LAKE OKEECHOBEE PROTECTION PROGRAM
EXOTIC SPECIES PLAN

June 1, 2002

Update: December 10, 2003

LAKE OKEECHOBEE PROTECTION PROGRAM EXOTIC SPECIES PLAN

Background

Pursuant to 373.4595(3)(e), F.S., a *Lake Okeechobee Exotic Species Control Program* was required to be developed by June 1, 2002. The statute, passed by the 2000 legislature, identified the Florida Department of Agriculture and Consumer Services (FDACS), the Florida Department of Environmental Protection (FDEP) and the South Florida Water Management District (SFWMD) as the three state agencies that would be responsible for the implementation of this statute. The Lake Okeechobee Protection Program – Program Management Plan, published in December 2001, further identified the SFWMD as the lead agency with regards to the Exotic Species Control Program.

Other agencies identified as cooperators in the statute include the Institute of Food and Agricultural Sciences of the University of Florida (IFAS), the United States Army Corps of Engineers (USACE), the United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) and the Florida Fish and Wildlife Conservation Commission (FFWCC).

Pursuant to the statute, the Exotic Species Control Program is required to **1) identify the exotic species that threaten native flora and fauna within the Lake Okeechobee Watershed and 2) develop and implement measures to protect native flora and fauna.**

The area defined as the Lake Okeechobee Watershed includes Lake Okeechobee and the 39 surrounding hydrologic basins as identified in the Lake Okeechobee Surface Water Improvement and Management (SWIM) Plan (see Figure 1). Table 1 lists the primary exotic plant species and Table 2 lists the primary exotic animal species that have been identified in the Lake Okeechobee Watershed. Tables 3 through 8 are species level programs for the primary exotic plant species including principal agencies, program components and program implementation. A general discussion of exotic animal species is also included. Table 9 summarizes the FY02 expenditures for invasive exotic management within the Lake Okeechobee Watershed. Table 10 includes information on current agency management of exotic animal species.

Approach

The exotic species listed in this document are the plants and animals that have been determined to be the primary species within the Lake Okeechobee Watershed (LOW) that require management of existing invasions or, in the case of some animal species, monitoring of possible future invasions. These species lists were compiled based on discussions of interagency staff and current management efforts within the LOW. In the future, other plants and animals may be added to this list as we discover new threats or as some other minor exotic species become more dominant. In addition, while there are other exotic species within the LOW that threaten agriculture and warrant additional focus, this plan only attempts to address exotic species that threaten *native flora and fauna*.

The approach to implementation of the exotic species plan within the Lake Okeechobee watershed has been and will continue to be through the cooperative efforts of state and federal agencies. Current management efforts of these state and federal agencies include the primary exotic species that are discussed in this plan as well as other less invasive, exotic species not listed in this plan. Also, the program goal of each primary exotic plant species is "maintenance" level control. Florida law (F.S. 372.925) defines "maintenance control" as "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." Maintenance control results in the use of less herbicides, less organic deposition in aquatic environments, less overall environmental impacts from the weeds and their management, and reduced management costs.

The species level programs outline the current and proposed management on public conservation lands within the LOW. Management efforts on private conservation lands have not been included in this document. However, public-private partnerships for the control of exotic species on private lands exist in the 2002 Farm Bill. Two major programs that came out of this legislation that will provide financial assistance to private landowners within the LOW with exotic species control are the Environmental Quality Incentives Program (EQIP) and the Wetland Reserve Program (WRP). The Wildlife Habitat Incentives Program (WHIP) will also provide some support. In calendar year 2003, two new programs are expected to come online, the Conservation Reserve Enhancement Program (CREP) and the Small Watershed Program (PL566), that will provide more aid for exotic species control to the private landowners. More information on these programs and those included in the 2002 Farm Bill can be found at www.usda.gov/farmbill.

Acronyms (in alphabetical order):

- FDACS – Florida Department of Agriculture and Consumer Services
- FDACS-DOF – Florida Department of Agriculture and Consumer Services, Division of Forestry
- FDEP – Florida Department of Environmental Protection
- FFWCC – Florida Fish and Wildlife Conservation Commission
- IFAS - Institute of Food and Agricultural Sciences of the University of Florida
- LOW – Lake Okeechobee Watershed
- SFERTF – South Florida Ecosystem Restoration Task Force
- SFWMD – South Florida Water Management District
- SFWMD-SOR – South Florida Water Management District, Save Our Rivers
- SWIM – Surface Water Improvement and Management
- USACE – United States Army Corps of Engineers
- USAF – United States Air Force
- USDA-ARS – United States Department of Agriculture, Agricultural Research Service
- USDA-NRCS - United States Department of Agriculture Natural Resources Conservation Service

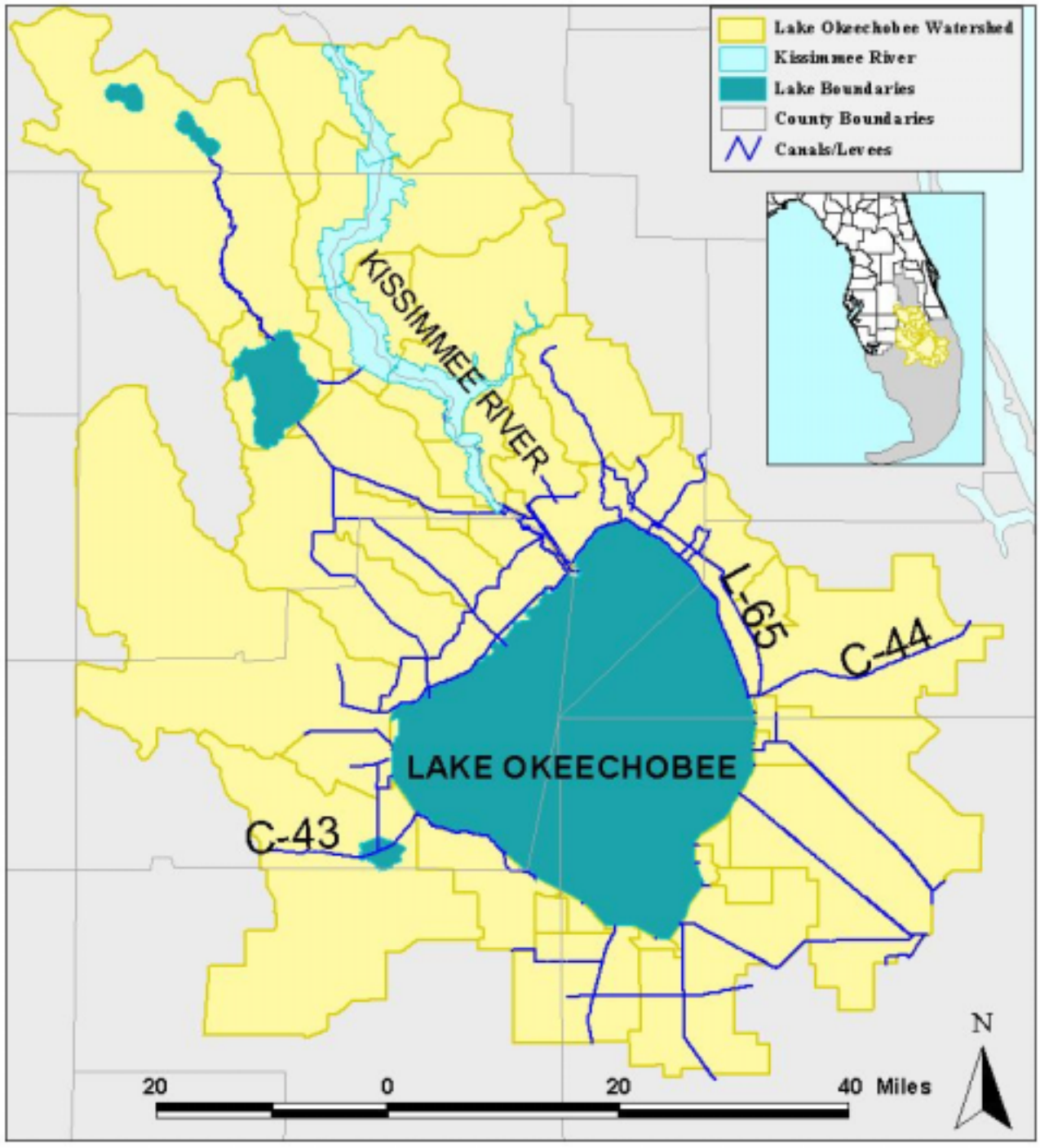
Managed conservation lands surveyed for this report:

- FDACS-DOF Lake Wales Ridge State Forest
- FDEP Kissimmee Prairie State Park
- FFWCC J.W. Corbett Wildlife Management Area
- SFWMD Canals/levees
- SFWMD Lake Okeechobee marsh
- SFWMD-SOR including DuPuis, Kissimmee River properties, Nicodemus Slough
- USACE Lake Okeechobee
- USAF Avon Park Bombing Range

Timeline includes year 2000 data through 2003:

- FDEP, FDACS and FFWCC – fiscal years are from beginning of July through end of June. FY01 would be July 2000 through June 2001.
- SFWMD – fiscal years are from beginning of October through end of September. FY01 would be October 2000 through September 2000.
- USACE - fiscal years are from beginning of October through end of September. FY01 would be October 2000 through September 2000.

FIGURE 1
LAKE OKEECHOBEE WATERSHED



Identification of Primary Exotic Species that Threaten Native Flora and Fauna

TABLE 1
EXOTIC PLANT SPECIES

Common Name	Scientific Name	Habitat(s) invaded (source: Langeland and Burks, 1998*)	Threat to flora and fauna (source: Langeland and Burks, 1998*)
Torpedograss	*Panicum repens*	In and near shallow waters; wetland marsh	Forms thick, monotypic growth, which displaces diverse native plants. Impacted areas no longer provide productive habitat for sport fish and other wildlife
Melaleuca	*Melaleuca quinquenervia*	Pine flatwoods, wetland marsh, cypress swamps	Grows extremely fast, produces dense stands, displaces native plants, diminishes animal habitat, and provides little food for wildlife.
Brazilian pepper	*Schinus terebinthifolius*	Pinelands, hardwood hammocks, roadsides, ditchbanks	Forms dense thickets of tangled woody stems that completely shade out and displace native vegetation.
Old World climbing fern	*Lygodium microphyllum*	Pinelands, tree islands, cypress swamps, wetland marsh	Forms dense, spongy mats, which are slow to decompose, excludes native understory plants and reduces plant diversity.
Hydrilla	*Hydrilla verticillata*	Freshwater: springs, lakes, marshes, ditches, rivers, tidal zones	Competitively displaces native submersed plant communities. Grows in dense stands, alters fisheries populations, causes shifts in zooplankton communities, and affects water chemistry.
Waterhyacinth	*Eichornia crassipes*	Lakes, rivers, ponds, ditches	Large mats degrade water quality and dramatically alter native plant and animal communities. Altered water chemistry results in lower fish production.
Waterlettuce	*Pistia stratiotes*	Rivers, lakes and ponds	Forms vast mats that disrupt submersed plant and animal communities.

*Langeland, K.A. and K.C. Burks, eds. 1998. Identification and Biology of Non-Native Plants in Florida's Natural Areas. University of Florida.

TABLE 2
EXOTIC ANIMAL SPECIES

Common Name	Scientific Name	Habitat(s) invaded (source: Goodyear, 2000[1])	Threat to flora and fauna (source: Goodyear, 2000[1])
Feral pig	*Sus scrofa*	Dry prairies, mesic hammocks, tropical hardwood hammocks, pine rocklands, mesic and hydric pine flatwoods, ponds, flowing waters and seepage swamps.	Rooting and trampling destroys native plant communities; disturbed areas serve as sites for exotic plant establishment and impedes wetland restoration. Harms other wildlife through direct predation and by destroying wildlife habitat.
Blue tilapia	*Oreochromis aureus*	Marshes, ponds, lakes, canals.	Competes directly with and impedes successful spawning of native fish. In Lake Okeechobee, feeds and burrows at the bottom and destroys submerged vegetation. Alters aquatic plant communities.
Asian swamp eel	*Monopterus albus*	Canals, ditches. Locally abundant and reproducing in south Broward and north Miami-Dade canals.	Well adapted to spread to sawgrass marsh and survive. This species is a potential threat to native fishes, frogs, and aquatic invertebrates.
Fire ant	*Solenopsis invicta*	Disturbed habitats, levees, pond margins, beaches, dunes, pine flatwoods, pine rocklands and hardwood hammocks.	Replaces native ant communities. Directly impacts native wildlife through predation and injury from stings. Indirect effects include reduced survival and weight gain in native invertebrates.
Spiney water flea	*Daphnia lumholtzii*	Lake Okeechobee	No impacts have been identified. At high density, they could impact larval fish and water quality.[2]
Asiatic clam	*Corbicula fluminea or C. manilensis*	Lakes, rivers, canals, ditches.	Outcompetes and can displace native mollusks. Accumulations of clamshells may change substrate and decimate populations of burrowing insects important to native fish.
Sailfin catfish (armored catfish)	*Pterygoplichthys multiradiatus*	Marshes, ponds, lakes, canals.	Competes directly with and impedes successful spawning of native fish. In Lake Okeechobee, feeds and burrows at the bottom and destroys submerged vegetation. Alters aquatic plant communities.[3]

Feral mallards	*Anas platyrhynchos*	Water bodies and adjacent uplands	Recently, domesticated strains of mallards have been released (in canals, lakes, parks, etc.) in Florida. These birds are non-migratory and interbreed with other waterfowl including Florida's native mottled duck (*Anas fulvigula fulvigula*). Hybridization compromises the mottled duck's genetic integrity and could lead to the eventual loss of this endemic duck.[4] Feral ducks also can spread diseases to wild duck populations.

[1]Goodyear, C. 2000. Draft initial status survey of nonindigenous animals in South Florida. A report by the South Florida Ecosystem Working Group.
[2]Haven, K. 2002. Personal communication. South Florida Water Management District.
[3] Fox, D. 2002. Personal communication. Florida Fish and Wildlife Conservation Commission.
[4] Moorman, T. E., and P. N. Gray. 1994. Mottled Duck. pages 1-20 in The Birds of North America, No. 81, A. Poole and F. Gill, eds., The Academy of Natural Sciences, Philadelphia, PA.

Exotic Plant Species

The following tables, Tables 3-8, have species level program components and implementations. For every species level plan the same five program components have been developed: 1) plan, 2) assess and map, 3) research, and 4) attend interagency meetings (communicate) and 5) treat. Each of these components is important to achieve a comprehensive approach to exotic plant management. The information included in the implementation column of the tables is taken from existing management efforts and future plans for exotic plant species control by state and federal agencies in the Lake Okeechobee Watershed.

TABLE 3
TORPEDOGRASS, Panicum repens

Program Goal: Bring torpedograss to maintenance level control in the Lake Okeechobee watershed

Principle Agency(s)	Program Components	Program Implementation
SFWMD	1) Develop a torpedograss management **plan** for primary area(s) of infestation in LOW.	1) Management plan(s) a) Torpedograss management plan for Lake Okeechobee was completed FY01.
SFWMD	2) **Assess and map** coverage of torpedograss in LOW	2) Assess and map a) SFWMD completed a map of the Lake Okeechobee marsh vegetation distribution, which includes torpedograss, in 1996. New aerial photography scheduled to be flown in early 2003. Update of assessment and coverage to be completed in FY04.
SFWMD, FDEP	3) **Conduct research** of torpedograss biology and management studies through support programs and in-house studies.	3) Research a) Support Programs i) Biology and growth responses of torpedograss completed under SFWMD directed research grant to Army Corps of Engineers. Research grant completed FY01. ii) Research contract executed by SFWMD with University of Florida IFAS for herbicide-screening trials to develop better control methodology for torpedograss. Contract to be executed FY02 for period of 1.5 years. The first phase was completed October 30, 2003; Phase II will then be initiated for an 18 month period. iii) Research contract executed by FDEP with University of Florida to assess efficacy of fungal pathogen control of torpedograss. Research contract through June 2003. iv) IFAS biocontrol 10/02-5/03. b) In-house Studies i) A seed germination study was conducted by SFWMD to evaluate commercial seed and naturalized torpedograss seed production and viability. Initial seed germination study has shown Moroccan plants produce viable seeds, still uncertain whether naturalized populations produce viable seeds 5/02 – 5/03.
All agencies	4) **Attend** Interagency **meetings** to provide leadership and technology transfer with respect to exotic species management in LOW.	4) Meetings a) Agency staff continues to attend all Lake Okeechobee Protection Plan Interagency meetings (monthly meetings for 2001 and 2002).

TABLE 3
TORPEDOGRASS, Panicum repens

Program Goal: Bring torpedograss to maintenance level control in the Lake Okeechobee watershed

Principle Agency(s)	Program Components	Program Implementation
SFWMD (FDEP provides herbicide treatment funding)	5) **Treat infestations** of torpedograss within LOW.	5) Treatment a) Herbicide i) FDEP Kissimmee Prairie State Park, have observed torpedograss, no active management. ii) SFWMD treated approximately 4,600 acres of torpedograss between June 2000 and June 2001 (FDEP FY01). From June 2001 to June 2002, approximately 5,000 acres have been treated (FDEP FY02). From June 2002 to June 2003 (FDEP FY03), SFWMD plans to treat at least 4,000 acres. Most herbicide treatments were done aerially. iii) SFWMD DuPuis Reserve, torpedograss is treated as soon as it is observed. b) Fire i) During FY01, SFWMD coordinated approximately 68,000 acres of prescribed burns in Lake Okeechobee marsh, which included torpedograss areas.

TABLE 4
MELALEUCA, *Melaleuca quinquenervia*

Program Goal: Bring melaleuca to maintenance level control in the Lake Okeechobee watershed

Principle Agency(s)	Program Components	Program Implementation
All agencies	1) Develop a melaleuca management **plan** for primary area(s) of infestation in LOW.	1) Management plan(s) a) In general, most agencies follow the guidelines set forth in the Florida Exotic Pest Plant Council's Melaleuca Management Plan, May 1999, Third edition.
SFWMD	2) **Assess and map** coverage of melaleuca in LOW	2) Assess and map a) USACE has compiled a map of previously treated areas of melaleuca, Australian pine and Brazilian pepper as well as areas with treatment needs along the Okeechobee Waterway, extension levees and recreational areas. USACE will update this information in FY02. b) SFWMD completed a map of the Lake Okeechobee marsh vegetation distribution, which includes melaleuca, in 1996. New aerial photography scheduled to be flown in FY02. Update of assessment and coverage to be completed in FY03. c) SFWMD conducts a bi-annual region-wide aerial survey of target exotic pest plants on all publicly and privately owned lands (except large metropolitan areas) in southern Florida, from the north rim of Lake Okeechobee south. Target plants are melaleuca, Brazilian pepper, Old World climbing fern and Australian pine. Survey began in 1993.
SFWMD, FDEP	3) **Conduct research** of melaleuca biology and management studies through support programs and in-house studies.	3) Research a) Support Programs i) USDA-ARS melaleuca biology research in watershed with FDEP support – biocontrol agents. ii) SFWMD and USACE provide funding to USDA-ARS for biological control research. b) In-house Studies i) SFWMD has ongoing internal review of management technology to achieve best management results for control of melaleuca. ii) In FY02, SFWMD has conducted a study to assess the use of aerial surfactants to improve efficacy of melaleuca aerial treatments. SFWMD will reassess this study in FY03.
All agencies	4) **Attend** Interagency **meetings** to provide leadership and technology transfer with respect to exotic species management in LOW.	4) Meetings a) Agency staff continues to attend all Lake Okeechobee Protection Plan Interagency meetings (monthly meetings for 2001 and 2002).

TABLE 4
MELALEUCA, *Melaleuca quinquenervia*

Program Goal: Bring melaleuca to maintenance level control in the Lake Okeechobee watershed

Principle Agency(s)	Program Components	Program Implementation
USACE, FFWCC, SFWMD (FDEP provides herbicide treatment funding to SFWMD and FFWCC)	5) **Treat** infestations of melaleuca within LOW.	5) Treatment a) Herbicide i) USAF Avon Park, low infestation, treats melaleuca seedlings and saplings aggressively when observed. ii) In FY01, USACE treated 2 linear miles and 82 acres as well as an additional 300 acres of mixed mature exotic vegetation and seedlings in USACE managed areas of Lake Okeechobee and the Okeechobee Waterway (OWW). In FY02, USACE plans to treat 200 acres of mixed melaleuca and Brazilian pepper as well as perform follow-up treatments and seedling removal of extensive areas along the Herbert Hoover Dike, the OWW and various levees. In FY03, USACE plans to treat 50 acres of melaleuca and Brazilian pepper within Lake Okeechobee as well as remove 10 acres of mature exotic vegetation along the OWW. iii) In FY01, USACE and SFWMD completed a joint project to treat exotic vegetation including both melaleuca and Brazilian pepper in USACE managed areas of Lake Okeechobee and the Okeechobee Waterway. iv) In Lake Okeechobee marsh, SFWMD treated 1500 acres aerially and 900 acres with ground crews in FY01. In FY02, 1200 acres will be treated aerially and 1200 acres with ground crews. In FY03, SFWMD plans to be in maintenance phase and will treat 600 acres of resprouts with ground crews. v) At DuPuis Reserve, during FY01, FY02 and FY03, SFWMD's exotic contractor treats approximately 75% of property each year. Primary species are melaleuca, Brazilian pepper and Old World climbing fern. Focus is on maintenance and treating new infestations. vi) FDEP Kissimmee Prairie State Park, have observed melaleuca, no active management. vii) At J.W. Corbett Wildlife Management Area, FFWCC treated 50 acres in FY01 and 2,750 acres in FY02. FFWCC plans to treat 2,500 acres of varying densities during FY03. b) Mechanical/manual i) In FY01, USACE removed 5 acres of dead standing melaleuca on tree islands along Okeechobee Waterway. In FY02, USACE plans on removing 5 acres of dead melaleuca along the Okeechobee Waterway. ii) SFWMD DuPuis Reserve treatments also incorporate rollerchopping. c) Fire i) During FY01, SFWMD coordinated approximately 68,000 acres of prescribed burns in Lake Okeechobee marsh, which included melaleuca areas. In FY02, SFWMD is planning a 1200 acre prescribed burn in the Moore Haven area to help control melaleuca. ii) SFWMD DuPuis Reserve treatments also include prescribed burning on a 3 year rotation. d) Biological control i) In FY02, USDA-ARS released melaleuca weevils at DuPuis. Previous releases on the Herbert Hoover Dike on west side of Lake Okeechobee.

TABLE 5
BRAZILIAN PEPPER, *Schinus terebinthifolius*

Program Goal: Bring Brazilian pepper to maintenance level control in the Lake Okeechobee watershed

Principle Agency(s)	Program Components	Program Implementation
All agencies	1) Develop a Brazilian pepper management **plan** for primary area(s) of infestation in LOW.	1) Management plan(s) a) In general, most agencies follow the guidelines set forth in the Florida Exotic Pest Plant Council's Brazilian Pepper Management Plan for Florida, July 1997.
USACE, USAF, SFWMD, FDACS-DOF	2) **Assess and map** coverage of Brazilian pepper in LOW	2) Assess and map a) USACE has compiled a map of previously treated areas of melaleuca, Australian pine and Brazilian pepper as well as areas with treatment needs along the Okeechobee Waterway, extension levees and recreational areas. USACE will update this information in FY02. b) USAF Avon Park maps all exotic invasive plants on park including Brazilian pepper and Old World climbing fern. This mapping effort began 3 years ago and is planned as an ongoing project. As of FY02 quarterly reports are available with treatments and locations. Avon Park has one full time employee to monitor for exotic invasive plants in park. c) SFWMD completed a map of the Lake Okeechobee marsh vegetation distribution, which includes Brazilian pepper, in 1996. New aerial photography scheduled to be flown in FY03. Update of assessment and coverage to be completed in FY04. d) SFWMD conducts a bi-annual region-wide aerial survey of target exotic pest plants on all publicly and privately owned lands (except large metropolitan areas) in southern Florida, from the north rim of Lake Okeechobee south. Target plants are melaleuca, Brazilian pepper, Old World climbing fern and Australian pine. Survey began in 1993. e) FDACS Lake Wales Ridge State Forest maps exotic plant infestation upon field observations. Primary species includes Brazilian pepper.
SFWMD	3) **Conduct research** of Brazilian pepper biology and management studies through support programs and in-house studies.	3) Research a) Support Programs i) SFWMD provides funding to the University of Florida to research biological control. b) In-house Studies
All agencies	4) **Attend** Interagency **meetings** to provide leadership and technology transfer with respect to exotic species management in LOW.	4) Meetings a) Agency staff continues to attend all Lake Okeechobee Protection Plan Interagency meetings (monthly meetings for 2001 and 2002).

TABLE 5
BRAZILIAN PEPPER, *Schinus terebinthifolius*

Program Goal: Bring Brazilian pepper to maintenance level control in the Lake Okeechobee watershed

Principle Agency(s)	Program Components	Program Implementation
USACE, FFWCC, SFWMD (some funds provided by FDEP)	5) **Treat** infestations of Brazilian pepper within LOW in accordance with Brazilian pepper management plan.	5) Treatment a) Herbicide i) USAF Avon Park treats Brazilian pepper seedlings and saplings aggressively when observed. ii) In FY01, USACE treated 95 acres of Brazilian pepper as well as an additional 300 acres of mixed mature exotic vegetation and seedlings in USACE managed areas of Lake Okeechobee and the Okeechobee Waterway. In FY02, USACE plans to treat 25 acres of Brazilian pepper, 200 acres of mixed melaleuca and Brazilian pepper as well as perform follow-up treatments and seedling removal of extensive areas along the Herbert Hoover Dike, the Okeechobee Waterway and various levees. In FY03, USACE plans to treat 50 acres of melaleuca and Brazilian pepper within Lake Okeechobee as well as remove 10 acres of mature exotic vegetation along the Okeechobee Waterway. iii) In FY01, USACE and SFWMD completed a joint project to treat exotic vegetation including both melaleuca and Brazilian pepper in USACE managed areas of Lake Okeechobee and the Okeechobee Waterway. iv) In Lake Okeechobee marsh, SFWMD treated 500 acres aerially in FY01. In FY02, 300 acres will be treated with ground crews on levees and the mud canal. In FY03, SFWMD plans to be in maintenance phase and will treat resprouts with ground crews only. v) In Kissimmee River Valley, SFWMD treated approximately 500 acres in FY01. In FY02, 200 acres will be treated. In FY03, treatment as time allows, primary focus will be Old World climbing fern. vi) At DuPuis Reserve, during FY01, FY02 and FY03, SFWMD's exotic contractor treats approximately 75% of property each year. Primary species are melaleuca, Brazilian pepper and Old World climbing fern. Focus is on maintenance and treating new infestations. vii) FDEP Kissimmee Prairie State Park, have observed Brazilian pepper, no active management. viii) FDACS-DOF Lake Wales Ridge State Forest routinely treats Brazilian pepper as soon as it is observed. ix) At J.W. Corbett Wildlife Management Area, FFWCC treats approximately 10 acres each year as observed. b) Mechanical/manual i) SFWMD DuPuis Reserve treatments also incorporate rollerchopping. c) Fire i) SFWMD DuPuis Reserve treatments also incorporate prescribed burning on a 3 year rotation.
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TABLE 6
OLD WORLD CLIMBING FERN, *Lygodium microphyllum*

Program Goal: Bring Old World climbing fern to maintenance level control in the Lake Okeechobee watershed

Principle Agency(s)	Program Components	Program Implementation
All agencies	1) Develop a Old World climbing fern management **plan** for primary area(s) of infestation in LOW.	1) Management plan(s) a) In general, most agencies follow the guidelines set forth in the Florida Exotic Pest Plant Council's Lygodium Management Plan for Florida, 2001, First Edition.
USAF, SFWMD, FDACS	2) **Assess and map** coverage of Old World climbing fern in LOW	2) Assess and map a) USAF Avon Park maps all exotic invasive plants on park including Brazilian pepper and Old World climbing fern. This mapping effort began 3 years ago and is planned as an ongoing project. As of FY02 quarterly reports are available with treatments and locations. Avon Park has one full time employee to monitor for exotic invasive plants in park. b) SFWMD conducts a bi-annual region-wide aerial survey of target exotic pest plants on all publicly and privately owned lands (except large metropolitan areas) in southern Florida, from the north rim of Lake Okeechobee south. Target plants are melaleuca, Brazilian pepper, Old World climbing fern and Australian pine. Survey began in 1993. c) FDACS Lake Wales Ridge State Forest maps exotic plant infestation upon field observations. Monitoring for new infestations of climbing fern.
SFWMD	3) **Conduct research** of Old World climbing fern biology and management studies through support programs and in-house studies.	3) Research a) Support Programs i) SFWMD provides funding to USDA-ARS for biocontrol research annually. ii) SFWMD, through a USDA contract, provides funding to the Institute for Regional Conservation to conduct annual long-term monitoring of expansion in different habitats including undisturbed flatwoods at J.W. Corbett and roller-chopped flatwoods at DuPuis. iii) SFWMD and University of Florida, Center for Aquatic and Invasive Plants are conducting and on-going assessment of efficacy and non-target damage post aerial treatment and throughout follow-up ground crew treatment operations at Corbett and DuPuis. b) In-house Studies i) SFWMD DuPuis, performing in-house study to show the difference of treatment vs. no treatment in flatwoods within normal management activities (rollerchopping and then 3 year prescribed burn rotation). Past years have performed herbicide screening trials both aerially and with ground crews and in different ecosystems.

TABLE 6
OLD WORLD CLIMBING FERN, *Lygodium microphyllum*

Program Goal: Bring Old World climbing fern to maintenance level control in the Lake Okeechobee watershed

Principle Agency(s)	Program Components	Program Implementation
All agencies	4) **Attend** Interagency **meetings** to provide leadership and technology transfer with respect to exotic species management in LOW.	4) Meetings a) Agency staff continues to attend all Lake Okeechobee Protection Plan Interagency meetings (monthly meetings for 2001 and 2002).
USAF, SFWMD, FDEP, FFWCC (some funds provided by FDEP and SFWMD)	5) **Treat** infestations of Old World climbing fern within LOW in accordance with Old World climbing fern management plan.	5) Treatment a) Herbicide i) USAF Avon Park treated both *Lygodium microphyllum* and *Lygodium japonicum* in FY01 and FY02. FY01 treated small outlier infestations throughout 23,000-acre cypress area. FY02 finished initial treatments of small infestations, now treating large (~100 acre) infestations throughout cypress area. FY03 will complete initial treatments of large infestations and start retreating all initial plots. ii) In Kissimmee River Valley, SFWMD treated small infestations in FY01. In FY02, 700 acres of Old World climbing fern will be treated aerially and 235 acres with ground crews. In FY03 1000 acres will be treated aerially and 220 acres with ground crews. FY03 ground treatments will target retreatment in FY02 ground crew areas. iii) At DuPuis Reserve, during FY01, FY02 and FY03, SFWMD's exotic contractor treats approximately 75% of property each year. Primary species are melaleuca, Brazilian pepper and Old World climbing fern. Focus is on maintenance and treating new infestations. iv) FDEP Kissimmee Prairie State Park, have observed Old World climbing fern, no active management. Treated small outlier area in FY02. v) At J.W. Corbett Wildlife Management Area, FFWCC treated 300 acres aerially and 750 acres with ground crews in FY01 and 27 acres with ground crews in FY02. FFWCC plans to treat 350 acres of dense infestation in FY03. b) Mechanical/manual i) SFWMD DuPuis Reserve treatments also incorporate rollerchopping. c) Fire i) SFWMD DuPuis Reserve treatments also incorporate prescribed burns on a 3 year rotation.

TABLE 7
HYDRILLA, *Hydrilla verticillata*

Program Goal: Bring primary submersed aquatic plants to maintenance level control in the Lake Okeechobee watershed

Principle Agency(s)	Program Components	Program Implementation
USACE, SFWMD	1) Develop a submersed aquatic plant management **plan** for primary area(s) of infestation in LOW.	1) Management plan(s) a) Lake Okeechobee and Kissimmee River aquatic plant management plans developed in the 1990s. This plan is revised as needed through interagency processes.
USACE, FDEP, SFWMD	2) **Assess and map** coverage of submersed aquatic plants in LOW	2) Assess and map a) USACE and interagency members informally assess in Lake Okeechobee and watershed during frequent inspections. b) FDEP formally surveys all State Waters annually. c) SFWMD formally monitors submersed aquatic plant populations through ongoing surveys in Lake Okeechobee- annually.
	3) **Conduct research** of submersed aquatic plant biology and management studies through support programs and in-house studies.	3) Research a) Support Programs i) Hydrilla resistance to herbicides conducted by IFAS, funds FDEP. Start 02-03 b) In-house Studies
All agencies	4) **Attend** Interagency **meetings** to provide leadership and technology transfer with respect to exotic species management in LOW.	4) Meetings a) Agency staff continues to attend all Lake Okeechobee Protection Plan Interagency meetings (monthly meetings for 2001 and 2002).
USACE, USDA-ARS, SFWMD (FDEP provides SFWMD funding for herbicide treatment in state waters outside Lake Okeechobee)	5) **Treat** infestations of submersed aquatic plants within LOW in accordance with submersed aquatic plant management plan.	5) Treatment a) Herbicide i) In SFWMD canals within the LOW, approximately 3 acres of hydrilla were treated in FY01. SFWMD plans to treat 20 acres of hydrilla during FY02 and FY03. ii) In FY01, SFWMD did not treat hydrilla in State Waters within the LOW (i.e. Old Kissimmee River, Taylor Creek, Lake Okeechobee tributaries and C-38). There are no projected treatments for FY02. In FY03, SFWMD estimates treating 100 acres in State Waters in LOW. b) Mechanical/manual i) USACE conducts harvesting in Lake Okeechobee. ii) SFWMD conducts occasional harvesting of submerged aquatic plants when densely collected in channels and water control structures. c) Biological control i) USDA-ARS performs ongoing monitoring of introduced hydrilla biocontrol insects.

TABLE 8
WATERHYACINTH, *Eichornia crassipes*
WATERLETTUCE, *Pistia stratiotes*

Program Goal: Bring primary floating aquatic plants to maintenance level control in the Lake Okeechobee watershed

Principle Agency(s)	Program Components	Program Implementation
USACE, IFAS, FDEP, FFWCC, SFWMD	1) Develop a floating aquatic plant management **plan** for primary area(s) of infestation in LOW.	1) Management plan(s) a) Lake Okeechobee and Kissimmee River aquatic plant management plans developed in the 1990s. Revised as needed through interagency processes.
USACE, FDEP, FFWCC, SFWMD	2) **Assess and map** coverage of floating aquatic plants in LOW	2) Assess and map a) Ongoing USACE inspections of Lake Okeechobee. b) Interagency group aerially inspects Lake Okeechobee bi-monthly. FDEP formally surveys all State Waters annually.
USDA-ARS	3) **Conduct research** of floating aquatic plant biology and management studies through support programs and in-house studies.	3) Research a) Support Programs i) USDA-ARS performs ongoing monitoring of introduced water hyacinth and waterlettuce biocontrol insects. b) In-house Studies
All agencies	4) **Attend** Interagency **meetings** to provide leadership and technology transfer with respect to exotic species management in LOW.	4) Meetings a) Agency staff continues to attend all Lake Okeechobee Protection Plan Interagency meetings (monthly meetings for 2001 and 2002).

TABLE 8
WATERHYACINTH, *Eichornia crassipes*
WATERLETTUCE, *Pistia stratiotes*

Program Goal: Bring primary floating aquatic plants to maintenance level control in the Lake Okeechobee watershed

Principle Agency(s)	Program Components	Program Implementation
USACE, FFWCC, FDEP, SFWMD (FDEP provides SFWMD funding for herbicide treatment in State Waters)	5) **Treat** infestations of floating aquatic plants within LOW in accordance with floating aquatic plant management plan.	5) Treatment a) Herbicide i) USACE treated 733 acres of floating plants in FY01. This number is low due to the drought. In FY02, USACE will treat approximately 7200 acres, and plans to treat 5000 acres in FY03. ii) In SFWMD canals within the LOW, approximately 1888 acres of waterlettuce and waterhyacinth were treated in FY01, 1195 acres of waterlettuce and waterhyacinth will be treated in FY02, and SFWMD plans to treat 4078 acres of waterlettuce and waterhyacinth in FY03. iii) SFWMD DuPuis Reserve routinely treats waterhyacinth and waterlettuce in the east, west and borrow ditches of the marsh every 4 months. iv) In FY01, SFWMD treated 947 acres of floating plants in State Waters within the LOW (i.e. Old Kissimmee River, Taylor Creek, Lake Okeechobee tributaries and C-38). In FY02, SFWMD plans on treating approximately 700 acres. In FY03, SFWMD estimates treating 600 acres in State Waters in LOW. v) FDACS-DOF Lake Wales Ridge State Forest treats waterhyacinth as soon as it is observed either chemically or manually (pull out of waterbody). vi) At J.W. Corbett Wildlife Management Area, FFWCC treats approximately 1 mile of waterhyacinth each year in internal canals. b) Mechanical/manual i) USACE, in Lake Okeechobee harvests densely collected floating plants as necessary. These efforts are done every year, on an as needed basis. ii) SFWMD, in other public waters of the LOW, harvests densely collected floating plants as necessary, usually near water management structures or from navigation channels. These efforts are done every year, on an as needed basis. FDACS-DOF Lake Wales Ridge State Forest treats waterhyacinth as soon as it is observed either chemically or manually (pull out of waterbody) c) Biological control i) Waterhyacinth and waterlettuce biocontrol insects were previously introduced into waterbodies in the LOW.

TABLE 9
FY02 EXOTIC PLANT SPECIES EXPENDITURES

Exotic Species	Agency	Costs*	Action
Lygodium	FDACS-DOF, Lake Wales Ridge State Forest	$24,000	90-95% of money spent on lygodium and on cogon grass. Lesser extent of treatment for star grass, Brazilian pepper, mimosa, camphor tree, air potato, tropical soda apple and rosary pea.
Melaleuca, lygodium, Brazilian pepper, hydrilla/ hyacinth	SFWMD- managed	$644,000	Primary species are lygodium, melaleuca and Brazilian pepper.
Melaleuca, lygodium, Brazilian pepper	FFWCC, J.W. Corbett Wildlife Management Area	$710,000	10 acres of pepper, 52 acres of melaleuca, 112 acres of lygodium; 1250 acres of melaleuca and lygodium retreatment
Lygodium	USAF Avon Park	$135,000	Primarily Old World climbing fern. Follow up treatments on Brazilian pepper and strawberry guava. In- house crews treated cogon grass and tropical soda apple.
Cogon grass	FDEP, Kissimmee Prairie State Park	$12,000	Currently (not FY02) treating cogon grass, air potato, lygodium, and tropical soda apple. Plan on treating Brazilian pepper and lygodium with DEP grant. Have a feral pig contract and will treat fire ants as needed.
Torpedograss, melaleuca, Brazilian pepper	SFWMD, Lake Okeechobee marsh	$1,647,000	Torpedograss treatment only on Lake Okeechobee marsh. Melaleuca treatment only throughout Lake Okeechobee. Brazilian pepper treatment throughout Lake Okeechobee.
Melalueca, Brazilian pepper	USACE, Lake Okeechobee waterway and HH Dike	$1,296,000	Includes $1,021,328 on floating vegetation and tussocks. Remainder of funds used to treat melaleuca, Brazilian pepper, Australian pine and bamboo.
Hydrilla/hyacinth	SFWMD, Lake Okeechobee, canals	$143,000	Includes funding for floating, emerged, submersed and ditchbank treatments on L-8, L-19, L-12, L-13, L-14, L-20, L-25, C-19, C-20, C-21, C-43, L-41, L-42
Brazilian pepper, melaleuca	SFWMD, Nicodemus Slough	$5,000	$4500 was for Brazilian pepper and $500 was for melaleuca.
Lygodium	SFWMD, Kissimmee River basin	$230,000	Lygodium, both ground and aerial, in Kissimmee River Pools.
Total		**$4,846,000**	

- Costs may include treatment for other invasive plants, in addition to the major exotic species.

Exotic Animal Species

The effort to address exotic animals in Florida has lagged behind that of invasive plants. While it is relatively easy to determine the extent to which exotic plants invade native areas, the impact of exotic animals on native communities and on those species with which they compete directly is frequently less obvious

The South Florida Ecosystem Restoration Task Force (SFERTF)-Working Group has been gathering information in the south Florida area as a basis for an assessment of the problem. The LOW is within the area assessed. In February 1998, the Working Group established an ad hoc interagency team to focus on South Florida and evaluate the status of non-indigenous animals in all habitats (freshwater, marine and terrestrial), describe efforts underway to deal with them, and identify agency needs and problems. Non-native animal species of concern include insects, marine and freshwater fish and invertebrates, reptiles and amphibians, mammals and birds. This non-native animal report was submitted to the Working Group in February 2000 in order to provide a broad picture of the status of non-indigenous animal species in South Florida. It focuses on the agencies, along with their respective departments, that are represented on the Working Group. It is hoped that this report will be used as a basis for the Working Group to evaluate its members' priorities relative to non-indigenous animals and to determine if and how it might assist the work of individual agencies, enhance interagency collaboration, and integrate South Florida efforts into state, regional, or national programs. The ultimate goal of any further efforts would be to develop a system-wide action plan to address non-indigenous animals in the South Florida ecosystem.

The following table, Table 10, lists current agency actions within the LOW with regards to the primary exotic animal species identified in Table 2. The coordinating agencies of the Lake Okeechobee Protection Program, FDEP, FDACS and SFWMD will begin discussions during the Lake Okeechobee Protection Plan Interagency meetings with the FFWCC and other cooperating agencies to determine future necessary actions to be taken with regards to exotic animal species. In addition, as more information is provided by the Working Group as to an action plan for non-indigenous animals in South Florida, the coordinating agencies will make efforts to incorporate these recommendations into future revisions of this plan.

TABLE 10
EXOTIC ANIMAL SPECIES MANAGEMENT

Exotic Animal	Agency	Action
Feral pig	USAF, Avon Park	Up to 2001, primary management of feral pigs has been through hunting. The year 2000 (August through late December) hunt had a harvest of 508 pigs. The year 2001 hunt had a harvest of 271 (park was closed due to security restrictions after September 11, 2001). Beginning in 2001, management has included trapping of feral pigs on the unhunted lands. Between November 2001 and March 2002 (breeding peak), 276 pigs were trapped. Future plans for management include both hunting and trapping. USAF conducts an annual pig survey every August.
	FDACS-DOF, Lake Wales Ridge State Forest	Management consists of allowing hunting for feral pigs.
	SFWMD-SOR	Planning on trapping feral pigs in KICCO area of Kissimmee River in FY03. This will be first management effort to utilize trapping on SOR lands. This will be coordinated with FFWCC. FFWCC manages game animal hunts, which includes feral pigs on KICCO and Hickory Hammock (both wildlife management areas) based on quota hunts. FFWCC also manages hunts on Kissimmee River and DuPuis SOR lands that are open to hunting.
	FDEP, Kissimmee Prairie State Park	Trapped over 700 feral pigs in FY01.
	FFWCC, J.W. Corbett Wildlife Management Area	Management consists of allowing hunting for feral pigs. Average harvest per year is 150 to 250 pigs.
Blue tilapia	FDEP, Kissimmee Prairie State Park	Observed in park, allow fishing for consumption, otherwise no activity.
	SFWMD, Lake Okeechobee	Observed by SFWMD staff as abundant in Lake Okeechobee. No current treatment.
Asian swamp eel	SFWMD, Lake Okeechobee	None observed. No current treatment in Lake Okeechobee. Have been observed in SFWMD Canals in Broward and Miami-Dade counties.
Fire ant	FDEP, Kissimmee Prairie State Park	Treat fire ants as an ongoing project. Spent $500 on fire ants in FY01.
Spiney water flea	SFWMD, Lake Okeechobee	Monitoring done monthly at 5 locations in the Lake Okeechobee's open-water region
Asiatic clam	SFWMD, Lake Okeechobee	Observed by SFWMD staff as abundant in Lake Okeechobee. No current treatment.
Sailfin catfish	FFWCC	Observed in Miami north to West Palm Beach also in Lake Okeechobee. No current treatment.
Feral Mallard	FFWCC	FFWCC has initiated a comprehensive program to educate the public

TABLE 10
EXOTIC ANIMAL SPECIES MANAGEMENT

Exotic Animal	Agency	Action
		about the serious problems feral mallards cause in order to increase awareness and reduce the number of mallards illegally released in the state. FFWCC also has secured a permit from the USFWS to control nuisance feral mallards, and is working to develop a sub-permitting process to allow local entities to control nuisance mallards between the months of May through September. Note: wild mallards migrate into (winter months) and out (spring) of Florida and are a natural part of the bird community. Mallard control efforts will target only the feral non-migratory birds that remain in the state during the spring and summer (i.e., the mottled duck breeding period), thus posing a hybridization threat to mottled ducks. Contact FFWCC's waterfowl program at 321-726-2862 or http://wld.fwc.state.fl.us/duck/ for further information