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A Scientific Framework for Managing Urban Natural Areas[1]

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The purposes of this paper are: *to present a scientific framework for managing urban natural areas; to discuss general ecological issues and management concerns identified from our early efforts at applying this approach to Broward County ESL sites; and to discuss the Pine Island Ridge ESL site as a case study.*

The Challenge

As natural areas shrink and fragment, our ability to sustain economic growth and conserve biological diversity and ecological integrity is being tested (Grumbine 1990, Noss and Cooperrider 1994).

Meeting the challenge of conserving regional ecological integrity in urban and urbanizing landscapes will depend on effective growth management planning, which includes both ecologically sensitive site design for specific projects and the development of ecological reserve systems (Adams and Dove 1989).

Protecting urban natural areas not only contributes to the conservation of biological diversity, but also provides valuable opportunities for human enjoyment. However, adding the variable of human use to the already complex equation of managing an urban natural area system exacerbates the difficulties inherent in managing fragmented, isolated, and, frequently, disturbed habitat patches.

Meeting the Challenge

It is clear that sound, science-based planning provides the only alternative for meeting the multiple demands, categorized as conservation or use, that society places on protected urban natural areas.

A science-based habitat planning program not only provides a foundation for making the best decisions possible and the flexibility of modifying them, but also fosters confidence and consensus from a public that has to both pay for and then live with the decisions made during this process. A scientific framework also provides consistency to the planning and management process through time and staff changes.

An Example

On 14 March 1989, voters in Broward County, Florida, approved a $75 million bond issue referendum to acquire and manage **environmentally sensitive lands (ESLs).** As of this writing, 17 sites have been purchased to preserve the best of the remaining natural heritage of Broward County. Management of the sites began immediately with a program of fencing, trash removal, and non-native plant control. The **Broward County Parks and Recreation Division (PRD)** has the responsibility of stewardship of the ESL sites.

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ESL resource management plans will combine modern ecological resource management practice with consensus building and conflict resolution to develop a scientific framework for managing these sites.

Adding a human dimension to natural area management through consensus building and conflict resolution is an essential aspect of any habitat conservation program. The public deserves good decisions regarding management of what will be the green space heritage of future generations. It is important to recognize that resource management is a long-term (greater than 50 years) commitment to restoring and maintaining the ecological integrity of natural areas, while providing opportunities for human enjoyment.

Natural area reserve design and selection has a substantial body of theory and practice to provide a framework for action (Bedward *et al.* 1992; Cocks and Baird 1989; Grumbine 1990; Noss 1983; Noss and Cooperrider 1994; Quinby 1986). No such framework is available for managing natural areas once selection and acquisition have occurred; yet the ultimate success of any natural system will depend on good, science-based management plans.

Scientific Framework

The scientific framework for developing a management plan is shown in Figure 1.

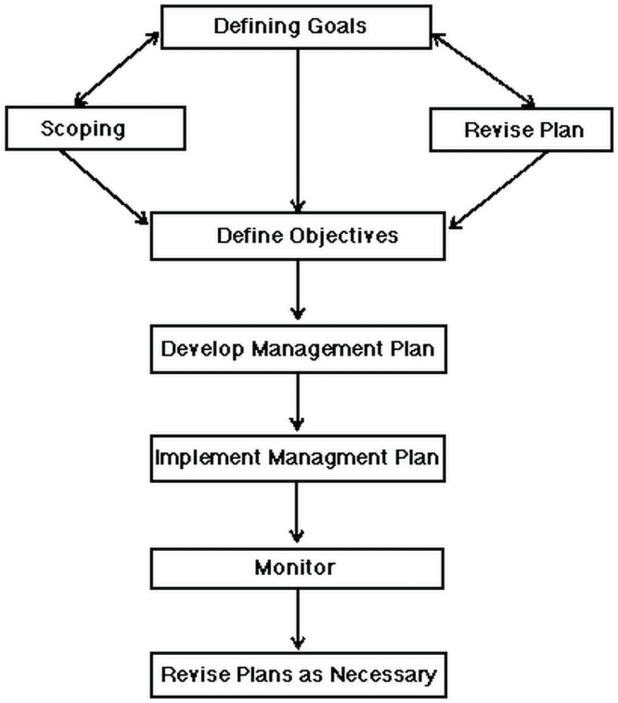

Figure 1.

Management goals and objectives are defined based on the results of the inventory and evaluation of resources and the scoping process. The scoping process (public involvement) is particularly important because the expectations of the public for conservation and use of the natural resources of a site are ascertained at that time. It is also an opportunity to make the public aware of unique, valuable, and/or threatened resources of a site. In Broward County, we use a combination of advisory committees and public workshops and hearings to accomplish this task.

Public participation and cooperation is important—if not essential—for successful management of urban natural area systems. People should be encouraged to use urban natural areas (Adams and Dove 1989). However, not every site will be able to withstand unregulated use. Controls should be established, when necessary, by site design (e.g. access points and paths), prescribing or limiting activities, or by active enforcement. It is crucial to recognize that limits to public use will be more readily accepted by the public if the need for restrictions is carefully explained prior to their institution.

A detailed natural resource evaluation should be performed for each site, including, but not necessarily limited to, vegetation mapping and wildlife inventories (Tylka and Cook 1986; Soule 1991). Some ESLs (such as Pine Island Ridge in Broward County—discussed later in this document) have valuable archaeological resources. These must be evaluated. Global positioning and geographic information system technology can be used to collect and manage a spatially explicit environmental database.

When all this has been accomplished, management plans can be developed for each site that identify significant resources, threats to ecological integrity, disturbed areas requiring restoration, potential for enhancement, necessary maintenance activities, and opportunities for public access and use.

Alternative plans for site management, if necessary, can be assessed for their consistency with regional ecological goals. Since management decisions inevitably will be made with a degree of uncertainty, site management plans will be implemented along with monitoring programs designed to evaluate the achievement of specific objectives. Management plans must be flexible enough to accommodate necessary modifications.

This approach allows for adaptive management of a reserve system (Holling 1978; Jones 1986). This is the cornerstone of a scientific approach to natural area management.

We view management decisions and actions as hypotheses of ecosystem response. That is, we predict that a particular fire management program or non-native plant management program is going to have a particular result or effect on the target system. The monitoring program is then viewed as an experiment designed to test the hypothesis or management decision. If our management activity yields the desired result (meets a specific measurable objective), then we have made the correct management decision. If not, then the management plans should be revised (adapted) and retested.

Successful management will be the result of an iterative process based on this procedure. And we point out that monitoring continues throughout the lifetime of the management process.

Ecological Issues and Management Concerns

Each ESL site is unique and will require an individually based management plan. However, resource inventories and the scoping process have revealed that some management issues—listed species, invasive non-native species, and public use—will be common to most sites. Other issues, such as using ESLs as recipient locations for off-site mitigation, will probably affect many sites.

This section covers concerns common to all sites, their relationship to ESL management in Broward County, and recommends a systematic approach for dealing with these issues on particular sites.

Realizing that there are limited resources to deal with the limitless problems of urban natural area management, an important part of our systematic approach for dealing with management issues is developing a ranking system to allow for setting priorities and policies for management actions.

Listed Species

Listed species are designated by state **(Florida Department of Agriculture [FDA]** and **Florida Game and Fresh Water Fish Commission [GFC])** and federal **(United States Fish and Wildlife Service [FWS])** governments as being in need of protection to prevent extinction.

The Florida Committee on Rare and Endangered Plants and Animals (FCREPA) is a Florida-based ranking system put together by scientists. **The Florida Natural Areas Inventory (FNAI)** is a state-specific agency which summarizes listings into categories of rankings.

State and federal governments—as well as the FCREPA—list species as threatened or endangered; the state of Florida also lists "species of special concern" (GFC) and "commercially exploited" species (FDA). FCREPA uses a "rare" designation.

Designations Explained

- Endangered species have the greatest risk of extinction, and threatened species could reach that status in the near future.
- Rare species are those with limited geographic distribution or a sparse distribution over a larger range.
- Species of special concern designation can be applied to those in danger of becoming threatened, species recently recovering from being threatened, poorly known species, or ecologically important species.
- Commercially exploited species are defined as being threatened by commercial collection.

FNAI classifies species as globally or state-imperiled, rare, or secure.

Since the most common form of endangerment of species is habitat loss, the acquisition of ESLs in Broward County may offer opportunities to protect remaining critical habitat.

Species Monitoring

To effectively observe changes in species population status, monitoring must be performed over extended periods of time. Monitoring programs must be designed to specifically identify depletions in species populations as well as status of populations already listed. Preventing a decline in species numbers to the point of listing is a more efficient way of managing species then trying to bring the species back tosatisfactory numbers after listing. A site-specific listing will be established for those species that have experienced declines in populations to a level of concern. Management priority for listed species is determined from the listing category, the status (resident breeding, resident non-breeding, transient) of the species on a site, and the feasibility of managing for a given species on a site (Table 1 and Table 2).

Invasive Non-native Species

"Non-native", "alien", "exotic", and "feral" species are all terms used to describe plants or animals that are of foreign origin—yet exist, and in some cases thrive—in natural areas.

Displacement of native species and alteration of ecosystem functions are possible results of invasion by non-native species. Florida, California, and Hawaii are more prone to invasion and have suffered greater ecological degradation than other areas of the United States.

Florida is especially vulnerable due to the disturbance of native habitats and its subtropical climate.

Some authorities consider exotic species to be the most pervasive factor influencing biological diversity in natural systems (Coblentz 1990). The effects of non-native species has been called an ecological explosion creating a biologically impoverished landscape (Schmitz and Brown 1994). This attitude of environmental crisis has resulted in current policies of eradication of non-indigenous species, especially plants (Westman 1990).

In reviewing eradication programs, two problems become readily apparent:

1. eradication is expensive; and

2. eradication can be destructive.

Furthermore, there is often a lack of knowledge about how to restore a native system after exotic plant eradication (Westman 1990).

Given on-site disturbance of urban natural areas and surroundings, and on-site seed sources—eradication of non-native plants cannot be achieved.

Past experience with exotic plant removal has shown that each species must be evaluated on an individual basis for its impact on existing resources, and that each invaded habitat should be evaluated for the best available technology for management.

Hence, species with the most impact are given highest management priority (Table 3), and techniques are developed that are sensitive to the existing condition of the management area. Relatively benign species should be given the lowest priority for removal. Recognizing that some non-native plant species may actually benefit wildlife in an urban environment is also important.

Mitigation

Mitigation, in this context, is defined as compensation for impacts to natural systems (primarily wetlands) caused by development. Relevant to ESL management, county, state and federal agencies issue permits to developers.

Although a controversial practice, the use of public lands as recipient sites for mitigation of habitat losses on private lands is occurring and will continue to occur. When mitigation on public lands is allowed, natural area management plans must address methods to best apply these mitigation opportunities to accomplish resource management goals.

To be effective, and to maximize the benefits to reserve systems, mitigation programs should be approached comprehensively.

In particular, mitigation programs should be consistent with existing management goals, objectives, and success criteria. Two things are accomplished by this tactic. First, this insures that resource management drives what mitigation is accepted for a site, rather than have mitigation drive management. (This allays the perception that mitigation opportunities are bought rather than earned.) Second, ESL management standards may be, and probably should be, higher than those set for typical mitigation projects. Mitigation on public lands should conform to the highest standards attainable.

ESL sites, with their wetland areas and non-native and nuisance species problems, provide occasions for mitigation by the private sector. One method of applying mitigation opportunities to accomplishing resource management objectives would be to establish a memorandum of agreement (MOA) between the public agency (for example, Broward County Parks and Recreation Division (PRD) and the relevant permitting agency. This would enable the participants to develop specific conditions, including methods, materials, liability, monitoring, and time frames, for permits to insure that ESL site management goals and objectives are being met.

Another alternative, a mitigation trust fund (MTF), would determine rates per acre for mitigation projects. Mitigation requirements would be met by deposits in the MTF. PRD could then apply the funds as set out in resource management plans.

Whichever the mechanism, a strong partnership between mitigation participants will be necessary for a successful mitigation program on ESLs.

Importance of Mitigation Activities in Upland Areas

We further recommend that any mitigation agreement recognize the importance of mitigation activities in the upland areas of ESL sites.

Uplands are among the most impacted habitats on many of the sites and the most diminished habitats in surrounding areas. The rationale for extending mitigation efforts to upland areas includes:

- Wetland permits frequently require consideration of upland buffers and listed species habitats; and
- The ecological functions of wetlands on ESL sites is dependent on restoring the upland matrix within which they historically occurred.

Public Use

Preserving and using natural areas can be characterized as the dual horns of the dilemma of natural area management. We establish reserve systems because we wish to preserve natural resources that have been identified as valuable and important to society. Natural area acquisition is frequently justified in terms of benefits and uses to humans, after all, humans are paying the cost of protection.

In Broward County, the numerous benefits include water storage and aquifer recharge, flood attenuation, plant and animal refuges, and recreational opportunities. Only recreation requires the presence of humans for benefits to accrue. Yet, it is human presence in natural areas that provides the greatest challenge to resource managers.

As stated earlier, one goal of ESL management to provide for recreational opportunities. The challenge is to achieve this goal in a manner that is compatible with ecosystem preservation. Since great efforts are being invested in managing natural and cultural resources of ESL sites, it makes sense that all recreational activities be resource-based. This approach provides the opportunity to integrate resource preservation with recreational activity as part of a comprehensive resource management plan.

In addition to being resource-based, we recommend that recreational activities be non-consumptive—that they do not use up resources, e.g. plant collecting. It would be nice to be able to recommend completely passive recreation activities. However, since passive by definition means non-affecting or having no impact, no activity meets the requirements of passivity. At a minimum, the impact on natural and cultural resources can be limited by restricting access to non-motorized vehicles only.

Areas with potential for resource based, non-consumptive recreation activities will be identified by applying guidelines shown in Table 4.

Types, levels, and locations of activities on individual ESL sites will be based on the level of public interest, the type of activity, the sensitivity of the site, and the amount of funds available for managing and monitoring programs.

Natural and cultural resources that are likely to show evidence of degradation from use include: soil, vegetation, wildlife, and archeological. Indigenous soils can be highly sensitive to impacts from public use (Soil Conservation Service 1984).

- Soils can be affected by churning, compaction, or exposure. Disturbance of soil layers can affect native vegetation growth and can expose archeological resources.
- Vegetation can be trampled or, in extreme cases, removed as a result of excessive use (Hammitt and Cole 1987).
- Wildlife can be disturbed, frightened, or, in some cases, removed.
- Archeological resources are non-renewable. Damage, once done, can not be corrected. Maintaining intact vegetation and soil layers are the best methods of protecting archeological sites.

To aid in the decision-making process, sensitivity rankings are assigned for each of the four resource categories for subsections of the site. Sections are ranked as

- critically sensitive = 0,
- highly sensitive = 1,
- sensitive = 2, and
- not sensitive = 3.

The four ranks for each area are then multiplied to get an overall ranking for the subsection. To produce a spatially explicit map of overall sensitivity ranking, the ranking for each category is manipulated in a geographic information system environment (SPANS).

The Pine Island Ridge Example

Description

The Pine Island Ridge ESL site in Broward County is a 40ha anchor-shaped parcel which is approximately 1.6km long and 1.6km wide (at its widest). The Pine Islands became a significant topographic feature as the Everglades were being formed 5000 to 7000 years ago, and were an ideal location for human habitation (Carr 1991).

Prior to drainage in the early part of the century, the Pine Island Ridge ESL site, as part of the Pine Island Ridge complex, was once a prominent upland island in the Everglades

landscape. A narrow island ridge extended to the west to Long Key on the Flamingo Road ESL Site. At 8.8m above sea level, Pine Island Ridge is the highest natural elevation in the county.

The Pine Island Ridge complex was first discovered by non-native Americans during the Second Seminole War. The complex was a Seminole settlement area, the location of many of the Seminole religious ceremonies, and was also used for raising crops. Although the Seminoles were forced to leave Pine Island, the area still remains a sacred and important place for them to this day.

Later development of the area concentrated on planting citrus groves on the lower—former wetlands—elevations surrounding the ESL site. The ridge/hammock itself was not a center for activity and, with the absence of fire, the slash-pine dominant vegetation has succeeded to an upland hardwood forest dominated by live oak, with occasional individuals or pockets of slash pine still interspersed throughout the site.

Today, the surrounding citrus groves are being converted to residential development. Non-native plant species are present to varying degrees within the upland forest, and along all edges of the forested ridge. Substantial areas are mowed with regularity to maintain an urban open space environment. Since all the former wetlands that once encompassed the site are gone, no opportunities for mitigation are present on this site.

A resource management plan has been written for the site which has set the direction for dealing with listed species, non-native plants, and public use.

Invasive non-native plants

Pine Island Ridge ESL contains 16 species that are categorized as Treatment Level 1 (Table 3). These species are all extremely disruptive to the maintenance of the structure and composition of natural vegetative types and need to be controlled as a very high priority. Twenty-three species are categorized as Treatment Level 2. These species are also disruptive to the vegetative structure and composition of the natural cover types, but are either more localized, or less numerous than those species in Treatment Level 1. Twenty-five species are categorized as Treatment Level 3. These species can be controlled by hand-pulling and localized herbicide usage. Control of these species is important, since they are all invasive, but can be postponed until higher priority species are eradicated. Nineteen species are categorized as Treatment Level 4, which basically indicates that the plants are exotic, but not necessarily invasive. Removal of these plants from the ESL can be delayed until specific restoration strategies for the areas that contain these plants are developed and implemented. In addition, 51 species are categorized as weedy. Control and removal efforts for these species is temporary and primarily geared toward aesthetics. These species tend to thrive in areas of disturbance; once the structure and composition of natural cover types are restored, these species will not be a major problem.

It is clear from the abundance, richness and distribution of exotic and nuisance species at the Pine Island Ridge ESL that an intensive program of exotic removal and control will be required. Because of disturbed conditions on site, and the perennial source of seeds form residential areas surrounding the site, full restoration may not be possible. A more realistic goal may be to first halt the spread of exotics into less impacted areas, and then move management efforts into the more heavily invaded areas.

Listed Species

Table 5 is a management priority list of listed species, along with habitats in which they are normally found. Species designated as highest priority for management on Pine Island Ridge are the gopher tortoise, coontie and strap fern. Listed species observed on a site will undergo further evaluation prior to the development of specific management plans.

In general, habitat restoration—coupled with the restriction of human activity from much of the hammock areas—will provide optimal conditions for these listed species to thrive within the Pine Island Ridge ESL. Maintaining open areas interspersed throughout the hammock will benefit both gopher tortoises and coontie.

One potential use of restored natural areas on this site is as a repository for two types of plant species: protected species and species that may be on the edge of either a temperate or subtropical range. The oak hammock forest would be ideal for re-introducing epiphytic orchids, bromeliads, and ferns. However, the relatively easy access to this site would likely result in these plants being stolen if they were re-introduced. Nonetheless, terrestrial herbs, trees, and shrubs could be introduced into this site and located so that most people would be completely unaware of their presence.

Public Use

For the purposes of evaluating the potential for public use, Pine Island Ridge was divided into areas based on sensitivity rankings for archaeology, wildlife, vegetation, and soils.

Ranking criteria are described in Table 4. A sensitivity map combining all layers is depicted in Figure 2.

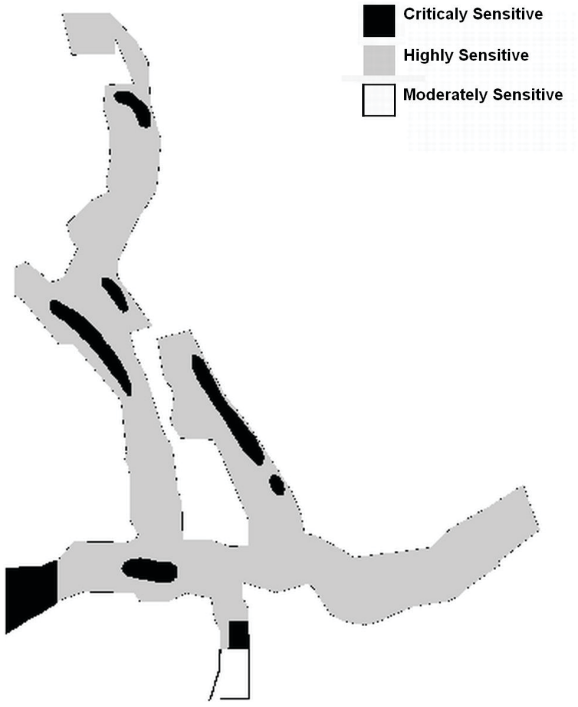

Figure 2.

The Pine Island Ridge ESL site will be managed as a multiple-use park. The overall management priority will be protection, enhancement, and interpretation as an archaeological and ecological preserve. Secondarily, the site will be managed as a non-consumptive recreational, educational, and wildlife management area.

As you can see from Figure 2, Pine Island Ridge ESL site contains three types of sensitive areas: some are critically sensitive. These are defined as areas of valuable resources, which could be irreversibly impacted by any disturbance, whether from a resource management action or from public use. In areas designated as critically sensitive these areas, access of any kind should be minimized.

A majority of this site is ranked highly sensitive and management efforts must be carefully planned to minimize impacts. Trails should be avoided when possible. If they must be created, precautions should be taken to avoid damage to the resource, such as artificial trail surfaces or boardwalks.

Finally, comprehensive monitoring programs must be implemented to insure that management objectives are being met. Moderately sensitive areas require less intensive management and monitoring, but still should avoid impacting any resources.

Comments and Cautions

The pieces of the framework for planning an urban natural area management program presented here are not new. The recipe for successful planning can be recognized as a mixture of the National Environmental Policy Act of 1969 with good old-fashioned field biology—well-seasoned with consensus building and conflict resolution (Westman 1985; National Research Council 1986). We have modified this approach to meet particular considerations of natural area management.

As mentioned previously, natural area managers frequently focus on two main overall goals:

1. Protection of natural resources; and

2. Provision of enjoyment of these resources consistent with the first goal.

In discussing risk assessment for land managers, Ruth (1990) described two philosophies or approaches to achieving these goals that also characterize natural area managers:

- Damage control and
- Anticipation/prevention.

Damage control-driven planning and management reacts to negative criticism and clearly demonstrated problems. Ruth (1990) terms this type of philosophy "a dinosaur". Certainly, the image of a large, cumbersome beast, alive long past its time in an environment completely unsuited for it does accurately describe a planning process that reacts to problems rather than anticipating and preventing them.

In contrast, management propelled by anticipation/prevention is proactive—capable of resolving or minimizing conflicts before they become intractable problems. Proactive management is characterized by identifying: goals and objectives, public expectations, and the resource base.

Goals are important not only because they set direction for management and provide a standard for measuring success, but also as a scale for balancing competing demands on what is ultimately always a limited resource.

Public involvement and ecological knowledge are the cornerstones of a successful, proactive habitat management plan. As self-evident as this statement should be, there are times when one or both of these cornerstones are weak or missing. Reasons for this can range from ignorance of the importance of ecological knowledge and public

involvement, to not believing that they are important, to inadequate attempts at obtaining them.

Weaknesses in ecological knowledge may take time to become evident which is another reason to monitor it. In turn, lack of appropriate information may be one of the causes of lack of public support. If natural area planners do not know what they are doing—how can they explain it to the public?

Evidence that the public is not involved in or does not support a habitat planning process is easy to see. These criticisms may or may not indicate problems in the planning process other than poor communication. Whatever the reason, poor communication or poor planning, the situation must be remedied.

Does using the scientific framework described above guarantee success—even if it is applied rigorously? Will the goals of conservation of ecological integrity, maintenance and improvement of sites and incorporation of human activities even be compatible, much less met?

Uncertainty will dog every step of any natural area decision-making process. Not only are time and funds not sufficient for making certain decisions, but, in many cases, management decisions must be made and implemented before their effects can be gauged. This scientific framework treats uncertainty planning and management decisions as hypotheses of ecosystem response. When used as experiments designed to test these hypotheses, monitoring programs become a safeguard against faulty decisions.

Human influence is the most pervasive factor affecting wildlife habitat planning and management. Anthropogenic changes and poor planning and management are the greatest threats to nature reserve systems (White and Bratton 1980). We have provided a framework for managing an urban natural area system that we hope will benefit natural area administrators, planners, and managers.

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Table 1. Management priorities and actions for Listed Plant Species observed on ESL sites.

Priority Level	Criteria	Management Action
1	Endangered, Threatened, or Rare status and management is feasible	• Document spatial and demographic distribution • Determine habitat requirements and assess available habitat • Restrict public access • Evaluate site management practices • Develop specific management and monitoring programs • Preserve plant germ plasm (Federally listed endangered
2	Species otherwise listed and management is feasible	• Document spatial and demographic distribution • Determine habitat requirements and assess available habitat • Regulate public access • Evaluate site management practices
3	Species listed but management is not feasible	• Document demographic distribution • Determined on a species by species basis • Management actions can be any combination of above

Table 2. Management priorities and actions for Listed Animal Species observed on ESL sites

PriorityLevel	Criteria	Management Action
1	Species is listed and has a breeding population on site, and management is feasible	• Document spatial and demographic distribution • Determine habitat requirements and assess available habitat • Restrict public access • Evaluate site management practices • Develop specific management and monitoring programs
2	Species is listed and utilize an area of the site to fulfill a habitat requirement, and management is feasible	• Document spatial and demographic distribution • Determine habitat requirements and assess available habitat • Evaluate site management practices • Develop specific management and monitoring program • Regulate public access
3	Listed species with occasional sightings or listed species where management is not feasible	• Document location of sightings and habitat • Determined on a species by species basis • Management actions can be any combination of above

Table 3. Assignment of treatment level priorities for non-native species. Highest priority (lowest number) should be targeted for treatment first.

Treatment Level	Capability of Invasion	Degree of Impact	Relative Abundance	Extent
1	High	Severe	High	Widespread
2	High	Moderate to Severe	Low	Localized
3	Moderate	Minor to Moderate	Low	Localized
4	Low	Minor	Low	Localized

Table 4. Guidelines for identifying sensitive areas on ESL sites

Category	Soil	Vegetation	Wildlife	Archaeological	Significance
Critically Sensitive		Unique and/or rare habitat, presence of rare, endemic or listed species	Presence of critical habitat feature; Presence of breeding rare, endemic, or listed species	Known resource at surface or nearly exposed	No public use; Careful management and monitoring
Highly Sensitive	Exposed upper level soils, and muck soils	Healthy or slightly impacted native plant communities	Presence of rare, endemic or listed species, breeding of native species	Known resource has some natural protection	Limited protected use with extensive monitoring, management, and mitigation for impacts
Moderately Sensitive	All other indigenous soils	Moderately impacted native plant communities or communities with restoration potential	Native wildlife populations	Potential or disturbed resource	Some use with management, monitoring, and mitigation for impacts, when applicable
Not Sensitive	Disturbed or altered soils	Very disturbed or cleared areas	Exotic or nuisance species; No native species	Not known or suspected of being an archaeological site	Use with limited management and monitoring

Table 5. Pine Island Ridge listed species management priorities. Criteria rating is descrtibed in Table 1 and Table 2.

Species	Habitat	Priority Level	Comments
Gopher Tortoise	uplands	1	Breeding population
Coopers Hawk	woodland edge	2	No confirmed breeding
Little Blue Heron	wetlands	2	Assess habitat use
Tri-colored Heron	wetlands	2	Assess habitat use
White Ibis	wetlands	2	Assess habitat use
Merlin	woodland edge	2	Assess habitat use
Least Tern	open water	2	Assess habitat use
Caspian Tern	open water	2	Assess habitat use
Atala	hammock	2	No confirmed breeding
Grasshopper Sparrow		3	Confirm sighting
Worm-eating Warbler	woodland	3	N. Florida nesting habitat in decline
American Red start	woodland	3	No breeding, common on sight
Strap Fern	hammock	1	
Florida Coontie	hammock	1	Host plant of listed animal
Leather Fern	wetland	2	Not rare in Broward County
Satin Lead	tropical hammock	2	Not rare in Broward County
Butterfly Orchid	hammock	2	Not rare in Broward County
Rein Orchid	hammock	2	Not rare in Broward County
Boston Fern	hammock	2	Not rare in Broward County
Sword Fern	hammock	2	Not rare in Broward County
Prickly Pear Cactus	pineland/scrub	2	Not rare in Broward County
Golden Polypody	hammock	2	Not rare in Broward County
Widespread Maiden Fern	hammock	2	Not rare in Broward County
Dahoon Holly	wetlands	3	Not rare in Broward County
Royal Palm		3	Not rare in Broward County
Stiff-leaved Wildpine	hammock	3	Not rare in Broward County
Giant Wildpine	hammock	3	Not rare in Broward County
Twisted Wildpine	hammock		Status unknown
Needle-leaved Air-plant	hammock		Status unknown