communities. Invasive "nurse" trees are normally eliminated in maritime hammocks at this time.

4.2.4 Search-and-destroy

This technique is used to eliminate populations of specific target species which cannot be controlled within a normal invasive species control program. Normally a single species, such as air-potato (*Dioscorea bulbifera*), is identified for removal using a specialized control treatment.

4.2.5 Broadcast glyphosate treatments

Broadcast treatments of glyphosate (Roundup and/or Rodeo) may be used along the edges of lawn areas to prevent the spread of lawn grasses and weeds into the adjacent natural communities.

In very special cases, broadcast glyphosate may be used to control small patches of low, dense invasive species such as Bermudagrass (*Cynodon dactylon*) or creeping wedelia (*Wedelia trilobata*).

4.3 Control techniques by habit (life form)

Table 4c lists the invasive plants recorded for Cape Florida by habit and indicates recommended control procedures for each taxon.

4.4 Volunteer training and implementation

Most volunteers can be trained to participate in search-and-destroy and hand-clean sweep operations which emphasize the hand-pulling and/or grubbing of one to a few taxa. Volunteers with significant experience and aptitude can be trained to conduct most hand-clean transects, although it must be recognized that hand-clean transect operations normally require significant plant identification skills.

Normally volunteers are not used to conduct Garlon transects, broadcast glyphosate treatments, or conduct herbicide treatments within search-and-destroy, hand-clean sweep, and hand-clean transect operations. These operations are normally conducted by one or more Park Biologist. However, volunteers can be trained to conduct these operations, and may be utilized if such training is recieved.

Following volunteer training, an invasive species control program should be implemented for each management unit as described herein and in Community Restoration Guidelines above.

4.5 Record keeping

An Exotic Control Data Sheet has been developed by American Littoral Society

and the Florida Park Service (Appendix D) and should be used to record volunteer invasive species control activities.

Table 4a. Exotic plant taxa recorded for Cape Florida ranked according to priority for control. (I) indicates that the taxon is ranked as a Category I species by the Florida Exotic Pest Plant Council (Florida EPPC) on their 1995 list of Florida's most invasive plant species (Florida EPPC 1995); (II) indicates that the taxon is ranked as a Category II species by Florida EPPC; (U) indicates a taxon of uncertain nativity.

Priority I. Taxa that are invading and disrupting native plant communities in south Florida. These taxa should be eradicated whenever encountered.

Abrus precatorius (I)
Casuarina litorea (I)
Calophyllum cf. calaba (I)
Cestrum diurnum (I)
Colubrina asiatica (I)
Dioscorea bulbifera (I)
Epipremnum pinnatum (II)
Eugenia uniflora (I)
Ficus microcarpa (I)
Hibiscus tileaceus (I)
Jasminum dichotomum (I)
Lantana camara (I)
Lantana camara X L. depressa var. floridana
Nephrolepis cordifolia (I)
Nephrolepis multiflora (II)
Neyraudia reynaudiana (I)
Panicum repens (I,U)
Pennisetum purpureum (I)
Psidium gaujava (I)
Pteris vittata
Rhychelytrum repens (II)
Ricinus communis
Scaevola taccada (I)
Schinus terebinthifolius (I)
Syngonium podophyllum (II)
Thespesia populnea (I)
Tradescantia spathacea (I)

Priority II. Taxa that have shown a potential to invade and disrupt native plant communities in south Florida, but which have not yet caused significant problems. These taxa should be controlled when conducting hand-clean transects or sweeps.

Bauhinia sp.
Blechum pyramidatum
Bothriochloa pertusa (U)
Brachiaria subquadripera
Carica papaya
Citrus aurantifolia
Citrus aurantium
Clusia rosea (U)
Cocos nucifera
Crotalaria incana
Cynodon dactylon
Dactyloctenium aegyptium
Eleusine indica
Gaillardia pulchella (U)
Hylocereus undatus (II)
Indigofera suffruticosa (U)
Kalanchoe cf. daigremontiana
Kalanchoe pinnata
Macroptilium lathyroides
Momordica charantia (U)
Morinda citrifolia
Muntingia calabura
Musa X paradisiaca
Opuntia cochenillifera
Paspalum urvillei
Phoenix cf. reclinata
Pithecellobium dulce
Pteris tripartita (U)
Ptychosperma elegans
Rottboellia cochinchinensis
Russellia equisetiformis
Sansevieria hyacinthoides (II)
Sarcostemma clausum (U)
Senna obtusifolia (U)
Senna occidentalis (U)
Solanum erianthum (U)
Solanum seaforthianum
Sorghum halapense
Sporobolus indicus (U)
Sporobolus jacquemontii (U)
Stenotaphrum secundatum (U)
Terminalia catappa (II)
Triumfetta semitriloba
Urena lobata (II)
Wedelia trilobata (II)
Xanthosoma sp.

Priority III. Taxa which primarily inhabit weedy areas or persist from cultivation. These taxa, however, may cause significant problems in coastal strand, and interdune swale restoration areas.

Acacia farnesiana (U)
Asclepias curassavica
Boehmeria diffusa (U)
Bucida bucerus X B. spinosa
Calyptocarpus vialis
Catharanthus roseus
Chamaesyce lasiocarpa (U)
Chamaesyce opthalmica (U)
Chenopodium ambrosioides (U)
Commelina diffusa (U)
Cyperus esculentus
Cyperus rotundus
Desmodium tortuosum (U)
Desmodium triflorum (U)
Digitaria ciliaris (U)
Drymaria cordata (U)
Emilia fosbergii (U)
Emilia sonchifolia (U)
Euphorbia graminea
Fimbristylis cymosa ssp. spathacea (U)
Flaveria trinervia (U)
Helianthus annuus
Heliotropium curassavicum (U)
Heliotropium polyphyllum var. **leavenworthii** (U)
Indigofera spicata
Kallstroemia maxima
Lolium perenne
Lycopersicon esculentum
Manilkara zapota
Melochia corchorifolium
Mirabilis jalapa
Oeceoclades maculata (I,U)
Oldenlandia corymbosa (U)
Oxalis corniculata (U)
Paspalum notatum (I)
Phyllanthus tenellus (U)
Portulaca oleracea (U)
Richardia grandiflora
Sonchus asper
Sonchus oleraceus
Spermacoce verticillta s.str.
Tribulus cistoides (II,U)
Tridax procumbens
Turnera ulmifolia
Verbena bonariensis
Yucca aloifolia (U)
Youngia japonica
Zeuxine strateumatica

Table 4b. Ruderal plant taxa recorded for Cape Florida.

Andropogon glomeratus var. pumilus
Ambrosia artemisiifolia
Ampelopsis arborea
Bidens alba var. radiata
Caesalpinia bonduc
Capraria biflora
Cassia nictitans var. aspera
Cenchrus echinatus
Cenchrus incertus
Chamaesyce blodgettii
Chamaesyce hirta
Chamaesyce hypericifolia
Chamaesyce maculata
Cissus sicyoides
Conyza canadensis var. pusilla
Cyperus compressus
Cyperus croceus
Cyperus ligularis
Cyperus polystachyos
Cyperus surinamensis
Dalbergia ecastophyllum
Desmodium incanum
Dichondra caroliniensis
Eclipta prostrata
Eragrostis ciliaris
Erechtites hieracifolia
Eupatorium capillifolium
Eupatorium odoratum
Gamochaeta falcata
Heliotropium angiospermum
Lepidium virginicum
Ludwigia octovalvis
Ipomoea alba
Ipomoea hederifolia
Ipomoea indica
Ipomoea triloba
Kyllinga brevifolia
Malvastrum corchorifolium
Melothria pendula
Mentzelia floridana
Panicum adspersum
Parietaria floridana
Parthenocissus quinquefolia
Pectis glaucescens
Pectis prostrata
Phyla nodiflora
Phyllanthus amarus
Physalis angulata
Pilea herniarioides
Plantago virginica
Pluchea caroliniensis
Plumbago scandens
Poinsettia cyathophora
Poinsettia heterophylla
Polypremum procumbens
Ptilimnium capillaceum
Salvia occidentalis
Scoparia dulcis
Sida acuta
Sida rhombifolia
Solanum americanum
Spermcoce assurgens
Stylosanthes hamata
Toxicodendron radicans
Typha latifolia
Vigna luteola
Vitis rotundifolia
Waltheria indica

Table 4c. Recommended control procedures for invasive plant taxa recorded for Cape Florida by habit.

Scientific Name[1]	Treatment Methods[2]
TREES AND SHRUBS	
Acacia farnesiana (U)	G4b; Cu&G3As.
Bauhinia sp.	G4b; Cu&G3As.
Bucida bucerus X B. spinosa	Hp; Gr; G4b.
Carica papaya	Hp; G4b; Cu&G3As.
Casuarina litorea	Hp; G4b; Fr&G3A; Cu&G3As.
Calophyllum cf. **calaba**	Hp; G4b; Fr&G3A; Cu&G3As.
Cestrum diurnum	Hp; G4b; Cu&G3As.
Citrus spp.	Hp; G4b; Cu&G3As.
Clusia rosea (U)	Hp; G4b; Cu&G3As.
Cocos nucifera	Hp; Gr; Cu.
Eugenia uniflora	Hp; G4b; Cu&G3As.
Ficus microcarpa	Hp; G4b; Cu&G3As.
Hibiscus tileaceus	Hp; G4b; G3As.
Lantana camara	Hp; Gr; G4b; Cu&G3As.
Lantana camara X L. depressa var. **floridana**	Hp; Gr; G4b; Cu&G3As.
Manilkara zapota	Hp; G4b; Fr&G3A; Cu&G3As.
Morinda citrifolia	Hp; Gr.
Muntingia calabura	Hp; G4b; Cu&G3As.
Musa X paradisiaca	Gr; Cu&Ro.
Opuntia cochenillifera	Cu&Ba; Gr&Ba.
Phoenix spp.	Gr; Bu.
Pithecellobium dulce	Hp; G4b; Cu&G3As.
Pluchea caroliniensis (R)	Hp; Gr; G4b; Cu&G4b; Cu&G3As.
Psidium guajava	Hp; G4b; Cu&G3As.
Ptychosperma elegans	Hp; Gr; Cu.
Ricinus communis	Hp; G4b; Cu&G3As.
Scaevola taccada	Hp; G4b; Cu&G3As.
Senna obtusifolia (U)	Hp; Gr.
Senna occidentalis (U)	Hp; Gr.
Shinus terebinthifolius	Hp; G4b; Cu&G3As.
Solanum erianthum (U)	Hp; Gr; G4b; Cu&G4As.
Terminalia catappa	Hp; G4b; Fr&G3A; Cu&G3As.
Thespesia populnea	Hp; G4b; Cu&G3As.

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[1] (R) indicates a ruderal native taxon; (U) indicates a taxon of uncertain nativity.

[2] Bu=bud treatment with Garlon 3A or 4;
Cu=cut;
Cu&Ba=cut, bag and remove from site;
Cu&G3As=cut and Garlon 3A application to stump;
Cu&G4b=cut and Garlon 4 basal application;
Cu&Ro=cut and treat re-sprouts with broadcast glyphosate (Roundup ® or Rodeo ®).
Fr&G3A=frill (a technique similar to girdling) and G3A application to frilled area;
G4b=Garlon 4 basal application;
Gr=grub (dig up using a grubbing tool);
Hp=hand-pull;
Hp&Ba=hand-pull, bag, and remove from site;
Ro=broadcast glyphosate (Roundup ® or Rodeo ®).

VINES AND SCANDENT SHRUBS

Abrus precatorius	Hp; Cu&G4b; Cu&G3As.
Ampelopsis arborea (R)	Hp; Cu&G4b; Cu&G3As.
Caesalpinia bonduc (R)	Hp; Cu&G4b; Cu&G3As.
Cissus sicyoides (R)	Hp&Ba; Cu&Ba.
Colubrina asiatica	Hp; Cu&G4b; Cu&G3As.
Dalbergia ecastophyllum (R)	Cu&G4b; Cu&G3As.
Dioscorea bulbifera	Gr&Ba.
Epipremnum pinnatum	Hp&Ba; Cu&Ba.
Hylocereus undatus	Cu&Ba.
Ipomoea alba (R)	Hp; Cu&Hp; G4b; Cu&G3As.
Ipomoea hederifolia (R)	Hp; Cu&Hp.
Ipomoea indica (R)	Hp; Cu&Hp; G4b; Cu&G3As.
Ipomoea triloba (R)	Hp; Cu&Hp.
Jasminum dichotomum	Hp; Cu&G4b; Cu&G3As.
Melothria pendula (R)	Hp; Cu&Hp.
Momordica charantia (U)	Hp; Cu&Hp; Cu&Gr.
Parthenocissus quinquefolia (R)	Hp; G4b; Cu&G4b; Cu&G3As.
Plumbago scandens (R)	Hp; Gr; G4b; Cu&G4b; Cu&G3As.
Sarcostemma clausum (U)	Hp; Cu&Hp.
Solanum seaforthianum	Hp; Cu&Hp; Cu&Gr.
Syngonium podophyllum	Hp&Ba; Cu&Ba.
Toxicodendron radicans ssp. **radicans** (R)	G4b.
Vigna luteola (R)	Hp; Cu&Hp.
Vitis rotundifolia (R)	Hp; G4c&b; Cu&G3As.

GRAMINOIDS

Andropogon glomeratus var. **pumilis** (R)	Hp.
Bothriochloa pertusa (U)	Hp.
Brachiaria subquadripara	Hp.
Cenchrus echinatus (R)	Hp.
Cenchrus incertus (R)	Hp.
Cynodon dactylon	Ro.
Cyperus compressus (R)	Hp.
Cyperus croceus (R)	Hp.
Cyperus esculentus	Hp; Ro.
Cyperus ligularis (R)	Hp.
Cyperus polystachyos (R)	Hp.
Cyperus rotundus	Hp; Ro.
Cyperus surinamensis (R)	Hp.
Dactyloctenium aegyptium	Hp.
Digitaria ciliaris (U)	Hp.
Eleusine indica	Hp.
Eragrostis ciliaris (R)	Hp.
Fimbristylis cymosa ssp. **spathacea** (U)	Hp; Gr.
Killinga brevifolia (R)	Hp.
Lolium perenne	Hp.

Neyraudia reynaudiana	Hp; Gr; Cu&Ro.
Panicum adspersum (R)	Hp.
Panicum dichotomiflorum var. bartowense (R)	Hp.
Panicum repens (U)	Ro.
Paspalum notatum	Gr; Ro.
Paspalum urvillei	Hp; Gr.
Pennisetum purpureum	Hp; Gr; Cu&Ro.
Rhychelytrum repens	Hp.
Rottboellia cochinchinensis	Hp.
Sorghum halapense	Hp.
Sporobolus indicus (U)	Hp; Gr.
Sporobolus jacquemontii (U)	Hp; Gr.
Stenotaphrum secundatum (U)	Hp; Ro.

FORBS

Ambrosia artemisiifolia	Hp.
Ascepias curassavica	Hp; Gr.
Bidens alba var. radiata (R)	Hp.
Blechum pyramidatum	Hp.
Boehmeria diffusa (U)	Hp.
Calyptocarpus vialis	Hp.
Capraria biflora (R)	Hp.
Cassia nictitans var aspera (R)	Hp
Catharanthus roseus	Hp.
Chamaesyce blodgettii (R)	Hp.
Chamaesyce hirta (R)	Hp.
Chamaesyce hypericifolia (R)	Hp.
Chamaesyce lasiocarpa	Hp.
Chamaesyce maculata (R)	Hp.
Chamaesyce opthalmica	Hp.
Commelina diffusa (U)	Hp&Ba.
Conyza canadensis var. pusilla	Hp.
Crotalaria incana	Hp.
Desmodium incanum (R)	Hp.
Desmodium tortuosum (U)	Hp.
Desmodium triflorum (U)	Hp.
Dichondra caroliniensis (R)	Hp.
Drymaria cordata (U)	Hp.
Eclipta prostrata (R)	Hp.
Emilia fosbergii (U)	Hp.
Emilia sonchifolia (U)	Hp.
Erechtites hieracifolia (R)	Hp.
Eupatorium capillifolium (R)	Hp; Gr.
Eupatorium odoratum (R)	Hp; C&Gr.
Euphorbia graminea	Hp.
Flaveria trinervia (U)	Hp.
Gaillardia pulchella (U)	Hp&Ba.
Gamochaeta falcata (R)	Hp.
Helianthus annuus	Hp; Gr.
Heliotropium angiospermum (R)	Hp.
Heliotropium curassavicum (U)	Hp.

Heliotropium polyphyllum var. leavenworthii (U)	Hp.
Indigofera spicata	Gr.
Indigofera suffruticosa (U)	Hp; Gr.
Kalanchoe cf. daigremontiana	Hp&Ba.
Kalanchoe pinnata	Hp&Ba.
Kallstroemia maxima	Hp.
Ludwigia octovalvis (R)	Hp;Gr.
Lycopersicon esculentum	Hp.
Macroptilium lathyroides	Hp.
Malvastrum corchorifolium (R)	Hp.
Melochia corchorifolium	Hp.
Mentzelia floridana (R)	Hp.
Mirabilis jalapa	Hp.
Nephrolepis cordifolia	Hp&Ba.
Nephrolepis multiflora	Hp.
Oeceoclades maculata (U)	Hp&Ba.
Oldenlandia corymbosa (U)	Hp.
Oxalis corniculata (U)	Hp.
Parietaria floridana (R)	Hp.
Pectis glaucescens (R)	Hp.
Pectis prostrata (R)	Hp.
Phyla nodiflora (R)	Hp.
Phyllanthus amarus (R)	Hp.
Phyllanthus tenellus	Hp.
Physalis angulata var. angulata (R)	Hp.
Pilea herniarioides (R)	Hp.
Plantago virginica (R)	Hp.
Poinsettia cyathophora (R)	Hp
Poinsettia heterophylla (R)	Hp.
Polypremum procumberns (R)	Hp.
Portulaca oleracea (U)	Hp&Ba.
Pteris tripartita (U)	Hp.
Pteris vittata	Hp.
Ptilimnium capillaceum (R)	Hp.
Richardia grandiflora	Hp.
Russellia equisetiformis	Hp&Ba.
Salvia occidentalis (R)	Hp.
Sansevieria hyacinthoides	Gr&Ba.
Scoparia dulcis (R)	Hp.
Sida acuta (R)	Hp.
Sida rhombifolia (R)	Hp.
Solanum americanum (R)	Hp.
Sonchus asper	Hp
Sonchus oleraceus	Hp.
Spermacoce assurgens (R)	Hp.
Spermacoce verticillata s.str.	Hp.
Stylosanthes hamata (R)	Hp.
Tradescantia spathacea	Hp&Ba.
Tribulus cistoides (U)	Hp.
Tridax procumbens	Hp&Ba.

Turnera ulmifolia	Hp.
Typha latifolia (R)	Hp; Gr; Ro.
Urena lobata (U)	Hp.
Verbena bonariensis	Hp.
Waltheria indica (R)	Hp.
Wedelia trilobata	Hp; Ro.
Xanthosoma sp.	Gr&Ba.
Youngia japonica	Hp.
Yucca aloifolia (U)	Cu&Gr.
Zeuxine strateumatica	Ro.

5. NURSERY OPERATIONS

The Cape Florida native plant nursery is a critical component of the Cape Florida Project (Schroeder 1994; Anon. n.d.). Table 5a lists eighty-two species recommended for cultivation and provides propagation sources, propagation methods, and other information necessary for the successful cultivation of native plants to be used in the restoration program.

5.1 Identification of taxa to be cultivated

Table 5a lists all native plant taxa recommended for potential cultivation for the Cape Florida Project. All of these taxa have been previously recorded at Cape Florida, Key Biscayne, or the Upper Sandy Keys.

5.2 Collection of propagules

Propagules should be collected from Cape Florida or a nearby source in order to "protect local genetic diversity and utilize local adaptation" (The Nature Conservancy 1992). Care should be exercised to collect only those propagules necessary for the successful completion of the Cape Florida Project.

5.2.1 Identification of Collecting sites

Table 5a identifies potential collecting locations for each taxon. Before any collecting is done, it is critical to obtain written permission from the landowner. In the case of state-listed endangered or commercially exploited species, a permit from the Florida Department of Agriculture and Consumer Services will be required.

5.2.2 Collection of seeds

Seeds should only be collected when ripe. Some experience is required to be able to determine the ripeness of seeds. In general, it is best not to collect seeds from the ground. Dry seeds should be placed in paper bags; fleshy seeds should be placed in plastic bags. All seeds should be placed in a cool location for transportation back to the nursery.

5.2.3. Seed storage and preparation

In general, no fleshy seed should be stored more than one week after collection. Some seeds of temperate species, however, respond better if placed in cold storage for one to three months prior to planting; these taxa are identified in Table 5a.

In general, seeds must be separated from any surrounding material before planting. This can usually be accomplished by hand separation, by rubbing the fruit over a screen on a frame, by threshing, or with a food processor. Some species benefit from scarification in order to speed up or assist in germination.

5.2.4 Collection of cuttings

Cuttings should be collected in the morning, placed into a plastic bag, kept out of the sun in a cool place (preferably in a dry cooler), and transported back to the nursery for immediate planting. All cuttings should be made with a sharp, clean tool.

5.2.5 Collection of bare-root seedlings

Bare-root seedlings should be collected as young as possible, but after the development of a strong main stem. As with cuttings, they should be collected in the morning, placed in plastic bags, kept out of the sun in a cool place (preferably in a dry cooler), and transported back to the nursery for immediate planting.

5.3 Propagation

This section provides basic information on propagation methods. These methods, which are listed in Table 5a, vary depending on taxon type. While most taxa are relatively easy to propagate, others will require significant experience and skill.

5.3.1 Planting seeds

Seeds may be planted in community pots, and transplanted later, or planted directly into individual containers. Depth of the container should be sufficient enough to allow for proper development of the root system. This is usually deeper for trees and shrubs, and less so for graminoids and forbs. Soils should be similar to or the same as the substrate into which the propagule will be out-planted. In general, seeds should be planted at a depth of one to one and a half times the thickness of the seed. Seeded containers may need to be protected from predators such as birds, mice, etc.

5.3.2 Planting cuttings

Cuttings should be placed into appropriate containers and most should be placed into the shade house until rooted; other species, especially those susceptible to fungal attacks, should be started under a plastic cover in the shade house, or in full sun. As above, soils should be similar to or the same as the substrate into which the propagule will be out-planted. Some species benefit from treatment with a rooting hormone and are so indicated in Table 5a. When using a rooting hormone, make sure to use concentrations consistent with the label; too high a concentration of hormone can cause bark rot.

5.3.3 Planting bare-root seedlings

Bare-root seedlings should be placed one to three per container, hand watered with a breaker nozzle, and placed in the shade house until stabilized (usually 2-4 weeks). Sufficient water during the stabilization stage is crucial to the survival of bare-root seedlings. After stabilization, they should then be moved into the sun for further growth and development.

5.3.4 Other propagation methods

Other propagation methods such as air-layering and marcotting should be attempted only if both trained staff and proper facilities are available. Few species identified for cultivation, however, require these advanced procedures.

5.4 Cultivation

Cultivation is the process of caring for propagated plants within the nursery setting. Below, basic cultivation practices are discussed.

5.4.1 Irrigation

Irrigation is crucial to the successful cultivation of plants. However, plants require relatively specific quantities of water and may be damaged by too little, or too much irrigation. In general, very young plants and plants with crowded root systems are more susceptible to damage from improper irrigation. Very young plants are often damaged by over watering, and plants with crowded root systems are most often damaged by under watering.

Water need is determined by a variety of factors including: container size, type of leaf structure (succulent, hairy, etc), type of root system, amount of air movement between plants, air temperature, humidity, etc. In general, plants are damaged more frequently by over watering than by under watering. Over watering can lead to root rot, and fungal attacks, both of which can lead to rapid death.

Watering should be conducted during the late afternoon or early evening, or during the early morning. If fungal attacks are a problem, then early morning watering is recommended. Water should be applied daily until it runs out the bottom of the pots, and then stopped. Periodic inspections should be conducted to ensure that the holes in the bottom of containers are not plugged, thus allowing water to accumulate in the pots.

5.4.2 Weeding

All containers and the nursery grounds should be kept free of weeds. In general, tables should be hand weeded at least once per week. The remainder of the facility should be weeded at least once per month. Weeding requirements for one gallon and larger containers can be reduced through the use of pre-emergent herbicides.

5.4.3 Fertilizing

In general, native plants will respond favorably to fertilizers which have been formulated for local use on palms because they contain minor and secondary elements needed for proper plant growth. Fertilizer should be incorporated into the soil when transplanting occurs, or top-dressed after seeds, cuttings, and bare-root seedlings have

become established. Top dressing should follow as needed according to the manufacturer's specification. Fertilizer can be depleted at an excessive rate during hot, wet periods of weather. Fertilization through the irrigation system is not recommended due to its role in promoting excessive weed growth.

5.4.4 Transplanting

Plants should be transplanted from community pots or small containers to larger containers or out-planted as soon as the roots fill out the container and before they become restricted, twisted, or otherwise damaged. Special concern should be given to trees with well-developed tap roots; damage to tap roots can cause irreparable damage to the tree. Soils should be similar to or the same as the soils into which the plant will be out-planted.

5.4.5 Pest and Disease Control

Most native plants are fairly disease resistant so long as good cultural practices are followed. Most important of these are:

(1) keep plants well-spaced so that air can freely circulate around each individual plant; and,

(2) don't over water --- over watering causes a multiplicity of problems including fungal attacks.

Plants susceptible to fungal attacks should be grown in full sun and may benefit from irrigation with salt or brackish water.

Finally, An Integrated Pest Management (IPM) program should be developed as soon as possible to deal with disease and pest problems which may affect the nursery operation, including fungal attacks, snail herbivory, etc.

5.4.6 Spacing.

Plants should be spaced so that air can freely circulate between each individual plant. Plants are usually grouped together according to container size, as well as light and water requirements. In general, plants can be placed relatively close together when they are young, but must be spread apart as they mature.

5.5 Preparing Plants for Out-planting

Plants grown in a nursery need to hardened off in preparation for out-planting. This can be accomplished by ensuring that plants are grown in the full sun for at least two weeks before out-planting.

5.6 Volunteer training and program implementation

Volunteers can be trained in virtually every aspect of nursery operations, from the collection of propagules, through propagation and cultivation.

5.7 Record keeping

Preliminary record keeping procedures have been developed (Anon., n.d.) and are being currently being re-designed by Florida Park Service staff (E. Carter, pers. comm.).

Scientific Name	Source	Type	Season	Treatment	Time	Propagation container size	Out-plant container size
Bursera simaruba	R	S[10]	Sp,Su	C&S	3-6w	T	T
Byrsonima lucida	K	S	Su,F	C&S	4-8w	T	T,1g
Callicarpa americana	R	S	F	C&St[11]	3-6w	C,T	T,1g
Chrysobalnus icaco	K	C[12]	Su,F	R	4-8w	3"	1g
Citharexylum fruticosum (d)	R	S	A	C&S	3-6w	T	T
Coccoloba diversifolia (d)	R	S	F,W	C&S	4-8w	T	T,3g
Conocarpus erecta cv. Green (d)[13]	K	S	A	C&S	3-6w	T	T,3g
Crossopetalum rhacoma	R	S	A	C&S	4-8w	T	T,1g
Diospyros virginiana (d)	R	S	Su,F	?	?	T	T,3g
Erithalis fruticosa	R	S	A	C&Sf	2-4w	T	T,1g
Erythrina herbacea	R	S[14]	Sp,Su	C&S[15]	4-8w	T	T
Eugenia axillaris	R	S[16]	Su,F	C&Ss	6-10w	T	T,1g

[10] Although *Bursera simaruba* can be easily propagated by stem cuttings, this practice is discouraged due to poor root development.
[11] Store in refrigerator during the winter and sow in spring.
[12] There appear to be several ecotypes of this species, and lineage strongly influences survivorship and health of progeny. Cuttings should be taken from parent plants growing in the community into which the propagules will be translocated. Cuttings must be of semi-hard wood (intermediate between green and mature wood).
[13] This species have been divided into two varieties based on the amount of hairs on the leaves. This characteristic, however, does not hold from seed. Regardless, the plants from Key Biscayne and northward appear to be mostly those without hairs on the leaves. Seeds, therefore, should be collected from parent trees without hairs on the leaves.
[14] Although *E. herbacea* can be propagated by cuttings, this practice should be discouraged due to poor root development.
[15] Can be stored for years in a dry place.

Scientific Name	Source	Type	Season	Treatment	Time	Propagation container size	Out-plant container size
Eugenia foetida	R	S[17]	Su,F	C&Ss	8-12w	T	T,1g
Exothea paniculata (d)	R	B[18]	Sp-Su	-	4-8w	T	T
Ficus aurea	R	S	Su	C&S[19]	3-6w	T	T
Forestiera segregata var. **segregata** (d)	K	S	W,Su	C&S	3-6w	T	T,1g
Gymnanthes lucida	K	S	Su-F	C&S	3-6w	T	T,1g,3g
Krugiodendron ferreum	K	S	Su,F	C&S	3-6w	T	T,1g
Laguncularia racemosa (d)	R	S	Su,F	S	2-4w	T	T
Lycium carolinianum	R	S	W	C&Sf	4-8w	T	T
Morus rubra	R	C[20]	S,F	R	8-12w	1g[21]	1g
Myrica cerifera (d)	K	S	F,W	C&St[22]	4-8w	T	T
Myrsine floridana	R	S[23]	not W	C&S	4-8w	T	T,1g
Ocotea coriacea	R	S	F,W	C&S	4-8w	T	T,1g

[16] Seeds of *E. axillaris* should be picked as soon as fully ripe. Avoid picking after dried on parent trees; ; however, the seed coat will harden if you wait until they are dry and this will make the process of cleaning the seeds more difficult.
[17] Seeds of *E. foetida* should be treated the same as those of *E. axillaris*.
[18] Collect bare-root seedlings and some leaf litter from underneath parent tree; mix leaf litter into soil bare root seedlings will be planted in.
[19] Fruits of *Ficus aurea* should be placed in a blender with water. Grind and pour liquid off; the viable seeds will be on the bottom.
[20] Cuttings should be stem cuttings about 4-5" long from wood more than one year old; all leaves should be removed.
[21] Six to a pot.
[22] Clean and place in refrigerator. Plant in spring.
[23] Pick as soon as seeds are ripe; don't pick when dried on parent plant.

Scientific Name	Source	Type	Season	Treatment	Time	Propagation container size	Out-plant container size
Pinus elliottii var. densa	R	S	Sp	S	4-8w	T	T,3g
Psychotria nervosa	R	B	F,W	-	-	T	T,1g
Randia aculeata	R	S	not Sp	C&S	3-6w	T	T,1g
Reynosia septentrionalis	K	S	Sp,Su	C&S	6-12w	T	T,1g
Rhizophora mangle	R	S	Su,F	S	-	D	D
Rhus copallina var. leucantha (d)	K	S	F	C&Sf	3-6w	T	T,1g
Sambucus simpsonii	R	S	A	C&S	3-6w	T	T,1g
Sapindus saponaria	R	S	Su,F	C&S	6-12w	T	T
Sideroxylon foetidissimum	K	S	W,Sp	C&Ss	6-12w	T	T,3g
Sideroxylon salicifolia	R	B	F	-	-	T	T,3g
Simarouba glauca (d)	K	S	Sp,Su	C&S	3-6w	T	T
Ximenia americana	R	S	A	C&S	?	T	T,1g[24]
Zanthoxylum clava-herculis	K	S	F,W	C&S	4-8w	T	T,1g
Zanthoxylum coriaceum	K	S	Su,F	?	?	T	T,1g
PALMS							
Coccothrinax argentata	C	S	Su,F	C&S	8-14w	T	T,1g
Serenoa repens	R	S	F	C&S[25]	8-26w	T,D	T,D

[24] Parasitic on roots; should be out-planted as soon as possible.

Scientific Name	Source	Type	Season	Treatment	Time	Propagation container size	Out-plant container size
VINES AND SCANDENT SHRUBS							
Echites umbellata	K	S	A	C&Sf	?	T	T
Pentalinon luteum	K	S	Su,F	C&S	?	T	T
GRAMINOIDS							
Cladium jamaicense	N	S	Su,F	C&S	4-8w	T	T
Dichanthelium aciculare	K	S	A	C&S	2-8w	T	T
Distichlis spicata (d)	K	S	Su-F	C&S	2-8w	3"	3"
Eragrostis elliottii	C	S	Su,F	C&S	2-8w	T	T
Eustachys petraea	C	S	A	C&S	4-8w	T	T
Fimbristylis caroliniana	K	S	F	C&S	2-8w	3"	3"
Fimbristylis castanea	K	S	Su-F	C&S	2-8w	3"	3"
Muhlenbergia capillaris	N	S	F,W	C&S	2-8w	T	T
Panicum virgatum	K	S	Su-F	C&S	2-8w	T	T
Paspalum caespitosum s.str.	C	S	Su,F	C&S	2-8w	T	T
Paspalum setaceum var. **ciliatifolia**	C	S	A	C&S	2-8w	T	T
Paspalum vaginatum	C	S	F	C&S	2-8w	3"	3"

[25] An alternate approach is to clean, dry for 3-4 weeks and then sow (Anon., n.d.).

Scientific Name	Source	Type	Season	Treatment	Time	Propagation container size	Out-plant container size
Setaria geniculata	C	S	A	C&S	2-8w	T	T
Spartina patens	C	S	Su,F	C&S	2-8w	3"	3"
Spartina spartinae	K	S	Su,F	C&S	2-8w	3"	3"
Sporobolus virginicus	K	S	A	C&S	2-8w	3"	3"
FORBS & WOODY GROUNDCOVERS							
Acrosticum aureum	K	Sp	A	S[26]	12-16w+	F	3",1g
Acrostichum danaeifolium	K	Sp	A	S[27]	12-16w+	F	3",1g
Blechnum serrulatum	K	Sp	A	S[28]	12-16w+	F	3",1g
Borrichia frutescens	C	C	not W	-	4-8w	3"	3",1g
Capsicum annuum var. glabriusculum	R	S	A	C&Sf	3-6w	T	T
Glandularia maritima	N	C	not W	Rf	2-4w	3"	1g
Hypericum tetrapetalum	N	?	?	?	?	3"	3"
Jacquemontia reclinata	K	?	?	?	?	?	?
Juncus megacephalus	N	S	Su-F	C&S	2-8w	3"	3"
Licania michauxii	K	S	?	C&S	12-26w+	D	D

[26] Set a flat of soil on a table in the shade house in 30% shade; lay a mature fertile frond on soil, fertile side down; keep moist; wait. For more complete instructions on fern propagation see Hoshizaki (1975).
[27] Treat the same as *A. aureum*.
[28] Treat the same as *Acrostichum aureum*.

Scientific Name	Source	Type	Season	Treatment	Time	Propagation container size	Out-plant container size
Nephrolepis biserrata	K	R[29]	not W	-	4-6w	1g	1g
Opuntia humifusa var. **austrina**	K	P	not W	-	4-6w	D	D
Osmunda regalis var. **spectabilis**	N	Sp	A	S[30]	12-16w	F	1g
Pteris bahamensis	N	Sp	A	S[31]	12-16w	F	1g
Salicornia virginica	N	C	not W	-	?	3"	3"
Solidago sempervirens var. **mexicana**	C	S	F,W	C&S	3-6w	T	T
Solidago stricta	C	S	F,W	C&S	3-6w	T	T
Zamia integrifolia	K	S	F,W	C&Ss	12-26w	D	D

[29] See Hoshizaki (1975) for methods of propagating ferns from rhizomes.
[30] Treat the same as *Acrostichum aureum*.
[31] Treat the same as *Acrostichum aureum*.

6. OUT-PLANTING

The out-planting of native plants will be critical to the success of the Cape Florida Project. This is especially true for coastal strand and mesic flatwoods, which have recieved little attention during prior parts of the project.

Two tables have been written to help facilitate this effort. Table 6a provides maximum recommended out-planting densities by habit (life form) for each natural community. Table 6b provides a list of native plant taxa recommended for out-planting with the highest recommended planting densities for each taxon by community type.

6.1 Out-planting in uplands

The bulk of the out-planting will be conducted in upland natural communities. In these communities, it is essential to install plants properly, and to give them sufficient water. Below, the basics of out-planting are presented.

6.1.1 Site preparation

The preferred method of site preparation is to conduct an invasive species control treatment of the planting area immediately prior to out-planting. As stated in Invasive Species Control, any mulch or organic debris should be removed prior to out-planting in coastal strand and mesic flatwoods communities.

6.1.2 Preparing the planting hole

Planting holes may be dug with a mechanical auger or by hand. In either case, make sure that the plant will fit comfortably within the planting hole, and that the plant is nearly level with the surrounding ground surface. Plants grown in relatively small containers (less than a one gallon) are often planted just below the ground surface to help avoid desiccation. Regardless, the planting hole should not be significantly larger than the root ball of the plant to be installed. Material excavated from the planting hole should be used as back fill; no soil amendments should be placed in or around the planting hole.

6.1.3 Placing the plant

Once the plant is placed into the planting hole, place half of the back fill in the hole and use a garden hose to water in the back fill, thus eliminating air pockets under and around the plant. Once this water has drained away, place the remaining back fill in the hole and again use a garden hose to flush out any remaining air pockets. During this process, use a shovel (or your hands) to lightly (not firmly) pack in the back fill around the plant. Finally, level out the planting surface so that it grades smoothly into the surrounding terrain. Plants grown in relatively small containers (less than a one gallon) are usually planted in a single operation and then watered in.

If watering is not possible, plant only when the soils are moist, such as after a heavy rain.

6.1.4 Mulching

Mulching is recommended only in the maritime hammock community where a 3-6 inch top dressing of hardwood mulch or chips should be applied. When applying mulch, make sure not to cover the trunks of the installed plants as this can cause bark rot and kill or damage the tree.

In general, a second mulching will not be required. However, in some cases, the mulch may be too thin or may oxidize (decompose) relatively quickly and a complete or partial re-mulching may be required.

6.1.5 Irrigation

Long-term survivorship of installed plants will be significantly enhanced with irrigation. In general, each watering should be equivalent to one inch of rainfall. During the first two weeks after installation water once per day, during the next two weeks water every other day, during the next four weeks water twice per week, and during the next four weeks water once per week. If field grown materials are installed, water them at least once per month for the following year; additional watering may be necessary during hot, dry periods during the spring and summer.

6.2 Out-planting in wetlands

Out-planting in wetlands is a fairly straight forward procedure. If planting in tidal wetlands, organize the out-planting so that the plants can be installed during the low tide. If planting in isolated wetlands, out-planting should occur during the drier times of the year. It is better to install wetland plants in areas slightly drier than what they are adapted to, than to plant them in areas that are too wet. In either case, anchoring is the key to success. Make sure when installing the plant to bury the plant slightly below grade, so that the top of the root ball can be covered with mud or sand.

6.3 Volunteer training and implementation

Volunteers can be easily trained to participate in out-planting activities. A Park Biologist or highly trained volunteer should select the plant materials to be installed and to supervise layout. Trained volunteers can conduct most other activities.

6.4 Record Keeping

Currently, all plants installed at Cape Florida are being recorded with a GIS system, including GPS coordinated. It is unknown if this system will be used in the future at Cape Florida and an alternative approach may need to be developed.

Table 6a. Maximum out-planting densities (units/100 square feet) for each natural community type by habit.

Habit Type	Beach Dune	Coastal Strand	Mesic Flatwoods	Maritime Hammock	Tidal Swamp	Tidal Marsh	Isolated Wetlands
Trees and shrubs	-	-	1	4	12	-	4
Palms	-	6	5	-	-	-	4
Vines and scandent shrubs	-	-	-	-	-	-	-
Graminoids	-	45	45	-	25	45	45
Forbs	-	4	4	-	-	10	12
Total	-	45	45	4	37	45	45

Table 6b. Native plant taxa recommended for out-planting at Cape Florida with highest recommended planting densities (units/100 sq. ft.) for each natural community type. Dash indicates none; augment pop. indicates that addional plants may be added to an existing population; establish pop. indicates that a population may be established within an area which has been stablilized.

Scientific Name[1]	Beach Dune	Coastal Strand	Mesic Flatwoods	Maritime Hammock	Tidal Swamp	Tidal Marsh	Isolated Wetlands
TREES AND SHRUBS							
Annona glabra	-	-	-	-	-	-	1
Ardisia escallonioides	-	-	-	1	-	-	-
Argusia gnaphalodes	augment pop.	-	-	-	-	-	-
Baccharis angustifolia	-	-	-	-	-	1	1
Batis maritima	-	-	-	-	100	50	-
Bourreria ovata	-	-	-	1	-	-	-
Bursera simaruba	-	-	-	1	-	-	-
Byrsonima lucida	-	-	-	1	-	-	-
Callicarpa americana	-	-	-	1	-	-	-
Chrysobalnus icaco	-	-	-	1	-	-	4
Citharexylum fruticosum	-	-	-	1	-	-	-
Coccoloba diversifolia	-	-	-	1	-	-	-
Conocarpus erecta cv. Green	-	-	-	-	1	-	-
Crossopetalum rhacoma	-	establish pop.	-	1	-	-	-
Diospyros virginiana	-	-	-	1	-	-	-
Erithalis fruticosa	-	-	1	-	-	-	-
Erythrina herbacea	-	establish pop.	-	1	-	-	-
Eugenia axillaris	-	-	-	1	-	-	-
Eugenia foetida	-	-	-	1	-	-	-
Exothea paniculata	-	-	-	1	-	-	-

[1] (I) indicates a taxon which represent an introduction or re-introduction at Cape Florida. These taxa have been recorded for Key Biscayne or the Upper Sandy Keys (Key Biscayne and Virginia Key) but not for Cape Florida.

Scientific Name	Beach Dune	Coastal Strand	Mesic Flatwoods	Maritime Hammock	Tidal Swamp	Tidal Marsh	Isolated Wetlands
Ficus aurea	-	-	-	1	-	-	-
Forestiera segregata var. segregata	-	-	-	1	-	-	-
Gymnanthes lucida	-	-	-	1	-	-	-
Krugiodendron ferreum	-	-	-	1	-	-	-
Laguncularia racemosa	-	-	-	-	10	-	-
Lycium carolinianum	-	-	-	-	-	1	-
Morus rubra	-	-	-	1	-	-	-
Myrica cerifera	-	-	-	1	-	-	1
Myrsine floridana	-	-	-	1	-	-	-
Ocotea coriacea	-	-	-	1	-	-	-
Pinus elliottii var. densa	-	-	1	-	-	-	-
Psychotria nervosa	-	-	-	1	-	-	-
Randia aculeata	-	-	-	1	-	-	-
Reynosia septentrionalis	-	-	-	establish pop.	-	-	-
Rhizophora mangle	-	-	-	-	50	-	-
Rhus copallina var. leucantha	-	-	1	-	-	-	-
Sambucus simpsonii	-	-	-	-	-	-	1
Sapindus saponaria	-	-	-	1	-	-	-
Sideroxylon foetidissimum	-	-	-	1	-	-	-
Sideroxylon salicifolia	-	-	-	1	-	-	-
Simarouba glauca	-	-	-	1	-	-	-
Ximenia americana	-	establ. pop.	-	-	-	-	-
Zanthoxylum clava-herculis	-	establ. pop.	-	-	-	-	-
Zanthoxylum coriaceum	-	establ. pop.	-	-	-	-	-

Scientific Name	Beach Dune	Coastal Strand	Mesic Flatwoods	Maritime Hammock	Tidal Swamp	Tidal Marsh	Isolated Wetlands
PALMS							
Coccothrinax argentata	-	-	0.5	0.5	-	-	-
Serenoa repens	-	5	4	-	-	-	4[2]
VINES AND SCANDENT SHRUBS							
Echites umbellata	-	establ. pop.	establ. pop.	-	-	-	-
Pentalinon luteum	-	-	-	establ. pop.	establ. pop.	-	-
GRAMINOIDS							
Cladium jamaicense	-	-	-	-	-	-	100
Dichanthelium aciculare	-	10	10	-	-	-	-
Distichlis spicata	-	-	-	-	-	50	-
Eragrostis elliottii	-	10	10	-	-	-	10
Eustachys petraea	-	10	10	-	-	-	10
Fimbristylis caroliniana	-	-	-	-	-	10	-
Fimbristylis castanea	-	-	-	-	-	10	-
Muhlenbergia capillaris							
Panicum virgatum	-	establ. pop.	establ. pop.	-	-	-	-
Paspalum caespitosum s.str.	-	10	10	-	-	-	-
Paspalum setaceum var. ciliatifolia	-	1	1	-	-	-	-
Paspalum vaginatum	-	-	-	-	-	10	-
Setaria geniculata	-	5	5	-	-	-	-
Spartina patens	-	-	-	-	-	10	-
Spartina spartinae	-	-	-	-	-	5	-
Sporobolus virginicus	-	-	-	-	-	5	-
FORBS & WOODY GROUNDCOVERS							

[2] Plant along upland edges, not in areas which are regularly inundated.

Scientific Name	Beach Dune	Coastal Strand	Mesic Flatwoods	Maritime Hammock	Tidal Swamp	Tidal Marsh	Isolated Wetlands
Acrosticum aureum	-	-	-	-	-	establ. pop.	-
Acrostichum danaeifolium	-	-	-	-	-	-	1
Blechnum serrulatum	-	-	-	-	-	-	10
Borrichia frutescens	-	-	-	-	-	5	-
Capsicum annuum var. glabriusculum	-	-	-	establ. pop.	-	-	-
Glandularia maritima	-	-	1	1	-	-	-
Hypericum tetrapetalum	-	-	-	-	-	-	5
Jacquemontia reclinata	establ. pop.	establ. pop.	-	-	-	-	-
Juncus megacephalus	-	-	-	-	-	-	5
Licania michauxii	-	1	1	-	-	-	-
Nephrolepis biserrata	-	-	-	establ. pop.	-	-	-
Opuntia humifusa var. austrina	-	-	establ. pop.	-	-	-	-
Osmunda regalis var. spectabilis	-	-	-	-	-	-	establ. pop.
Pteris bahamensis	-	establ. pop.	establ. pop.	-	-	-	-
Salicornia virginica	-	-	-	-	-	5	-
Solidago sempervirens var. mexicana	-	1	1	-	-	-	1
Solidago stricta	-	1	1	-	-	-	1
Zamia integrifolia	-	1	1	-	-	-	-

7. PROTECTION AND ENHANCEMENT OF RARE PLANTS

Twenty-eight plant taxa recorded for Cape Florida are listed by the Florida Natural Areas Inventory (FNAI), the Florida Department of Agriculture and Consumer Services (FDACS), or the United States Fish and Wildlife Service (USFWS). An additional fifteen taxa which have been recorded for Key Biscayne or the Upper Sandy Keys are likewise listed. Listed plant taxa range from relatively common, commercially-exploited species, such as royal fern (*Osmunda regalis* var. *spectabilis*), to the extremely rare and globally imperiled east coast lantana (*Lantana depressa* var. *floridana*). This section has been written to facilitate the protection and enhancement of rare plants as part of the overall ecological restoration program.

The rare plant taxa known from Cape Florida, Key Biscayne and/or the Upper Sandy Keys are ranked below according to degree of rarity. Agency rankings for each taxon are listed below; rankings by FNAI are from a March 1994 computer printout; rankings from FDACS and USFWS are from Coile (1993). The following sections review and develop recommended procedures for the management of each taxon.

7.1 Priority A Taxa

Priority A taxa are taxa that are considered by FNAI to be imperiled or critically imperiled in the state. These taxa should receive the highest level of management concern. Under no circumstances should extirpations of natural populations of these taxa be allowed to occur. When needed and appropriate, efforts should be made to augment existing populations. Extirpated taxa should be strongly considered for re-introduction.

Byrsonima lucida (locustberry).

This shrub was recorded for Key Biscayne by Goodwin (Goodwin in Schroeder 1995). In south Florida, locustberry is typically found in pinelands and in open hammocks or hammock edges in Dade County and the Florida Keys. It may have been present at Cape Florida prior to massive disturbance. Locustberry is listed as imperiled by FNAI; it is listed as endangered by FDACS; it is not listed by USFWS.

The restoration of coastal strand, mesic flatwoods, and maritime hammock will create new habitats for this species and its introduction should be considered. However, due to apparent genetic differences in populations, propagules should be collected only from Key Biscayne.

Chamaesyce porteriana var. **scoparia** (Porter's broom spurge).

This endemic herb was recorded for Key Biscayne by MacAllister (1938). Other than one specimen assigned to this taxon from Big Cypress National Preserve, this taxon is known only from the Florida Keys (Avery & Loope 1980). This may represent a

misidentification. Porter's broom spurge is listed as imperiled by FNAI; the species taxon is listed as endangered by FDACS; it is not listed by USFWS.

No action should be taken concerning this taxon until material at the Duke University herbarium can be examined.

Coccothrinax argentata (silver palm).

This small palm grows in the coastal strand at Cape Florida. In south Florida, silver palm is typically found growing in open pinelands from Broward County to the Florida Keys, although it is occasionally found growing in coastal strand and in open maritime hammocks. Silver palm is listed as imperiled by FNAI; it is listed as commercially exploited by FDACS; it is not listed by USFWS.

The restoration of significant areas of coastal strand and mesic flatwoods will create additional habitats for this species, and an augmentation of this population should be considered.

Cordia sebestena (geiger tree).

This small tree is historically known from Key Biscayne (MacAllister 1938) and has been out-planted as part of the restoration process. However, the nativity of geiger tree is uncertain, and it appears to be introduced and naturalized (Little 1978). Geiger trees is listed as imperiled by FNAI; it is listed as endangered by FDACS; it is not listed by USFWS.

This taxon should be limited to the cultural area or removed from park.

Crossopetalum rhacoma (rhacoma).

This small shrub has been recently out-planted at Cape Florida as part of the restoration process. Previously, it had been unknown at the park, but had been recorded at Crandon Park (Fairchild Tropical Garden 1991). In southeastern Florida, rhacoma is found growing in open pinelands, on hammock edges, and in coastal strand. Rhacoma is listed as imperiled by FNAI; it is listed as endangered by FDACS; it is not listed by USFWS.

A small population of rhacoma should be established as part of the restoration process within coastal strand and mesic flatwoods communities.

Cyrtopodium punctatum (cowhorn orchid).

This epiphytic orchid was noted at Cape Florida growing in mangroves along Pines Canal (R. Hammer, pers. comm.). This population has not been seen since

Hurricane Andrew and it is thought to be extirpated within the park. Cowhorn orchid is listed as critically imperiled by FNAI; it is listed as endangered by FDACS; it is not listed by USFWS.

The restoration of significant areas of tidal swamp will provide an opportunity to re-introduce this orchid to the park and to establish a viable population.

Glandularia maritima (=*Verbena maritima*; beach verbena).

This prostrate herb was recorded for the Upper Sandy Keys by Small (1913) and for Key Biscayne by MacAllister (1938). It has not been recorded in recent years at either Cape Florida or Crandon Park and is now thought to be extirpated on Key Biscayne. In southeastern Florida, beach verbena is found growing in open pinelands, on beach dunes and in coastal strands. It was probably present at Cape Florida prior to massive disturbance. Beach verbena is listed as imperiled by FNAI; it is listed as endangered by FDA; it is not listed by USFWS.

The re-introduction of beach verbena on the beach dune at Cape Florida should be seriously considered. The restoration of significant areas of coastal strand and mesic flatwoods will also create new habitats for this species, and it should be considered for re-introduction there.

Jacquemontia reclinata (beach jacquemontia).

This endemic herb is presently unknown at Cape Florida, but has been recorded at Crandon Park (Fairchild Tropical Garden 1991). In southeastern Florida beach jacquemontia is found on the leeward side of beach dunes, and in open areas of coastal strand. It was probably present at Cape Florida prior to massive disturbance. Beach jacquemontia is listed as critically imperiled by FNAI; it is listed as endangered by FDACS; it is listed as endangered by USFWS.

The re-introduction of beach jacquemontia should be seriously considered. In addition, the restoration of coastal strand may provide additional habitat for this species and it may be appropriate to re-introduce it there.

Lantana depressa var. floridana (=*L. ovatifolia* auct., non Britt.; east coast lantana).

This endemic shrub is historically known from coastal strand at Cape Florida, but is in immediate danger of extirpation at Cape Florida due to hybridization with the exotic *L. camara*. During a recent site visit most plants referable to *L. depressa* var. *florida* appeared to be hybrids (G. Gann & K. Bradley, pers. obs., 1995). East coast lantana is listed as imperiled by FNAI; the species taxon is listed by FDACS; it is not listed by USFWS.

Immediate action needs to be taken if east coast lantana is to survive at Cape Florida. A survey should be conducted as soon as possible to determine exactly how many pure east coast lantanas still survive. Once this is complete, all *L. camara* and *L. camara* X *L. depressa* var. *floridana* within the park should be eliminated utilizing search-and-destroy methods described in Invasive Species Control above.

Melanthera parvifolia (Everglades black-anthers).

This endemic herb was recorded for the Upper Sandy Keys by Small (1913). It has not been recorded recently at either Cape Florida or Crandon Park and is thought to be extirpated on Key Biscayne. In south Florida, Everglades black-anthers is found growing primarily in open pine rocklands. Everglades black-anthers is listed as imperiled by FNAI; it is listed as endangered by FDACS; it is not listed by USFWS.

The restoration of significant areas of coastal strand and mesic flatwoods will create new habitat for Everglades black anthers and it should be considered for re-introduction.

Poinsettia pinetorum (pineland poinsettia).

This herb was recorded for Key Biscayne by MacAllister (1938). It has not been recorded recently at either Cape Florida or Crandon Park and is thought to be extirpated on Key Biscayne. In south Florida, pineland poinsettia is typically found in open pinelands in Dade County and the Florida Keys. It may have been present at Cape Florida prior to massive disturbance. Pineland poinsettia is listed as imperiled by FNAI; it is listed as endangered by FDACS; it is not listed by USFWS.

The restoration of coastal strand and mesic flatwoods will create new habitat for this species, and its re-introduction to Cape Florida should be seriously considered.

Savia bahamensis (maidenbush).

This shrub was cultivated and out-planted near the lighthouse (R. Hammer, pers. comm., 1995). Maidenbush is naturally found only in the lower Florida Keys (Little 1978) and is well outside its historic range at Cape Florida. Maidenbush is listed as critically imperiled by FNAI; it is listed as endangered by FDACS; it is not listed by USFWS.

Any remaining individuals of this species should be removed from the park.

Stillingia sylvatica ssp. **tenuis** (Everglades Queen's-delight).

This endemic herb was recorded for the Upper Sandy Keys by Small (1913). It has not been recorded recently at either Cape Florida or Crandon Park and is thought to

be extirpated on Key Biscayne. In south Florida, Everglades Queen's-delight is typically found in open pine rocklands. It may have been present at Cape Florida prior to massive disturbance. Everglades Queen's-delight is listed as imperiled by FNAI; it is not listed by FDACS; it is not listed by USFWS.

Although the restoration of coastal strand and mesic flatwoods will create new habitat for this taxon, its re-introduction should be approached cautiously. Considerable taxonomic confusion surrounds the *Stillingia sylvatica* complex and some exploration of these issues should be conducted prior to any introductions.

Zanthoxylum coriaceum (Biscayne prickly-ash).

A few plants of this shrub to small tree have been cultivated and out-planted near the lighthouse (E. Carter, pers. comm., 1995). In southeastern Florida, Biscayne prickly-ash is found exclusively on barrier islands from Palm Beach to Dade counties. It was probably present at Cape Florida prior to massive disturbance. Biscayne prickly-ash is listed as critically imperiled by FNAI; it is listed as endangered by FDACS; it is not listed by USFWS.

The population of Biscayne prickly-ash presently at Cape Florida should be protected. The restoration of significant areas of coastal strand will create additional habitat for this species, and the augmentation of the present population should be seriously considered.

7.2 Priority B Taxa

Priority B taxa are taxa that are considered by FNAI to be rare in the state. These taxa should receive significant management concern. Under no circumstances should extirpations of natural populations of these taxa be allowed to occur. If needed, population numbers should be increased, so long as this does not adversely impact natural community level restoration; extirpated taxa should be strongly considered for re-introduction.

Acrostichum aureum (golden leather fern).

This large fern is not presently known from Cape Florida, but has been recorded at Crandon Park (Fairchild Tropical Garden 1991). In southeastern Florida, golden leather fern is found in tidal swamps and marshes. It was probably present at Cape Florida prior to massive disturbance. Golden leather fern is listed as endangered by FDACS; it is not listed by USFWS.

The restoration of significant areas of tidal swamp and tidal marsh will provide new habitat for this rare fern, and it should be strongly considered for re-introduction.

Argusia gnaphalodes (sea-lavender).

This medium shrub grows in open sands on the front line of the coastal strand immediately adjacent to the beach dune. Only a few individuals are presently known from Cape Florida. Sea-lavender is listed as endangered by FDACS; it is not listed by USFWS.

Some consideration should be given to augmenting this population.

Cyperus pedunculatus (=*Remirea maritima*; beach-star).

This diminutive sedge grows in open sand on the beach dune at Cape Florida. The population is apparently secure, assuming no major beach erosion or significant damage due to foot or vehicular traffic. Beach-star is listed as endangered by FDACS; it is not listed by USFWS.

This population should be monitored to ensure that it is not damaged by human foot traffic or other types of human disturbances, and to determine if any special actions are required.

Eriogonum longifolium var. **gnaphalifolium** (=*E. floridanum*; scrub-buckwheat).

This herb was recorded for Key Biscayne by MacAllister (1938), but has not been recorded since. Otherwise, this taxon is known as an endemic to central Florida scrub and sandhills (Coile 1993). Scrub-buckwheat is listed as rare by FNAI; it is listed as endangered by FDA; it is listed as threatened by USFWS.

This record should be treated with some skepticism until material at the Duke University herbarium can be examined.

Halophila johnsoni (Johnson's sea-grass).

This marine submerged aquatic grows in shallow water on the Bay side of Cape Florida (R. Hammer. pers. comm., 1995). Johnson's sea-grass is not listed by FDACS; it is not listed by USFWS.

Some work should be done to determine the status of Johnson's sea-grass, as little is known about its abundance at Cape Florida, and what, if any, impact the restoration of the tidal swamp is having on its population.

Pteris bahamensis (Bahama brake).

This medium-sized fern was noted at Cape Florida by Hammer & Popenoe (1992). It was growing in the northern part of the park near what was apparently a perched water

table. It has not been seen since Hurricane Andrew and may be extirpated at Cape Florida. In southeastern Florida, Bahama brake is known from open pinelands from Palm Beach to Monroe counties. Bahama brake is not listed by FDACS; it is not listed by USFWS.

The restoration of significant areas of coastal strand and mesic flatwoods will provide new habitat for this fern and it should be considered for re-introduction. Before such a re-introduction is conducted, however, all China brake (*Pteris vittata*) should be eliminated from the park, as it will hybridize with Bahama brake.

Sophora tomentosa var. **truncata** (necklace-pod).

This shrub grows in coastal strand at Cape Florida, which is its primary habitat in southeastern Florida. It has also been out-planted as part of the restoration process. Unfortunately, there are several distinct forms of this necklace-pod in south Florida; the one typically found on the barrier islands of southeastern Florida has leaves which are glabrous or sparingly pubescent. A form with very hairy leaves has been cultivated from material originally collected from southwestern Florida and is the form which has been out-planted at Cape Florida. Necklace-pod is not listed by FDACS; it is not listed by USFWS.

The hairy from of necklace-pod, which has been out-planted at Cape Florida, should be removed from the park. Follow-up surveys should be conducted to determine if the two forms have hybridized.

Swietenia mahagoni (West Indian mahogany).

This tree has been cultivated and out-planted near the Cape Florida headquarters. It is native to the Florida Keys and the northern shores of Florida Bay (Little 1978) and is outside of its natural range at Cape Florida. West Indian mahogany is listed as endangered by FDACS; it is not listed by USFWS.

Any remaining individuals of West Indian mahogany should be removed from the park.

Thrinax morrisii (silver thatch palm).

This small palm was cultivated near the Cape Florida Light House (R. Hammer, pers. comm, 1995). It is growing outside of its natural range at Cape Florida (see Little 1978). Silver thatch palm is listed as commercially exploited by FDACS; it is not listed by USFWS.

Any remaining individuals of silver thatch palm should be removed from the park.

Tillandsia flexuosa (banded wild-pine).

This epiphytic bromeliad was historically noted for Key Biscayne by MacAllister (1938). It was not recorded in recent years at either Cape Florida or Crandon Park, and is now thought to be extirpated on Key Biscayne. In south Florida, banded wild pine typically grows in coastal hammocks and scrub (Wunderlin 1982; Gann, pers. obs.), and it was probably present at Cape Florida prior to massive disturbance. Banded wild-pine is listed as threatened by FDACS; it is not listed by USFWS.

The restoration of significant areas of tidal swamp and maritime hammock at Cape Florida will provide new habitat for this taxon, and it should be considered for re-introduction.

7.3 Priority C Taxa

Priority C taxa are taxa that are listed as endangered, threatened or commercially exploited by FDA, but which are not listed by FNAI or USFWS. These taxa should receive moderate management concern. At a minimum, extirpations of natural populations of these taxa should be prevented. Extirpated taxa should be considered for re-introduction.

Acrostichum danaeifolium (giant leather fern).

This large fern grows in freshwater wetlands at Cape Florida. In southeastern Florida it is found in a variety of wetland situations. Giant leather fern is listed as threatened by FDACS.

The restoration of isolated wetlands at Cape Florida will provide additional habitat for this species, and its population can be augmented as part of the restoration process.

Aceolorrhaphe wrightii (paurotis palm).

This large clumping palm was cultivated and planted near the front entrance of the park. It is native to southwestern Florida (Little 1978) and is growing outside of its natural range at Cape Florida. Paurotis palm is listed as threatened by FDACS.

Any remaining plants of paurotis palm should be removed from the park.

Anemia adiantifolia (pine fern).

This small fern has been recently found growing at Cape Florida by Carter (1995b) in disturbed coastal strand (E. Carter, pers. comm., 1995). Although it may represent a recent introduction, this seems unlikely since this species is rarely cultivated. In southeastern Florida, pine fern grows in open pinelands from Martin County to the Florida

Keys. Pine fern is listed as threatened by FDACS.

This population should be surveyed to determine if any special action is required.

Clusia rosea (pitch-apple).

This hemi-epiphytic[1] tree has been cultivated and out-planted near the Cape Florida Lighthouse (Hammer 1995). It is doubtfully native to south Florida, but even if it is, then it is well outside of natural range at Cape Florida (see Little 1978). Pitch-apple is listed as endangered by FDACS.

Any remaining individuals of pitch-apple should be removed from the park.

Encyclia tampensis (butterfly orchid).

This epiphytic orchid was historically noted on Key Biscayne by MacAllister (1938), and it has been recorded in recent years at Crandon Park (Fairchild Tropical Garden 1991). In southeastern Florida, butterfly orchid is found in tidal swamps and maritime hammocks (Wunderlin 1982; Gann, pers. obs.). It was probably present at Cape Florida prior to massive disturbance. Butterfly orchid is listed as threatened by FDACS.

The restoration of tidal swamp and maritime hammock will provide new habitat for this taxon at Cape Florida, and it should be considered for re-introduction.

Ernodea littoralis var. **littoralis** (beach golden creeper).

This woody ground cover grows in open patches of sand on the leeward side of the beach dune and in the coastal strand at Cape Florida. Beach golden creeper is listed as threatened by FDACS.

This population should be monitored to determine if any special action is required.

Habenaria odontopetala (rein orchid).

This terrestrial orchid grew in the understory of the Australian-pine forest prior to Hurricane Andrew (R. Hammer, pers. comm., 1995). Although it has not been seen recently, it is probably still present in the park. The habitat of rein orchid in south Florida is primarily moist, shaded environments. It is listed as threatened by FDACS.

The restoration of maritime hammock will re-create habitat for this orchid, and the

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[1] A hemi-epiphyte starts its life cycle as an epiphyte (usually in the top of another tree) and sends roots down to the ground, thus ending its life cycle as a tree.

augmentation of any existing population or the re-introduction of a new population should be considered after the maritime hammock reaches an appropriate level of maturity.

Nephrolepis biserrata (sword fern).

This large fern is not presently known from Cape Florida, but it has been recorded at Crandon Park (Fairchild Tropical Garden 1991). In southeastern Florida sword fern is found primarily in hammocks. It may have been present at Cape Florida prior to massive disturbance. Sword fern is listed as threatened by FDACS.

The restoration of maritime hammock will provide new habitat for this taxon at Cape Florida, and it should be considered for re-introduction. Before such a re-introduction is conducted, however, all populations of other species of Nephrolepis should be eliminated from the park as they may hybridize with sword fern.

Okenia hypogaea (beach-peanut).

This annual herb grows in open sand in beach dune at Cape Florida, which is its typical habitat is southeastern Florida.

This population should be surveyed to determined if any special action is needed.

Opuntia stricta (a prickly-pear cactus).

This cactus grows in coastal strand at Cape Florida, which is one of its primary habitats in south Florida. It is listed as threatened by FDACS.

This population should be surveyed to determine if any special action is needed.

Osmunda regalis var. spectabilis (royal fern).

This medium-sized fern was historically noted on Key Biscayne by MacAllister (1938). It has not been recorded in recent years at either Cape Florida or Crandon Park, and is now thought to be extirpated on Key Biscayne. In southeastern Florida, royal fern typically grows in marshes and swamps (Gann, pers. obs.). It was probably present at Cape Florida prior to massive disturbance. Royal fern is listed as commercially exploited by FDACS.

The restoration of isolated wetlands at Cape Florida will provide new habitat for this taxon at Cape Florida, and it should be considered for re-introduction.

Psilotum nudum (whisk fern).

This small fern relative was observed growing on the bases of cabbage palms

(Sabal palmetto) prior to Hurricane Andrew (R. Hammer, pers. comm., 1995). Although it has not been recorded recently, it is probably still present at Cape Florida. Moist, shaded environments are the primary habitat for whisk fern in south Florida. Whisk fern is listed as threatened by FDACS.

The restoration of maritime forest will re-create new habitat for this fern, and the augmentation of any existing population, or the re-introduction of a new population should be considered after the maritime hammock reaches an appropriate level of maturity.

Scaevola plumieri (inkberry).

This shrub grows primarily in the ecotone between beach dune and coastal strand at Cape Florida, which is its typical habitat in southeastern Florida. Inkberry is listed as threatened by FDACS.

This population should be surveyed to determine if any special action is needed.

Suriana maritima (bay-cedar).

This shrub grows primarily in the ecotone between beach dune and coastal strand at Cape Florida, which is its typical habitat in southeastern Florida. It has also been out-planted as part of the restoration process. Bay-cedar is listed as endangered by FDACS.

This population of should be surveyed to determine if any special action is needed.

Tillandsia balbisiana (reflexed wild-pine).

This epiphytic bromeliad was historically recorded for Key Biscayne by MacAllister (1938). It has not been recorded in recent years for either Cape Florida or Crandon Park, and is now thought to be extirpated on Key Biscayne. In southeastern Florida, reflexed wild-pine grows in hammocks, pinelands, and scrub (Wunderlin 1982; Gann, pers. obs.). It was probably present at Cape Florida prior to massive disturbance. Reflexed wild-pine is listed as threatened by FDACS.

The restoration of tidal swamp and maritime hammock at Cape Florida will provide new habitat for this taxon, and it should be considered for re-introduction.

Thelypteris interrupta (a shield fern).

This terrestrial fern is not presently known from Cape Florida, but has been recorded for Crandon Park (Fairchild Tropical Garden 1991). In southeastern Florida, interrupted shield fern is found growing in wet freshwater areas, primarily wet hammocks and cypress swamps (Wunderlin 1982; R. Hammer, pers. comm., 1995). It may have been present at Cape Florida prior to massive disturbance. Interrupted shield fern is listed

as threatened by FDA..

The restoration of isolated wetlands at Cape Florida will create new habitat for interrupted shield fern at Cape Florida, and it should be considered for re-introduction.

Triphora gentianoides (an orchid).

This terrestrial orchid was recorded growing around trailers near park headquarters (R. Hammer, pers. comm., 1995). Although it has not been seen recently, it is probably still present in the park. In southeastern Florida, it is found growing in hammocks and surrounding lawns (R. Hammer, pers. comm., 1995).. Triphora gentianoides is listed as threatened by FDACS.

The restoration of maritime hammock will re-create habitat for this species, and an augmentation of its population or the re-introduction of a new population should be considered after the maritime hammock reaches the appropriate level of maturity.

Vittaria lineata (shoestring fern).

This epiphytic fern has been recently introduced to Cape Florida on cabbage palms (*Sabal palmetto*). In southeastern Florida it is typically found in moist to wet protected areas. It is listed as threatened by FDACS.

Shoestring fern should not be expected to persist at Cape Florida.

Zamia integrifolia (coontie).

This small herbaceous gymnosperm grows in coastal strand at Cape Florida. It has also been cultivated and out-planted around the site. In south Florida, coontie typically grows in pinelands, hammock edges, and rarely on coastal dunes (Small 1933; G. Gann, pers. obs.). Coontie is listed as commercially exploited by FDA.

This population should be surveyed to determine if any special action should be taken.

7.4 Other Rare Plant Taxa

Cyperus floridanus (Florida sedge).

This tiny sedge grows in disturbed coastal strand at Cape Florida, and is known from only three other stations in Florida, one each in Dade, Monroe, and Collier counties (K. Bradley, pers. comm., 1995). Very little is known about this species except for the fact that is grows in relatively open, disturbed coastal environments. In the Bahamas, the only other country it is native to, it grows "in sandy sinks" (Correll & Correll 1982, p.

218).

This population should be surveyed to determine if any special actions are needed.

8. ADDITIONAL CONSIDERATIONS

Additional considerations for the Cape Florida Project include fire management and wildlife.

8.1 Fire Management

The use of prescribed fire to restore and maintain mesic flatwoods and coastal strand should be seriously considered. Primary responsibility for prescribed burning should be assumed by the Florida Park Service. Assistance for such a program could be provided by Metro-Dade Fire and Rescue, Florida Division of Forestry, The Nature Conservancy, and trained volunteers.

A fire management plan for Cape Florida must be written as soon as possible. The plan must consider the surrounding land uses, safety issues in the event of wildfire, and the ecological consequences of specific fire management strategies. It should also address the role of fire in each of the natural communities on the site. A program of public education should be initiated concerning the pyrogenic histories of the natural communities at Cape Florida.

Both coastal strand and mesic flatwoods are probably dependent on fire for their long-term restoration and maintenance. Given the extensive alterations that have been made to the local landscape, lightning-induced fire can not be expected to fulfill the fire needs of these communities. Fire management units should be relatively large, so that fires can burn through ecotones and move in a more natural, spotty fashion across the landscape. The resulting patchwork of burned and unburned areas within a management unit would produce a mosaic of vegetation at various stages of maturity, thereby maximizing diversity within and among communities. This would provide habitats for individual species which favor, or may be restricted to, communities in a particular state of maturity.

The defensibility of management units, however, is another important consideration. They must not be so large that control of a prescribed fire and attendant smoke becomes difficult or tenuous. This is especially important at sites such as Cape Florida where public fear of fire, as well as restrictions on the production of smoke, may override preferable ecological fire design.

Active fire suppression measures that rely upon the use of heavy machinery and plowlines are extremely destructive to native vegetation and other natural features. In the event that such measures become necessary to control a fire, all plowlines should be backfilled and other disturbed areas rehabilitated to the greatest extent possible. Avoidance of active fire suppression measures of this type should be strongly emphasized.

To the extent possible, the seasonality and frequency of prescribed fires should

seek to mimic the natural incidence of fire in the site's natural communities. Generally, prescribed fires should be conducted during the growing season, which extends from early spring to late fall. The natural incidence of winter fire is presumed to have been quite low. Prescribed winter fires, therefore, should be similarly rare in occurrence to ensure that fire events are in synch with the fire-adapted life histories and phenologies of resident species.

8.2 Wildlife

A total of 13 species of invertebrates, 16 species of reptiles and amphibians, one species of fish, 79 species of birds, and 6 species of mammals have been recorded since June 1994 at Cape Florida (Appendix B). The effect of ecological restoration on wildlife at Cape Florida has not been investigated to any great extent and deserves a significant amount of attention. Any work on wildlife should include an investigation of the invertebrate fauna of Cape Florida (Huck 1993).