

Phragmites
Scientific name: *Phragmites australis*

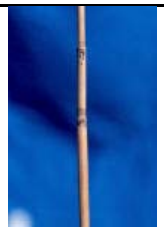
Description
Phragmites is a tall perennial grass found on every continent except Antarctica. The native range of phragmites is disputed because of its wide distribution (Marks et al. 1993). It is located throughout the U. S. and Canada and throughout the temperate climate zones. It grows in freshwater, brackish, and alkaline wetland habitats.
Another common name for phragmites is common reed.

Phragmites' status as a non-native invasive has been subject to much research, especially in the coastal northeastern Atlantic U. S. Studies have concluded that the plant has been in the U. S. since before the arrival of Europeans. However, studies also show that a non-native haplotype has been introduced and is dominating the native population in the northeast, resulting in a cryptic invasion (Saltonstall 2002, 2003). Genetic analyses were performed by Saltonstall (2003) to determine genetic differences in the native and non-native forms, including the native haplotype on the Gulf Coast. The haplotypes are very similar in appearance, but can be distinguished by slight morphological differences (B. Blossey pers. comm.).

The non-native form of phragmites has not been recorded in Florida (Wunderlin and Hansen 2004, K. Craddock Burks pers. comm.). Specimens from the ANERR during July 2006 were morphologically analyzed by researcher Bernd Blossey at Cornell University and reported to be a native haplotype (B. Blossey pers. comm.*).*

Blossey (2002a) created the following table to distinguish native and non-native haplotypes:

Table 3. Morphological differences between native and non-native haplotypes of phragmites

Trait	Native Haplotypes	Introduced Haplotypes (Haplotype M)	Gulf Coast (Haplotype I)
Leaf sheaths	Fall off in the fall or are easily removed if they stay on the stem.	Leaf sheaths stay on the plant, occasionally basal sheaths fall off the stem. Leaf sheaths are difficult to remove (use a twisting motion)	Leaf sheaths are loose, tight in the growing season. Sheaths start to fall off in the fall (starting in July).
Stem color at base (spring/summer) Note: Leaf sheath must be removed	Red to Chestnut 	Tan Very occasionally lower internodes show a brownish coloration in the winter.	Stems may have a reddish color in late summer after leaf sheaths begin to fall off. Stems may look redder on the edges of the population.
Stem color at base (winter) Note: Leaf sheath needs to be removed on introduced haplotype	 Light chestnut to light brown/gray	Tan 	No information provided
Stem texture Note: Run your finger across and up and down the stem after removing the leaf sheath	 Smooth and shiny (Looks polished. Often with dark spots [fungal attack] clustered at nodes in winter). Stem fungus absent in currently known Western and southwestern populations)	Rough and dull (Stems are ribbed. Ridges visible with naked eye. Occasionally basal internodes appear smooth)	Stems are shiny, glossy, and very large in diameter (up to 3cm)
Stem flexibility	High	Rigid	Not known
Stem toughness	Low	High	Not known
Stem density	Low 	High 	High

Time of Flowering	Early (July-August)	Intermediate (August - September)	Late (October-November)
Inflorescence	 Sparse Please note that sparse inflorescences do not automatically indicate native status!	Dense 	Not known
Senescence	Early Please note that native southwestern genotypes (3 examined in AZ) appear to be evergreen without senescing. Instead, stems branch at the top and lower leaves fall off.	Late	Not known
Leaf color	Yellow-green	Inland populations: Dark green/gray Coastal populations: yellow-green to dark green/gray	Yellow-green
Rhizome density	Low 	High	Not known
Rhizome color	Yellowish	White to light yellow. Rhizomes will darken after excavation	Not known
Rhizome diameter	Usually less than 15mm and almost perfectly round. Occasionally slightly compressed.	Few nodes less than 15mm, most >15mm. Mostly compressed (oval)	Not known
Clonal expansion rate	Slow	Rapid	Rapid
Habitat requirements	Potentially restricted. All examined native populations grow in moist soils. Sites can be under tidal influence but are never continuously inundated.	Wide range of conditions Introduced genotypes can grow on fairly dry sites and on sites where rhizomes are continuously inundated.	Not known

Although the non-native genotype has not been documented in our region, the plant is known to be weedy. Expanding populations of phragmites, native or non-native, are considered invasive, while stable populations (i.e., populations that are not expanding) are thought to be natural components of wetland habitats (Marks et al. 1993; Weinstein and Balletto 1999). Phragmites can become invasive when sites are disturbed, which includes altered hydrology, pollution, dredging, increased sedimentation, changes in salinity, and changes in nutrient concentrations, especially nitrates (NatureServe 2006).

A comparison of historical and current aerial photos of known sites may help to determine the extent to which phragmites may (or may not) be spreading.

Impacts

Expanding populations of phragmites can create dense monocultures, threatening native plant populations. Displaced populations of native plants due to a phragmites invasion have demonstrated negative effects for waterfowl because of lack of foraging opportunities (Marks et al. 1993). Food webs may also be changed when phragmites supplants native plants such as cordgrass (*Spartina* spp.) because it lowers the water table, thus reducing the influx of water from tidal flow and subsequently reducing habitat for fish during tidal inundation (Weinstein and Balletto 1999). It also has the potential to alter fire regimes in marsh habitats (NatureServe 2006).

Goals and Objectives

Goal: Prevent introduction of non-native haplotypes.

Objectives:

1. To determine whether populations of phragmites are expanding or not, especially populations in disturbed areas.
2. Identify populations of phragmites and measure diameter of the population. Compare current size of the population to historical aerial photos or data to determine if the population has grown significantly or misplaced native plant species.
3. Distribute information to land managers and scientists for morphological testing of native and non-native genotypes.

Management Options

Identification of expanding populations, especially in disturbed areas, is crucial to early management of the weed. Control of phragmites is not recommended, except possibly in areas where disturbance has allowed its rapid expansion and maintenance control is chosen by individual land managers.

Land managers have been using a variety of methods to deal with phragmites in the northeastern U. S. Managers at National Wildlife Refuges have reported that spraying glyphosate during late growing season is effective, along with prescribed fire or mowing to remove the dead stalks; retreatment is often necessary (Blossey 2002b).

Biological: Research of potential biocontrols against phragmites began in the U. S. in 1998. Biocontrols have been identified in Europe and the U. S. but further investigation is necessary to determine their viability for controlling this species (Van Driesche et al. 2002).

Chemical:

- *Foliar*:

1. Glyphosate (a mixture of commercial brand Rodeo©, water, and a surfactant) has been effective in managing phragmites. The herbicide is applied after the tasseling stage when the plant is supplying nutrients to rhizomes and the chemical is therefore transferred as well (Marks et al. 1993). This herbicide is not selective and may kill native grasses or broadleaved plants.
2. Diuron and imazapyr have also been used against phragmites (Vandiver 2002).
3. Habitat© (imazapyr) has also been recommended for use against phragmites (J. Bean pers. comm.).

Cultural: Prescribed fire can help to manage phragmites, but it will not kill it totally unless the rhizomes and roots are burned. This proves difficult because rhizomes and roots are usually submerged under water or soil (Marks et al. 1993).

Mechanical or Manual: Mowing will also help manage the weed, but does not kill rhizomes and so is ineffective as a true control method. Discing has also been used, but is ineffective because it can cause fragmentation of rhizomes leading to regrowth, perhaps even more rigorous than before the treatment.

Distribution in the Region

Distributional data for phragmites has been collected by the CISMA in the ANERR and Apalachicola Wildlife and Environmental Area (Figure 24).

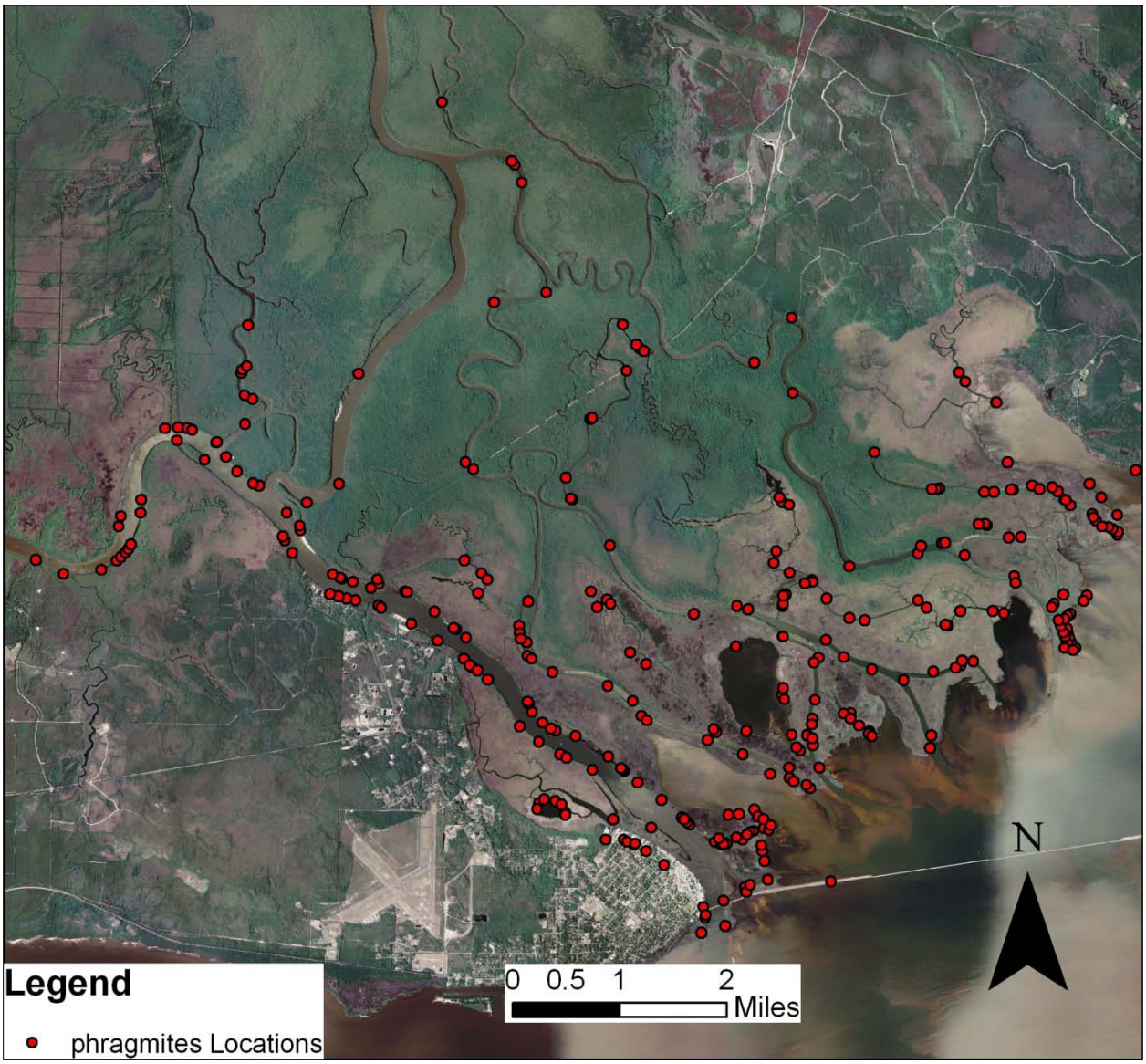


Figure 24. Phragmites locations in the Apalachicola River delta

Golden bamboo
Scientific name: *Phyllostachys aurea*

Description
Golden bamboo is a perennial reed-like species native to Asia, and was introduced to the U.S in 1882 as an ornamental (United States Department of Agriculture Forest Service et al. 2006). It has been documented in all of the southeastern U. S. north to Maryland, and in California and Oregon (United States Department of Agriculture Natural Resources Conservation Service 2006). It grows best in moist soils with full sunlight but can also be found in dry soils with some shade (United States Department of Agriculture Forest Service et al. 2006).

Several other species of bamboo have been introduced to the United States, primarily as ornamentals. The range of introduced bamboos stretches across the southeastern U.S and in some western states. Bamboos can reach heights of up to 40 feet (Miller 2003).

The native switchcane (*Arundinaria gigantean*) is often misidentified as a non-native bamboo. Switchcane can be found throughout the southeastern U. S. It is generally much smaller than the non-native species, only growing up to 8 feet, and has persistent sheaths (Miller 2003).

Impacts
Golden bamboo is fast growing and forms colonies from rhizome growth. It can quickly become a dense monoculture, especially in moist soils. Areas next to private lands where the species has escaped cultivation are potentially at risk.

Goals and Objectives

Goal: Eradicate from natural areas.

Objectives:

1. Identify populations within and surrounding managed areas and conduct annual monitoring.
2. Reduce populations by managing infestations.
3. Prevent spread of the plant to other natural areas. Encourage private land owners to manage bamboo on their property to limit its spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.

Management Options
Chemical:

- *Cut stump*: Cut all stems just above the ground when the ground is not frozen. 25% glyphosate and water (United States Department of Agriculture Forest Service et al. 2006). Swearingen et al. (2002) recommends re-treating two weeks after initial treatment.
- *Foliar*: Thoroughly wet all leaves when the temperature is above 65°F.
    1. 2% glyphosate in water with a 0.5% non-ionic surfactant (United States Department of Agriculture Forest Service et al. 2006).

2. 1% Imazapyr in water with a surfactant.
3. Combination of imazapyr and glyphosate (Miller 2003).

Mechanical or Manual: Mow infestation in the growing season. Plants will resprout so several cuttings are necessary. Treatment will take several growing seasons until nutrients stored in the rhizomes are depleted (United States Department of Agriculture Forest Service et al. 2006). This treatment is non-selective and not recommended in sensitive areas.

Distribution in the Region

Distributional data for golden bamboo has been collected by the CISMA in the lower Apalachicola region (Figure 25) and has been reported in the upper region as well.

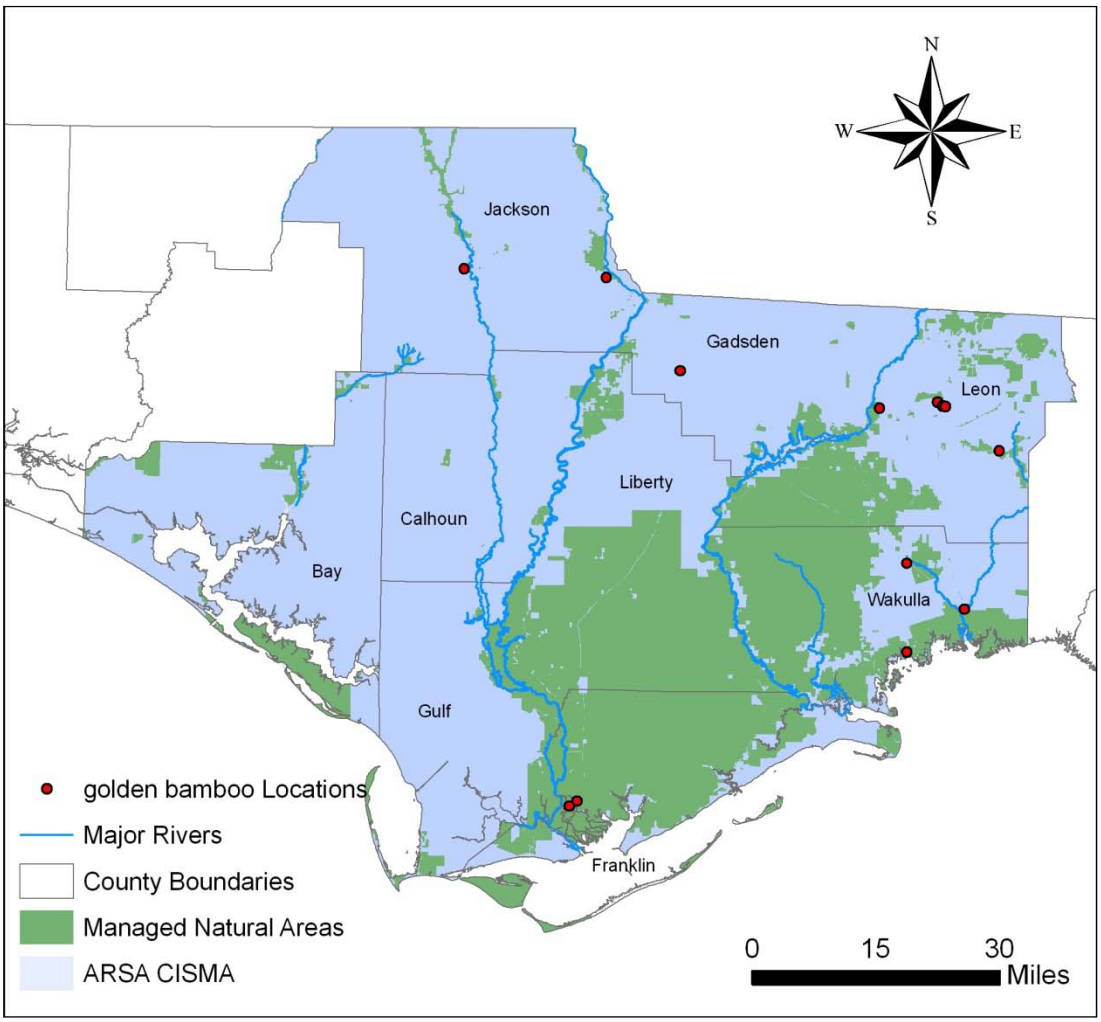


Figure 25. Golden bamboo locations in the Apalachicola River region

Kudzu

Scientific name: *Pueraria montana* var. *lobata*

Description

Kudzu is a climbing perennial vine native to Asia. It was introduced to the U. S. in 1876 at the Philadelphia Centennial Exposition where it was promoted as ornamental and as potential forage for livestock (Alien Plant Invaders of Natural Areas 2005). It was also sold by the USDA as an erosion control plant for road right-of-ways and ditches. The current range of kudzu in the U. S. extends across the southeastern states north to Pennsylvania and as far west as Oregon (Alien Plant Invaders of Natural Areas. 2005). It can be found mostly in disturbed areas including roadsides, abandoned fields and forest edges. It is a FLEPPC Category I pest plant, Florida Noxious Weed, and a Federal Noxious Weed.

Impacts

Kudzu can grow over native vegetation, forming dense mats and completely covering understory plants as it reaches for sunlight. It can climb into tree canopies, covering foliage and reaching heights of 100 feet (Alien Plant Invaders of Natural Areas 2005).

Goals and Objectives

Goal: Eradicate kudzu from natural areas.

Objectives:

1. Identify populations within managed area and conduct annual monitoring.
2. Reduce population by managing infestations.
3. Prevent spread of the plant to other natural areas.
    A. Encourage private land owners to manage kudzu on their property to limit its spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.
    B. Encourage DOT to manage kudzu in road right-of-ways.

Management Options

Management of kudzu is difficult when it has become well established. It is best to eradicate infestations as soon as they are identified. In order for eradication to occur every root crown must be killed (Munger 2002). The most successful treatment is an integrative pest management approach.

Biological:

- Goats and cattle have been used to control kudzu in some areas of the southeast, especially of dense infestations in disturbed areas. Defoliation of the plant results in weakened root systems, but will not completely eradicate them. Chemical treatments are recommended after intense foraging (Munger 2002). It is recommended to overgraze in August and September to minimize transfer of nutrients to roots (Miller 1996). This treatment is not recommended in natural areas because this is a non-selective control method.

- Research for pathogenic biocontrols began in the 1990s, including work in China and the U. S. Researchers in Mississippi found the fungus *Myrothecium verrucaria* to be effective. The fungus *Colletotrichum gloeosporiodes* has been researched in Georgia (VanDriesche et al. 2002).

Chemical: The following herbicides are registered for use against kudzu: glyphosate, imazapyr, sulfometurn, metsulfuron, fosamine, triclopyr, picloram+ 2,4-D, picloram, clopyralid, and dicambia + 2,4-D (Miller 1996). A careful inspection of the infected area is required for safety precautions and maximizing overall effectiveness (Miller 1996 is a kudzu specific source for chemical control options. See this source to identify which herbicides are appropriate for your site). Most sites will require a combination of mechanical, grazing or prescribed fire to maximize the use of chemicals.

Miller (2003) recommends the following treatments:

- *Basal bark*: 20% Garlon 4 (triclopyr ester) in basal oil, diesel fuel, kerosene with a penetrant from January to April.
- *Cut stump*: 2% glyphosate in water with a surfactant applied during growing season.
- *Foliar*: (may take several years to completely control):
    1. 3% Tordon 101© (2,4-D and picloram) in water with a surfactant from July to October.
    2. 2% Tordon K© (picloram) in water with a surfactant from July to October.
    3. 0.5% Transline© (clopyralid) in water from July to September.
    4. 3–4 ounces Escort© (metsulfuron) per acre in water from July to September.

Cultural: Prescribed burning during the dry season (February-March) will help to kill small plants and reduce foliage. However, burning will not kill root crown so the use of herbicides after the burn will be more effective once the leaf masses have been burned (Miller 1996).

Mechanical or Manual:

- Mowing can be effective to defoliate kudzu, eventually stressing the root crown enough to kill the vines, but will take several years of effort depending on the size of the patch. Mowing must occur at least twice a month (United States Department of Agriculture Forest Service et al. 2006). This is a non-selective control method and not recommended in sensitive natural areas.
- Small patches of kudzu can be removed by hand or with a weeding tool such as a pulaski or weeding rake, but root crowns must be fully extracted from the soil (Munger 2002).

<u>Distribution in the Region</u>

Distributional data has for kudzu has been collected by the CISMA in various locations of the Apalachicola River region (Figure 26).

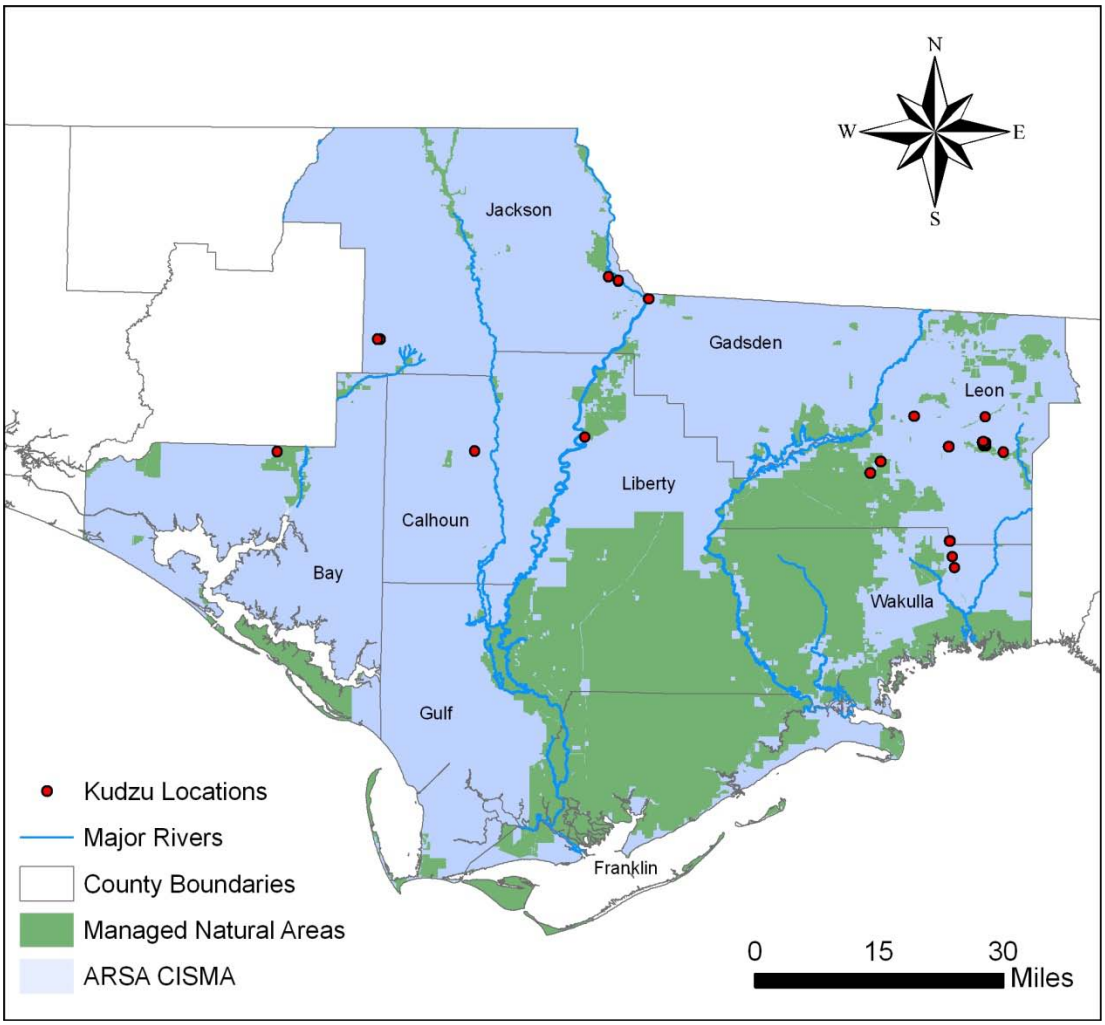


Figure 26. Kudzu locations in the Apalachicola River region

Mexican petunia

Scientific name: *Ruellia tweediana* (synonyms: *R. brittoniana, R. caerulea, and R. malacosperma)*

Description

Mexican petunia is a perennial herb native to Mexico. It was introduced to the U. S. as an ornamental and continues to be sold in nurseries and garden centers across the state. It has been documented throughout the southeastern U. S., Hawaii, and in the Caribbean (United States Department of Agriculture Natural Resources Conservation Service 2006). Mexican petunia can be found in moist soils especially in disturbed areas such as ditches or culverts close to yards (Hammer 2002). Mexican petunia is a FLEPPC Category I pest plant.

There are five native and three naturalized species of the genus *Ruellia* in Florida (Wunderlin and Hansen 2004). Other common names for Mexican petunia are Britton's wild petunia and Mexican bluebell.

Impacts

Mexican petunia can form dense monocultures; it can reproduce from seeds, rhizomes, stem sprouts, and cuttings.

Goals and Objectives

Goal: Prevention.

Objectives:

1. Monitor natural areas for Mexican petunia.
2. Eradicate Mexican petunia when it is found in natural areas.
3. Encourage private landowners not to use it as a landscape plant.
4. Encourage nurseries not to sell Mexican petunia.
5. Encourage research for effective control methods.

Management Options

Effective control options were not identified.

Hand pulling is not advised because Mexican petunia has underground seed banks and will continue to grow after above ground portion is pulled (Hammer 2002).

Distribution in the Region

Distributional data for Mexican petunia has been collected by the CISMA in Franklin County (Figure 27). It is widely used as an ornamental in yards on the Gulf Coast.

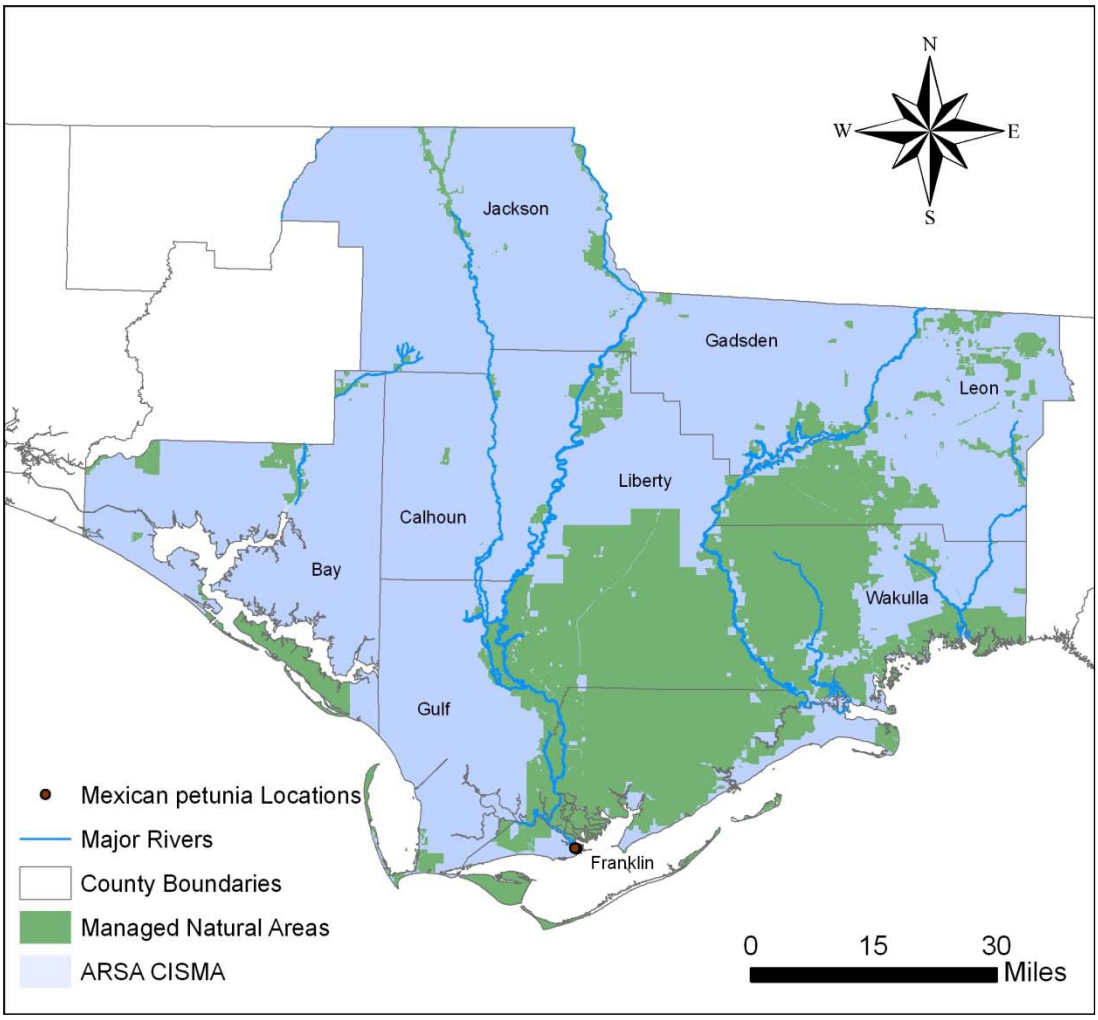


Figure 27. Mexican petunia locations in the Apalachicola River region

Chinese tallow
Scientific name: *Sapium sebiferum*

Description
Chinese tallow is a small to medium deciduous tree native to Japan and China. It was first introduced to South Carolina in the 1700s as an ornamental, a potential crop for tallow oil, and soap (United States Department of Agriculture Forest Service et al. 2006). Its current range extends from Florida to Texas and north from North Carolina to Arkansas; it has been recently discovered in California. It grows in dry and moist soils and can be found in a variety of disturbed and undisturbed habitats including lowlands, roadsides, coastal prairies, uplands, and riparian habitats (United States Department of Agriculture Forest Service et al. 2006). It is a FLEPPC Category I pest and a Florida Noxious Weed. Other common names for Chinese tallow are popcorn tree and tallow tree.

Impacts
Chinese tallow can form monocultures, out-competing native plants. Its leaf litter may alter soil conditions by increasing the levels of tannins and augmenting eutrophication (Bogler 2000), which is of special concern for the alluvial river where the food web is dependent on substrates carried from the floodplain forest. Chinese tallow reproduces vigorously by seeds, which are widely spread by birds and water; it can also reproduce vegetatively.

Chinese tallow has also been reported to significantly alter fire regimes by inhibiting the spread of fire by reducing fuel loads (McCormick 2005). Upland species such as flatwoods salamander, red-cockaded woodpecker, Harper's beauty, Florida skullcap require fire to maintain an open canopy and a change in fire cycle in the presence of tallow may negatively impact these federally listed species.

Goals and Objectives
Goal: Maintenance control.
Objectives:
1. Identify populations within managed areas, conduct annual monitoring. Prioritize sites located in the floodplain, in close proximity to flowing water, and upland sites where it may alter fire functions
2. Reduce population by managing infestations.
3. Prevent spread of the plant to other natural areas. Identify tallow on private lands and encourage land owners to manage it, especially infestations on private property close to flowing water. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.
4. Encourage further development of biological control agents currently under investigation.

Management Options
Chinese tallow is difficult to manage because of its adaptability to a range of habitats and soil compositions and its ability to reproduce vigorously (Bogler 2000). An approach that includes

both mechanical and chemical methods is recommended (McCormick 2005 is a good reference for Chinese tallow management options).

Biological: Research for biocontrols is currently underway. Several options have been identified in its native range, and researchers are hopeful that at least one of the insects will prove to be an effective biocontrol agent and can be released (Wheeler et al. 2007).

Grazing by goats and sheep may be effective for smaller trees.

Chemical: Treatments are most effective in late summer or early fall (Demers and Long 2002).

- *Basal bark*: Highly recommended treatment. This is most effective for smaller trees; large trees with thick bark may require the cut stump method. Apply a 20% solution of triclopyr ester and basal oil, diesel, or kerosene with a penetrant (Miller 2003).
- *Cut stump*: Apply 10 % solution of triclopyr ester (in oil), triclopyr amine (in water) (McCormick 2005).
- *Foliar*: For saplings and seedlings use the following treatment from July-October.
    1. 1% solution of Arsenal AC© (imazapyr) in water with a surfactant (Miller 2003).
    2. 30% solution of Krenite S© (fosamine) in water with a surfactant (Miller 2003).
    3. 2% solution of Garlon 4© (triclopyr ester) in water with a surfactant (Miller 2003).
    4. 3% solution of Garlon 3A (triclopyr amine) in water with a surfactant (Demers and Long 2002).

Manual:

- Hand pulling: Effective for small trees that have not flowered (usually less than three feet tall) if all roots are extracted from the soil (Bogler 2000).

<u>Distribution in the Region</u>

Distributional data for Chinese tallow has been collected by the CISMA in various locations throughout the region (Figure 28).

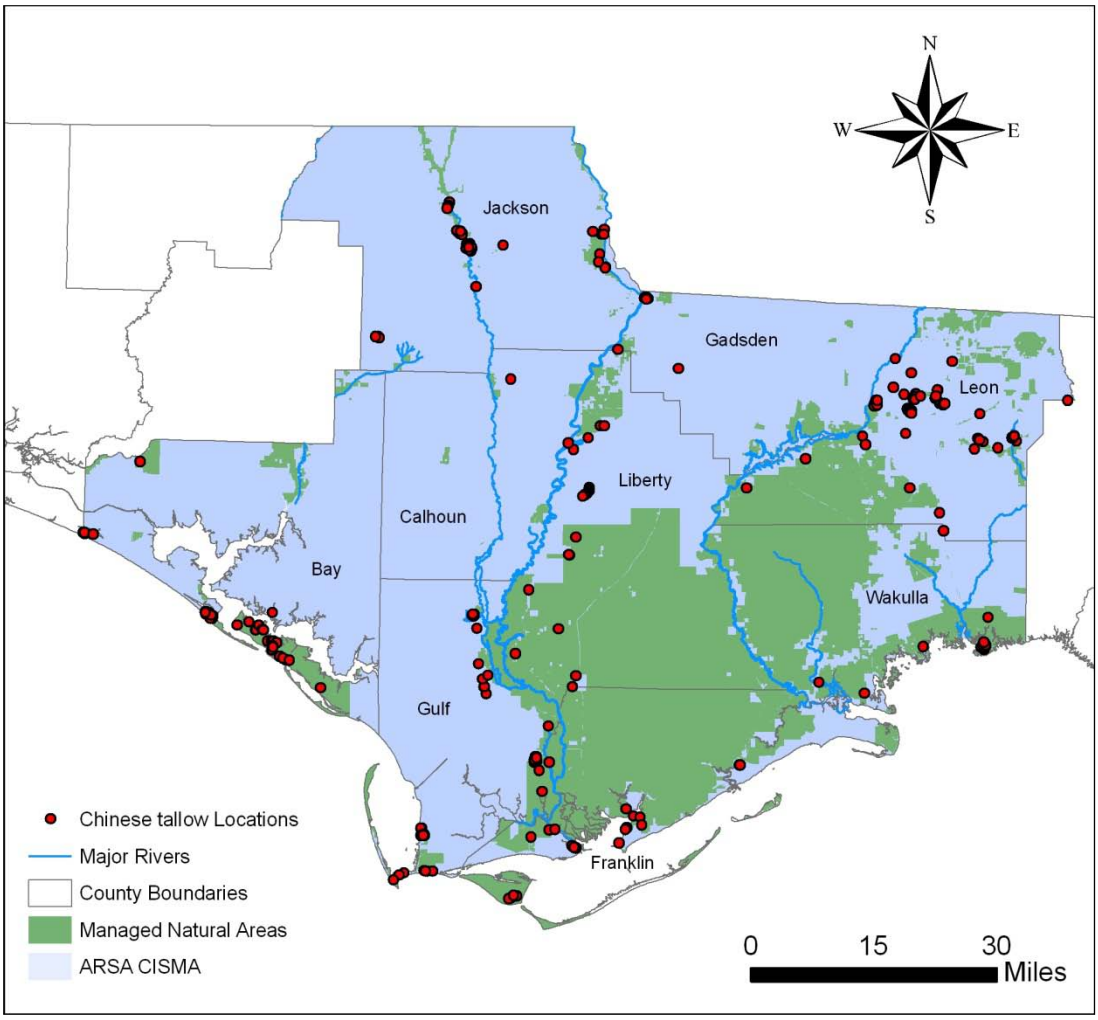


Figure 28. Chinese tallow locations in the Apalachicola River region

Rattlebox
Scientific name: *Sesbania punicea*

Description
Rattlebox is a small tree native to South America and was introduced to the U. S. as an ornamental. Its range in the U.S. extends from Florida north to Virginia and west to Texas. It is also a problem in California (California Invasive Plant Council 2006). The plant can be found in moist and dry soils in natural and disturbed sites. It is a FLEPPC Category II pest plant.

There are two native *Sesbania* species in the Apalachicola region, bladderpod (*S. vesicaria*) and danglepod (*S. herbacea*), which can both be found in wet or dry soils (Wunderlin and Hansen 2004). Other common names for rattlebox are purple sesban and Spanish gold.

Impacts
Rattlebox can form monocultures, especially along the edges of water bodies, displacing native ground cover and inhibiting recruitment of native species. Rattlebox is poisonous to most bird and animal species and can replace non-poisonous natives used as forage by wildlife (California Invasive Plant Council 2006).

Goals and Objectives

Goal: Eradicate rattlebox from natural areas.

Objectives:

1. Identify populations within managed area and conduct annual monitoring.
2. Reduce population by managing infestations.
3. Prevent spread of the plant to other natural areas.
    A. Encourage private land owners to manage rattlebox on their property to limit its spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.
    B. Educate land managers on identification.

Management Options
Biological: Three biological controls are used in South Africa, where rattlebox is a serious invader (Rice 1998). No biological controls have been released in the U. S.

Mechanical or Manual: Trees in standing water may be cut below the waterline without the use of chemicals to kill the plant (Rice 1998).

Chemical: Information on effective chemical control methods was not found.

- Foliar sprays of glyphosate (1%) and a mix of triclopyr amine and glyphosate (1% glyphosate and 1% triclopyr) have been ineffective (Rice 1998).

Distribution in the Region
Distributional data for rattlebox has been collected by the CISMA in various locations throughout the region (Figure 29). There is a significant population of rattlebox in the ANERR in

the salt marshes of the river delta. There is also a sizeable population in the Angus Gholson Jr. Nature Park of Chattahoochee and surrounding areas.

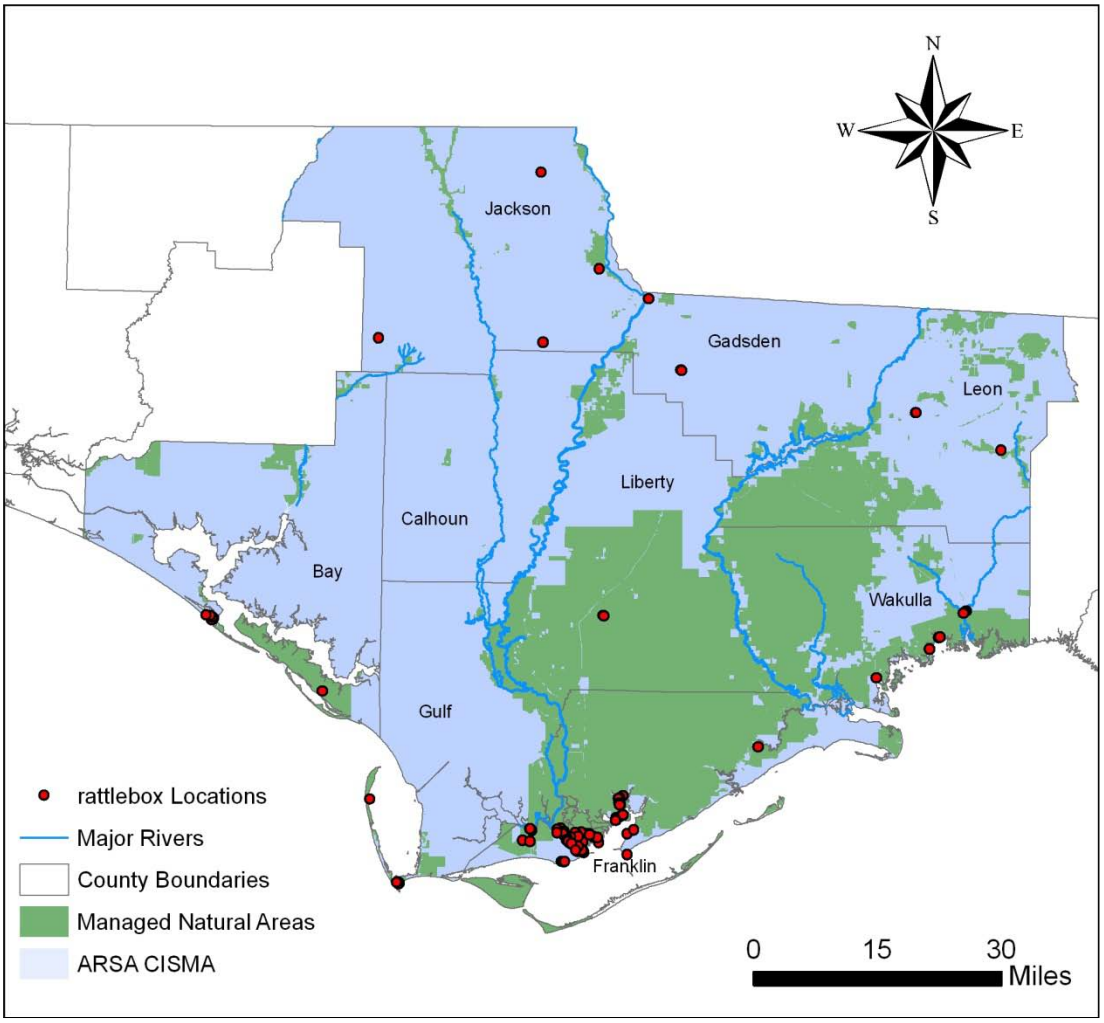


Figure 29. Rattlebox locations in the Apalachicola River region

Tropical soda apple
Scientific name: *Solanum viarum* Dunal

Description
Tropical soda apple is native to South America and was first found in Florida in the 1980s. The plant has been recorded as far north as Pennsylvania and west to Louisiana (Mullahey et al. 2006). Tropical soda apple can be found in disturbed sites such as pastures, ditch banks and roadsides, as well as natural areas such as hammocks (Van Driesche et al. 2002). It is a FLEPPC Category I pest plant, Florida Noxious Weed and a Federal Noxious Weed.

Impacts
Tropical soda apple can rapidly invade native grasslands, displacing native species. Agriculture in the central region of Florida has also been heavily affected by the species, as it will also overrun pastures, reducing stocking rates for cattle and other livestock (Mullahey et al. 2006).

Goals and Objectives
Goal: Prevent spread to natural areas.
Objectives:
1. Conduct monitoring for tropical soda apple to protect natural areas.
2. Address private landowners who may have the plant on their property and recommend management options. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.
3. Depending on known infestations, encourage release of biocontrols in the region.

Management Options
Prevention of the spread of tropical soda apple is the best way to manage this invasive because infestations are likely when the plants are allowed to seed. Biological controls are being investigated and the current recommended management of tropical soda apple involves both mechanical and chemical efforts. A recently released herbicide, Milestone© (in 2006) has proven very effective in controlling tropical soda apple (see herbicide section below) (Ferrell and Mullahey 2005). Individual plants can be dug up with a shovel, but make sure to move plants with seeds to a safe place (Mullahey and Hogue 2003).

Biological: Researchers in Florida are currently investigating several biocontrols against tropical soda apple. The pathogen tobacco mild green virus (TMGMV) has proven to effectively kill tropical soda apple in laboratory tests (University of Florida Department of Plant Pathology 2002). Researchers have applied for an experimental use permit and that will hopefully be issued in spring 2007, with a full release permit in fall 2007 or spring 2008 (R. Charudattan, pers. comm.*)*.

The tropical soda leaf beetle (*Gratiana boliviana*) was released in Florida in 2003 in Polk, Alachua, Hendry, and Sumter counties after being approved by USDA-Animal Plant Health Inspection Service-Plant Protection and Quarantine on May 7, 2003. The beetle is reported to defoliate the plant rapidly (Medal et al. 2003).

The flower feeding weevil (*Anthonomus tenebrosus*) has been under investigation at the Florida Biological Control Quarantine Laboratory in Ft. Lauderdale (Medal et al. 2002a).

Mechanical + Chemical: To control dense tropical soda apple patches in North Florida the following practices are recommended:

1. Mow the infected area in April when the plant begins to flower.
2. In late May–early June spray entire foliage of plants with the following solution: Remedy© (triclopyr ester) - 1 quart/acre with 0.10–0.25% nonionic surfactant in 40 gallons of water.
3. Monitor infestations and spot-spray, making sure to cover all leaves, in August-September with the following solution: Remedy©- 0.5% solution with 0.10–0.25% nonionic surfactant and color marker.
4. Wait until the following spring and use the aforementioned spot-spray method in April, and again in late June–early July. Repeat the following year until all plants are killed.

This method will require several years of aggressive application. The key is to not allow the plants to produce seeds. The spot spray method can be used for small populations. (Information adapted from Mullahey et al. 2006 and Mullahey 2005).

Chemical: Milestone© (aminopyralid) has been reported to be the most effective herbicide for tropical soda apple. Mowing prior to treatment is unnecessary and the treatment has been reported to control germinating seedlings for more than six months after treatment. Apply 5–7 ounces per acre (7-ounce doses are recommended when there are large quantities of seeds on the ground) in 20 gallons of water with 0.25% surfactant. Plants must be covered completely by the solution (Ferrell and Mullahey 2005).

Milestone© can also be applied to individual plants in the following formula:

- *Foliar*: 0.5–0.8 ounces per 2.5 gallon with a 0.25% nonionic surfactant and a color marker. Make sure to cover the entire plant (Ferrell and Mullahey 2005).

Miller (2003) recommends the following treatments (make sure to cover all leaves and stems):

- *Foliar*:
    1. 2% solutions of Garlon 4© (triclopyr ester), Remedy© (triclopyr ester), Arsenal AC© (imazapyr) in water with a surfactant.
    2. 3% solution of glyphosate.

<u>Distribution in the Region</u>

Distributional data for tropical soda apple has not been collected by the CISMA in the Apalachicola region (Wunderlin and Hansen 2004); however, it has recently been reported in Jackson County agricultural areas (C. Smith pers. comm.). It has also been documented in the Ocklockonee River watershed (Wunderlin and Hansen 2004).

Wandering jew
Scientific name: *Tradescantia fluminensis*

Description
Wandering jew is a perennial herb native to Brazil, where it is considered an agricultural weed. It was brought to the U.S as an ornamental and continues to be sold as such (Langeland and Craddock Burks 1998). It has been documented in Florida, Georgia, Alabama, Louisiana, California and Kentucky (United States Department of Agriculture Natural Resources Conservation Service 2006). Wandering jew can be found in both disturbed and undisturbed sites, especially hammocks, and in wet and dry soils (Langeland and Craddock Burks 1998). Wandering jew is a FLEPPC Category I pest plant. Other common names for wandering jew are white-flowered wandering jew and small leafed spiderwort.

Impacts
Wandering jew can create dense monocultures in the understory of forests, out-competing native vegetation (Langeland and Craddock Burks 1998). It is especially invasive in wetlands (Standish et al. 2001). The plant continues to be sold in nurseries and may spread from private lands that use it as an ornamental. Disturbed areas that have increased sunlight or soil nutrient influx are particularly susceptible to invasions (Standish 2005).

Goals and Objectives
Goal: Maintenance control.
Objectives:
1. Promote awareness of this species. It has been documented in the floodplain, and is receiving little attention.
2. Survey for populations, especially in the floodplain. Prioritize areas that are sensitive where an infestation would impede native vegetation.
3. Manage known infestations.
4. Contact private landowners who may have the plant on their property. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.
5. Survey for populations on private lands where it may be used as an ornamental.
6. Discourage sale of this species in nurseries and garden centers.

Management Options
Chemical: Triclopyr amine has been used to treat wandering jew, though it may kill non-target species and repeated applications are necessary (Standish 2005).

Mechanical: Hand pulling of a similar species, tall oyster plant (*T. spathacea*), is recommended by Langeland and Stocker (1997), however, it can reproduce vegetatively and the entire root system must be extracted from the soil. The same method can be used for wandering jew.

Distribution in the Region

Distributional data for wandering jew has been collected by the CISMA in the Apalachicola River floodplain, Liberty County (Figure 30). There are also documentations of the species in Calhoun and Leon Counties (Wunderlin and Hansen 2004).

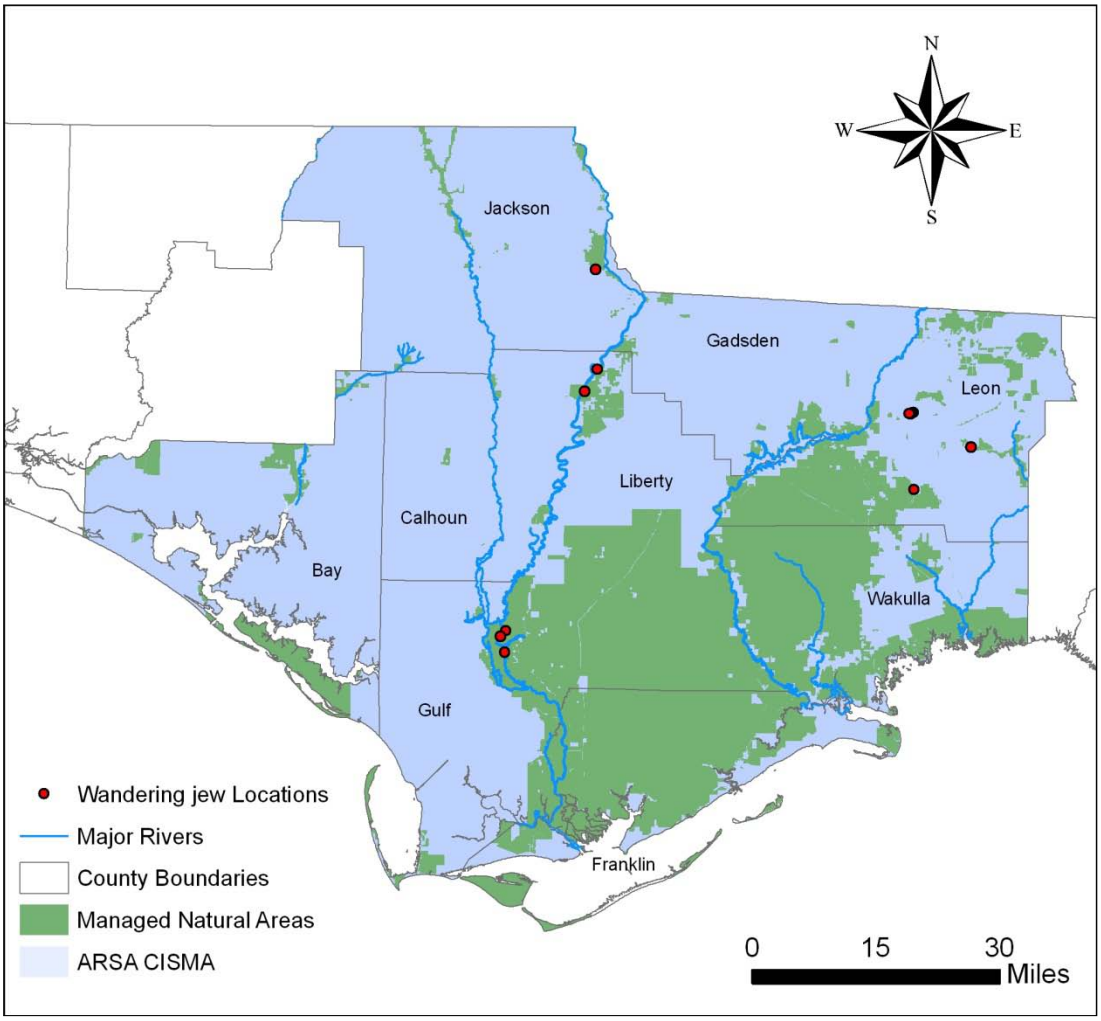


Figure 30. Wandering jew locations in the Apalachicola River region

Chinese wisteria
Scientific name: *Wisteria sinensis*

Description
Chinese wisteria is a deciduous woody vine native to China. It was introduced to the U. S. in 1830 as an ornamental (United States Department of Agriculture Forest Service et al. 2006). Its range in the U. S. extends from Florida to Texas, north from Vermont to Michigan, and in Hawaii (United States Department of Agriculture Natural Resources Conservation Service 2006). Chinese wisteria can be found in natural areas, and in disturbed sites including roadsides, forest edges, and ditches. It prefers sunny locations, but can be found in partial shade (Remaley 2005). It is a FLEPPC Category II pest plant.
The native wisteria, American wisteria (*W. frutescens*) is present in the region and may be confused with Chinese wisteria (Wunderlin and Hansen 2004). American wisteria can be found in the floodplain and upland thickets. The major differences between the two species are the pods (American wisteria pods are glabrous and Chinese wisteria pods are pubescent) (Clewell 1988) and growth habit (Chinese wisteria often girdles trees and can be found climbing into tree canopies).

Impacts
Chinese wisteria can strangle native trees and shrubs by girdling trunks and stems. Once it has been established wisteria can form dense stands, out-competing native vegetation (NatureServe 2006).

Goals and Objectives
Goal: Eradicate wisteria from natural areas.
Objectives:
1. Identify populations within managed areas and conduct annual monitoring.
2. Reduce population by managing infestations.
3. Prevent spread of the plant to other natural areas. Encourage private land owners to manage wisteria on their property to limit its spread to natural areas. Refer landowners to EQIP, WHIP, LIP, and Forest Stewardship for invasive management funding opportunities.
4. Educate on identification between native and non-native.

Management Options
Chemical:
- *Cut stump*: Cut individual plants and immediately apply a 25% solution of glyphosate or triclopyr amine in water. Sprouts can be treated with a foliar spray recommended below (Remaley 2005).
- *Foliar*:
    1. 2% glyphosate or triclopyr amine in water with a 0.5% non-ionic surfactant.
    2. 0.5% Chlorpyralid in water with a 0.5% non-ionic surfactant (Remaley 2005).

Miller (2003) recommends the following foliar treatments, all of which may require several applications:

3. 3% solution of Tordon 101© (picloram and 2-4, D) in water with a surfactant applied July-Oct.
4. 2% solution of Tordon K© (picloram) in water with a surfactant applied July-Oct.
5. 4% solution of Garlon 4© (triclopyr ester) in water with a surfactant applied July-Oct.
6. 0.5% solution of Transline© (clopyralid) in water with a surfactant applied July-Sept.
7. Repeated applications of a 2% solution of glyphosate applied in September and October.

Mechanical or Manual: Young plants can be hand pulled if all roots are extracted from the ground. Larger plants can be cut at the stem flush to the ground, but further monitoring is needed because sprouts will grow out of the cut stump. Sprouts can be treated with herbicide or cut until root base is expired (Remaley 2005).

Distribution in the Region

Distributional data for Chinese wisteria has been collected by the CISMA in various locations in the region (Figure 31).

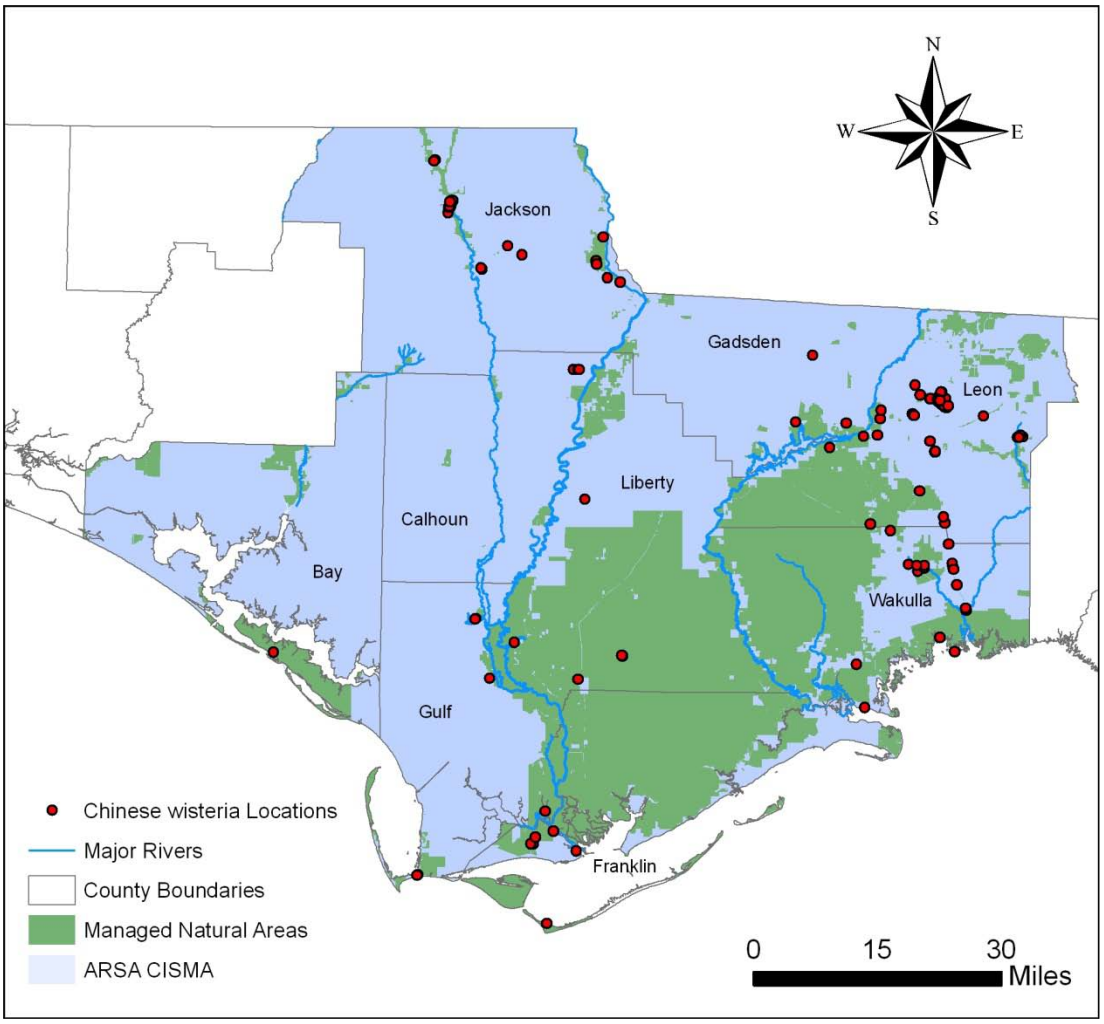


Figure 31. Chinese wisteria locations in the Apalachicola River region

Aquatic Plants

Table 4. Aquatic non-native invasive plants of the Apalachicola River region

Scientific name	Common name
Alternanthera philoxeroides	alligator weed
Egeria densa	Brazilian waterweed
Eichhornia crassipes	water hyacinth
Hydrilla verticillata	hydrilla
Landoltia punctata	dotted duckweed
Limnophila sessiliflora	Asian marshweed
Myriophyllum aquaticum	parrot-feather
Myriophyllum spicatum	Eurasian water-milfoil
Pistia stratiotes	water lettuce
Potamogeton crispus	curly pondweed
Salvinia minima	water spangles
Salvinia molesta	giant salvinia

Alligatorweed
Scientific name: *Alternanthera philoxeroides*

Description
Alligatorweed is a terrestrial and aquatic perennial herb native to South America, where it is considered invasive. It was most likely introduced to the U. S. in ship ballast (United State Department of Agriculture Forest Service et al. 2006). It has been documented across the southeastern U. S. west to Texas and north to Virginia, and in coastal regions of California. It is found in fresh to brackish water (Gunasekera 2005). It is a FLEPPC Category II pest plant.

Impacts
The terrestrial and aquatic forms are threats to waterways, agriculture, and biodiversity. Extending across the surface of aquatic habitats, alligatorweed can form dense mats that out-compete native submerged and emerged plants that serve as food sources for native fish and wildlife. Terrestrial alligatorweed growing along the edges of water sources can also form a dense monoculture, inhibiting growth of other native herbaceous plants.

Alligatorweed reproduces vegetatively and can be spread when fragmented by any disturbance, including boat traffic or use of mechanical controls.

Goals and Objectives

Goal: Allow the biocontrols to manage alligatorweed. The plant will never be eradicated, but it is no longer considered a high priority species.

Objectives:

1. Monitor known infestations and look for signs of suppression by biological control insects. Alligatorweed should be intermixed with other species, not a dense monoculture.

Management Options
Efforts to control alligatorweed have been in effect since the late 1950s, including biological, mechanical and chemical controls. The U. S. Army Corps of Engineers banned the use of herbicides on alligator weed in the mid 1960s because it is believed that the introduced biocontrols are effective (Cervone 2003b).

Biological: In the mid 1960s three biocontrols were introduced: a flea beetle (*Agasicles hygrophila*), a stem borer (*Vogtia malloi*), and alligatorweed thrips (*Amynothrips andersoni*). The flea beetle eats foliage of the aquatic form and was released near Jacksonville in 1963 and was thought to have a positive effect in lessening alligator weed's ability to compete with other plants (Maddox et al. 1971). The flea beetle does not have an effect on the terrestrial form of alligatorweed; the stem borer eats the stems of the aquatic form, but like the flea beetle, does not affect the terrestrial form; alligatorweed thrips eats the tips of the terrestrial form's stems, and is effective in controlling it (Schoeing 2005). It is generally believed that the combination of the three controls is effective in combating the spread of alligatorweed. Although the plant

grows rapidly in the spring, these biocontrol insects usually have alligatorweed controlled by late summer (T. Center pers. comm.).

Distribution in the Region

Distributional data for alligatorweed has been collected by the CISMA in Franklin and Gulf Counties (Figure 32). It has also been documented in Calhoun, Gadsden, and Jackson Counties (Wunderlin and Hansen 2004).

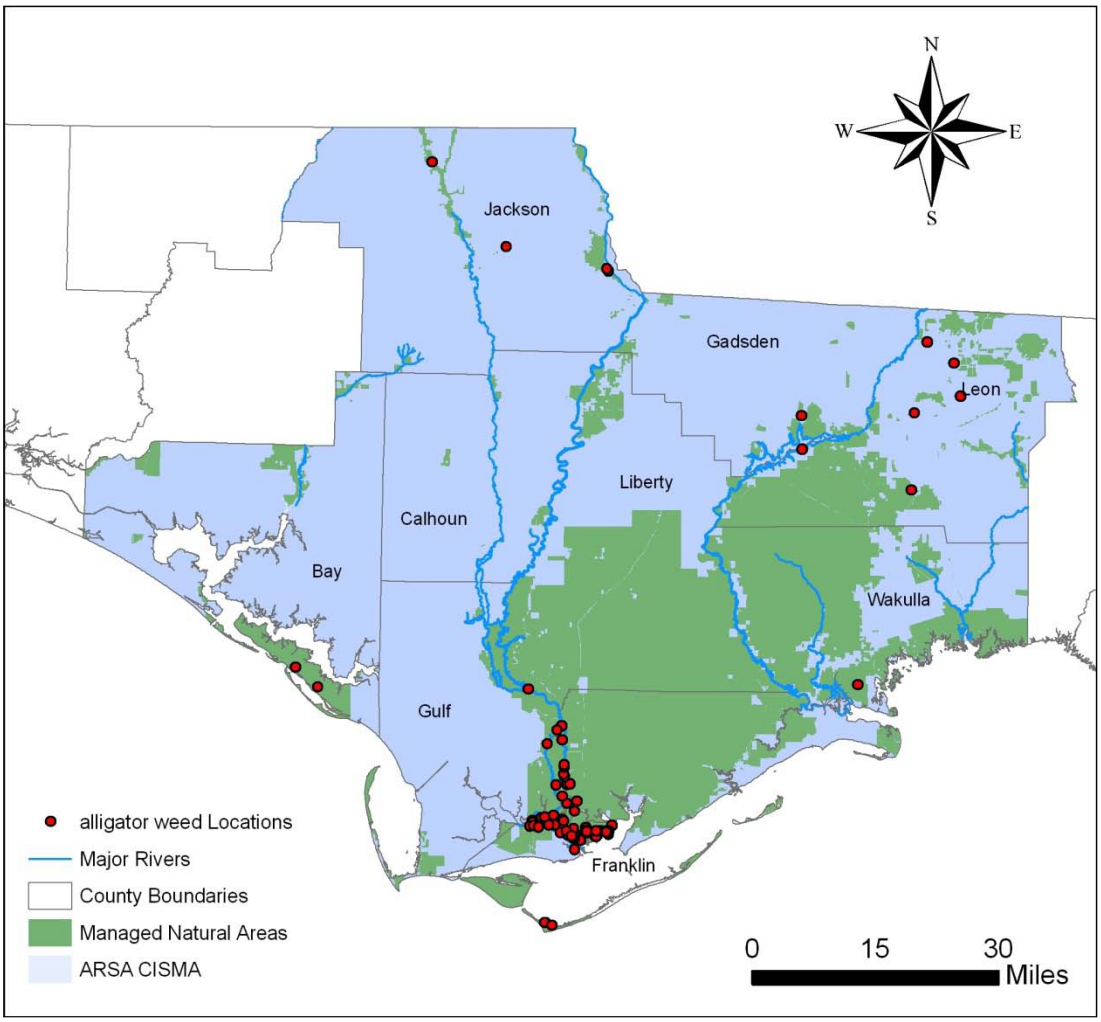


Figure 32. Alligatorweed locations in the Apalachicola River region

Brazilian waterweed
Scientific name: *Egeria densa*

Description
Brazilian waterweed is an aquatic perennial herb native to South America. It was introduced to the U. S. in the late 1800s as an aquarium plant. It has been recorded throughout the continental U. S. and in Hawaii. Brazilian waterweed cannot tolerate high water temperatures and can be found in slow-moving or stagnant water bodies such as streams, lakes, rivers, springs, ponds, etc (McCann et al. 1996). Another common name for Brazilian waterweed is common waterweed.

Impacts
Brazilian waterweed can form dense monocultures, out-competing native vegetation and clogging waterways. Vegetative reproduction allows the plant to spread when stems are fragmented by any disturbance. Brazilian waterweed is a noxious weed elsewhere in the U. S. and is documented in adjacent regions (Wunderlin and Hansen 2004).

Goals and Objectives
Goal: Prevention
Objectives:
1. Conduct surveys for Brazilian waterweed.
2. Eradicate if found to minimize future workloads.

Management Options
Biological: Biocontrols are being investigated in Brazil. Triploid grass carp will eat Brazilian waterweed (Western Aquatic Plant Management Society 2006).

Chemical: Applications of diquat and a combination of endothall and copper have been used in other states. Repeated applications of fluridone have been reported as highly effective in Washington State (Western Aquatic Plant Management Society 2006).

Mechanical: Mechanical controls are not effective in areas where the plant reproduce from fragmented stems.

Distribution in the Region
No distributional data for Brazilian waterweed has been collected by the CISMA in the Apalachicola region. It has been documented in the Wakulla and Ocklockonee River watersheds (Wunderlin and Hansen 2004).

Water hyacinth
Scientific name: *Eichhornia crassipes*

Description
Water hyacinth is an aquatic floating herb native to South America. It was first introduced as an ornamental to the U. S. in 1884 at the Cotton States Exposition in New Orleans (Langeland and Craddock Burks 1998). Its current range extends north to North Carolina and west to Texas and it is established in California and Hawaii. Water hyacinth is abundant throughout Florida and can be found in ponds, lakes, rivers, marshes, and other wetland habitats. Water hyacinth is a FLEPPC Category I pest plant and Florida Noxious Aquatic Plant.

Impacts
Water hyacinth rapidly forms dense mats on the surface of water sources, restricting light penetration to underwater species and depleting oxygen levels. The destruction of waterways due to water hyacinth has resulted in millions of dollars of removal efforts each year nationwide (United States Department of Agriculture Forest Service et al. 2003). Water hyacinth's ability to reproduce vegetatively allows it to spread when disturbed by boats or mechanical control efforts.

Goals and Objectives
Goal: Maintenance control.
Objectives:
1. Identify current populations and continue monitoring, especially for highly valued sites as well as locations in the upper region.
2. Use management options to reduce population where feasible.
3. Follow research conducted for potential biological control agents.

Management Options
Various control methods have been used to manage water hyacinth and it seems that an integrated pest management approach is necessary for management of this species.

Biological: Several biocontrols have been introduced for the control of water hyacinth. Two weevils, mottled water hyacinth weevil (*Neochetina eichhorniae*), and chevroned water hyacinth weevil (*Neochetina bruchi*), are known to feed on the plant as both larvae and adults. The water hyacinth moth (*Sameodes albiguttalis*) has proven to feed on the plant in its larval stage.

While these controls have been somewhat effective in slowing the growth of water hyacinth, they should be used in conjunction with other treatments because of the rapid growth of the plant (Ramey 2001). However, herbicides and mechanical controls, which can more quickly control water hyacinth growth, can interfere with biological controls and their effectiveness over longer periods of time (Center et al. 2002). In addition, researchers are exploring potential pathogens to control this species (University of Florida Department of Plant Pathology 2002).

Chemical: Herbicides with the active ingredients glyphosate, diquat, and 2-4,D are commonly used to manage water hyacinth (Vandiver 2002). It is necessary to reapply in most cases and herbicides can negatively affect other aquatic plants and animals.

2-4,D can be especially effective at warm temperatures because translocation from stolons to roots is augmented in warm weather. 2-4, D herbicide is selective to broad-leafed plants and is not known to affect grasses, but it can be toxic to birds, fishes, and aquatic invertebrates. Saline formulas of 2-4,D (e.g. Aqua-Kleen©) are recommended because they are less toxic (Batcher 2000a).

Aquatic forms of glyphosate have been reported to kill water hyacinth in about eight weeks. However, this herbicide is non-selective and can be toxic to other aquatic plants. It is reported to be non-toxic to fish, but mildly toxic to invertebrates (Batcher 2000a).

Herbicides containing copper are effective in large quantities, but are reported to be toxic to fish and aquatic invertebrates (Batcher 2000a).

Mechanical or Manual: Cervone (2003a) recommends the following:
Mechanical harvesters physically remove the plant and deposit it on dry land to desiccate. This method is expensive, labor intensive, and requires large areas available to deposit the extracted plants. Water hyacinth can weigh up to 200 tons per acre, making the sheer volume of plants a significant factor in the process of removing the plant mechanically.

Chopping machines are used to shred the plant and spray the slurry back onto the water's surface.

Both methods of mechanical controls are effective in removing the plant that has clogged regularly used waterways. However, most land managers choose not to use mechanical methods because of the high costs and the many disadvantages to their usage (e.g., machines cannot differentiate between wanted and unwanted species, increased turbidity levels, the need to remove plants several times during the year, and the disruption of habitats and wildlife).

<u>Distribution in the Region</u>
Distributional data for water hyacinth has been collected by the CISMA in Franklin and Gulf Counties (Figure 33). It is prolific in the lower Apalachicola River delta (Figure 34), especially in slow-moving streams.

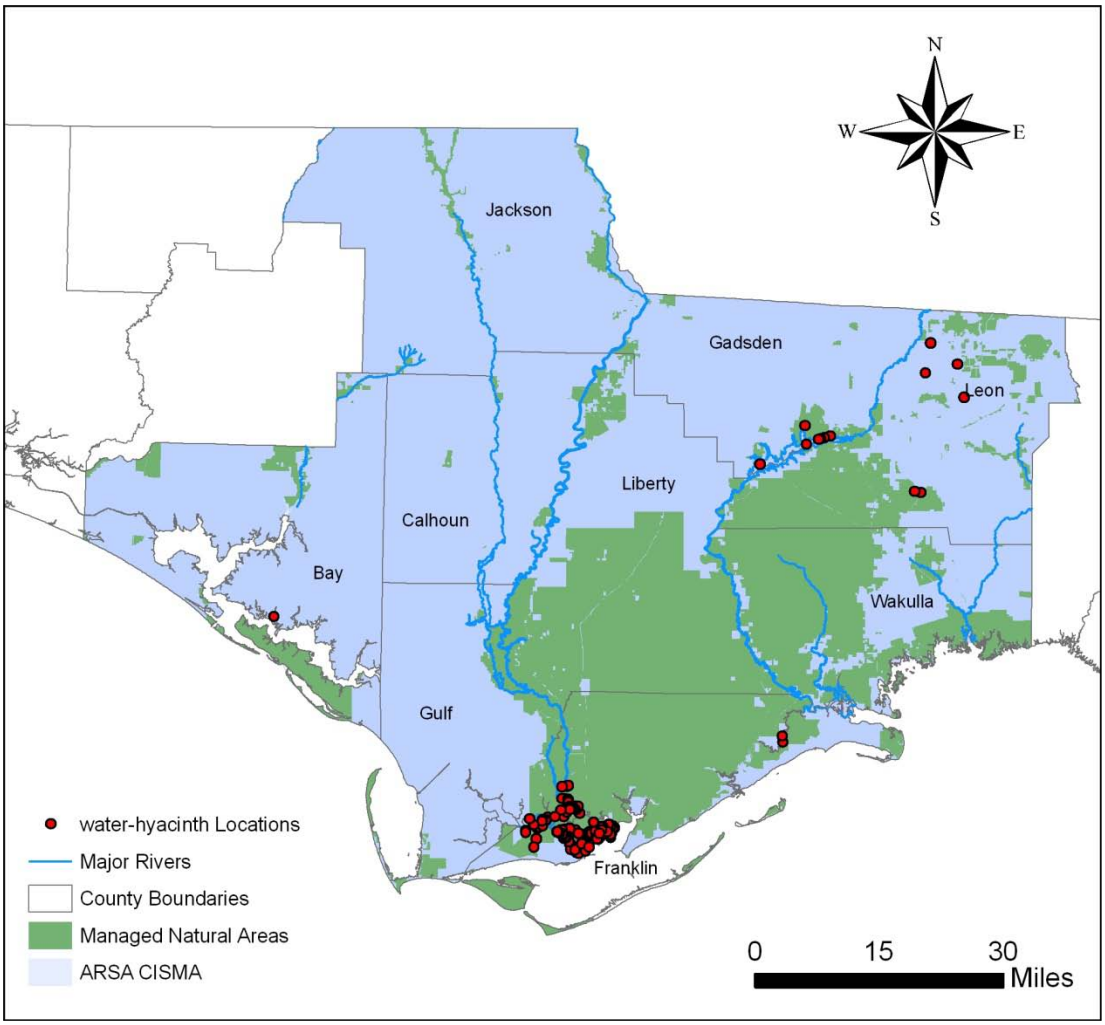


Figure 33. Water hyacinth locations in the Apalachicola River region

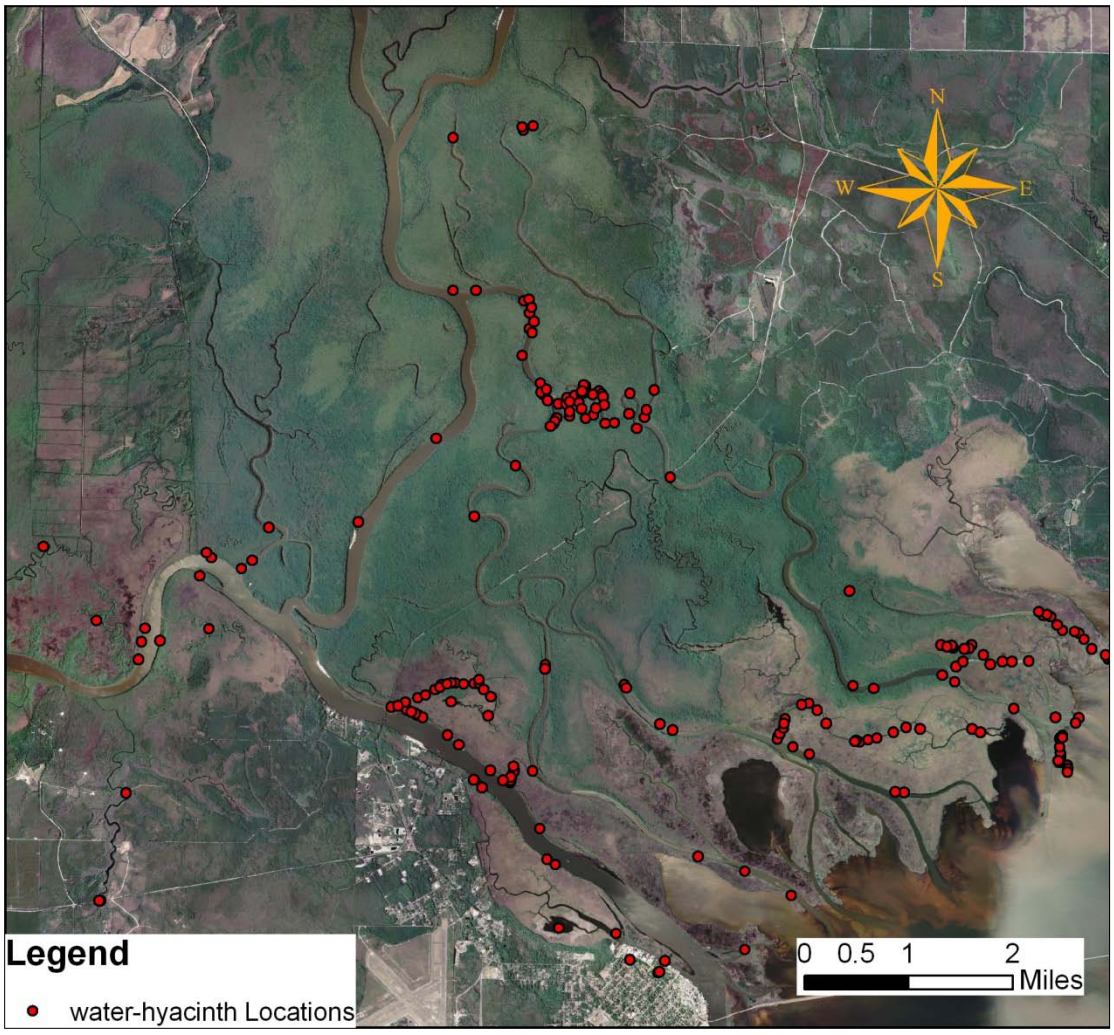


Figure 34. Water hyacinth locations in the Apalachicola River delta

Hydrilla
Scientific name: *Hydrilla verticillata*

Description
Hydrilla is a submersed aquatic perennial herb believed to be native to Korea. It was most likely introduced to the U. S. as an aquarium plant in the 1950s. It has been documented across the southeastern U. S. north to Connecticut and west to California and Washington (Ramey 2001). It can be found in stagnant and flowing freshwater habitats. Rooted to hydrosoils, hydrilla can grow in water depths of two inches to over twenty feet. It can tolerate salinity rates of up to 7% and requires only 1% full sunlight in order to persist (Ramey 2001). It is a FLEPPC Category I pest plant, Florida Noxious Aquatic Plant and Federal Noxious Weed.

Impacts
Hydrilla can alter water chemistry and oxygen levels, and cause shifts in zooplankton communities (Langeland and Craddock Burks 1998). When the root base has been established hydrilla can out-compete other native submerged or emerged aquatic species. Once it has reached the water's surface hydrilla can severely clog waterways, limiting water resource use in many areas. Millions of dollars are spent each year to combat hydrilla in Florida alone (Florida Department of Environmental Protection 2003).

Disturbance from boat traffic or efforts to control the plant mechanically can easily spread the plant, which can reproduces from stem fragments, tubers, and turions. Tubers can remain viable for up to four years, and fragments caught in boats may be transported to water sources that have not yet been affected.

Goals and Objectives
Goal: Prevention.
Objectives:
1. Conduct surveys for hydrilla. Locate documented population in Franklin County from Wunderlin and Hansen (2004). If found, begin maintenance control.
2. Survey for infestations, especially in the upper region close to Jim Woodruff dam (hydrilla is present in Lake Seminole).
3. Encourage boaters to clean their boats and trailers before leaving an area.

Management Options
Land managers and scientists have been searching for an effective method of controlling hydrilla without marked success. The plant's aggressive reproductive cycle makes it extremely difficult to control. Drawdowns have been effective in water sources that can be manipulated, but it must be done before the growing season in spring and it is possible that turions buried under the soil will remain viable and sprout up when water levels have been restored (Batcher 2000b*)*.

Biological: Six different biological controls against hydrilla have been introduced since the early 1980s. The four insects, *Bagous affinis, B. hydrellia, Hydrellia pakistanae, h. balciunasi,* and

have not been very effective, nor has *Cricotopus lebetis*, (a midge). Grass carp (*Ctenopharyngodon idella*) has been effective against hydrilla, but also kills native plants once hydrilla has been consumed. Triploid (sterile) grass carp are legal, but it is a possibility that the released fish may still be diploid (fertile) and could reproduce within the water body and eventually consume all aquatic native and non-native plants in the water body (Cervone 2003b).

Chemical: The use of herbicides with the active ingredients copper, fluridone, endothal, and diquat (Vandiver 2002) is recommended for hydrilla. Copper and endothal are non-selective and can therefore potentially kill other native plants. Copper has been reported to be toxic to fish. Fluridone has been used in Lake Okeechobee with little reported impacts to native aquatic plants (Batcher 2000b*)*. However, some types of hydrilla have proven resistant to fluridone (Weed Science Society 2005).

Mechanical: Harvesters and chopping machines have been used to rid Florida's waterways of hydrilla. However, mechanical removal of hydrilla may cause fragmentation of stems, which then take root in other areas. It is recommended that harvesting machines be used only when the plant has taken over the entire water body. Efforts to control hydrilla mechanically have proven expensive and must be done repeatedly throughout the year (Cervone 2003a).

Distribution in the Region

Distributional data for hydrilla has been collected by the CISMA in Jackson county (Figure 35). It has also been documented in Franklin County (Wunderlin and Hansen 2004).

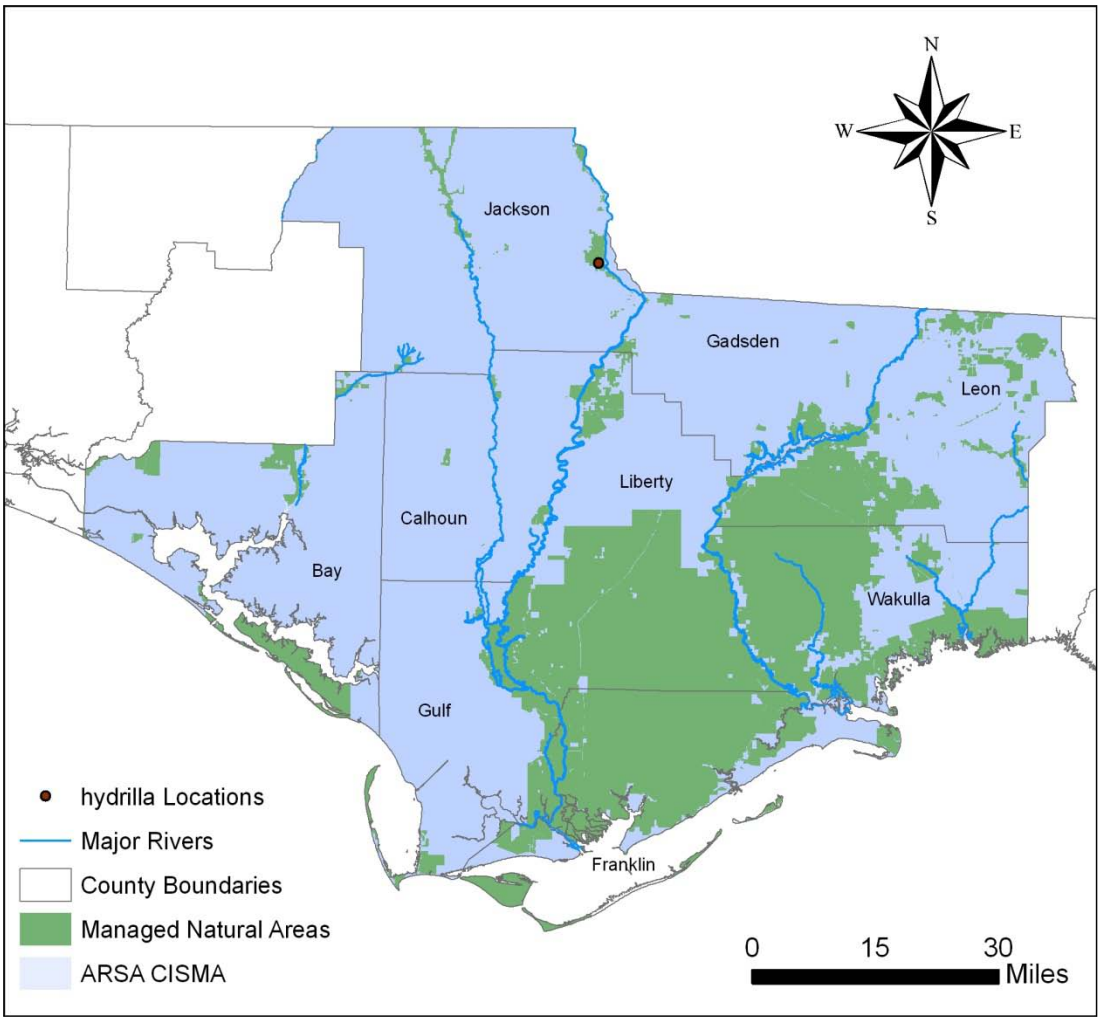


Figure 35. Hydrilla locations in the Apalachicola River region

Dotted duckweed
Scientific name: *Landoltia punctata*

Description
Dotted duckweed is a small aquatic plant native to Australia and Southeast Asia. It is believed to have been brought to the U. S. as an aquarium plant. Range of duckweed in the U. S. extends north from Florida to Massachusetts and west to California (NatureServe 2006). It can be found in stagnant or low-flow, nutrient rich water bodies including ponds, lakes, ditches, and swamps.

Dotted duckweed is very similar to several native duckweeds, *Spirodela polyrhiza* and *Lemna* spp., and is often confused with them (Ramey 2001).

Impacts
Although specific impacts of the plant are unsure, dotted duckweed can form monocultures, out-competing native aquatic species (Jacono 2002). It can also be spread easily by animals and waterfowl that may get leaves caught in their coats or feathers.

Specific impacts of the species are unknown, thus evaluation of the infestation is necessary if it is found in stagnant water bodies. If it has become a problem the land manager may want consider management options.

Goals and Objectives
Goal: Prevention.
Objectives:
1. Conduct surveys for dotted duckweed.

Management Options
Chemical: It has been reported that some biotypes of dotted duckweed are resistant to the D-22 herbicides including diquat and paraquat (Weed Science Society 2005). However, diquat is reported to be effective on the non-resistant biotype of duckweed. Solutions of copper and diquat are recommended in flowing water and fluridone is recommended in stagnant water bodies (T, Koschnick pers. comm.).

Distribution in the Region
Distributional data for dotted duckweed has been collected by the CISMA in Franklin County (Figure 36). It has been documented in Jackson, Liberty, and Franklin counties and in adjacent regions (Wunderlin and Hansen 2004).

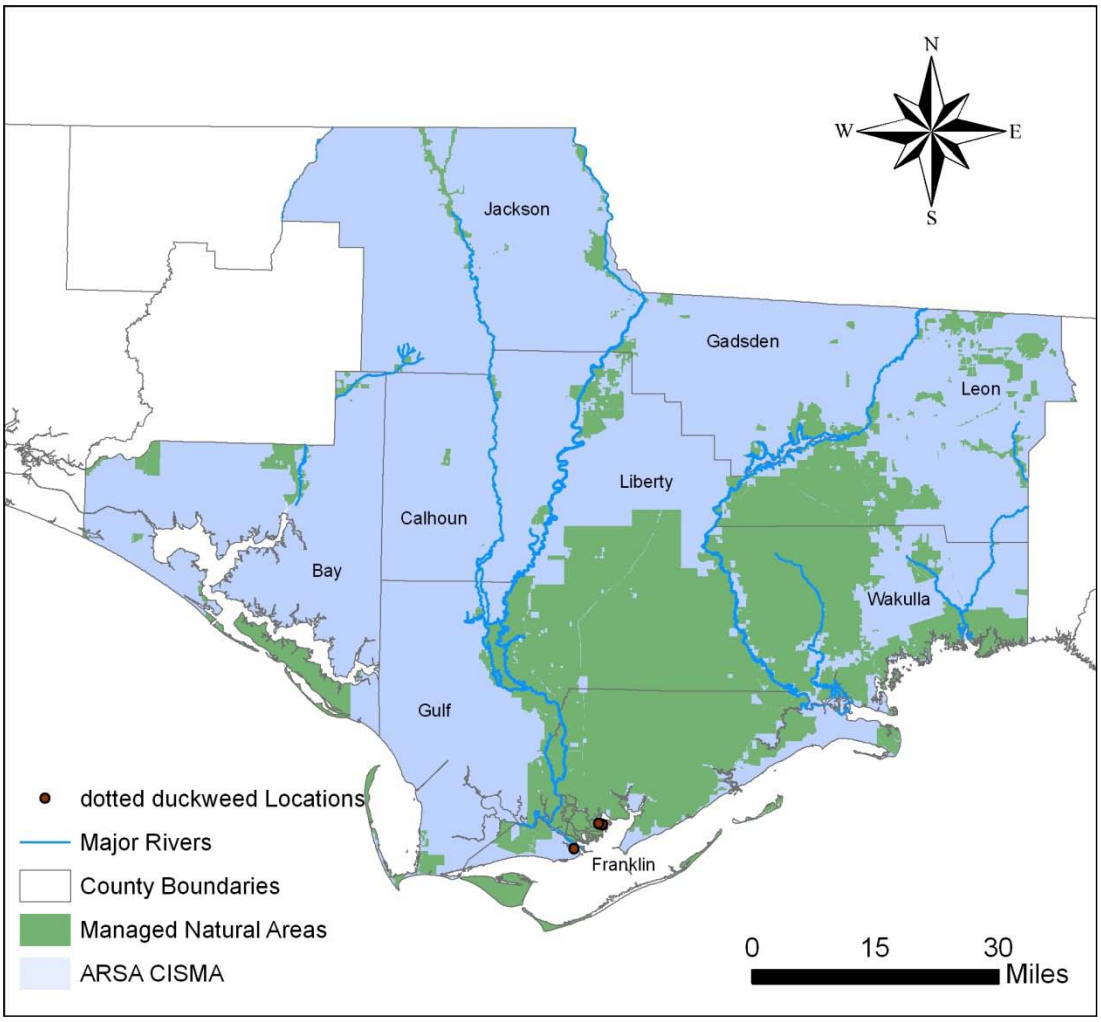


Figure 36. Dotted duckweed locations in the Apalachicola River region

Asian marshweed
Scientific name: *Limnophila sessiliflora*

Description
Asian marshweed is an aquatic submerged and emerged herb native to India and Southeast Asia. It was most likely introduced to the U. S. as an aquarium plant. It was first found in Florida in the mid-1960s and has been recorded in Georgia and Texas (Jacono and Richerson 2003). It can be found in a variety of aquatic habitats, including rivers, lakes, and streams. Asian marshweed is a FLEPPC Category II pest plant and a Federal Noxious Weed.

Impacts
Asian marshweed blankets the surface of water bodies, limiting light penetration to underwater species and reducing oxygen levels (Ramey 2001). It also clogs waterways, making swimming and boating difficult. Disturbance can cause the plant to spread because it reproduces vegetatively.

Goals and Objectives
Goal: Maintenance control.
Objectives:
1. Identify populations within managed areas and conduct annual monitoring.
2. Reduce population by managing infestations.
3. Prevent spread of the plant to other natural areas.
4. Support research for new control options.

Management Options
Effective management options have yet to be identified. Mechanical and biological controls have not been effective. High levels of 2-4,D herbicide have been used in Florida (Ramey 2001).

Distribution in the Region
Distributional data for Asian marshweed has been collected by the CISMA in Franklin County (Figure 37). It has been documented in Gulf County (Wunderlin and Hansen 2004).

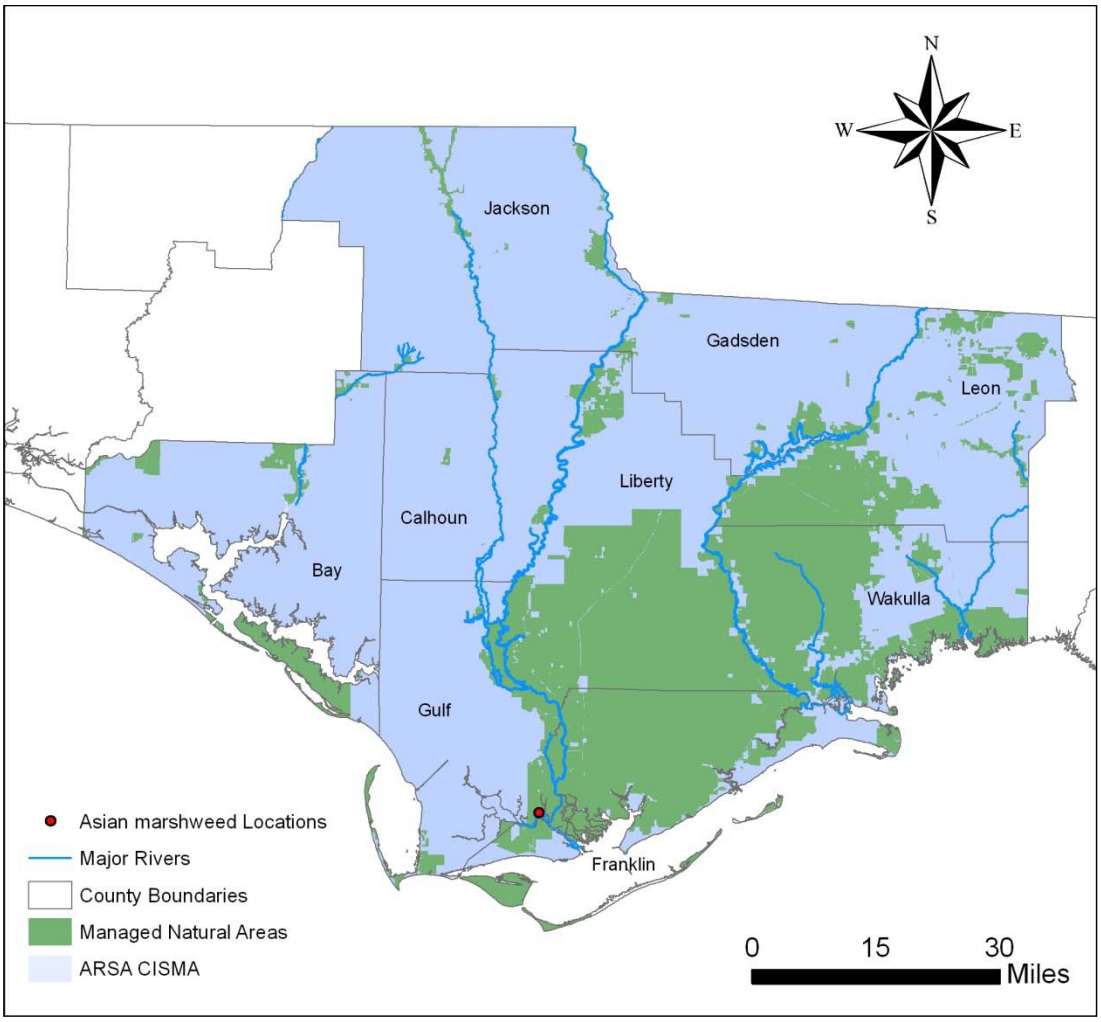


Figure 37. Asian marshweed locations in the Apalachicola River region

Parrot feather
Scientific name: *Myriophyllum aquaticum*

Description
Parrot feather is an aquatic submerged and emerged species native to South America. It was introduced to the U. S. as an aquarium plant in the Washington D.C. area ca. 1980 (Swearingen et al. 2002). Its current range in the U. S. extends north to Connecticut and west to California and Washington and has been recorded in 26 states. Parrot feather is found in freshwater lakes, ponds, and slow moving streams.

Impacts
Parrot feather creates dense mats of vegetations, out-competing native species and limiting light penetration below the water's surface. The plant also obstructs waterways, clogging irrigation and drainage ditches. It is spread easily because it reproduces vegetatively from fragmented stems. It continues to be sold in some nurseries and aquarium shops.

Goals and Objectives
Goal: Maintenance control
Objectives:
1. Identify populations within managed areas.
2. Reduce population by managing infestations in highly valued sites.
3. Prevent spread of the plant to other natural areas.

Management Options
Chemical: Control with herbicides has proven difficult because of stems and emergent leaves have a waxy coating that impedes absorption of chemicals (Reynolds 1999). Herbicides containing 2,4-D, endothall, and fluridone have been recommended for maintenance control (Vandiver 2002).

Cultural: One study found that a complete draw down of a water source during winter will kill the plant (Reynolds 1999).

Mechanical: Mechanical controls have not proven effective because fragmented stems create new plants.

Distribution in the Region
Distributional data for parrot feather has been collected by the CISMA in Franklin and Gulf Counties (Figure 38). It has also been documented in Gadsden, Leon, and Bay Counties (Wunderlin and Hansen 2004).

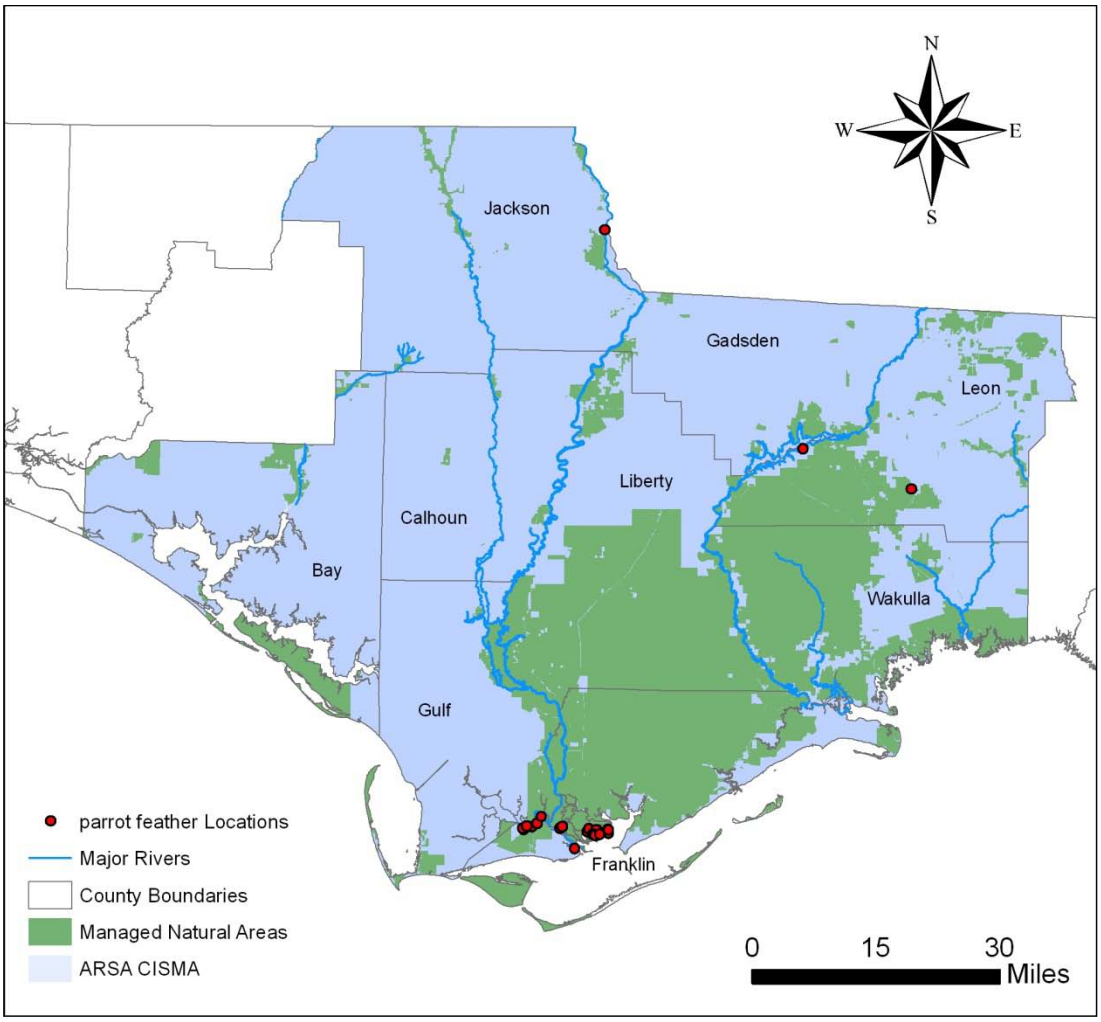


Figure 38. Parrot feather locations in the Apalachicola River region

Eurasian watermilfoil
Scientific name: *Myriophyllum spicatum*

Description
Eurasian watermilfoil is a submersed perennial aquatic plant native to Europe, Asia and northern Africa. It was first recorded in the U. S. in a pond near Washington D.C. in 1942 (Department of Conservation and Virginia Native Plant Society 1999). It has since been documented in 45 states. It can be found in slow moving or stagnant water bodies and can tolerate brackish water habitats. It has been reported to thrive in disturbed areas where native plants are not established (Swearingen, et al. 2002). It is a FLEPPC Category II pest plant and a Florida Noxious Aquatic Plant.

Impacts
Eurasian watermilfoil reduces light penetration to native submersed plants. This species out-competes native aquatic vegetation and reduces fish spawning and activity in areas where it is well established (Van Driesche et al. 2002). The dense mats formed by the plant also inhibit recreational use of water bodies. Millions of dollars are spent each year to manage watermilfoil nationwide (Van Driesche et al. 2002).

Boating traffic is one of the major sources of spread throughout the U. S. because stems fragmented by propellers will form new plants downstream. Mechanical control also proves difficult for the same reason.

Goals and Objectives
Goal: Maintenance control.
Objectives:
1. Identify populations within managed area and conduct annual monitoring.
2. Reduce population by managing infestations when feasible.
3. Prevent spread of the plant to other natural areas.

Management Options
Biological: Several biocontrols have been researched, including Eurasian watermilfoil weevil (*Euhrychiopsis lecontei*), which is believed to be effective in reducing the species' biomass (Ramey 2001).

Chemical: Herbicides with the active ingredients diquat, copper, endothall, and fluridone have been used to control this species, though they do not completely eradicate an infestation. Retreatments and monitoring are required after initial treatment (Ramey 2001).
Cultural: Draw-downs of water levels have been used in Tennessee; this method is only effective in water bodies that can be manipulated (Ramey 2001).

Mechanical: Mechanical harvesters and chopping machines have been used, but disturbance can result in stem fragmentation.

Distribution in the Region

Distributional data for Eurasian watermilfoil has been collected by the CISMA in Franklin County (Figure 39).

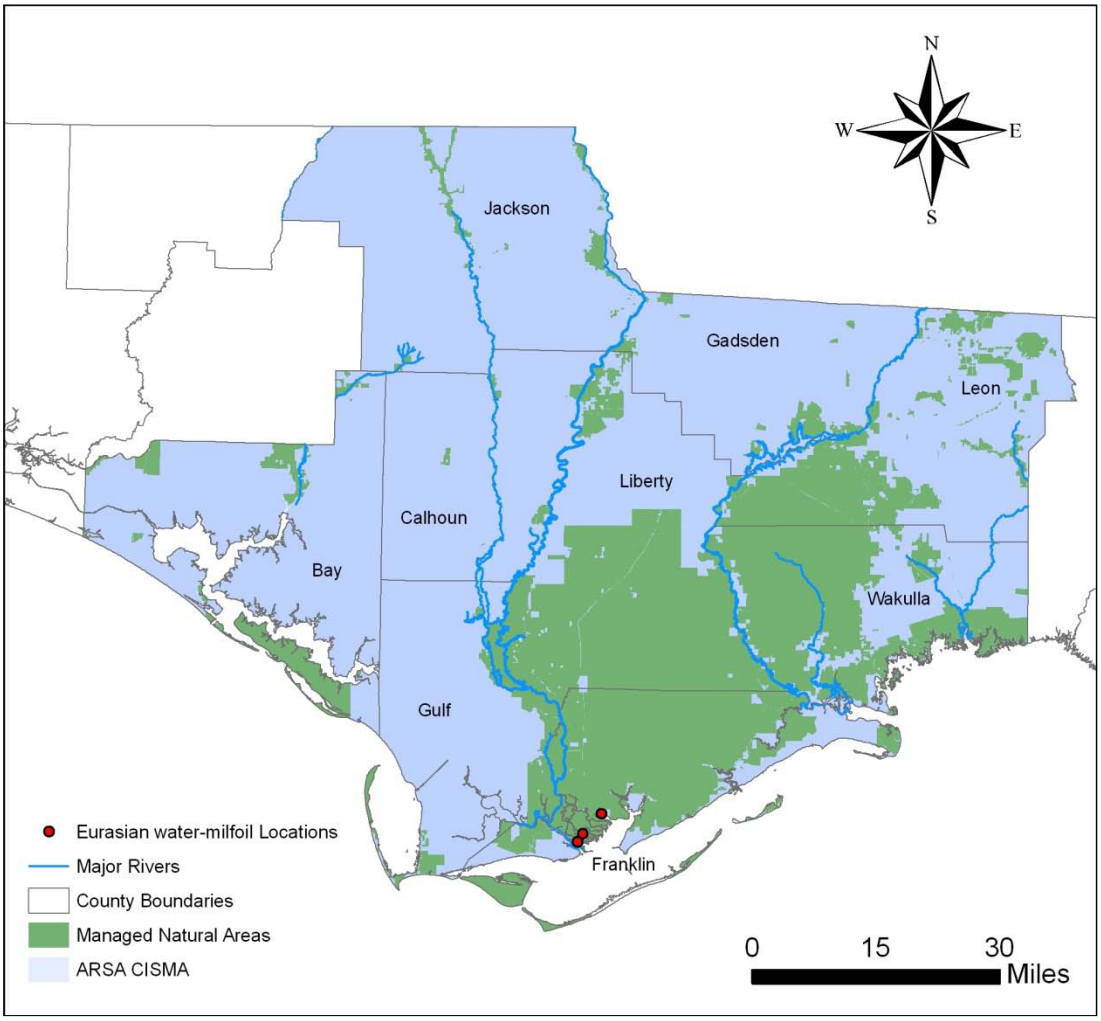


Figure 39. Eurasian watermilfoil locations in the Apalachicola River region

Water lettuce
Scientific name: *Pistia stratiotes*

Description
Water lettuce is an aquatic floating herb thought to be native to Africa and South America. It was first recorded in the U. S. in the late 1700s, but how it arrived is unknown. Scientists disagree as to whether the plant is native or not; it was recorded by William Bartram on the St. John's River in the 1700s (Ramey 2001). It has been recorded in Florida north to New York and west to California (United States Department of Agriculture Natural Resources Conservation Service 2006). It is also naturalized in Hawaii. Water lettuce can be found in freshwater ponds, lakes, ditches, and slow moving streams (United States Department of Agriculture Forest Service et al. 2006). It is a FLEPPC Category I pest plant and a Florida Noxious Aquatic Plant.

Impacts
Water lettuce can form dense mats of floating vegetation that block sunlight to water bodies, alter oxygen levels, increase siltation, limit fish spawning sites, and restrict water flows and boating traffic (United States Department of Agriculture Forest Service et al. 2006). The plant can be spread easily by disturbance because it reproduces vegetatively.
Goals and Objectives
Goal: Prevention
Objectives:
1. Conduct surveys for water lettuce.
2. Rapid response-eradication if found.

Management Options
Biological: Two insects were released in Florida to control water lettuce. The South American native weevil (*Neohydronomus affinis*) has not been entirely effective in release sites. The other released insect, a moth (*Spodoptera pectinicornus*) from Southeast Asia has not naturalized and is therefore deemed ineffective (VanDriesche et al. 2002).

Chemical: Herbicides with the active ingredients glyphosate, copper, and diquat have been recommended to control water lettuce (Vandiver 2002).

Mechanical: Water lettuce has been extracted from water bodies with the use of mechanical harvestors and chopping machines, and deposited on dry land to desiccate (VanDriesche et al. 2002).

Distribution in the Region
Distributional data for water lettuce has been collected by the CISMA in Gadsden and Leon Counties (Figure 40). It has also been documented in adjacent regions to the east and west (Wunderlin and Hansen 2004).

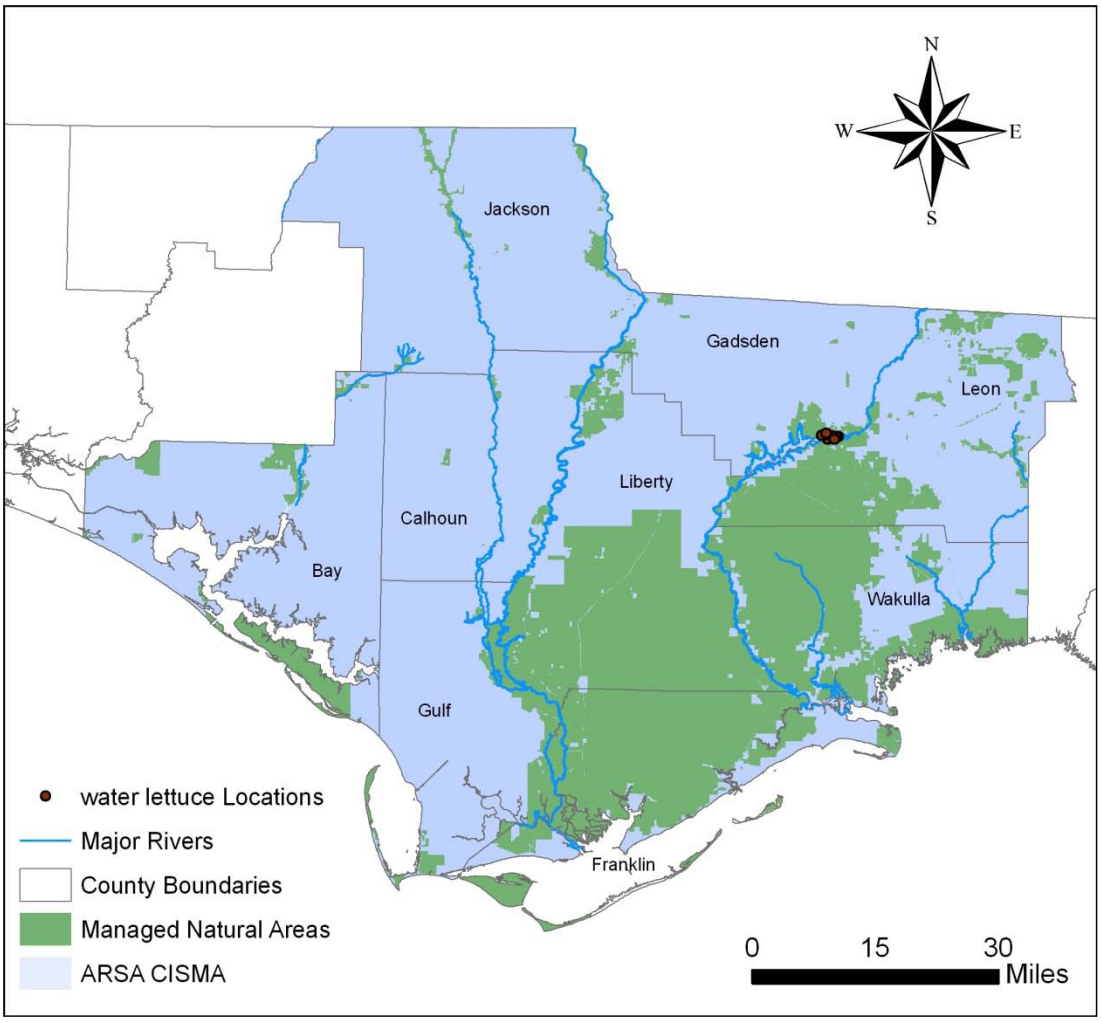


Figure 40. Water lettuce locations in the Apalachicola River region

Curly pondweed
Scientific name: *Potamogeton crispus*

Description
Curly pondweed is a submersed perennial aquatic herb native to Europe. It has been documented throughout the U. S. and Canada, but is not considered as problematic in Florida as some other aquatic invasive species (Ramey 2001). It can be found in fresh to slightly brackish water bodies including streams, lakes, ponds, and rivers. Curly pondweed can live in shallow or deep waters with little light and nutrient rich soils (National Biological Infrastructure and Invasive Species Specialist Group 2005).

Impacts
Curly pondweed is a noxious weed in other states, especially in the colder climates of northeastern states. It has been reported to create dense masses of vegetation, out-competing native plants that are important foraging materials for waterfowl and fish. Curly pondweed can increase oxygen and phosphate levels, leading to increased algae content (National Biological Infrastructure and Invasive Species Specialist Group 2005). It can be easily spread because it reproduces vegetatively from stem fragments. Boats are often vectors of the plant as it will easily attach to boats and be transported to other non-invaded water bodies.

Goals and Objectives
Goal: Prevention
Objectives:
1. Locate population in Jackson County and eradicate.
2. Conduct surveys for curly pondweed.
3. Eradicate if found to minimize future workloads.

Management Options
Chemical: Diquat, fluridone, and endothall have been used to control pondweed in other states and in Australia (National Biological Infrastructure and Invasive Species Specialist Group 2005). Diquat and endothall have been effective in reducing biomass in the northern U. S. (Poovey et al. 2002).

Mechanical: Raking, cutting, or harvesting is recommended before turions are produced to reduce biomass and help to break the life cycle (Crowell Undated).

Distribution in the Region
No distributional data for curly pondweed has been collected by the CISMA in the Apalachicola region. It has been documented in Jackson County (Wunderlin and Hansen 2004).

Water spangles
Scientific name: *Salvinia minima*

Description
Water spangles is a floating aquatic fern native to Central and South America. Its range in the U. S. extends across the southern states from Florida to Texas. It was probably introduced as an aquarium plant and continues to be sold as such. The plant can be found in shallow freshwater bodies including lakes, ponds, ditches, cypress swamps, marshes, and slow-moving streams (Jacono 2002). Another common name for water spangles is water fern.

Impacts
Water spangles can form dense floating monocultures, out-competing native aquatic species that are important forage for wildlife. Its potential for exponential growth also gives this species an advantage over native aquatic plants. Water spangles can be easily spread by boats or on animal fur and human clothing (Jacono 2002).

Goals and Objectives
Goal: Prevention.
Objectives:
1. Survey for this species.
2. If deemed necessary, land managers may want to initiate management options in stagnant water bodies.

Management Options
Chemical: Diquat is often used to manage water spangles (McCann et al. 1996).

Mechanical: Mechanical controls are not advised because water spangles can reproduce vegetatively. Small infestations can be removed by hand and allowed to desiccate on dry land away from the water source.

Distribution in the Region
Distributional data for water spangles has been collected by the CISMA in Franklin and Gulf Counties (Figure 41). It has also been documented in Gadsden, Jackson, and Liberty Counties (Wunderlin and Hansen 2004).

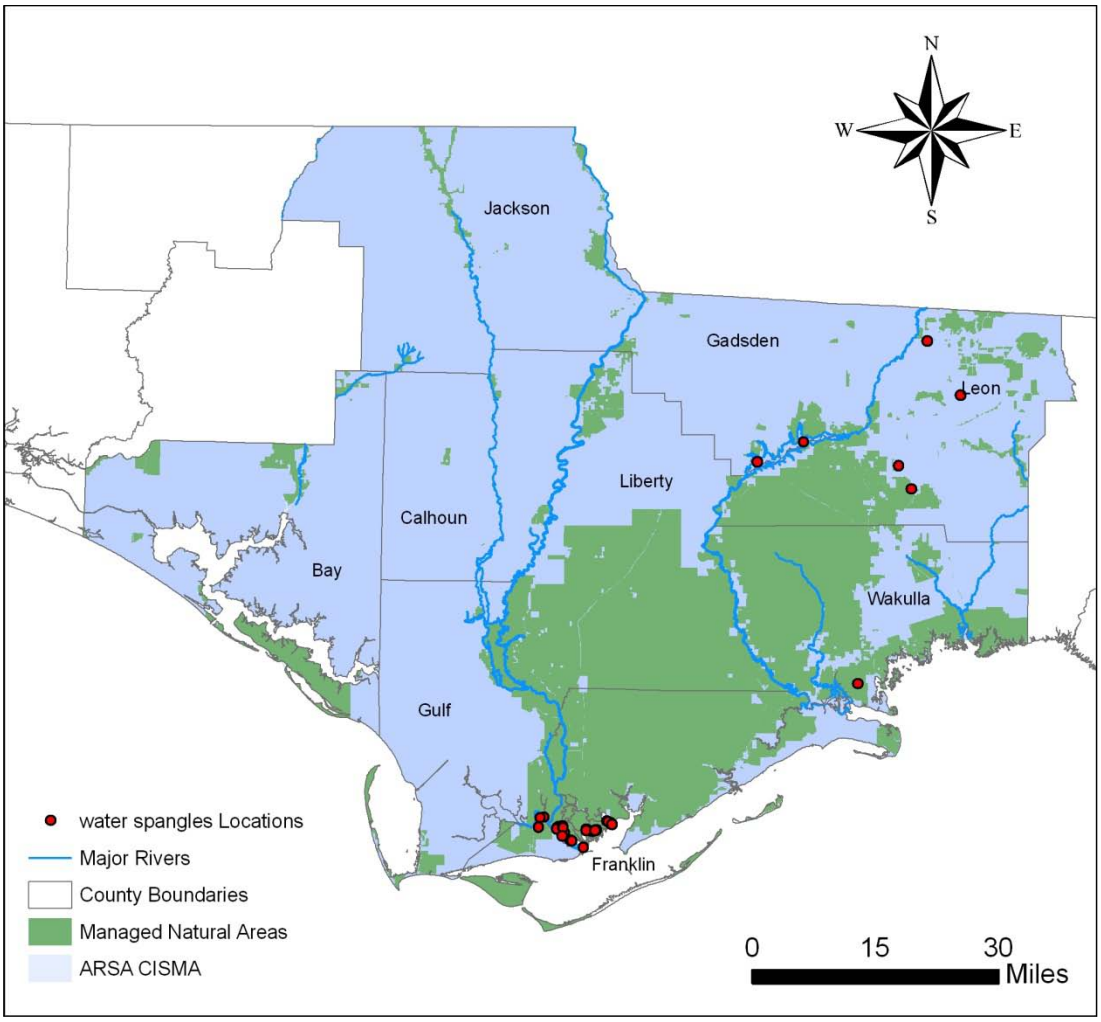


Figure 41. Water spangles locations in the Apalachicola River region

Giant salvinia
Scientific name: *Salvinia molesta*

Description
Giant salvinia is an aquatic fern native to South America. It was introduced to the U. S. as an ornamental for aquariums and private ponds. It has been reported across the southeastern U. S. north to Virginia and west to Texas and in southern California and Hawaii (United States Geological Survey 2005). It was has been documented in Collier County, south Florida (Wunderlin and Hansen 2004). It can be found in slow moving freshwater habitats including ponds, ditches, lakes, and canals. Giant salvinia is listed as a Federal Noxious Weed.

Impacts
Giant salvinia can form dense mats of up to one-meter thick, restricting oxygen levels and light penetration to aquatic habitats (United States Geological Survey 2005). Water sources with high concentrations of the plant can become impassable to boat traffic or swimmers. It is not known to spread by spores in the U. S.; it can reproduce vegetatively and can therefore be spread by disturbance.

Goals and Objectives
Goal: Prevention
Objectives:
1. Conduct surveys for giant salvinia.
2. Eradicate if found to minimize future workloads.

Management Options
Biological: Biological controls of several species of weevil belonging to the genus *Cyrtobagous* have been tested in eastern Texas and western Louisiana and have been effective (VanDriesche et al. 2002).

Chemical: Diquat and fluridone have been used against giant salvinia: (Vandiver 2002). Diquat has been effective in sites with flowing water in Georgia; glyphosate has also been effective in stagnant water bodies (Miller 2001).

Distribution in the Region
No distributional data for giant salvinia has been collected by the CISMA in the Apalachicola region. It has not been documented in adjacent regions, but there are records of the species in Georgia and Alabama (NatureServe 2006).

VERTEBRATES

Mammals

Table 5. Non-native invasive mammals of the Apalachicola River region

Scientific Name	Common Name
Canis familiaris	feral dog
Canis latrans	coyote
Cervus unicolour	sambar deer
Dasypus novemcinctus	nine-banded armadillo
Felis catus	feral cat
Sus scrofa	feral hog
Vulpes vulpes	red fox

Feral dog
Scientific name: *Canis familiaris*

Description
Feral dog is usually a domestic dog released by its owners. Feral dog will often form packs in natural areas.

Impacts
Feral dog is a predator of native vertebrates and invertebrates. It is also a carrier of rabies (Florida Fish and Wildlife Conservation Commission 2004). Feral dog can be particularly damaging to native ground nesting species, especially threatened and endangered shore birds and sea turtle nests.

Goals and Objectives
Goal: Reduce impacts of feral dog to native species, especially rare and federally listed species.
Objectives:
1. Monitor natural areas for feral dog and control as needed.
2. Educate the public about being responsible for their pets, such as putting bells on collars, making sure dogs do not run loose in natural areas, encouraging pet owners to spay or neuter pets, not releasing dogs, etc.
3. Prioritize maintenance control in highly sensitive areas where predation affects native vertebrates and invertebrates.

Management Options
Preventative measures can be taken by educating dog owners about the risks of feral dog to native species. Packs of feral dog can be trapped and taken to animal shelters or euthanized (National Biological Infrastructure and Invasive Species Specialist Group 2005).

Distribution in the Region
Feral dog can be found throughout the region.

Coyote
Scientific name: *Canis latrans*

Description
Coyote was once only found in the western U. S., but the population has expanded to the eastern states. It is believed that coyote began expanding to the southeast in the 1970s after eradication of the wolf (*C. lupus* and *C. rufus*) (Main et al. 2004) and the decline of other large carnivores (Coates et al. 2002). This species has also been introduced illegally by humans from the western U. S. Coyote is very adaptable and can be found in various habitats. Diet includes rodents, rabbits, birds, livestock, small ungulates, insects, and carrion (Florida Fish and Wildlife Conservation Commission 2004).

Impacts
Coyote is a carrier of rabies and is a potential predator of endangered species and/or domestic animals and livestock (Main et al. 2004).

Goals and Objectives
Goal: Maintenance control.
Objectives:
1. Reduce population in localized coastal areas to reduce the threat to local populations of threatened and endangered species such as sea turtles, shorebirds, and beach mice. Reduce the number of nests predated.
2. Monitor natural coastal areas supporting threatened & endangered species, especially throughout the shorebird and sea turtle nesting seasons.
3. Monitor other populations that may be predating ground nesting species in other areas. Reduce population when necessary.

Management Options
Viable control options are:
1. Trapping and shooting. The use of poisoned baits (i.e. in food) is not allowed for control of coyote in Florida (Coates et al. 2002)

Distribution in the Region
Coyote can be found throughout the region.

Sambar deer
Scientific name: *Cervus unicolour*

Description
Native to Southeast Asia, Sambar deer were introduced as game species to the U. S. in 1908 (Florida Fish and Wildlife Conservation Commission 2004). It is naturalized on St. Vincent Island National Wildlife Refuge (St. Vincent), a barrier island managed by FWS. Sambar deer is the same genus as western elk and is much larger than the native white-tailed deer. This herbivore eats primarily aquatic plants and can be found near marshes and wetlands.

Impacts
Sambar deer creates disturbance in wetland habitats and may displace native white-tailed deer.

Goals and Objectives
Goal: Assure that the population on St. Vincent does not spread to the mainland.

Management Options
Monitor hunting of this species to ensure no live Sambar deer are brought to the mainland.

Distribution in the Region
Currently, Sambar deer is restricted St. Vincent.

Nine-banded armadillo

Scientific name: *Dasypus novemcinctus*

Description

Nine-banded armadillo is native to Texas. The species has migrated east to Florida over the past 50 years. It prefers forests and semi-open habitats with loose soil. Plants, insects, and other invertebrates are the primary food items of this species (Schaefer and Hostetler 2003).

Impacts

Disturbance by digging and rooting are the primary threats created by nine-banded armadillo. This disturbance commonly facilitates the colonization of weedy plants, as well as changes in soil ecology because of mixing. Populations of native plants, insects, and amphibians are also threatened by nine-banded armadillo predation (Schaefer and Hostetler 2003). It may also predate nests of gopher tortoises (Puckett and Franz 2001).

Goals and Objectives

Goal: Reduce population in localized sensitive areas and minimize digging of rare plants, insects, and amphibians.

Objectives:

1. Landowners and land managers should set own objectives for control.
2. Reduce predation of threatened and endangered species.
3. Monitor coastal areas throughout the shorebird and sea turtle nesting seasons.

Management Options

Viable control options are:

1. Trapping and shooting. It is illegal to transport, relocate or poison nine banded armadillo in Florida (Schaefer and Hostetler 2003).
2. Construction of barriers such as fencing to reduce predation of ground nesting species and limit entry to sensitive natural areas.

Distribution in the Region

Nine-banded armadillo can be found throughout the Apalachicola region and the State of Florida.

Feral cat
Scientific name: *Felis catus*

Description
Feral cat populations and individuals are a result of domestic cats that have either escaped or been released by humans. The estimated population of stray and feral cats in the United States ranges from 60–100 million (Florida Fish and Wildlife Conservation Commission 2004).

Impacts
Feral cat competes with native predators for food and can spread diseases to native animals. Birds are especially at risk to predation by populations of feral cat. Beach mice may also be impacted by feral cat predation.

Domestic cats kept as pets also pose a threat to native species (e.g. birds and mice), especially when owners do not have control over their pets and allow them to stay outside.

Goals and Objectives

Goal: Reduce population in localized areas.

Objectives:

1. Landowners and land managers should set own objectives for control.
2. Minimize the presence of feral cat in natural areas, especially with listed species.
3. Minimize impacts of domestic cats kept as pets in urban interface areas.
4. Educate the public about the impacts of domestic/feral cats on native species. Encourage pet owners to be responsible by keeping cats indoors, putting bells on cats' collars, not feeding stray cats, spay or neuter their pets, etc.

Management Options
Viable control options are:

1. Live trapping and relocation to local animal shelters or humane societies.

Distribution in the Region
Feral cat can be found anywhere in the region, especially in areas with urban interface where domestic cats have been released.

Feral hog
Scientific name: *Sus scrofa*

Description
Feral hog was introduced to the U. S. in the 1500s when Europeans first settled the continent. Today feral hog is believed to be a hybrid of Eurasian wild hog and domestic swine. Feral hog can be found in a variety of habitats, but it prefers large forested areas close to water and far from humans (Giuliano and Tanner 2005).

Impacts
Feral hog is an opportunistic omnivore and can cause significant damage to native vertebrate and invertebrate species. Wallowing in wet areas can alter soil structure, affect water quality, and cause erosion. Disturbance created by rooting and wallowing can alter vegetation by facilitating the establishment of weeds and non-native invasive plants. Rubbing on trees can cause tree death. Feral hog also carries many diseases that are potentially harmful to native animals and livestock (information from Giuliano and Tanner 2005).

Goals and Objectives
Goal: Maintenance control.
Objectives:
1. Identify and control population according to each land managers abilities and resources. Reduce or eliminate populations of feral hog in localized areas with high-quality habitats and or imperiled species.
2. Educate private landowners on control methods and ecological problems associated with feral hog.
3. Develop Memorandum of Agreement between agencies for feral hog management.
4. Modify current hunting zones and allow control in non-hunting zones. Allow for more liberal hunting regulations for feral hog.

Management Options
Viable control options are:
1. Baiting, trapping and shooting.

Distribution in the Region
Feral hog can be found throughout the region and the State of Florida.

Red fox
Scientific name: *Vulpes vulpes*

Description
Red fox is the largest species in its genus and among the most widely spread predators in the world. A European subspecies was introduced to the U. S. in the 1600s and is believed to have mixed with the native subspecies and subsequently spread throughout the eastern U. S., especially as forests were cleared for agriculture and livestock (Artois, 1999). Red fox is nocturnal but can be seen during the day. Preferred habitats include fields and weedy pastures; they are seldom found in heavily wooded areas typically inhabited by gray fox (*Urocyon cinereoargenteus*) (Florida Fish and Wildlife Conservation Commission 2004).

Impacts
Red fox prey on small native mammals and can be especially harmful to ground nesting birds and imperiled species in coastal habitats. It is also a carrier of rabies and other diseases (Florida Fish and Wildlife Conservation Commission 2004).

Goals and Objectives
Goal: Maintenance control.
Objectives:
1. Reduce population in areas with populations of ground nesting species, such as gopher turtles, sea turtles, shorebirds, and beach mice. Reduce the number of nests predated.
2. Monitor natural coastal areas supporting threatened and endangered species, especially throughout the shorebird and sea turtle nesting seasons.

Management Options
Viable control options are:
1. Trapping and shooting

Distribution in the Region
Red fox can be found throughout the region and the State of Florida.

Birds

Table 6. Non-native invasive birds of the Apalachicola River region

Scientific Name	Common Name
Carpodacus mexicanus	house finch
Passer domesticus	house sparrow
Sturnus vulgaris	European starling

House finch
Scientific name: *Carpodacus mexicanus*

Description
House finch is native to the western U.S. and is currently recorded throughout the continental U. S. This species has spread naturally and by human introduction to the eastern U. S. House finch is most commonly found in urban and agricultural areas (Florida Fish and Wildlife Conservation Commission 2004).

Impacts
House finch may spread disease to native birds. Agricultural operations have identified house finch as an agricultural pest because it consumes grain crops (Florida Fish and Wildlife Conservation Commission 2004).

Goals and Objectives
Monitor natural areas assess impacts and threats.

Management Options
Viable control options are:

1. No treatment. This species is naturalized and the costs of management would most likely outweigh the benefits of control.

Distribution in the Region
House finch can be found throughout the Apalachicola region and in the State of Florida.

House sparrow
Scientific name: *Passer domesticus*

Description
House sparrow is native to Eurasia and Northern Africa and was introduced to the U. S. in the mid 1800s. It can now be found throughout the U. S. and Canada. House sparrow is common to urban and agricultural areas and is rarely found in undisturbed sites (Gulf Coast Marine Fisheries Commission 2005).

Impacts
House sparrow may evict native bird species from their nests. Diseases carried by house sparrow can be transmitted to native species. It is identified as an agricultural pest because it consumes newly planted seeds or cultivated crops (Florida Fish and Wildlife Conservation Commission 2004).

Goals and Objectives
Monitor natural areas to assess impacts and threats.

Management Options
Viable control options are:

1. No treatment. This species is naturalized and the costs of management would most likely outweigh the benefits of control.

Distribution in the Region
House sparrow can be found throughout the Apalachicola region and the State of Florida, especially in urban areas.

European starling
Scientific name: *Sturnus vulgaris*

Description
European starling is native to Europe and was introduced to the U. S. in 1890. It is now documented throughout the U. S. and Canada. European starling travels in large flocks, often with grackles or cowbirds. It can be found in virtually any habitat and is common in urban areas (Florida Fish and Wildlife Conservation Commission 2004).

Impacts
European starling competes with native birds for food and will often use or steal nesting cavities from native species such as the red-headed woodpecker (*Melanerpes erythrocephalus*). Roosting habits make it an urban nuisance because it can gather in large numbers creating noise and soiling areas with their droppings. Agricultural areas have also been negatively impacted by European starling consumption of newly planted seeds or cultivated crops (Gulf Coast Marine Fisheries Commission 2005).

Goals and Objectives
Monitor natural areas to assess impacts and threats.

Management Options
Viable control options are:

1. No treatment. This species is naturalized and the costs of management would most likely outweigh the benefits of control.

Distribution in the Region
European starling can be found throughout the region and the State of Florida.

Fish

The control and eradication of non-native invasive fish in the Apalachicola region is not an economically viable option for the majority of land managers in the region. However, monitoring of the known species and their possible effects in the region will help to better assess their impacts and implement management practices if necessary. Distribution of these species is unknown.

Table 7. Non-native invasive fish of the Apalachicola River region

Scientific Name	Common Name
Ctenopharyngodon idella	grass carp
Cyprinus carpio	common carp
Fundulus lineolatus	lined topminnow
Ictalurus furcatus	blue catfish
Lepomis cyanellus	green sunfish
Lepomis humilis	orange spotted sunfish
Micropterus punctulatus	spotted bass hybrids
Morone hybrids	striped bass hybrids
Morone chrysops	white bass
Oreochromis niloticus	Nile tilapia
Polyodon spathula	paddlefish
Pylodictis olivaris	flathead catfish

Grass carp
Scientific name: *Ctenopharyngodon idella*

Description
Grass carp is native to Russia and China and was initially introduced to Florida in the 1960s as a biological control for aquatic plants (Fuller et al.1999). It is has been documented in over 40 states (Fuller 2005). It can be found in slow flowing or stagnant water bodies such as lakes, ponds, pools, and backwaters of large rivers. Although it is primarily found in fresh water habitats, it can tolerate low levels of salinity and is sometimes found in brackish waters (Fuller 2005). Grass carp is a commonly used aquaculture species for aquatic vegetation control and state-specific regulations often require the use of reproductively unviable triploid fish. Florida, Georgia, and Alabama all require that aquaculture grown grass carp be triploid.

Impacts
Impacts of grass carp on aquatic systems in Florida have been difficult to assess because of varied stocking rates, different water body structures, and macrophyte population levels (Fuller et al. 1999).

Grass carp is an herbivore and has been effective in controlling non-native aquatic weeds such as hydrilla. However, it has been reported to consume native aquatic vegetation as well, resulting in changes to the structure and food webs of Florida's water bodies (Cervone 2003b). One study showed the removal of vegetation by grass carp dramatically increased predation of native foraging species by reducing plant cover and revealing these species to predators such as largemouth bass or waterfowl (NatureServe 2006).

Grass carp may also carry parasites such as fish tapeworms or other diseases harmful to native fishes (McCann 1996).

Goals and Objectives
Goal: Prevent the establishment of a reproductively viable population.
Objectives: FWS annually samples (internal samples) grass carp populations in the Apalachicola River to check reproductive status. This monitoring can ensure that any found samples are indeed triploid and should be supported. If samples prove that some fish are not triploid, then coordination between the FWS and other agencies in Florida, Georgia, and Alabama should occur to prevent permanent establishment.

Management Options
Eradication of this species from the Apalachicola River Basin is only possible if 1. There are no reproducing populations, and 2. Current stocking of these fish throughout the basin ceases and remaining fish naturally perish. Currently there is no evidence suggesting that grass carp reproduce in this drainage, though eliminating its use within the basin is, at this time, unrealistic. As such, continued support of strict regulations (e.g., triploid requirements) on this species and its use may help lessen its impacts in this system.

Common carp
Scientific name: *Cyprinus carpio*

Description
Common carp is native to Eurasia and was introduced to the U. S. in the early 1800s (Fuller et al. 1999). It is now established throughout the U. S. and Canada. Common carp can be found in a variety of fresh or brackish water bodies and is most common in shallow areas with little to no current (NatureServe 2006).

Impacts
Impacts on aquatic habitats depend greatly on the size of the common carp population within the water body. Common carp is considered a pest because its spawning and feeding habits involve churning of substrates which increases water turbidity. This fish may also consume flora important for waterfowl and aquatic vertebrate and invertebrate species. It has also been reported to eat native fish eggs (Fuller et al. 1999).

Goals and Objectives

Goal: Limit or prevent its use as a bait fish.

Objectives: Common carp is currently prohibited for use as freshwater bait in Florida, but not Alabama or Georgia. All three states have regulations prohibiting the transfer of bait into any water body except from which it was taken. Recently, vendors have begun selling common carp as salt water bait (e.g., the "black salty"). Limiting/preventing its use as a bait fish in both marine and freshwater systems may help prevent further population supplementation in this system.

Management Options
Eradication of the species is not a viable option, though limiting populations may lower impacts (such as turbidity) to aquatic habitats, flora, and fauna. Options include:

- Seining: use in early morning and late afternoon when fish bunch together (NatureServe 2006).
- Drawdowns: Used only in water bodies that can be manipulated, during spawning to kill eggs layed in shallow areas (NatureServe 2006).

Lined topminnow
Scientific name: *Fundulus lineolatus*

Description
Lined topminnow is native to northern and central Florida east of the Apalachicola River. It can be found throughout the Atlantic and Southern coastal plains north to Virginia. A specimen was collected in the Apalachicola River in 1958; this specimen was probably introduced from a bait bucket (Fuller 2005). Lined topminnow can be found in swamps and other vegetated water bodies, quiet pools, and backwater areas of streams.

It has also been recorded from Kelley Branch at TNC's Apalachicola Bluffs and Ravines Preserve in Bristol, Florida. This population was most likely introduced by bait buckets as well, and was able to reproduce because of suitable habitat created by an impoundment. The impoundment, which has been drained and will be restored to its former stream state, will most likely no longer provide suitable habitat for the lined topminnow on this site.

Impacts
Potential damage and threats posed to natural areas by the lined topminnow are unknown.

Goals and Objectives
Goals on the Apalachicola Bluffs and Ravines Preserve for this species are to eliminate the lined topminnow from the Kelley Branch. The drawdown of the lake allowed for predation of the topminnow as predators became concentrated in pools left after the majority of the water was drained. The lake was bottom-drained to prevent topminnows from spilling over the existing standpipe while it was draining. Populations found downstream of the dam and impoundment prior to removal probably spilled over and found habitat in the pool created directly below the dam. The removal of the dam will decrease the available habitat may eradicate the species from the stream.

Because it has not been collected in the main stem and the Kelley Branch population may have been established for some time, the Apalachicola River does not appear provide suitable habitat for the lined topminnow, but monitoring in the floodplain and other streams might be necessary.

Management Options
No management options at this time. See previous section for recommendations.

Blue catfish
Scientific name: *Ictalurus furcatus*

Description
Blue catfish is native to the Mississippi River basin, the Gulf slope from the Mobile Bay basin, and the Atlantic slope of Mexico (Fuller et al.1999). The species was first recorded in the Apalachicola River in 1995. It is believed that the population in the Apalachicola River came from the Chattahoochee River, where the species was introduced when a storm created overflow from a stocked pond (Fuller 2005). Habitats include freshwater streams and rivers (Froese and Pauly 2006).

Impacts
Impacts of blue catfish to native species and natural communities are unknown. However, because of its life history and potential to reach large sizes, blue catfish, like flathead catfish, may be an important invasive predator in the Apalachicola River.

Goals and Objectives

Goal: Discourage management as a sportfish.

Objectives: Management of this species as a viable sportfish in the Apalachicola River can result in increased population size (e.g., via stocking) and larger population size-structure for this species, thus increasing its potential to negatively affect the system. An effort should be made to work with the state agencies to prevent its management as such.

Management Options
No management options at this time. See previous section for recommendations.

Green sunfish
Scientific name: *Lepomis cyanellus*

Description
Green sunfish is native to the Mississippi River basin, the Great Lakes, Hudson Bay, and the Gulf Slope from Mobile Bay west to the Rio Grande River (Fuller et al. 1999). The species was first documented in the Apalachicola River watershed in the late 1950s and was probably introduced as a game fish (Fuller 2005). Habitat includes freshwater streams, lakes, and ponds. FWC lists green sunfish as a prohibited species (Florida Fish and Wildlife Conservation Commission 2004).

Impacts
Green sunfish is reported to be very aggressive and has been found out-competing native species in areas of introduction. Green sunfish may hybridize with other *Lepomis* species (Fuller 2005).

Goals and Objectives
None at this time

Management Options
No management options at this time.

Orange spotted sunfish
Scientific name: *Lepomis humilis*

Description
Orange spotted sunfish is native to the Mississippi River, the lower Great Lakes, Hudson Bay, and the Gulf Slope from Mobile Bay to the Colorado River (Fuller et al. 1999). It was first documented in the Apalachicola River watershed in the early 1960s, but was probably stocked unintentionally (Fuller 2005). Habitats include quiet pools of freshwater lakes, rivers, and streams (Froese and Pauly 2006).

Impacts
Orange spotted sunfish may compete with native species for food (Fuller et al. 1999).

Goals and Objectives
None at this time

Management Options
No management options at this time.

Spotted bass

Scientific name: *Micropterus punctulatus*, *M. punctulatus* subspecies (*M. punctulatus punctulatus, M. punctulatus henshalli*)

Description

Spotted bass are native to the Mississippi River drainage and the Gulf slope drainage to the Chattahoochee River (Fuller et al. 1999). These species are stocked for sport fishing (Florida Fish and Wildlife Conservation Commission 2006). Habitat of spotted bass includes freshwater rivers and streams (Froese and Pauly 2006).

Impacts

Spotted bass may hybridize with native species such as smallmouth bass (Fuller 2005); these species may also prey on smaller fish species.

Goals and Objectives

Goals: Discourage management as a sportfish.

Objectives: Management of this species as a viable sportfish in the Apalachicola River can result in increased population size (e.g., via stocking) and larger population size-structure for this species, thus increasing its potential to negatively affect the system. An effort should be made to work with the state agencies to prevent its management as such.

Management Options

No management options at this time. See previous section for recommendations.

Striped bass hybrids

Scientific name: *Morone* spp. (bass hybrids including *M. chrysops x M. saxatilis*)

Description

Striped bass are native to Florida and the Apalachicola River, but introduced subspecies from the Atlantic were introduced to hybridize with the native population for sport fishing. Striped bass are anadromous and can be found in marine and brackish water for the majority of the year. Freshwater streams, rivers, and lakes are used in the spring for spawning (Froese and Pauly 2006).

Impacts

Striped bass hybrids prey upon smaller native fish species and have a genetic advantage over native, non-hybridized striped bass populations (Fuller et al. 1999).

Goals and Objectives

Goal: Discourage management as a sportfish.

Objectives: Management of this species as a viable sportfish in the Apalachicola River can result in increased population size (e.g., via stocking) and thus increase predation on native fishes. Eradication of this species from the Apalachicola River Basin is only possible if 1) there are no reproducing populations, and 2) current stocking of these fish throughout the basin ceases and remaining fish naturally perish. Currently there is no evidence suggesting that striped bass hybrids reproduce in this drainage. Eliminating this species from the drainage is currently unrealistic because of its popularity as a highly-prized sportfish throughout the drainage.

Management Options

No management options at this time. See previous section for recommendations.

White bass

Scientific name: *Morone chrysops*

Description

White bass is native to the Great Lakes, St. Lawrence River watershed, Mississippi River watershed, and the Rio Grande River watershed in Texas and New Mexico (Fuller et al. 1999). It is stocked in Florida for sport-fishing. White bass is potadromous and is found in demersal regions of freshwater rivers, streams, and lakes (Froese and Pauly 2006).

Impacts

White bass is a predator of native fish species and competitor to native species for food. There is potential for white bass to hybridize with indigenous striped bass (*M. saxatilis*) and potentially undermine the population genetics of this native species, though this is unlikely.

Goals and Objectives

Goal: Discourage management as a sportfish.

Objectives: Management of this species as a viable sportfish in the Apalachicola River can result in increased population size (e.g., via stocking) and larger population size-structure for this species, thus increasing its potential to negatively affect the system. An effort should be made to work with the state agencies to prevent its management as such.

Management Options

No management options at this time. See previous section for recommendations.

Nile tilapia
Scientific name: *Oreochromis niloticus*

Description
Nile tilapia is native to Africa and the Middle East and was most likely introduced when it escaped from fish farms where it was used for aquaculture purposes (Fuller et al. 1999). It was first documented in the Apalachicola River watershed in the late 1980s in Lake Seminole (McCann 1996). Nile tilapia can be found in a variety of freshwater habitats including rivers, lakes, canals, and irrigation channels (Froese and Pauly 2006). Currently, this species is found only within Lake Seminole.

In addition, records of blue tilapia (*O*. *aureus*) collected from Lake Seminole are considered misidentified Nile tilapia (Fuller et al. 1999).

The presence of this species in the Apalachicola River drainage (in Lake Seminole) appears predicated on the presence of freshwater springs, which ameliorate the killing effects of cold water temperatures during winter months. Of note, aquaculturists are increasingly using hybrids of *O. niloticus* x *O. aureus* (Blue tilapia) in hatcheries in the region and nationwide. These hybrids occasionally express color patterns consistent with identification of either parent, so genetic analysis may be required for positive species identification should an *Oreochromis* sp. be collected in the basin.

Impacts
Impacts are unknown. Nile tilapia may compete with native fishes for spawning areas (Fuller et al. 1999).

Goals and Objectives

Goal: Limit the spread of Nile tilapia in the Apalachicola River drainage.

Objectives: Monitor the Nile tilapia population in Lake Seminole via coordination with state and federal agencies and coordinate on management decisions based on the data collected.

Management Options
No management options at this time. See previous section for recommendations.

Paddlefish
Scientific name: *Polyodon spathula*

Description
Paddlefish is native to the Mississippi River drainage and tributaries. The first collections of paddlefish in the Apalachicola River were documented in the early 1990s (Fuller 2005). It is believed that the introduction of this species occurred in 1994 when tropical storm Alberto flooded an aquaculture facility on the Flint River, allowing over 1000 paddlefish to escape into the Apalachicola-Chattahoochee-Flint system (Fuller, 2005). Paddlefish can be found in slow moving fresh water of large rivers (Froese and Pauly 2006).

Impacts
Impacts of paddlefish are unknown.

Goals and Objectives
Goal: Continued monitoring of paddlefish is necessary to determine if this species can/has become reproductively established in the Apalachicola River system.

Management Options
No management options at this time. See previous section for recommendations.

Flathead catfish
Scientific name: *Pylodictis olivaris*

Description
Flathead catfish is native to the Mississippi River basin, the lower Great Lakes, the Gulf Slope/Mobile Bay drainage, and Georgia, and Alabama (Fuller et al. 1999). First records in the Apalachicola occurred in the early 1990s; it was most likely introduced from populations upstream in the Flint River (Fuller 2005). Flathead catfish can be found in small to large freshwater rivers, lakes, and impoundments (Froese and Pauly 2006). Adult flathead catfish are solitary and spend most of their time in deep waters near log jams or fallen trees (Florida Fish and Wildlife Conservation Commission 2004) where food sources are abundant.

Impacts
Flathead catfish is commonly considered one of the most deleterious invasive fishes east of the Mississippi River due to its potential to reach large sizes and predatory life history. This species preys upon other catfish species, sunfish, and suckers. It has been suggested that flathead catfish may also consume the federally endangered Gulf sturgeon young (Fuller et al. 1999), though compelling evidence has been lacking to date. Non-native populations of this species are known to have severely suppressed and/or eliminated native sunfish populations in Atlantic Coast drainages.

Goals and Objectives

Goal: Discourage management as a sportfish.

Objectives: Management of this species as a viable sportfish in the Apalachicola River can result in increased population size (e.g., via stocking) and larger population size-structure for this species, thus increasing its potential to negatively affect the system. An effort should be made to work with the state agencies to prevent its management as such. This may be especially challenging due to its growing popularity among anglers, as evidenced by numerous flathead catfish tournaments held each year along the Apalachicola River.

Management Options
No management options at this time. See previous section for recommendations.

INVERTEBRATES

Insects

Table 8. Non-native invasive insects of the Apalachicola River region

Scientific Name	Common Name
Cactoblastis cactorum	cactoblastis moth
Solenopsis invicta	red imported fire ant

Cactoblastis moth
Scientific name: *Cactoblastis cactorum*

Description
Cactoblastis moth is native to South America and was discovered in the Florida Keys in 1989. It is believed to have spread to Florida either naturally or by humans from introduced populations in the Caribbean (Habeck and Bennett 2002), where it is used as a biological control for invasive species of prickly pear cactus (*Opuntia* spp.) (Bloem 2005). It has spread north to South Carolina and west to Alabama, especially in coastal areas.

Impacts
Damage caused to native prickly pear plants is extensive in Florida. Once hatched from egg sticks attached to prickly pear pads, larvae burrow into the pads and eat all of the inner tissue until the food supply is exhausted (Habeck and Bennet 2002). Spread of the moth into the western U. S. and Mexico could cause severe damage to prickly pear populations, especially in Mexico where there are 54 species (38 of which are endemic) of prickly pear, which compromises 2% of total annual food crop production in the country (Bloem 2005).

Goals and Objectives

Goal: Monitor and control cactoblastis moth infestations to reduce local impacts and constrain further spread.

Objectives:

1. Establish a monitoring and control program for cactus moth on managed areas. If found, destroy individual prickly pear plants which are infested. Land managers can make requests for initial monitoring by USDA Agricultural Research Service.
2. Educate public to recognize and control infestations on ornamental plantings.
3. Coordinate with the Cactus Moth Monitoring and Detection Network (http://www.gri.msstate.edu/research/cmdmn/) to share data and track distribution of the moth within the region.

Management Options
Biological controls: Research on biological controls for cactoblastis moth has been conducted, but options were limited due to potential negative impacts on native moth populations (Pemberton and Cordo 2001). The release of sterile males to stymie population growth is also underway in Alabama. Release sterile insects will hopefully reduce the further western spread of established breeding populations (Durham 2006).

Chemical controls: The use of pesticides is not recommended because of negative effects on native insects (Habeck and Bennett 2002).

Distribution in the Region
Cactoblastis moth has been found in coastal regions of the CISMA and adjacent regions (S. Hight pers. comm.).

Red imported fire ant
Scientific name: *Solenopsis invicta*

Description
Red imported fire ant is native to South America and was probably introduced accidentally to the U. S. in ship ballast in the 1930s. It has become established in all of the southeastern U. S. Red imported fire ants is considered one of the "World's Worst Invaders" (National Biological Infrastructure and Invasive Species Specialist Group 2005) and has been under federal quarantine since 1958. Federal quarantine of the species restricts interstate movement of materials from quarantined counties (all counties in Florida are under this quarantine) where red imported fire ant is present (United States Department of Agriculture Animal Plant Health Inspection Service 1992).

Impacts
Red imported fire ant is a nuisance to the public and can cause health problems to humans. It is also a problem in agricultural areas and has been documented to lower crop yields (Collins and Scheffrahn 2005). Red imported fire ant has also been reported to negatively impact native ant species by competing for food and predation; ground nesting species such as birds and rodents have been reported to be affected by this species because it bites them during and directly after birth or hatching (Willcox and Giuliano 2006). Destruction of electric boxes due to red imported fire ant infestations is common and has resulted in a huge expense for electric companies (Vander Meer 2006).

Goals and Objectives
Goal: Maintenance control as needed.
Objectives:
1. Land managers can control fire ants using available management options using their own discretion.

Management Options
Biological: Two pathogens have been investigated as biological controls for fire ants: a microsporidian protozoan (*Thelohania solenopsae*) which causes disease and weakens the colony (Weaver-Misseck 1999) and a fungus (*Beauveria bassiana*) which also causes disease.

Two species of parasitic flies have been released as biocontrols against fire ants: *Pseudacteon tricuspus and P. curvatus*. Both species lay eggs in the head of red imported fire ant and cause decapitation; these species are established in Florida and expanding. A parasitic ant (*Solenopsis daguerri*) is also under investigation as a possible biological control in the U. S. (Collins and Scheffrahn 2005).

Chemical: There are a number of approaches to red imported fire ant control with chemicals. Researchers at Texas A&M University (2006) recommend the following treatments:

- Surface mound treatments: especially when native ants are located in the same area. Not cost effective in areas in need of large-scale treatment.

1. Mound drenches. Mix several gallons of hot water (may be mixed with insecticides) and pour into mound. This method may not reach the queen. Insecticides with the following active ingredients are recommended: carbaryl, chlorpyrifos, diazinon, and permethrin.
2. Surface dusts. Pour insecticide over mound. Insecticides with the active ingredient acephate are recommended.
3. Mound injections. Pressurized insecticides are pumped into the mound.
4. Bait. Bait is spread around the mound and carried into the mound by the workers. This method is effective because the bait will be carried to the queen. This method can be done by individual mounds or broadcast treatments. Baits with active ingredients hydramethylnon, abamectin, fenoxycarb, methoprene, and pyriproxyfen are recommended.

- Broadcast treatments. Granular and baits are both used for treatments of large areas. Broadcast treatments are non-selective and may harm native ant species (Collins and Scheffrahn 2005). Granular treatments are applied to mounds and sprayed with water. Recommended granular treatments are chlorpyrifos, diazinon, deltamethrin, and permethrin (Texas A & M University 2006).

Distribution in the Region

Red imported fire ant can be found throughout the region and the State of Florida (NatureServe 2006).

Mollusks

Table 9. Non-native invasive mollusks of the Apalachicola River region

Scientific Name	Common Name
Corbicula fluminea	Asian clam

Asian clam
Scientific name: *Corbicula fluminea*

Description
The native range of Asian clam extends from Southeast Asia west to the Mediterranean Sea, Africa, and south to Australia. The method of introduction is unknown, though it is believed that the clam was brought to the U. S. by Chinese immigrants in the 1930s and spread naturally and by humans since it was first recorded (McCann 1996). Distribution is widespread in areas throughout the U. S. and Florida. Asian clam has been recorded in the Apalachicola River watershed since the early 1960s (Fuller 2005). It can be found in slow or rapid flowing fresh and brackish waters, though it does not tolerate high salinity (Gulf Coast Marine Fisheries Commission 2005).

Impacts
Asian clam grows and reproduces rapidly and may compete with native mollusks for habitat (Light et al. 2006). Large populations of Asian clam may also impact nutrient dynamics of water bodies (Gulf Coast Marine Fisheries Commission 2005). Asian clam has also been reported to clog irrigation ditches, dams, power plants, and industrial water systems (Fuller 2005).

Goals and Objectives

Goal: Support research for impacts to natural communities and control options.

Objectives:

1. Monitor populations, especially known spawning sites for federally listed species.

Management Options
No management options at this time.

Distribution in the Region
Asian clam has been documented in the Apalachicola and Chipola rivers (Fuller 2005).

GLOSSARY OF TERMS

ACF: Apalachicola-Chattahoochee-Flint watershed.

ANERR: Apalachicola National Estuarine Research Reserve.

APRS: Alien Plants Ranking System.

Biological control methods: The use of animals, fungi, or other microbes to feed upon, parasitize or otherwise interfere with a targeted invasive species. Synonym: biocontrol (Tu et al. 2001).

Chemical control methods: The use of herbicides to control or eradicate invasive plants. Techniques include the following:

- *Basal bark*: A band of chemicals is sprayed around the trunk of a tree on the lowest 12–20 inches of the woody stem. Spray bottles, backpack sprayers, wick applicators, etc. can be used to apply herbicide mixtures (Miller 2003).
- *Cut stump*: Freshly cut stems are treated with chemicals. Large stems only require the circumference of the cut stump to be treated (to affect the cambium layer). Smaller stems require treatment of the entire cut stump. Herbicides are applied with a backpack sprayer, spray bottle, paint brush, etc. (Miller 2003).
- *Foliar*: Herbicides are diluted and applied to leaves using aerial or ground spraying equipment (Langeland and Stocker 1997).
- *Stem injection*: Herbicides are applied to the cambium layer of woody stems using a downward incision. This technique is used for stems with a diameter larger than two inches. Synonym: hack and squirt (Miller 2003).

Control: The management of a population of invasive species to reduce the overall numbers, but recognizing that eradication is not attainable with available resources. The goal of control project should be maintenance (Serbesoff-King and Gordon 2005).

Cultural control methods: Methods such as prescribed burning or water level manipulations to control or eradicate invasive plants (Langeland and Stocker 1997).

EQIP: Environmental Quality Incentives Program. EQIP is a Farm Bill program administered by local NRCS representatives to provide land management funding for private land owners with eligible agricultural lands.

Eradication: The elimination of all members of a population in a given area (Serbesoff-King and Gordon 2005).

FDACS: Florida Department of Agriculture and Consumer Services.

FDEP: Florida Department of Environmental Protection.

FDOT: Florida Department of Transportation.

Federal Noxious Weed: A species designated by the USDA that "can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment" (United States Department of Agriculture 2001).

FLEPPC: Florida Exotic Pest Plant Council.

FLEPPC Category I Pest Plant: A species that alters "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" (Florida Exotic Pest Plant Council 2005).

FLEPPC Category II Pest Plant: A non-native invasive species that has "increased in abundance or frequency but (has) not yet altered Florida plant communities to the extent shown by (FLEPPC) Category I species. These species may become Category I if ecological damage is demonstrated" (Florida Exotic Pest Plant Council 2005).

Florida Noxious Aquatic Plant: "Any part, including but not limited to seeds or reproductive parts, of an aquatic plant which has the potential to hinder the growth of beneficial aquatic plants, to interfere with irrigation or navigation, or to adversely affect the public welfare or the natural resources of this state" (Florida Department of Environmental Protection Division of State Lands 1996).

Florida Noxious Weed: "Any living stage, including, but not limited to, seeds and reproductive parts, of a parasitic or other plant of a kind, or subdivision of a kind, which may be a serious agricultural threat in Florida, or have a negative impact on the plant species protected under Section 581.185, F.S., or if the plant is a naturalized plant that disrupts naturally occurring native plant communities" (Florida Division of Plant Industry 2004).

Forest Stewardship Program: A program administered by FDACS, Division of Forestry to provide funding to private land owners with property of more than 25 acres of land not used for manufacturing products or provision of public utilities.

Non-native invasive species: A non-native species that has the capacity to form self-sustaining, free-living populations, expanding in one or more assemblages of species with which it has not previously been associated (Vitousek et al. 1995). Direct or indirect human actions were responsible for the species introduction to the area where it is non-native. An example of indirect actions could include converted natural habitat to land for livestock production that has allowed the non-native species to move across a barrier it could not have surmounted naturally. The Federal government further defines this as a species that "may also cause or be likely to cause economic or environmental harm or harm to human health" (United States Department of Agriculture National Invasive Species Information Center 1999).

Integrated pest management control methods: The use of two or more control methods to manage a population of invasive species.

LIP: Landowner Incentive Program. LIP is a cost share program administered by FWC for private land owners to improve natural habitat.

Maintenance: A method of managing exotic plants in which control techniques are utilized in a coordinated manner on a continuous basis in order to maintain a plant population at the lowest feasible level (Florida State Statute 2006).

Mechanical and manual control methods: Techniques used to control plants that include pulling, cutting or otherwise damaging invasive plants (Tu et al. 2001).

Naturalized species: A non-native species persisting and reproducing outside of human cultivation or care. The species is not spreading with evidence of harm to native species or communities in natural areas (Serbesoff-King and Gordon 2005).

Non-native species: A species present outside its natural range or natural zone of dispersal; includes all domesticated and feral species and all hybrids except for naturally occurring crosses between native species (Vitousek et al. 1995). Synonyms: non-indigenous, exotic, alien.

NRCS: Natural Resources Conservation Service.

UNESCO: United Nations Educational, Scientific, and Cultural Organization.

USDA: United States Department of Agriculture.

USGS: United States Geological Survey.

WHIP: Wildlife Habitat Incentive Program. WHIP is a cost share program administered by local NRCS representatives for private land owners to improve wildlife habitat.

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APPENDIX

RARE, THREATENED, AND ENDANGERED SPECIES OF THE APALACHICOLA RIVER REGION

Table Key

LE – Listed Endangered
LT – Listed Threatened
SC – Species of Special Concern

Table 10. Rare mammals of the Apalachicola River region

Species	Common name	Natural Community/Habitat	Federal Status	State Status	Locations by County
Myotis grisescens	gray bat	Mesic Uplands: Upland Glade, Subterranean-Karst	LE	LE	JAC,LEON
Peromyscus polionotus allophrys	Choctawhatchee beach mouse	Coastal: sand dunes, sand live oak	LE	LE	BAY
Peromyscus polionotus peninsularis	St. Andrew's beach mouse	Coastal: sand dunes, sand live oak	LE	LE	BAY,GULF
Podomys floridanus	Florida mouse	Xeric Uplands: sandhills, Gopher Tortoise.		SC	FRA
Sciurus niger shermani	Sherman's fox squirrel	Xeric Uplands & Mesic/Wet Flatlands: sandhills, flatwoods		SC	FRA,LEON, LIB
Trichechus manatus	Florida manatee	Marine/Estuarine	LE	LE	BAY,FRA, GULF,WAK
Ursus americanus floridanus	Florida black bear	Various		LT	All

Table 11. Rare birds of the Apalachicola River region

Species	Common name	Natural Community/Habitat	Federal Status	State Status	Locations by County
Ammodramus maritimus peninsulae	Scott's seaside sparrow	Marine and Estuarine / Coastal uplands		SC	BAY,FRA, GULF,WAK
Aramus guarauna	limpkin	Various: near water		SC	CAL,FRA, GAD,GULF, JAC,LEON, LIB,WAK
Charadrius alexandrinus	snowy plover	Marine and Estuarine / Coastal uplands: Barrier islands		LT	BAY,FRA, GULF
Charadrius melodus	piping plover	Marine and Estuarine / Coastal uplands: Barrier islands	LT	LT	BAY,FRA, GULF,WAK
Cistothorus palustris marianae	marsh wren	Marine and Estuarine / Coastal uplands: tidal marsh, with *Juncus* spp.		SC	BAY,FRA, WAK
Egretta caerulea	little blue heron	Various: near water		SC	All
Egretta rufescens	reddish egret	Marine and Estuarine / Coastal uplands-shallow		SC	BAY,FRA, GULF,WAK
Egretta thula	snowy egret	Various: near water		SC	All
Egretta tricolor	tricolored heron	Various: near water		SC	All
Eudocimus albus	white ibis	Various: near water		SC	All
Falco sparverius paulus	southeastern American kestrel	Various		LT	All
Haematopus palliates	American oystercatcher	Marine and Estuarine / Coastal uplands		SC	BAY,FRA, GULF,WAK

Species	Common name	Natural Community/Habitat	Federal Status	State Status	Locations by County
Haliaeetus luecocephalus	bald eagle	Various: near water, live pine	LT	LT	All
Mycteria americana	wood stork	Various	LE	LE	All
Pandion haliaetus	osprey	Various: near water		SC	All
Pelecanus occidentalis	brown pelican	Marine and Estuarine / Coastal uplands		SC	BAY,FRA, GULF,WAK
Picoides borealis	red-cockaded woodpecker	Xeric Uplands & Mesic/Wet flatlands: long-leaf pine flatwoods, savannahs	LE	LE	BAY,FRA, GULF,LEON, LIB,WAK
Rynchops niger	black skimmer	Marine and Estuarine / Coastal uplands		SC	BAY,FRA, GULF,WAK
Sterna antilliarum	least tern	Marine and Estuarine / Coastal uplands: barrier islands		LT	BAY,FRA, GULF,LEON, WAK

Table 12. Rare reptiles of the Apalachicola River region

Species	Common name	Natural Community/Habitat	Federal Status	State Status	Locations by County
Alligator mississippiensis	American alligator	Riverine: Lacustrine, Palustrine	LT	LT	All
Caretta caretta	loggerhead	Marine and Estuarine / Coastal uplands: barrier islands	LT	LT	BAY,FRA, GULF,WAK
Chelonia mydas	green sea turtle	Marine and Estuarine / Coastal uplands: barrier islands	LE	LE	BAY,FRA, GULF,WAK
Dermochelys coriacea	leatherback	Marine and Estuarine / Coastal uplands: barrier islands	LE	LE	BAY,FRA, GULF,WAK
Drymarchon couperi	eastern indigo snake	Xeric Uplands and Mesic/Wet flatlands: sandhills, scrub, wet prairies, etc	LT	LT	All
Gopherus polyphemus	gopher tortoise	Xeric Upland: sandhills, scrub		LT	All
Graptemys barbouri	Barbour's map turtle	Riverine		SC	CAL,FRA, GAD,GULF JAC,LEON, LIB
Lepidochelys kempii	Kemp's ridley	Marine and Estuarine / Coastal uplands: Barrier Islands	LE	LE	BAY,FRA, GULF,WAK
Macrochelys temminckii	alligator snapping turtle	Riverine: Lacustrine, Palustrine		SC	All
Pituophis melanoluecus mugitus	Florida pine snake	Xeric Uplands: sandhills		SC	All
Pseudemys concinna suwanniensis	Suwannee cooter	Riverine		SC	CAL,FRA, GAD,GULF JAC,LEON, LIB,WAK

Table 13. Rare amphibians of the Apalachicola River region

Species	Common name	Natural Community/Habitat	Federal Status	State Status	Locations by County
Ambystoma bishop	reticulated flatwoods salamander	Xeric Uplands & Mesic/Wet flatlands: longleaf/wiregrass, savannas, isolated wetlands, ephemeral ponds	LE	LE	CAL,JACK
Ambystoma cingulatum	frosted flatwoods salamander	Xeric Uplands & Mesic/Wet flatlands: longleaf/wiregrass, savannas, isolated wetlands, ephemeral ponds	LT	LT	FRA,GAD, GULF,LIB, WAK
Desmoganthus apalachicolae	Apalachicola dusky salamander	Mesic Uplands: Slope Forest: edges of small seepage streams, steepheads		SC	CAL,GAD, LIB
Haideotriton wallacei	Georgia blind salamander	Mesic Upland: Upland Glade/Karst: subterranean and aquatic caves		SC	JAC
Rana capito	gopher frog	Xeric Uplands and Mesic/Wet flatlands: gopher tortoise burrows, sandhills, scrub, ponds.		SC	All

Table 14. Rare fish of the Apalachicola River region

Species	Common name	Natural Community/Habitat	Federal Status	State Status	Locations by County
Acipenser oxyrinchus desotoi	Gulf sturgeon	Riverine/ Marine & Estuarine	LT	LT	All
Alosa alabamae	Alabama shad	Riverine/ Marine & Estuarine	SC		CAL,FRA, GAD,GULF JAC,LIB
Micropterus cataractae	shoal bass	Riverine		SC	CAL,GAD, JAC,LIB
Pteronotropis welaka	bluenose shiner	Riverine		SC	JAC

Table 15. Rare invertebrates of the Apalachicola River region

Species	Common name	Natural Community/Habitat	Federal Status	State Status	Locations by County
Amblema neislerii	fat threeridge	Riverine	LE		CAL,FRA, GAD,GULF, JAC,LIB
Elliptio chipolaensis	Chipola slabshell	Riverine	LT		CAL,GULF, JAC
Elliptoideus sloatianus	purple bankclimber	Riverine	LT		CAL,FRA, GAD,GULF, JAC,LEON, LIB,WAK
Lampsilis subangulata (syn. *Hamiota subangulata)*	shiny-rayed pocketbook,	Riverine	LE		CAL,GAD, JAC,LEON, LIB
Medionidus penicillatus	gulf moccasinshell	Riverine	LE	LE	BAY.CAL, JAC
Medionidus simpsonianus	Ochlockonee maccosinshell	Riverine	LE	LE	LEON,WAK
Pleurobema pyriforme	oval pigtoe	Riverine	LE	LE	BAY,CAL, GAD,GULF, JAC,LEON
Procambarus econfinae	Panama City crayfish	Wet flatlands		SC	BAY

Table 16. Rare plants of the Apalachicola River region

Species	Common name	Natural Community/ Habitat	Federal Status	State Status	Locations by County
Actaea pachypoda	white baneberry	Mesic Uplands- slope forest. Mixed pine hardwood forest		LE	
Agrimonia incisa	incised groove-bur	Xeric Uplands and Mesic/Wet flatlands- pine forests, along bluffs, pine-oak forests		LE	CAL,GAD, JAC,LIB, WAK
Andropogon arctatus	pine-woods bluestem	Mesic/Wet flatlands: pine flatwoods, savannas, edges of titi swamps, pitcherplant bogs, flatwoods pond edges.		LT	BAY,CAL, FRA,GULF, JAC,LIB
Aquilegia canadensis var. *australis*	Marianna columbine	Mesic Uplands: Upland Glade: limestone outcroppings		LE	JAC,LIB
Arabis canadensis	sicklepod	Mesic uplands: Slope forest		LE	JAC,LIB
Arnica acaulis	leopard's bane	Mesic/Wet flatlands		LE	
Arnoglossum album	Chalky Indian-plantain	Floodplain Forest: stream banks of bottomland hardwood forests		LE	BAY
Arnoglossum diversifolium	variable-leaved Indian plantain	Floodplain Forest: stream banks of bottomland hardwood forests		LT	CAL,JAC, LEON
Asclepias viridula	southern milkweed	Mesic/Wet flatlands: flatwoods, wet prairies, seepage slopes, bogs		LT	BAY,FRA, GULF,LEON, LIB,WAK
Asplenium monanthes	single-sorus spleenwort	Mesic Upland: Upland Glades: outcroppings, cave openings, karst sinkholes		LE	JAC
Aster spinulosus	pine-woods aster	Mesic/Wet flatlands: seepage slopes, pine savannas, pine flatwoods with palmetto and gallberry		LE	BAY,CAL, FRA,GULF
Baptisia megacarpa	Apalachicola wild indigo	Mesic Upland: Mixed hardwood, Slope Forest, Ravines		LE	CAL,GAD, JAC,LIB

Species	Common name	Natural Community/ Habitat	Federal Status	State Status	Locations by County
Baptisia simplicifolia	scare-weed	Xeric Uplands: pine flatwoods, sandhills, clayhills		LT	FRA,GAD, LEON,LIB, WAK
Brickellia cordifolia	Flyr's brickell-bush	Xeric Uplands, Mesic Uplands: Slope forest		LE	GAD,JAC, LEON,LIB, WAK
Calamintha dentata	toothed savory	Xeric Uplands: sandhills		LT	BAY,GAD, JAC,LIB
Calamovilfa curtissil	Curtiss' sandgrass	Mesic Uplands/flatlands		LT	BAY,WAK
Callirhoe papaver	poppy-mallow	Mesic Upland: Upland Glade		LE	GAD,JAC
Calopogon multiflorus	many-flowered grasspink	Xeric Uplands/ Mesic/Wet flatlands: longleaf/palmetto/wiregrass flatwoods		LE	FRA,WAK
Calycanthus floridus	sweet-shrub	Mesic Upland: Bluffs, riparian		LE	FRA,GAD, JAC,LEON, LIB
Carex baltzellii	Baltzell's sedge	Mesic Upland		LT	BAY,CAL, GAD,LIB
Carex chapmani	Chapman's sedge	Mesic Upland		LT	WAK
Carex microdonta	small-toothed sedge	Mesic Uplands: Upland Glades		LE	GAD
Chrysopsis godfreyi	Godfrey's goldenaster	Coastal Scrub		LE	BAY
Chrysopsis gossypina	Cruise's goldenaster	Coastal Scrub		LE	BAY
Coelorachis tuberculosa	piedmont jointgrass	Wet flatlands/Riparian		LT	BAY
Conradina glabra	Apalachicola rosemary	Xeric Uplands: sandhills	LE	LE	LIB
Coreopsis integrifolia	Chipola dye-flower	Floodplain Forest: stream floodplain, rocky banks		LE	CAL,JAC
Cornus alternifolia	alternate-leaf dogwood	Mesic Uplands: hardwood slope forests, creek swamps		LE	CAL,LIB, GAD

Species	Common name	Natural Community/ Habitat	Federal Status	State Status	Locations by County
Crataegus phaenopyrum	Washington hawthorn	Floodplain Forest: swamps		LE	LIB,WAK
Croomia pauciflora	croomia	Mesic Uplands: ravine slopes, hardwoods		LE	GAD,LIB
Cryptotaenia canadensis	Canada hawthorne	Floodplain Forest		LE	GAD,JAC, LIB
Cuphea aspera	Florida waxweed	Mesic/Wet flatlands: open areas, pine flatwoods, prairies		LE	CAL,FRA, GULF
Cynoglossum virginianum	wild comphrey	Mesic Uplands		LE	JAC,LIB
Delphinium carolinianum	Carolina larkspur	Mesic Uplands: Upland Glades, Mixed hardwoods		LE	GAD,JAC
Desmodium orchroleucum	cream-flowered tick-trefoil	Mesic Uplands: Upland Glade: upland hardwood and mixed forests.		LE	JAC
Dirca palustris	eastern leatherwood	Mesic uplands: Slope forests, ravines		LE	GAD,LIB
Dodecatheon meadia	shootingstar	Mesic Uplands: Upland Glades, Mixed hardwoods		LE	GAD
Drosera filiformis	thread-leaf sundew	Mesic flatlands		LE	BAY,LIB
Drosera intermedia	spoon-leaved sundew	Mesic/Wet flatlands: Savannas, depression marsh edges		LT	BAY,GULF, FRA,LEON, WAK
Echinacea purpurea	purple coneflower	Mesic Uplands: Upland Glade, exposed limestone, sunny upland hardwood forests		LE	GAD,JAC
Eleocharis rostellata	beaked spikerush			LE	WAK
Epigaea repens	trailing arbutus	Mesic Uplands: Slope forest, ecotone of Xeric Uplands and Mesic Uplands		LE	LIB
Eriocaulon nigrobracteatum	dark-headed hatpins	Mesic/Wet flatlands: bogs, mesic soils		LE	BAY,CAL, GULF
Erythronium umbilicatum	trout lily	Mesic Uplands: Slope Forest		LE	GAD,LEON, LIB

Species	Common name	Natural Community/ Habitat	Federal Status	State Status	Locations by County
Euonymus atropurpureus	eastern wahoo	Mesic Uplands: Slope Forest		LE	GAD
Euphorbia commutata	wood spurge	Mesic Uplands: Upland Glades, Mixed hardwoods		LE	GAD,JAC
Euphorbia telephioides	telephus spurge	Xeric Uplands and Mesic/Wet flatlands: longleaf/wiregrass flatwoods, savannas, xeric pine/oak scrub	LT	LE	BAY,FRA, GULF
Forestiera godfreyi	Godfrey's privet	Mesic Uplands: Upland Glades: upland hardwood forests, slopes above rivers and streams.		LE	GAD,JAC, LIB
Gentiana pennelliana	wiregrass gentian	Xeric Uplands and Mesic/Wet flatlands: longleaf/wiregrass flatwoods and savannas		LE	BAY,CAL, FRA,GAD, GULF,LEON, LIB,WAK
Goodyera pubescens	downy-rattlesnake plantain	Mesic Uplands: Slope forest		LE	LIB
Harperocallis flava	Harper's beauty	Mesic/Wet flatlands: acidic, wet prairies, seepage slopes, bogs	LE	LE	FRA,LIB
Hepatica nobilis	liverleaf	Mesic Uplands, Slope forest		LE	GAD,JAC
Hexastylis arifolia	heartleaf	Mesic Uplands, Slope forest		LT	GAD,LEON, LIB
Hybanthus concolor	green violet	Mesic Upland, Slope forest		LE	GAD
Hydrangea arborescens	wild hydrangea	Mesic Upland: bluffs, limestone		LE	LIB
Hymenocallis godfreyi	Godfrey's spiderlily	Wet Flatwoods		LE	WAK
Hymenocallis henryae	Mrs. Henry's spiderlily	Mesic/Wet flatlands: mesic flatwoods, edges of cypress swamps, pond edges		LE	BAY,FRA, GULF,LIB
Hypericum lissophloeus	smoothbark St. John's wort	Xeric Uplands: ponds & lake shores		LE	BAY

Species	Common name	Natural Community/ Habitat	Federal Status	State Status	Locations by County
Isotria verticillata	large whorled pogonia	Mesic Uplands		LE	GAD
Juncus gymnocarpus	Coville's Rush			LE	BAY
Justicia crassifolia	thick-leaved water willow	Mesic/Wet flatlands: mesic flatwoods, wet prairies, seepage slopes, bogs		LE	FRA,GULF
Kalmia latifolia	Mountain laurel	Mesic Upland: Slope Forest, Mixed hardwoods w/pine		LT	BAY,CAL, GAD,LEON, LIB
Lanchnocaulon digynum	bog button	Mesic/Wet flatlands: bogs, pond edges, seepage slopes		LT	BAY,CAL, FRA,GULF, LIB
Leitneria floridana	corkwood	Floodplain Forest/Estuarine		LT	FRA,WAK
Lepuropetalon spathulatum	little people	Mesic Uplands/Wetlands		LT	GAD
Liatris gholsonii	bluff's blazing star	Xeric Uplands: Sandhills		LE	LIB
Liatris provincialis	Godfrey's blazing star	Xeric Uplands Mesic/Wet flatlands: Coastal, transition between coastal scrub and flatwoods, between flatwoods and sandhills		LE	BAY,FRA, WAK
Lilium michauxii	Carolina lily	Mesic Uplands: Slope Forest: hardwood slope forests		LE	GAD,JAC, LIB
Lilium superbum	Turk's cap lily	Floodplain Forest, Mesic Uplands: Upland Glades, Riparian		LE	GAD,JAC, LEON
Linum westii	West's flax	Mesic/Wet flatlands: depression ponds, edges of cypress swamps		LE	CAL,FRA, GULF,JAC
Litsea aestivalis	pondspice	Mesic/Wet flatwoods		LE	LEON
Lupinus westianus	Gulf Coast lupine	Xeric Uplands		LT	BAY
Lythrum curtissii	Curtiss's loosestrife	Mesic/Wet flatlands, Floodplain Forest: open patches of riparian.		LE	FRA,GAD, LIB

Species	Common name	Natural Community/ Habitat	Federal Status	State Status	Locations by County
Macbridea alba	white-birds-in-a-nest	Xeric Uplands and Mesic/Wet flatwoods	LT	LE	BAY,FRA, GULF,LIB
Macranthera flammea	hummingbird flower	Mesic/Wet flatwoods: seepage slopes, riparian, edges of cypress swamps		LE	BAY,CAL, FRA,GAD, JAC,LIB
Magnolia ashei	Ashe's magnolia	Mesic Uplands/Floodplain Forest: hardwood forests, bluffs		LE	BAY,GAD, LEON,LIB, WAK
Magnolia pyramidata	pyramid magnolia	Mesic Uplands: bluff hardwood		LE	BAY,CAL, GAD,JAC, LEON,LIB
Malaxis unifolia	green Adder's mouth orchid			LE	LEON
Matalea alabamensis	Alabama spiny-pod	Mesic Uplands: mixed pine-hardwood		LE	GAD,LIB
Matalea floridana	Florida spiny-pod	Mesic Uplands: mixed pine-hardwood		LE	GAD,LIB
Medeola virginiana	Indian cucumber-root	Mesic Uplands: Slope Forest		LE	GAD,LIB
Najas filifolia	narrowleaf naiad	Riparian		LT	LEON
Nolina atopocarpa	Florida beargrass	Mesic Flatwoods: mesic pine flatwoods		LT	FRA,LIB
Oxypolis greenmanii	giant water-dropwort	Mesic/Wet Flatlands		LE	BAY,CAL, FRA,GULF
Pachysandra procumbens	Alleghany spurge	Mesic Uplands: Slope Forest		LE	GAD,JAC
Panicum nudicaule	naked-stemmed panicgrass			LT	BAY
Parnassia caroliniana	Carolina grass of parnassus	Mesic/Wet flatlands: wet prairies, open seepage slopes, edges of cypress swamps		LE	FRA,LIB
Parnassia grandifolia	large-leaved grass of parnassus	Mesic/Wet flatlands: wet prairies, open seepage slopes, edges of cypress swamps		LE	FRA,LIB

Species	Common name	Natural Community/ Habitat	Federal Status	State Status	Locations by County
Paronychia chartacea	crystal lake nailwort	Xeric Uplands: ponds & lake shores	LT	LE	BAY
Phoebanthus tenuifolius	narrow-leaved phoebanthus	Xeric Uplands & Mesic/Wet flatlands: sandhills, longleaf pine savannah, pine flatwoods.		LT	BAY,CAL, FRA,GULF, LIB
Physocarpus opulifolius	ninebark	Riparian		LE	JAC
Physostegia godfreyi	Apalachicola dragon-head	Mesic/Wet flatlands: mesic flatwoods, wet prairies, pitcherplant bogs		LT	BAY,CAL, FRA,GULF, LIB
Pinguicula ionantha	Godfrey's butterwort	Mesic/Wet flatlands: seepage bogs, edges of cypress swamps in pine flatwoods, mesic flatwoods and wet prairies	LT	LE	BAY,FRA, GULF,LIB
Pinguicula primuliflora	primrose-flowered butterwort	Mesic/Wet flatlands: seepage bogs, edges of cypress swamps in pine flatwoods, mesic flatwoods and wet prairies		LE	BAY
Pityopsis flexuosa	bent golden aster	Xeric uplands: sandhills		LE	FRA,GAD, LEON,LIB, WAK
Platanthera clavellata	little club-spur orchid	Floodplain Forest: stream banks		LE	CAL,GAD, LIB,WAK
Platanthera integra	yellow fringeless orchid	Mesic/Wet flatlands: seepage slopes, depression marshes, savannas		LE	BAY,CAL, FRA,GULF, JAC,LIB
Polygonella macrophylla	large-leaved jointweed	Coastal uplands: dunes, sand-pine-oak scrub,		LT	BAY,FRA
Polygonum meisnerianum	Mexican tear-thumb			LE	LEON
Pteroglossaspis ecristata	giant orchid	Xeric Uplands		LT	LEON
Pycnanthemum floridanum	Florida mountain-mint	Mesic/Wet Flatlands		LT	LEON

Species	Common name	Natural Community/ Habitat	Federal Status	State Status	Locations by County
Quercus arkansana	Arkansas oak	Xeric Uplands		LT	LIB
Rhexia parviflora	small flowered meadow beauty	Mesic/Wet flatlands: seepage slopes, depression marshes,		LE	BAY,CAL, FRA,GULF, LIB
Rhexia salicifolia	panhandle meadow-beauty	Mesic/Wet flatlands: edges of flatwoods ponds, depression marshes, karst ponds, Sandhill lakes		LT	BAY,CAL, LEON,WAK
Rhododendron alabamense	Alabama rhododendron	Mesic Upland: Slope Forest: upland hardwood forests, bluffs, stream banks		LE	LEON
Rhododendron austrinum	Florida flame azalea	Mesic Upland: Slope Forest: upland hardwood forests, bluffs, stream banks		LE	CAL,GAD, FRA,JAC, LEON,LIB
Rhododendron chapmanii	Chapman's rhododendron	Mesic/Wet flatlands: pine flatwoods, Titi swamp edges	LE	LE	GAD,GULF, LIB
Rhynchospora crinipes	hairy-peduncled beakrush	Mesic Uplands: Riparian		LE	GULF,LIB
Rudbeckia nitida	St. John's black-eyed susan	Mesic/Wet Flatlands: mesic flatwoods, bogs, savannas, seepage slopes		LE	GULF
Ruellia noctiflora	nightflowering wild petunia	Mesic/Wet Flatlands: mesic flatwoods, seepage slopes		LE	BAY,FRA, GULF,JAC, LIB,WAK
Salix floridana	Florida willow	Springheads/Floodplains		LE	WAK
Salvia urticifolia	nettleleaf sage	Mesic Uplands; Hardwood forest, Upland Glades		LE	GAD,JAC
Sarracenia leucophylla	white-topped pitcherplant	Mesic/Wet Flatlands: bogs, seepage slopes, wet prairies, mesic pine flatwoods		LE	BAY,CAL, FRA,LIB
Schisandra glabra	bay star vine	Mesic Uplands		LE	GAD,JAC, LEON,LIB, WAK

Species	Common name	Natural Community/ Habitat	Federal Status	State Status	Locations by County
Schwalbea americana	chaffseed	Xeric Uplands/Mesic/Wet flatlands: mesic transition areas of ponds in sandhills, savannas, flatwoods. Semi-parasitic on Gallberry, Huckleberry, St. John's Wort, Silk grass roots.	LE	LE	GAD,LEON
Scuttellaria floridana	Florida skullcap	Mesic/Wet Flatlands: mesic pine flatwoods, edges of cypress stands, transitions between flatwoods and wetlands	LT	LE	BAY,FRA, GULF,LIB
Sideroxylon lyciodes	Apalachicola buckthorn	Floodplain Forest: high riverbanks, riparian		LE	GAD,JAC, LIB
Sideroxylon thornei	Thorne's buckthorn	Mesic/Wet Flatlands: mesic soils, edges of cypress ponds, riparian Floodplain Forest		LE	FRA,GULF, JAC
Silene polypetala	fringed campion	Mesic Upland: Slope Forest: hardwood forests, stream banks	LE	LE	GAD,JAC
Silene virginica	fire pink			LE	BAY
Spigelia gentinoides	gentian pinkroot	Xeric Upland: pine-oak forest	LE	LE	CAL,JAC
Stachydeoma graveolens	mock pennyroyal	Xeric Upland: sandhills, xeric pine-palmetto-wiregrass flatwoods		LE	BAY,CAL, FRA,GULF, LEON,LIB
Stachys hyssopifolia	Tallahassee hedge-nettle			LE	LEON
Staphylea trifolia	American bladdernut	Mesic Upland: Slope Forest: bluffs, hardwood forests		LE	LIB,GAD
Stewartia malacodendron	silky camellia	Mesic Upland: Slope Forest: bluffs, hardwood forests		LE	BAY,CAL, GAD,LIB
Taxus floridana	Florida yew	Mesic Upland: Slope Forest: hardwood slope forests, steepheads		LE	GAD,LIB
Thalictrum thalictroides	windflower	Mesic Uplands: Slope Forests		LE	GAD,LIB

Species	Common name	Natural Community/ Habitat	Federal Status	State Status	Locations by County
Torreya taxifolia	Florida torreya	Mesic Uplands: Slope Forest: hardwood slope forests, steepheads	LE	LE	FRA,GAD
Trillium lancifolium	lance-leaved trillium	Mesic Uplands: Slope Forest: hardwood forests, upland hardwood forests		LE	GAD,JAC, LIB
Uvularia floridana	Florida bellwort	Floodplain Forest: bottomland hardwood forests, mesic ravines		LE	GAD,JAC, LEON
Veratrum woodii	false hellebore	Mesic Uplands: Slope Forest		LE	GAD,LIB
Verbesina chapmanii	Chapman's crownbeard	Mesic/Wet Flatlands: wet flatwoods, savanna		LT	BAY,CAL, FRA,GULF, LIB
Xanthorhiza simplicissima	yellow-root	Mesic Uplands: Riparian		LE	GAD
Xyris longisepala	karst pond xyris	Mesic/Wet Flatlands: edges of karst ponds, sinkholes, Sandhill upland lakes, seepage slopes, wet prairies, bogs		LE	LEON,WAK
Xyris isoteifolia	quillwort yellow-eyed grass	Mesic/Wet Flatlands: edges of karst ponds, sinkholes, Sandhill upland lakes, seepage slopes, wet prairies, bogs		LE	BAY,GULF
Xyris scabrifolia	Harper's yellow-eyed grass	Mesic/Wet Flatlands: Pine flatwoods, bogs, seepage		LT	BAY,FRA, GAD,GULF, JAC,LIB

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