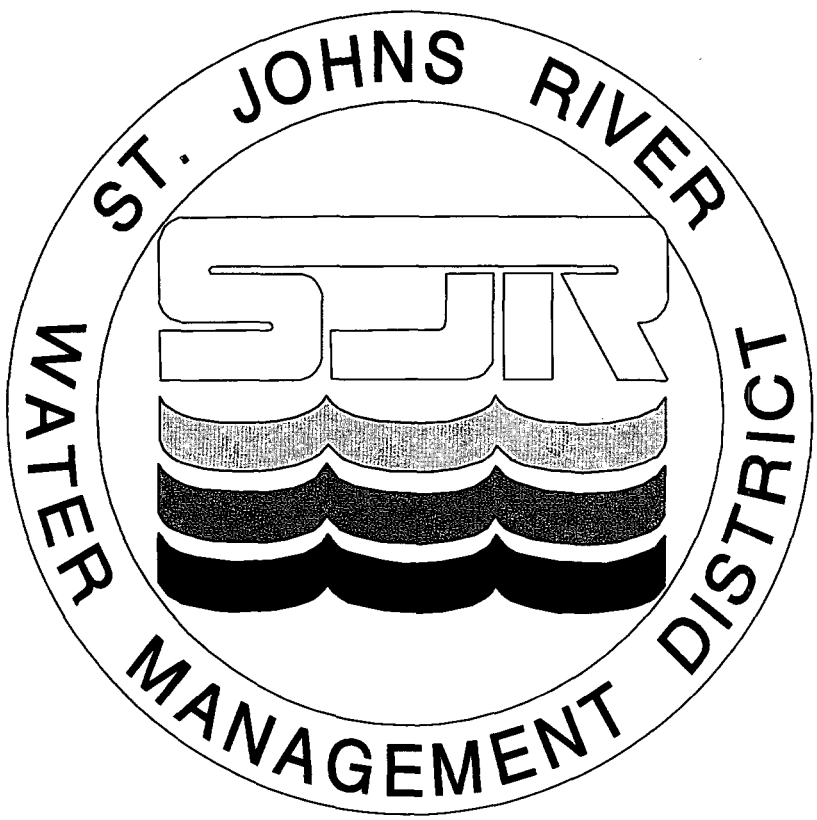
Special Publication SJ2000-SP3

Management Plan for the Control of Nuisance Plants on Lands Owned by the St. Johns River Water Management District



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MANAGEMENT PLAN FOR THE CONTROL OF NUISANCE PLANTS ON LANDS OWNED BY THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

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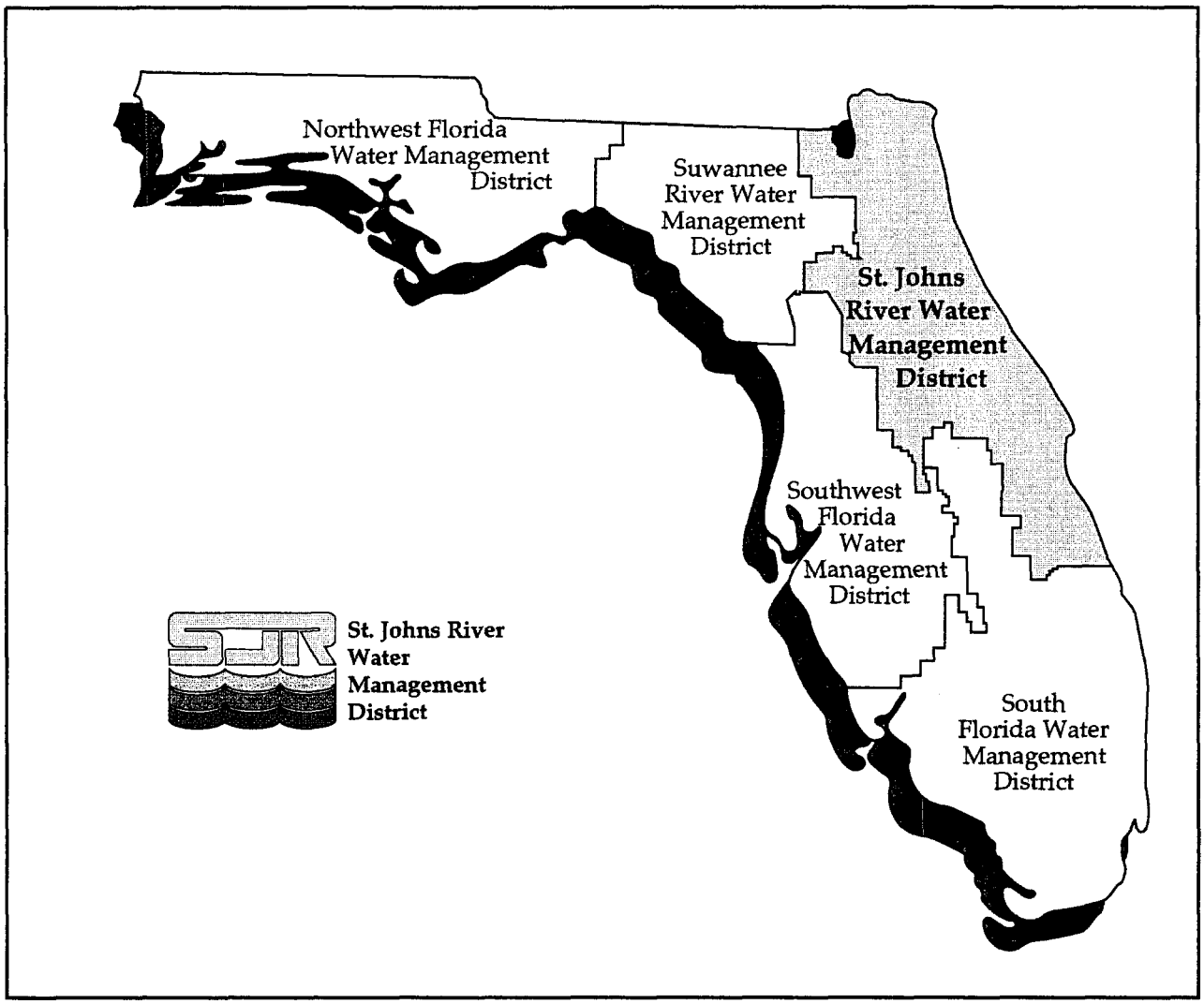
Palatka, Florida

2000



The St. Johns River Water Management District (SJRWMD) was created by the Florida Legislature in 1972 to be one of five water management districts in Florida. It includes all or part of 19 counties in northeast Florida. The mission of SJRWMD is to manage water resources to ensure their continued availability while maximizing environmental and economic benefits. It accomplishes its mission through regulation; applied research; assistance to federal, state, and local governments; operation and maintenance of water control works; and land acquisition and management.

Special Publications are published to disseminate information collected by SJRWMD in pursuit of its mission. Copies of this report can be obtained from:

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EXECUTIVE SUMMARY

The St. Johns River Water Management District (SJRWMD) owns more than 420,000 acres of land as of October 1, 1997, which are managed for water resource protection, environmental preservation and restoration, and public recreation. One of the most serious threats to the biological diversity and recreational value of these lands is the proliferation of invasive exotic plants. Exotic plants are plants that are not native to an area, yet persist and thrive. Because of the absence of natural biological controls (biocontrols), exotic plants frequently out-compete native species, causing a decline in biological diversity (biodiversity), and a loss of native habitat. More than 27% of the total number of plant species found in Florida are exotic; more than 1.6 million acres of Florida's remaining natural areas are infested by invasive exotics. Both upland and aquatic ecosystems are threatened by exotic plants.

Management of exotic plants on SJRWMD land is a complex problem given the number of species present and the number of acres to be managed. To help effectively allocate available resources, this management plan has three objectives (1) to establish goals and priorities for the treatment of exotic plant species on SJRWMD lands, (2) to describe methods that will be used to treat various exotic plants, and (3) to outline departmental responsibilities and procedures for implementing plant control activities.

The goal of SJRWMD regarding invasive exotic plants is to safely manage populations to achieve the lowest feasible levels, while minimizing costs, impacts to native vegetation, and water quality problems. Successfully achieving this goal is dependent on available technology, and more importantly available funds. SJRWMD will accomplish this through a program of "maintenance control." The maintenance control philosophy emphasizes keeping nuisance populations at their lowest feasible levels. Lowest feasible levels are defined as levels from which nuisance populations would not quickly become a problem if the control program were to be discontinued. Studies have shown that a program of maintenance control minimizes both the environmental and economic impacts of control activities.

This management plan is divided into two main sections: Aquatic Nuisance Plants and Terrestrial Nuisance Plants. The aquatic section contains a brief description of exotic plant problems and treatment strategies. Priorities for treating aquatic plants are established for two major basins where problems are greatest: the Upper St. Johns River Basin and the upper part of the Ocklawaha River Basin. Similar priorities will be established for additional basins or areas as needed. The terrestrial section also contains

a description of major species of concern, treatment strategies, and priorities. In addition, the plan provides a method for establishing treatment priorities, presents the process to be followed for reporting the occurrence of exotic plants, and detailed responsibilities by SJRWMD department.

Staff in the Department of Operations and Land Resources (Invasive Plant Management Program) will have the primary responsibility of implementing this plan. Regular meetings will be held by SJRWMD staff to discuss plant management activities and future treatment priorities. To ensure that all concerns are addressed, SJRWMD will solicit the advice and comments of other state and local agencies regarding SJRWMD plant management plans and activities. Concerns of local municipal and county governments, user groups, environmental organizations, and citizens will also be considered. This plan has been reviewed by the U. S. Army Corps of Engineers, the U. S. Fish and Wildlife Service, the Florida Department of Environmental Protection and Florida Fish and Wildlife Conservation Commission (formerly the Florida Game and Fresh Water Fish Commission).

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INTRODUCTION

Invasive exotic plants pose a serious threat to the conservation of Florida's biological resources. Exotic plants are defined as plant species that are growing outside their natural geographic range (Jensen and Vosick 1994). Exotic plants usually are removed from co-evolved diseases, parasites, and herbivores. As a result, the absence of these natural biocontrols allows certain exotic plants to develop large, expansive populations, which eventually negatively impact native ecosystems. Exotic species can damage native ecosystems by displacing native species, modifying nutrient and hydrologic cycles, changing natural fire regimes, altering wildlife habitat, and disrupting food webs (Jensen and Vosick 1994; Schmitz 1994). The overall result of invasions of exotic species is often a decline in native biodiversity, a loss of native habitat, and reduced recreational and commercial value for affected areas.

Florida is particularly prone to invasions of exotic species because of its tropical climate and the extensive destruction and disturbance that have occurred to many of its native habitats. In 1994, Schmitz estimated that at least 27% (more than 900 species) of the total number of plant species found in Florida were exotic. In addition, more than 1.6 million acres of Florida's remaining natural areas have become infested with exotic plants.

The St. Johns River Water Management District (SJRWMD) owns more than 420,000 acres of land, which are managed for water resource protection, environmental preservation and restoration, and public recreation. Invasive exotic plants already constitute a serious problem on much of this land. Management of exotic plants on SJRWMD land is a complex problem given the number of species present and the number of acres being managed. This plan has been created to help guide exotic plant management activities on SJRWMD land. There are three major objectives

- To establish goals and priorities for the treatment of aquatic and terrestrial exotic plants on SJRWMD-owned lands
- To describe methods that will be used to treat exotic plants
- To outline departmental responsibilities and procedures for implementing nuisance plant control activities

This management plan is divided into two main sections: Aquatic Nuisance Plants and Terrestrial Nuisance Plants. The aquatic section contains a brief description of exotic plant problems and treatment strategies. Priorities for treating aquatic plants are established for basins where the problems are greatest. Similar priorities will be established for additional basins as needed. The terrestrial section also contains a description of major species of concern, treatment strategies, and priorities. In addition, the plan provides a method for establishing treatment priorities, presents the process to be followed for reporting the occurrence of exotic plants, and details responsibilities by SJRWMD departments.

This plan has been reviewed and commented on by the U. S. Army Corps of Engineers (USACE), the U. S. Fish and Wildlife Service (USFWS), the Florida Department of Environmental Protection (FDEP), and the Florida Fish and Wildlife Conservation Commission (formerly the Florida Game and Fresh Water Fish Commission) (Appendix A).

AQUATIC NUISANCE PLANTS

SJRWMD covers an area of approximately 12,400 square miles (mi^2), including more than 1,100 mi^2 of surface water (Figure 1). Because of the warm climate and nutrient availability, much of the surface water within SJRWMD provides an ideal environment for the establishment and expansion of nuisance native and exotic aquatic plants.

The most significant nuisance aquatic plant species are waterhyacinth (*Eichhornia crassipes*), waterlettuce (*Pistia stratiotes*), hydrilla (*Hydrilla verticillata*) and cattails (*Typha* spp.). Since the early 1900s, the floating exotic species waterhyacinth and waterlettuce have created problems for navigation, flood control, recreation, and maintenance of fish and wildlife habitat (Schardt 1994). Within the past 25 years, the submersed exotic plant hydrilla has become a threat and now covers nearly 90,000 acres of state waterways (Schmitz et al. 1995). In addition to impeding navigation and recreation and degrading fish habitats, hydrilla has contributed to the decline of native aquatic plants through direct competition. Cattails, although a native species, also can create problems by developing dense monotypic stands. Under high nutrient conditions and appropriate hydroperiods, cattails have been shown to displace other native species (Urban et al. 1993). Expansion of cattail also has been associated with disturbances, such as fire (Urban et. al 1993; Miller et al. 1996)

Many control methods and techniques have been employed to manage invasive aquatic plants, including mechanical harvesting, chemical treatments with herbicides, habitat manipulation, and biological control agents. Mechanical control removes plant biomass and associated nutrients from the system. This control method is generally a costly and inefficient method when a large number of acres must be treated. Chemical control with contact or systemic herbicides has proven to be both economical and efficient. Chemicals, however, can be potentially harmful to desirable native vegetation and aquatic organisms. Host-specific biological controls are the most desirable techniques. Most introductions of biological control agents have had limited success.

Until effective biological control agents are discovered, chemical treatments are the most practical method for controlling nuisance aquatic plants on a large scale. However, when possible, an integrated approach to plant control will be used. For example, waterhyacinth weevils (*Neochetina* spp.) have been introduced to slow the growth of waterhyacinth populations—the plants are not killed. Complete control of waterhyacinths by the weevils is unlikely because weevils only stress the waterhyacinths by scarring the

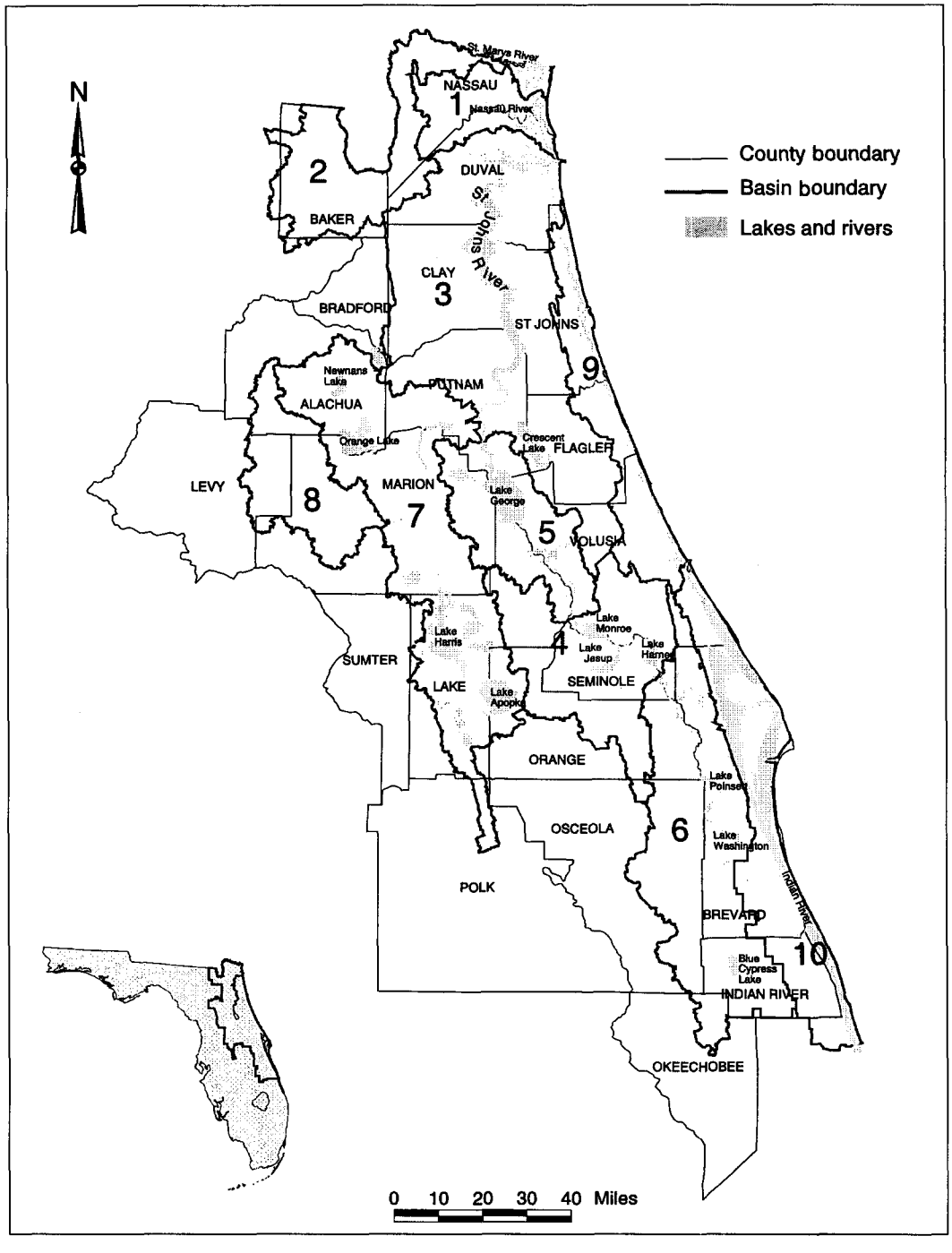

Figure 1. Major basins of the St. Johns River Water Management District

leaf tissue (Center et al. 1994). Scarring the leaf tissues, however, reduces leaf surface area available for photosynthesis which leads to slower growing populations that contain fewer, smaller plants. These smaller populations are controlled more easily and inexpensively with herbicides than are larger populations.

MANAGEMENT AUTHORITY AND PHILOSOPHY

SJRWMD is solely responsible for funding and management of the exotic and nuisance plant control program on SJRWMD-owned lands. At this time, FDEP is the permitting agency for all aquatic plant management in waterbodies in Florida and will have the opportunity to comment on all control activities. In addition, the FWC will be given an opportunity to comment on these same control activities in the permit process. USFWS will be given an opportunity to comment on any control activities taking place in areas of endangered species activity.

The aquatic plant management program at SJRWMD will be conducted according to the maintenance control philosophy conceived by USACE and adopted by FDEP in statutory authority. Paragraph 369.22(2)(d), *Florida Statutes* (1995), states that

> A "maintenance program" is a method for the control of non-indigenous aquatic plants in which control techniques are utilized in a coordinated manner on a continuous basis in order to maintain the plant population at the lowest feasible level as determined by the department [Department of Environmental Protection].

The concept of maintenance control as a goal for aquatic plant management was formulated by USACE in 1973 for controlling waterhyacinths (Schardt 1994). Prior to this date, waterhyacinths had been allowed to reach problem levels before control measures were implemented. Treating extensive areas of waterhyacinths caused severe negative environmental impacts from heavy detrital loading. Preventing this type of negative impact could only be achieved by aggressively preventing waterhyacinths from reaching problem levels. Subsequent studies by Joyce (1985) documented that maintaining a 5% or less cover of waterhyacinths under a herbicide maintenance program, as opposed to allowing complete cover to occur before treatment, reduced herbicide use by a factor of up to 2.6, reduced sedimentation in infested areas by a factor of 4.0, and greatly reduced oxygen depressions caused by shading and plant decomposition. These and other studies have clearly demonstrated that a program of maintenance control minimizes both environmental and economic impacts.

GOAL

The goal of SJRWMD regarding invasive, nuisance aquatic plants found on SJRWMD lands is to safely manage populations to achieve the lowest feasible levels, while minimizing costs, impacts to native vegetation, and water quality problems.

The strategy to achieve this goal is for SJRWMD to treat invasive aquatic plants according to the maintenance control philosophy (Schardt 1994). Complete eradication of established nuisance aquatic plants may not be possible. Therefore, the maintenance control philosophy emphasizes keeping nuisance populations at the lowest possible levels. Lowest possible levels are defined as levels from which nuisance populations would not quickly become a problem if the control program were to be discontinued. Successfully achieving this goal is dependent on available technology, chemical restrictions, and available funds.

TREATMENT STRATEGIES

Treatment strategies vary depending upon the species of plant to be controlled. Additionally, the size of the population and its location are important factors in determining an appropriate treatment strategy.

Floating Species

The primary floating species addressed by this plan are waterhyacinths and waterlettuce. Both species are free-floating and can be readily transported throughout waterways by wind and currents. Mats of these plants can block water control structures, interfere with structure operation, and impede recreation and navigation. Waterhyacinth and waterlettuce populations expand rapidly and continually shed leaf and root material. This expansion results in the degradation of aquatic ecosystems by displacing native plant communities, increasing the accumulation of organic sediments, up-rooting or smothering native plant communities, and depleting locally available dissolved oxygen in the water column and sediments.

Controlling of floating exotic plant species is the highest priority of FDEP because of the rapid growth and mobility of these species (Schardt 1994). Between 1982 and 1993, more than $23 million was spent by the state of Florida to control these plants (Figure 2). During this period, waterhyacinth and waterlettuce populations were reduced from a

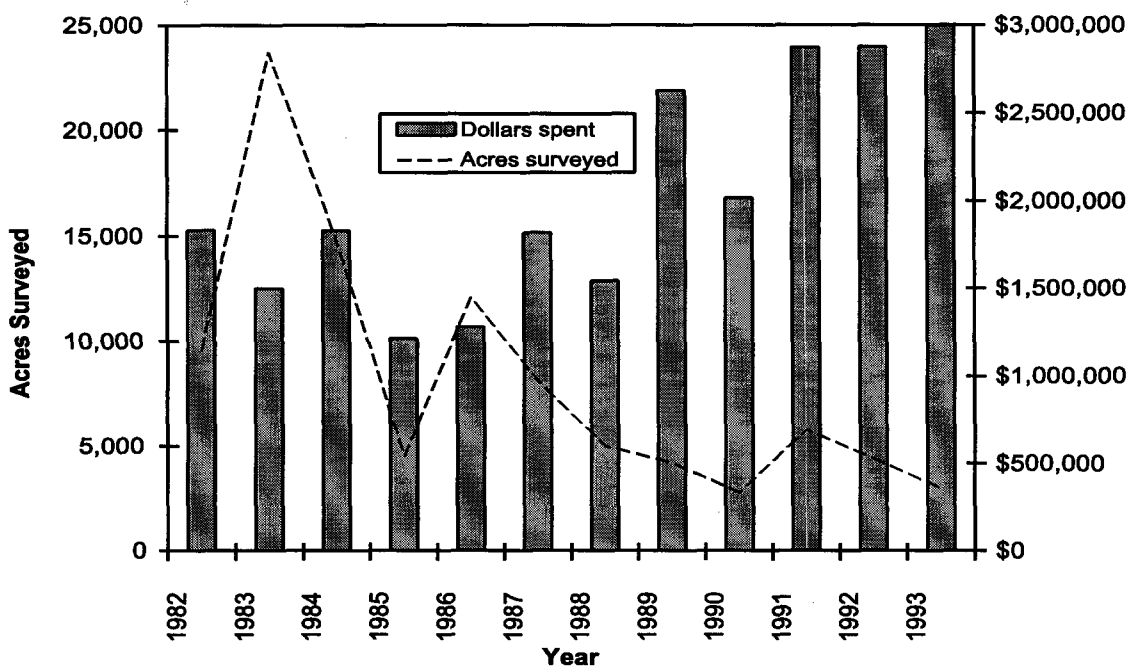

Figure 2. Estimated acreage of waterhyacinth and waterlettuce in Florida public lakes and rivers from 1982 to 1993 and dollars spent for control (taken from Schardt 1994).

statewide high of 24,000 acres in 1983 to 3,000 acres in 1993. The infestation of these plants in public waterways was considered to be under maintenance control at the beginning of 1994 (Schardt 1994). To maintain lowest possible levels of infestation, approximately 34,000 acres of waterhyacinth and waterlettuce are treated annually.

An integrated biological, chemical, and mechanical control program will be used by SJRWMD to manage floating plants. Mechanical harvesters may be used in some situations, such as near drinking water intake structures or in small water bodies. Backhoes or draglines may be used to remove plants from water bodies or around water control structures, where access is available (e.g., along canal banks). For chemical treatments, the U.S. Environmental Protection Agency (EPA) approved herbicides, such as Weedar 64 (2,4-D Amine [2, 4-D]), Reward® (diquat dibromide), and Rodeo® (glyphosate), will be applied to floating vegetation at the specified label rates. Experiments being conducted on the use of biological control agents to combat expanding invasive plants show some promise. Certain host-specific insects and pathogens released in Florida have slowed the growth and expansion of both waterhyacinths and

waterlettuce but, as of yet, are not effective for wide-spread control (Schardt 1994). Biological control agents will be used as appropriate, depending on environmental circumstances and EPA approval. As of 1996, herbicides are the most effective and cost-efficient means to manage floating aquatic plants throughout SJRWMD.

The herbicide 2,4-D will be used to control waterhyacinths, and Reward® and Rodeo® will be used to control mixed populations of waterhyacinths and waterlettuce, in most water bodies. These chemicals provide acceptable cost-effective controls. Under maintenance control conditions and when used with polymers for drift control, overspray and impacts to non-target species are minimized. The herbicide 2,4-D is the least expensive herbicide for controlling waterhyacinth and provides excellent control. However, 2,4-D is not effective on waterlettuce. Reward® provides the most effective control of waterlettuce and will also control waterhyacinths, making this herbicide the better choice for controlling mixed populations . Rodeo®, is effective on both waterhyacinths and waterlettuce, but it also controls cattail, Hydrocotyle, Nuphar, Nymphaea and a number of emergent grasses.

SJRWMD will use 2,4-D to control monotypic populations of waterhyacinths. Reward® will be used when controlling monotypic stands of waterlettuce and for controlling mixed populations of waterhyacinths and waterlettuce. In addition, Reward®, rather than 2,4-D, will be used to control waterhyacinths when these plants are mixed in or are adjacent to the native bulrush (*Scirpus* spp.).

Floating vegetation tends to accumulate along shorelines, in open marsh and slough areas around lakes, and in canals. These areas should be patrolled (surveyed) at least monthly. Waterhyacinths and waterlettuce found in open water or in areas where these species are not intermixed with native vegetation should be treated immediately with herbicides, regardless of the size of the area the plants cover. Waterhyacinths and waterlettuce found intermixed or along the littoral vegetation—open water interface should be treated only when individual communities exceed approximately 100 square feet (ft^2)—approximately the size of an airboat.

Establishing a minimum area of 100 ft^2 helps minimize the impacts of the herbicides on the native plant communities. Attempts to treat individual plants or small patches of waterhyacinths and waterlettuce that are intermixed in native vegetation occasionally can result in more extensive damage to native communities than is desirable (D. Thayer, South Florida Water Management District, pers. com. 1995). USACE, working with the Lake Okeechobee Aquatic Plant Management Interagency Task Force, developed

the 100 ft^2 minimum for treatment of mixed communities in the Lake Okeechobee system (USACE 1989).

Maintenance control of floating exotic plants will only be achieved through a program of frequent surveillance and treatment of SJRWMD water bodies. As the area covered by floating plants gets smaller, actual spray time will decrease and time to patrol or to survey populations will increase. Environmental damage will be minimized, herbicide applied will be reduced, the overall cost of the program will be decreased, and the effectiveness of plant control will be increased (Schardt 1994).

Submergent Species

Exotic submergent plants that pose significant threats to native communities include Hydrilla (*Hydrilla verticillata*), Brazilian elodea (*Egeria densa*), African elodea (*Lagarosiphon spp*) and Eurasian watermilfoil (*Myriophyllum spicatum*). Hydrilla currently poses the most significant threat. The latter three plant species are rarely found in SJRWMD waters.

Hydrilla quickly grows to fill the water column and form dense surface mats. The resulting diminished light and oxygen levels allow hydrilla to displace native plants, reducing species diversity. While hydrilla provides a food source for some waterfowl species and serves as refuge habitat for small game fishes, it is undesirable when it forms huge monospecific stands and replaces native submersed species. The management dilemma regarding hydrilla is that it is extremely difficult and expensive to contain at the densities that appear beneficial to fish and wildlife (generally < 30% coverage). From 1982 through 1993, more than $36 million was spent in the state of Florida to control hydrilla (Schardt 1994) and the number of acres infested continues to increase (Figure 3). In most cases, management efforts have been temporary, rarely lasting longer than two years (Schardt 1994). Because there is a general lack of financial support for control programs, hydrilla is continuing to expand its range in Florida and has already become a significant problem in many SJRWMD water bodies.

An integrated program of biological control, chemical control with herbicides, and mechanical control will be used to manage hydrilla. Biological control agents hold the greatest promise for any widespread control of hydrilla. These agents are more cost effective to use than herbicides. The leaf mining fly (*Hydrellia pakistanae*) has been released in numerous lakes throughout the state, but little evidence exists suggesting hydrilla is declining because of it. In other parts of Florida and in Alabama, this fly has

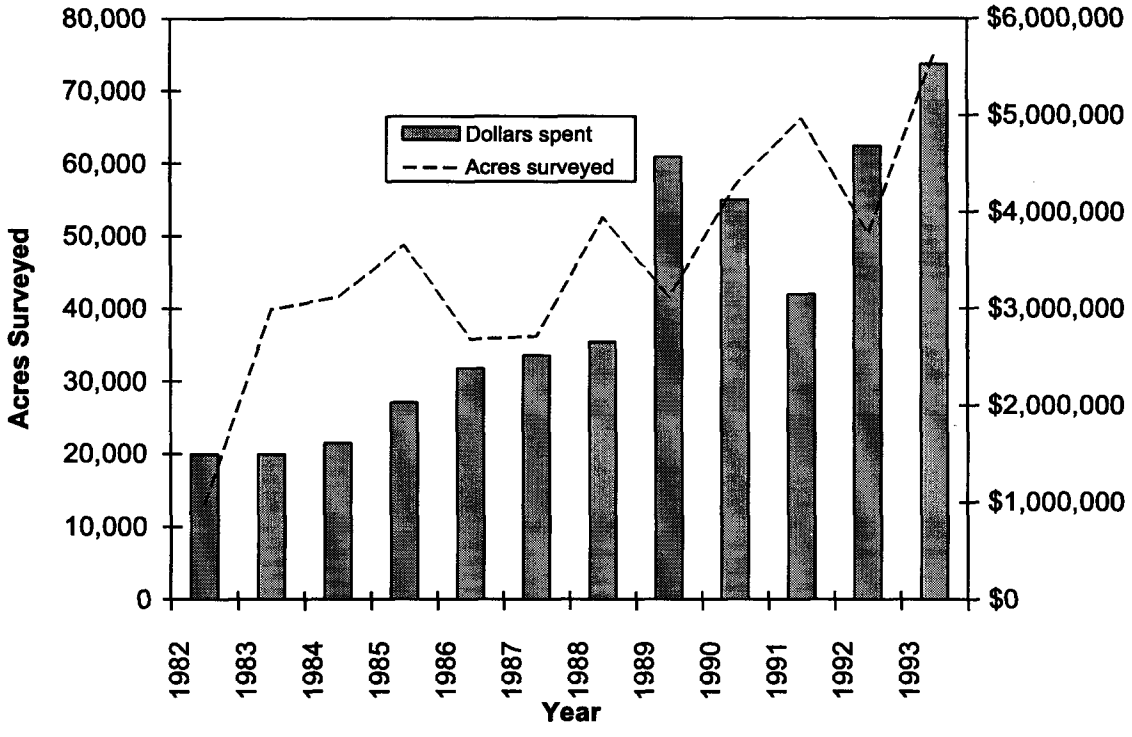

Figure 3. Estimated acreage of hydrilla surveyed in Florida Public Lakes and Rivers from 1982 to 1993 and dollars spent for control (taken from Schardt 1994).

been associated with declining hydrilla populations (Center et al. 1994). Triploid grass carp (*Ctenopharyngodon idella*) is the most widely used biological, although consumption of non-target plants by the carp can be problematic. Mechanical control of hydrilla is costly, but has applicability in some situations. Herbicides also are very costly ($260–$720 per acre), but at present provide the most effective means currently available for control of hydrilla.

Because of the high cost of hydrilla control, areas in need of treatment need to be prioritized. Hydrilla is difficult to control in flowing water as compared to lakes, which are generally more confined. Treating lakes in SJRWMD should receive first priority. Large-scale control will be carried out using the herbicide Sonar® (liquid or pellet formulation). Timing and application rate will be modified as new findings come from aquatic plant management research.

Hydrilla treatment in some areas may be conducted using other herbicides, such as Reward®, chelated copper, monoamine salt formulations of endothal, or dipotassium salt formulations of endothal. EPA-approved herbicides, such as those listed, will be applied at specified label rates.

Emergent Species

There are a few exotic emergent species that pose significant problems to native wetland plant communities. Pará grass (*Brachiaria mutica*), torpedo grass (*Panicum repens*), wild taro (*Colocasia esculenta*), and alligator weed (*Alternanthera philoxeroides*) are examples of potential nuisance plants. Often, emergent invasive species do not interfere with flood control, navigation, or recreation and, therefore, do not receive priority for treatment. From an ecosystem management perspective, these species have the potential to cause significant harm by replacing populations of native species and by their ability to form dense monocultures that have low fish and wildlife habitat values.

Where herbicide treatments are needed, either Rodeo® or 2,4-D, will be used on wild taro and Rodeo® will be used on the grasses. Specific goals need to be established so that a maintenance control program can be implemented. Emergent vegetation needs to be treated carefully to avoid negative impacts to non-target species. Consideration will be given to the use of mechanical harvesters when and where applicable.

Research of New Products

Current products may be lost to the lack of re-registration and new products may be introduced with discoveries of new compounds. Before new products are released, they must undergo extensive field testing. SJRWMD will cooperate with industry and researchers in there efforts to test these products as they become available.

Native Species

Although the major ecological concerns in vegetation management are focused on exotic species, native aquatic species, including floating, submerged, and emergent types, may become a nuisance in certain situations. Problems caused by native plants usually occur as a result of watershed alterations, such as stabilized water levels, disturbance to wetlands, or excessive nutrient input (Schardt 1994). Cattail is the most common native species that is classified as a nuisance, but there are others. Goals for managing native species will be established for individual areas as needed. Native species and communities should not be treated on a routine basis. The need for and probable outcome

of treatment should be assessed. Where feasible, treatment of native communities should be conducted, taking into consideration avoiding impacts to desirable native communities, while using economical and practical methods. Practical methods would include mechanical harvesters or cutters, fire, herbicides, biological control organisms, or by manipulating the hydrological regime, where possible. Where herbicide treatments of native plants are needed, herbicides will be selected according to selectivity to the target plant, non-selectivity to non-target plants, economics, and practicality.

SPECIAL CONSIDERATIONS

There are some circumstances under which application of herbicides should be curtailed. Consideration should be given to dissolved oxygen (DO), endangered species, and impacts to non-target species. Under a program of maintenance control, these limitations should not lead to nuisance plant populations increasing to problem levels.

Dissolved Oxygen

There has been a public misconception that aquatic weed treatment activities cause low DO levels and result in fish kills. Decreases in DO due to the decomposition of aquatic plants killed by herbicides generally do not occur until four to six weeks after the treatment, when the plants sink below the surface of the water. However, low dissolved oxygen resulting in fish kills may occur for a number of other reasons, such as after heavy rains, or if project structures are opened or closed too rapidly. In order to be sensitive to public concerns, aquatic weed treatment should be avoided for five days in areas where fish kills have occurred. Additionally, during times when fish kills are likely, spray crews should limit their activities to high priority areas.

Fish kills are likely to occur when DO levels fall below 2.0 parts per million (ppm). During late summer months (August–October) when DO levels are naturally low, spray crews should be equipped to monitor DO levels and spray activities curtailed when surface levels are at or below the 2.0 ppm threshold.

Endangered Species

Exotic plant control operations can be conducted in areas that have been identified as nesting and foraging habitat for a number of endangered or threatened bird species, particularly the snail kite (*Rostrhamus sociablis).* Aquatic plant control activities will be coordinated with the SJRWMD Division of Environmental Sciences, Division of Land

Management, FWC, and USFWS to identify such habitats. Treatment activities will be planned to avoid disrupting nesting and foraging activities of endangered species and ensure that treatment activities do not adversely affect endangered species.

Non-Target Species

Herbicides will be applied to control invasive aquatic plants at the appropriate concentrations and rates so as not to affect non-target species. There is very little information on the long-term effects of herbicidal treatments on non-target species. Vegetation shifts associated with the invasion of and subsequent herbicide treatment of exotic plants should be monitored. These data will provide valuable information for future aquatic plant management activities.

BASIN PRIORITIES

Although aquatic weed problems exist throughout the District, the most significant problems and the major portion of District activity are confined to the Upper St. Johns and the Ocklawaha basins. Each has a number of different concerns.

Upper St. Johns River Basin

Background

The Upper St. Johns River Basin (USJRB) is located in east-central Florida and covers an area of approximately 1,783 mi^2 (Figure 4). USJRB extends nearly 116 miles from the Indian River–St. Lucie county line in the south, to State Road 46 near the headwaters of Lake Harney in the north. The USJRB has over 16,000 acres of natural lakes, over 70 miles of river channel, and hundreds of miles of drainage canals. In addition to providing valuable fish and wildlife habitat, USJRB is used for flood control, for navigation, as water supply for urban and agricultural areas, and for recreation.

Located within the USJRB is the federally funded Upper St. Johns River Basin Project (USJRBP). The USJRBP encompasses an area of more than 144,000 acres and is intended to provide flood protection, environmental enhancement, recreation, and water supply. More than 50,000 acres of land previously diked and drained for agricultural

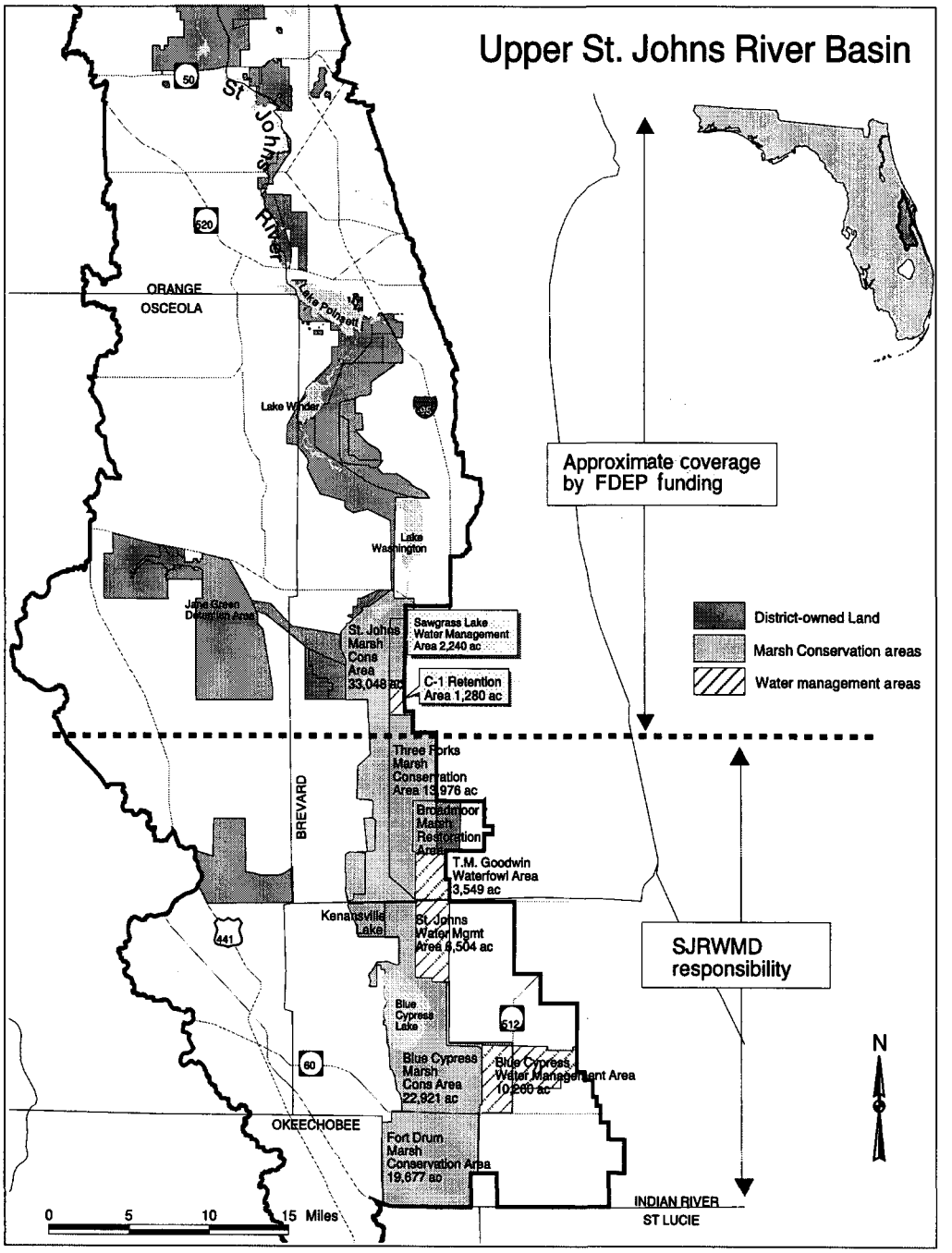

Figure 4. Map of USJRBP

purposes are being restored to wetlands. More natural hydrologic regimes will be reestablished on more than 60,000 acres of existing marsh. The USJRBP contains four marsh conservation areas and two water management areas. The purposes of the marsh conservation areas are to temporarily retain flood water, to provide for long-term water conservation storage, and to restore and to preserve floodplain wetlands. The purposes of the water management areas are to temporarily retain flood waters from agricultural lands and to segregate farm discharges from the marsh conservation areas. The water management areas also may provide water for farm irrigation. All of these areas are subject to infestation with both floating and submersed exotic plant species.

Management Responsibility

When the USJRBP is completed there will be approximately 144,132 acres of District owned wetland and open water habitat in the Upper Basin. An estimated 2,550 acres will need to be treated annually to keep the area under maintenance control. SJRWMD is solely responsible for funding and the management of the aquatic plant control program in the USJRB. At this time, FDEP is the permitting agency for all aquatic plant management in waterbodies in Florida and will have the opportunity to comment on all control activities. This permitting responsibility does not, at this time, extend to the marshes in the USJRB (Figure 4). In addition, the FWC will be given an opportunity to comment on these same control activities in the permit process. The USFWS will be given an opportunity to comment on any control activities taking place in areas of endangered species activity.

Priorities

Priorities for controlling invasive aquatic plants will vary with natural conditions and as USJRBP becomes operational. Therefore, a number of factors (e.g. structure opening and closing, restoration activities, etc.) must be considered when monthly treatment schedules are planned. General project priorities are to control the following:

1. Floating vegetation and hydrilla in all major conveyance canals, in flow-ways, at all water control structures, and in natural lakes and river channel reaches.

2. Waterlettuce and waterhyacinths in the marsh conservation areas, canals, flow-ways, and open water areas. Boat ramps and other areas of recreational access should be kept clear of plants that interfere with navigation or has the potential to become a safety hazard.

3. Exotics in the canals and interior marsh areas of the Blue Cypress Water Management Area (Figure 4). This area provides critical habitat for endangered species.

4. Exotics in recreational fishing areas such as the St. Johns Water Management Area and the S. N. Knight impoundment (Kenansville Lake)(Figure 4).

5. Exotics in areas scheduled for restoration. The goal in these areas is to keep invasive aquatic plants from negatively affecting the re-establishment of native marsh vegetation. Initial treatment may be needed before these areas are re-flooded. Aquatic plant management will be included in the restoration plan. Once restoration has been initiated, maintenance treatments will be needed.

Additional Issue

- Discharges into the river upstream of Lake Washington from the USJRBP occur through a number of gated and un-gated discharge structures. In addition, a continuous discharge from the Blue Cypress Marsh Conservation Area occurs through the flood control Structure S-96C. These continuous discharges are important to meeting long-term environmental goals for this project. Requests to lower discharges from the USJRBP to facilitate Sonar® treatments of hydrilla in Lake Washington must consider the impacts these lower discharges will have on the flora and fauna of upstream areas and may not be possible.

Upper Part of the Ocklawaha River Basin

Background

The upper part of the Ocklawaha River Basin (ORB) is located in Marion, Lake, Orange, and Sumter counties in central Florida and covers an area of approximately 638 mi^2 (Figure 5). The drainage basin extends from the Apopka-Beauclair water control structure north of Lake Apopka to State Road 40 near Ocala. The southern region includes several interconnected lakes which comprise most of the Ocklawaha chain of lakes. Virtually all of the surface water flow is regulated by water control structures. Moss Bluff Dam controls water levels in and discharge from Lake Griffin. The Yale-Griffin Canal controls water levels in Lake Yale. Haines Creek, which is channelized, controls water flow from Lake Eustis to Lake Griffin via the Burrell Dam. These structures dampen the

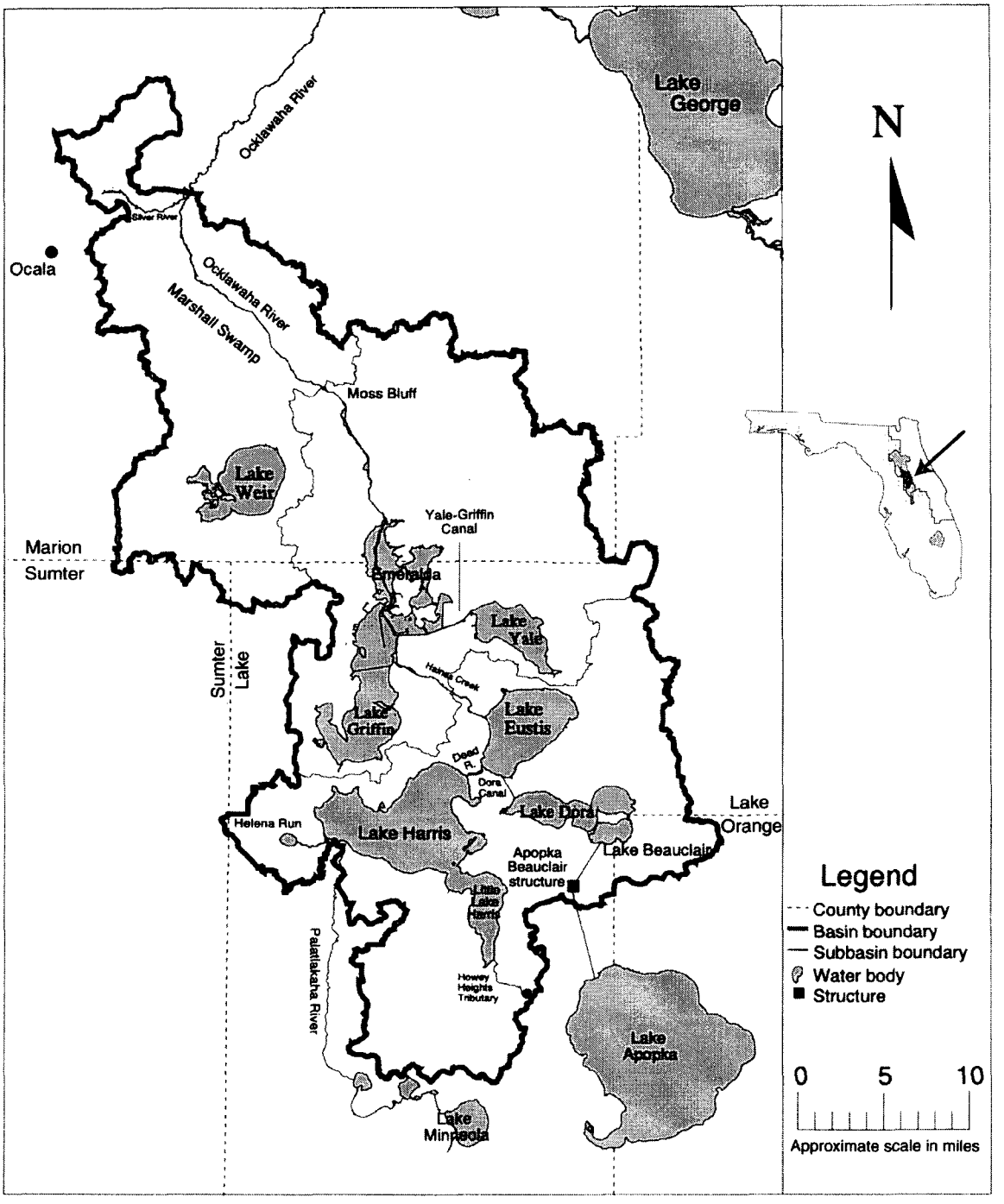

Figure 5. The upper part of the Ocklawaha River basin.

natural periodic fluctuations in lake stages and stream discharges. As a result, the lakes function as managed reservoirs rather than as natural water bodies.

Surface water inflow to the upper part of ORB occurs from upstream drainage through the Dora Canal, the Dead River, the Palatlakaha River, Helena Run, Haines Creek, Lake Yale, Lake Weir, Marshall Swamp, and the Silver River (Figure 5). Portions of the Ocklawaha River between Lake Griffin and State Road 40 near Ocala have been channelized. More than 12,000 acres of historical marshland in the chain-of-lakes region as well as in the floodplain north of Lake Griffin were converted to farmland and pasture. SJRWMD has purchased many of the farms since 1991 with the goals of reducing nutrients in the lake and establishing diverse habitats for fish and wildlife. These historical marshlands are the focus management areas and include the Emeralda Marsh Conservation Area, the Lake Harris Conservation Area, Sunnyhill Farm, and Ocklawaha Farm (Figure 5).

Management Responsibility

SJRWMD presently operates approximately 1,500 acres as marsh flow-way projects in the upper part of the ORB with an eventual total of 2,000 acres. All of these converted muck farms will need to be treated annually to keep the area under maintenance control. In addition to these flow-ways, responsibility extends to the Emeralda Marsh Conservation Area, the Lake Harris Conservation Area, Sunnyhill Restoration Area, and Ocklawaha Prairie Restoration Area. The SJRWMD is solely responsible for funding and the management of the aquatic plant control program in the UOB. At this time, the FDEP is the permitting agency for all aquatic plant management in water bodies in Florida and will have the opportunity to comment on all control activities. In addition, FWC will be given an opportunity to comment on these same control activities in the permit process. USFWS will be given an opportunity to comment on any control activities taking place in areas of endangered species activity.

Priorities

Priorities for controlling invasive aquatic plants vary with restoration goals, natural conditions, and the sequence of flooding the farms. Therefore, these various factors must be considered when monthly treatment schedules are planned. General priorities are to control the following:

1. Waterhyacinths, waterlettuce, and hydrilla in major conveyance canals and in the flow-ways.

2. Waterhyacinths, waterlettuce, and hydrilla in restoration areas and associated canals and flow-ways.

3. Invasive native plants (e.g., cattails) in areas scheduled for restoration. The goal in these areas is to keep invasive aquatic plants from negatively affecting the re-establishment of native marsh vegetation. Initial treatment may be needed before these areas are re-flooded. Aquatic plant management will be included in the restoration plan. Once restoration has been initiated, maintenance treatments may continue to be needed.

TERRESTRIAL NUISANCE PLANTS

Of the almost 420,000 acres of land SJRWMD owns, nearly 170,000 acres could be invaded by terrestrial exotic plants. Land types cover the full range of ecosystems from scrub to floodplain swamp. Maintaining these systems requires management of these terrestrial exotics.

The most significant exotic terrestrial species are cogon grass, tropical soda apple, Brazilian pepper, camphor, Chinese tallow, melaleuca, Lygodium, and Australian pine. Fortunately, these species are still limited enough in their range and coverage that SJRWMD can, and should, attempt eradication. The primary threat from each of these is that they form monotypic stands and compete vigorously enough to suppress and replace native species. Additionally, species like cogon grass, Lygodium and Melaleuca are extremely flammable, more so than the natives they replace, making fire management hazardous. Between their aggressiveness and their fire characteristics these species have the ability to completely alter ecosystems.

Control methods currently include mechanical and chemical treatment with chemical control being the most effective. There are essentially three methods of treating upland invasives. Cutting and removing the stems followed by herbicide treatment of the cut stump, the standard foliar treatment, and a basil/bark treatment with a combination of herbicides and crop oil. Most larger tree species are controlled by the basil-bark or the cut-stump method. The smaller herbaceous species are normally controlled by using the foliar method. With cogon grass, fire, mowing or disking followed by a foliar herbicide treatment, provides more effective control than the foliar alone.

In Florida, the search for biological controls has traditionally been focused on aquatic weeds. However one agent, the gray-brown Melaleuca leaf weevil(*Oxyops vitiosa*), has been released and several others are going through the screening process.

MANAGEMENT AUTHORITY AND PHILOSOPHY

SJRWMD is charged by the Legislature through *Florida Statutes 3.73.59*

> ...to manage and maintain land, water, and related resources in an environmentally acceptable manner, and to the extent practicable, to restore and protect their natural state and condition.

Exotic vegetation clearly does not have a place in lands managed under such a mission.

The Governing Board of SJRWMD has defined more clearly the SJRWMD policy (90-14) toward exotics:

> Where practical and/or necessary, established populations and isolated occurrences of plant and animals not native to Florida will be monitored and either controlled, utilized, or eliminated.

GOAL

The goal of SJRWMD regarding invasive, nuisance terrestrial plants is to safely manage populations to achieve the lowest possible levels or, in the case of new invasions, attempt elimination, while minimizing effort, costs, and impacts to native vegetation.

There are at least two strategies to achieve this goal. SJRWMD will eradicate invasive terrestrial plants, when feasible, or treat these plants according to the maintenance control philosophy. Maintenance control philosophy emphasizes keeping nuisance populations at the lowest possible levels. Lowest possible levels are defined as those levels from which nuisance populations would not quickly become a problem if the control program were to be discontinued. Successfully achieving this goal is dependent on available technology and available funds.

TREATMENT STRATEGIES

An integrated mechanical, biological, and chemical control program will be used to manage exotic upland plants. No specific treatment techniques are listed in this plan because new control methods are continually being discovered and because the Vegetation Management Program should have the latitude to employ the most up-to-date and effective method of control. However, the following guidelines for treatment are suggested. When treating woody vegetation, stem or basal treatments are preferred. This limits the potential exposure of non-target species. Burning the dead material is desired with prolific seed-producing species such as Brazilian pepper, melaleuca, and the Chinese tallow tree. Annual inspections of the treated sites will be conducted by staff in the Division of Land Management or the Division of Environmental Sciences to record the success of treatments and to determine the need for additional action. Treatment of grass species such as cogon grass may involve a combination of mechanical and chemical treatments. Vine species such as air potato (*Discorea bulbifera)* will be cleared by hand, and

then the cut stems will be treated with a systemic herbicide, until a better management practice is adapted.

SJRWMD staff who find terrestrial exotic plants on SJRWMD lands should contact the Division of Land Management and complete the Exotic Plant Identification form (Appendix B). Staff in the Division of Land Management or the Division of Environmental Sciences will prepare work orders for the Vegetation Management Program to begin control of the plants identified.

PRIORITIES

Priorities for controlling invasive terrestrial plants will vary with natural conditions. Therefore, various factors will be used to determine priorities for treatment. These factors are species, potential for spread, and size of established populations.

The Exotic Pest Plant Council has produced a list of the most troublesome invasive plant species in Florida (Appendix C). Many of the species listed are known to occur on District-owned land and will be considered for elimination when practical. However, relative few terrestrial plant species are considered, as of 1996, to pose significant threats to native habitats. These species are cogon grass (*Imperata* spp.), tropical soda apple (*Solanum viarum*), Brazilian pepper (*Shinus terebinthifolius*), melaleuca (*Melaleuca quinquenervia*), Chinese tallow (*Sapium sebiferum*), and Australian pine (*Casuarina spp*). Currently, the priority species for control are:

1. Cogon grass
2. Tropical soda apple
3. Lygodium
4. Melaleuca
5. Brazilian pepper
6. Chinese tallow
7. Australian pine

The form to be used to establish the actual priority is in Appendix B. This form will be completed by staff upon locating exotic plants. Once completed, this form will be attached to the work order for treatment to be arranged by staff in the Invasive Plant Management Program.

SPECIAL CONSIDERATION

Throughout SJRWMD, levees are often constructed and/or maintained for flood control or other purposes. To protect these levees from erosion, grasses which are identified as invasive (e.g., bahia [*Paspalum notatum*]) (Appendix C) are often planted. These grasses have a low potential for invading marshes but should be monitored and controlled if the grass invades adjacent upland areas.

PLAN IMPLEMENTATION

Implementation of plant management activities is strictly the responsibility of Invasive Plant Management staff, located within the Division of Land Management (Department of Operations and Land Resources). Staff will prepare an annual work plan that is reviewed by the Division of Environmental Sciences and the Division of Engineering (Department of Water Resources). Establishing treatment priorities is the responsibility of the Department of Operations and Land Resources and will be developed with consideration for the concerns of other departments.

Regular meetings will be held by SJRWMD staff to discuss plant management activities and future treatment priorities. Over flights and field visits to assess the status of invasive exotic plant populations will be arranged as needed by staff in the Division of Land Management, the Division of Environmental Sciences, and the Division of Engineering. Plant management activities will be initiated based on budgetary and labor constraints. Staff in the Department of Operations and Land Resources will assess and report on the impact of these constraints on treatment activities. Staff in the Division of Environmental Sciences, the Division of Engineering, and the Division of Land Management will document adverse environmental and flood control impacts of invasive species that could not be treated.

Management of exotic plants will be conducted in an environmentally sensitive manner. Staff will keep up to date on the latest technology regarding plant management strategies, including biological control. The annual work plan, which is based on this management plan, will be prepared by the Invasive Plant Management staff in the Division of Land Management. The Division of Land Management will consult flood control issues and concerns produced by the Division of Engineering and area management and restoration plans produced by the Division of Environmental Sciences in preparation of the annual work plan.

Emergency requests for plant management activities will be considered by the Invasive Plant Management staff in the Division of Land Management and will be conducted within money, technology, and time constraints. If requested emergency activities will interfere with achieving established objectives, other departments may be asked to review the request and help prioritize activities.

To ensure that all major concerns are addressed, SJRWMD will solicit the advice and comments of other state and local agencies and seek review of SJRWMD plant

management plans and activities from other agencies. Invasive Plant Management staff in the Division of Land Management will arrange regular meetings with other concerned agencies to provide a forum for review of work plans for annual plant management and priorities by these agencies. The concerns of local municipal and county governments, user groups, environmental organizations, and concerned citizens also will be considered.

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APPENDIX A—INTERAGENCY REVIEW COMMENTS

Department of Environmental Protection

Lawton Chiles
Governor

Virginia B. Wetherell
Secretary

November 8, 1995

Mr. Steven J. Miller
St. Johns River Water Management District
Post Office Box 1429
Palatka, Florida 32178/1429

Dear Steve:

Several people with this Bureau have reviewed your draft plan for invasive exotic plant management. It looks good. Only a few changes were suggested. If you would like to discuss the review, please call me at 904-488-5631. Thank you for the opportunity to review the plan.

Sincerely,

Jeffrey D. Schardt
Environmental Administrator
Bureau of Aquatic Plant Mgmt.

JDS/ld

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO ATTENTION OF

December 29, 1995

Construction-Operations Division
Aquatic Plant Control Section

St. Johns River Water Management District
Attention: Steven J. Miller
Post Office Box 1429
Palatka, Florida 32178-1429

Dear Mr. Miller:

The draft copy of your agency's report entitled "Plan for the Control and Management of Aquatic and Terrestrial Invasive Exotic Plant Species" has been received and reviewed by the Jacksonville District's Aquatic Plant Control Section. That review has identified two areas which the Corps would like to comment on.

First, at the top of page 21 the report claims that U.S. 192 is the line of demarcation for aquatic plant management responsibilities on the St. Johns River. This is incorrect. The Corps, along with the Florida Department of Environmental Protection (FDEP), has historically assisted operationally and/or financially in these activities well upstream of this point. FDEP should be consulted to ascertain the exact boundary of the cooperative aquatic plant management program.

Secondly, in the section describing management priorities for the Orange Creek Basin (page 24 and 25), the Corps believes that the continued maintenance control of floating exotic species (e.g. hyacinth and water lettuce) should be the number one priority, not number four as the draft report suggests.

Thank your for the opportunity to review the draft report. If you have any further questions, please contact Wayne T. Jipsen at 904-232-2219.

Sincerely,

Charles J. McGahee
for Girlamo DiChiara
Chief, Construction-Operations Division

FLORIDA GAME AND FRESH WATER FISH COMMISSION

JULIE K. MORRIS
Sarasota

QUINTON L. HEDGEPETH, DDS
Miami

MRS. GILBERT W. HUMPHREY
Miccosukee

THOMAS B. KIBLER
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(904) 488-0331
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TDD (904) 488-9542

November 14, 1995

Steven Miller
St. Johns River Water Management District
P.O. Box 1429
Palataka, Florida 32178-1429

Dear Mr. ~~Miller~~ Steve:

The Florida Game and Fresh Water Fish Commission, Division of Fisheries, has reviewed the St. Johns River Water Management District's "Plan for the Control and Management of Aquatic and Terrestrial Invasive Exotic Plant Species". We would suggest that you use Reward (diquat), rather than 2,4-D for water hyacinths when they are mixed or adjacent to bulrush (Scirpus spp.). We believe that this change will reduce damage to the native bulrush. Thank you for this opportunity to comment.

Sincerely,

Jerome V. Shireman, Director
Division of Fisheries

JVS/de
ORG 2

1943 - 1993
50 YEARS AS STEWARD OF FLORIDA'S FISH AND WILDLIFE

APPENDIX B—EXOTIC PLANT IDENTIFICATION FORM

Completed by _____ Date _____

Management Unit _____ Location (specific) _____

Plant Community _____ Size of Plants _____

Circle appropriate score for each criteria. Use a separate form for each species. The higher the total score, the higher the treatment priority.

Criteria	Points	Comments
Species		
Cogon grass	5	
Brazilian pepper	5	
Chinese tallow	5	
Soda apple	5	
Melaleuca	5	
Lygodium	5	
Australian pine	4	
Other (Name)	3	
Cover		
<0.10 acre	5	
0.10-0.50 acre	4	
>0.50 acre	3	
Potential for spread		
Can spread easily	5	
Somewhat restricted	3	
Isolated	1	
Ease of treatment (based on terrain, surrounding vegetation, etc.) describe any difficulties		
Difficult	5	
Somewhat difficult	3	
Easy	1	
Access for equipment and personnel (describe)		
Poor	5	
Moderate	3	
Good	1	
Proximity to District boundary/how soon might population cross boundary?		
Close—will cross soon	5	
Will not cross soon	3	
Will not cross	1	
Total score		

APPENDIX C—EXOTIC PEST PLANT COUNCIL'S 1995 LIST OF FLORIDA'S MOST INVASIVE SPECIES

The following is an excerpt from Exotic Pest Plant Council (1997):

DEFINITIONS

Category I: Species that are invading and disrupting native plant communities in Florida. This definition does not rely on the economic severity or geographic range of the problem but on the documented ecological damage caused.

Category II: Species that have shown the potential to disrupt native plant communities. *These species may become ranked as Category I, but have not yet demonstrated disruption of natural Florida communities.*

Abbreviation Keys: P = Prohibited by the Florida Department of Environmental Protection, **N** = Noxious weed as listed by the Florida Department of Agriculture and Consumer Services and/or the U.S. Department of Agriculture.

Species and Common Name	Key	Category
Abrus precatorius (rosary pea)		I
Acacia auriculiformis (earleaf acacia)		I
Adenanthera pavonina (red sandlewood)		II
Agave sisalana (sisal hemp)		II
Albizia julibrissin (mimosa)		II
Albizia lebbeck (woman's tongue)		I
Aleurites fordii (tung oil tree)		II
Alstonia macrophylla (devil tree)		II
Alternanthera philoxeroides (alligator weed)	P	II
Antigonon leptopus (coral vine)	P	II
Ardisia crenulata (syn. *A. crenata)* (coral ardisia)		I
Ardisia elliptica (syn. *A. humilis*) (shoebutton ardisia)		I
Aristolochia littoralis (calico flower)		II
Asparagus densiflorus (asparagus fern)		I
Asystasia gangetica (ganges primrose)		II
Bauhinia variegata (orchid tree)		I
Bischofia javanica (bischofia)		I
Brachiaria mutica (Pará grass)		I
Broussonetica papyrifera (paper mulberry)		II
Callisia fragrans (inch plant, spironema)		II

Species and Common Name	Key	Category
Calophyllum calaba (syn. *C. inophyllum* of authors) (mast wood, Alexandrian laurel)		I
Casuarina cunninghamiana (Cunningham's Australian pine)	P	II
Casuarina equisetifolia (syn. *C. litorea*) (Australian pine)	P	I
Casuarina glauca (suckering Australian pine)	P	I
Cereus undatus (night-blooming cereus)		II
Cestrum diurnum (day jasmine)		I
Cinnamomum camphora (camphor tree)		I
Clerodendron bungei (strong-scented glorybower)		II
Colocasia esculenta (taro)		I
Colubrina asiatica (lather leaf)		I
Cryptostegia madagascariensis (rubber vine)		II
Cupaniopsis anacardioides (carrotwood)		I
Cyperus alternifolios (umbrella plant)		II
Cyperus prolifer (dwarf papyrus)		II
Dalbergia sissoo (Indian dalbergia, sissoo)		II
Dioscorea alata (Winged yam)		I
Disocorea bulbifera (air potato)		I
Eichhornia crassipes (waterhyacinth)	P	I
Enterolobium contortislilquum (ear-pod tree)		II
Epipremnum pinnatum (pothos)		II
Eugenia uniflora (Surinam cherry)		I
Ficus altissima (false banyan)		II
Ficus benjamina (weeping fig)		II
Ficus microcarpa (syn. *F. nitida, F. retusa* var. *nitida*) (laurel fig)		I
Ficus religiosa (bo tree)		II
Flacourtia indica (governor's plum)		II
Flueggea virosa (flueggea)		II
Hibiscus tiliaceus (mahoe)		II
Hydrilla verticillata (hydrilla)	P,N	I
Hygrophila polysperma (green hygro)	P,N	I
Hymenachne amplexicaulis (West Indian marsh grass)		I
Hyptage benghalensis (hyptage)		II
Imperata brasiliensis (syn. *I. cylindrica*) (cogon grass)	N	I
Ipomoea aquatica (water spinach)	P,N	I
Jasminum dichotomum (Gold Coast jasmine)		I

Species and Common Name	Key	Category
Jasminum fluminense (jasmine)		I
Jasminum sambac (Arabian jasmine)		II
Koelreuteria elegans (golden shower tree)		II
Lantana camara (lantana)		I
Leucaena leucocephala (lead tree)		II
Ligustrum japonicom (Japanese privet)		II
Ligustrum lucidum (glossy privet)		II
Ligustrum sinense (hedge privet)		I
Lonicera japonica (Japanese honeysuckle)		I
Lygodium japonicum (Japanese climbing fern)		I
Lygodium microphyllum (Old World climbing fern)		I
Macfadyena unguis-cati (cat's claw)		I
Melaleuca quinquenervia (melaleuca)	P,N	I
Melia azedarach (Chinaberry)		I
Melinis minutiflora (molasses grass)		II
Merremia tuberosa (wood rose)		II
Mimosa pigra (catclaw mimosa)	P,N	I
Murraya paniculata (orange-jasmine)		II
Myriophyllum spicatum (Eurasian water-milfoil)	P	II
Nandina domestica (nandina, heavenly bamboo)		I
Nephrolepis cordifolia (sword fern)		I
Nephrolepis multiflora (Asian sword fern)		II
Neyraudia reynaudiana (Burma reed; cane grass)		I
Ochrosia parviflora (syn. *O. elliptica*) (kopsia)		II
Oeceoclades maculata (ground orchid)		II
Paederia craddasiana (sewer vine, onion vine)		I
Paederia foetida (skunk vine)		I
Panicum repens (torpedo grass)		I
Passiflora foetida (stinking passion flower)		II
Pennisetum purpureum (napier grass)		I
Pistia stratiotes (waterlettuce)	P	I
Phoenix reclinata (reclining date palm)		II
Pittosporum pentandrum (pittosporum)		II
Pittosporum tobira (Janapnese pittosporum, pittosporum)		II
Psidium guajava (guava)		I
Psidium cattleianum (syn. *P. littorale*) (strawberry guava)		I

Species and Common Name	Key	Category
Pueraria montana (syn. *P. lobata*) (kudzu)		I
Rhodomyrtus tomentosus (downy myrtle)		I
Rhoeo spathacea (syn. *R. discolor*) (oyster plant)		I
Rhynchelytrum repens (Natal grass)		II
Sansevieria hyacinthoides (syn. *S. trifasciata*) (bowstring-hemp)		II
Sapium sebiferum (popcorn tree; Chinese tallow tree)		I
Scaevola taccada var. *sericea* (syn. *S. frutescens, S. sericea*) (scaevola, half-flower, beach naupaka)		I
Schefflera actinophylla (syn. *Brassaia actinophylla*) (schefflera)		I
Schinus terebinthifolius (Brazilian pepper)	P,N	I
Senna pendula (syn *Cassia coluteoides.*) (climbing cassia; Christmas cassia, Christmas senna)		I
Solanum diphyllum (twinleaf nightshade)		II
Solanum tampicense(=S.houstonii)(aquatic soda berry)		I
Solanum torvum (turkey berry)	N	I
Solanum viarum (tropical soda apple)	N	I
Syngonium podophyllum (arrowhead vine)		II
Syzygium cumini (jambolan, Java plum)		I
Syzygium jambos (rose-apple)		II
Tectaria incisa (incised halberd fern)		I
Terminalia catappa (tropical-almond)		II
Thespesia populnea (seaside mahoe)		I
Tradescantia fluminensis (white-flowered wandering Jew)		I
Tribulus cistoides (puncture vine)		II
Triphasia trifoliata (lime berry)		II
Urena lobata (Caesar weed)		II
Wedelia trilobata (wedelia)		II
Wisteria sinensis (Chinese wisteria)		II
Xanthosoma sagittifolium (melanga, elephant ear)		II