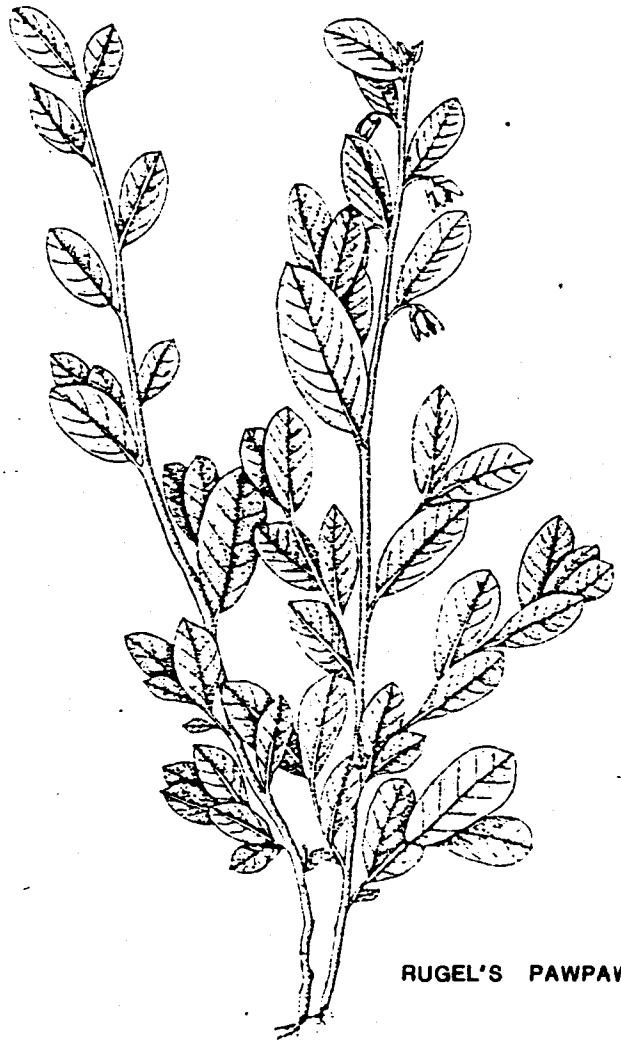
RECOVERY PLAN
FOR
THREE FLORIDA PAWPAWS



RUGEL'S PAWPAW

RECOVERY PLAN FOR THREE FLORIDA PAWPAWS

Four petal pawpaw (*Asimina tetramera*) -
Beautiful pawpaw (*Deeringothamnus pulchellus*)
Rugel's pawpaw (*Deeringothamnus rugelii*)

Prepard by

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Approved: _____
Regional Director, Southeast Region

Date: April 5, 1988

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Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1988. Recovery Plan for Three Florida Pawpaws. U.S. Fish and Wildlife Service, Atlanta, Georgia. 20 pp.

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RECOVERY PLAN EXECUTIVE SUMMARY

1. Point or condition when the species can be considered recovered?

   Reclassification of the two species of *Deeringothamnus* and of *Asimina tetramera* to "threatened" could be considered when ten viable populations of each species are established at secure sites. Delisting could be considered if 20 such populations are secured.

2. What must be done to reach recovery?

   Asimina tetramera has 4 protected sites, and the two *Deeringothamnus* species have only one. Protected sites must be managed properly, with prescribed burning, brush control, or mowing. A large increase in protected and managed sites is necessary.

3. What specifically must be done to meet the needs of #2?

   Remaining populations must be located, protected, and managed. Propagation and reintroduction of *Asimina tetramera* will be necessary. All three species require proper management of the vegetation within which they occur, by burning at frequent intervals (2-8 years) for *Deeringothamnus* and infrequent intervals for *Asimina tetramera*. Mowing or brush cutting can substitute for fire; for *Asimina tetramera* and other species of the Atlantic coastal scrub (including the threatened Florida scrub jay), appropriate techniques must be developed and disseminated for management of small tracts of scrub vegetation located in or near urban areas.

4. What management/maintenance needs have been identified to keep these species recovered?

   Habitat would require continued protection and management. Without controlled burns or mechanical vegetation control, these species will likely fall victim to competition from larger trees and shrubs.

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PART I. INTRODUCTION

The four-petal or opossum pawpaw (Asimina tetramera), the beautiful pawpaw or squirrel-banana (Deeringothamnus pulchellus), and Rugel's pawpaw or yellow squirrel-banana (Deeringothamnus rugelii) are shrubs of the custard apple family (Annonaceae) native to the Florida peninsula. These three shrubs were determined to be endangered species pursuant to the Endangered Species Act of 1973, as amended, on September 26, 1986 (51 FR 34415-34420). A brief summary of information on the pawpaws is presented in Table 1, and their distributions are shown in Figure 1.

Distribution, Habitats and Population Status

Asimina tetramera has been extirpated from most of its known historic range by two expanding urban areas: West Palm Beach (including Juno Beach) and Stuart (including Jensen Beach and Hobe Sound). Although fragments of the original sand pine scrub vegetation and individual Asimina plants persist on private lands, the species is now largely restricted to Jonathan Dickinson State Park (fewer than 100 plants); Hobe Sound National Wildlife Refuge (fewer than a dozen plants), a Palm Beach County Park (approximately 40 plants), a site that may be purchased for the Savannas State Reserve (a few plants), and the grounds of an office building in Juno Beach (fewer than 70 plants). These sites are protected. Several dozen plants are known to persist on unprotected sites, but those are being rapidly destroyed by real estate development (Austin et al. 1980, Kral 1983, Moyroud 1985).

Deeringothamnus pulchellus occurs in the vicinity of Charlotte Harbor and the Caloosahatchee River from Punta Gorda to Fort Myers in southwestern Florida. The largest known populations are on Pine Island, where the pawpaw occurs in undisturbed flatwoods and in modified flatwoods, on road edges and subdivision lots that are occasionally mowed. A population is known on the mainland in southern Charlotte County on State Road 765 near Pirate Harbor. In the past, the plant occurred in what is now the Cecil M. Webb Wildlife Management Area, owned by the Florida Game and Fresh Water Fish Commission. Plants were also once found in and near Fort Myers. Additional localities would probably be found elsewhere in the general area if a more extensive search is made (Repenning 1985, Wunderlin et al. 1981, Kral 1983). Two sites in southeastern Orlando, Orange County, were discovered in 1986 and 1987 by Steve Riefler of Green Images Nursery. One site is included in the Florida Natural Areas Registry maintained by the Florida Nature Conservancy. These sites and a historic locality at Bithlo in eastern Orange County, indicate that more sites may exist in the Orlando area.

Deeringothamnus pulchellus in Lee and Charlotte Counties is native to longleaf pine and slash pine flatwoods with an understory of wiregrass (mostly Aristida stricta) and low shrubs including evergreen blueberries (Vaccinium myrsinites), saw palmetto (Serenoa repens), wax myrtle (Myrica cerifera), dwarf pawpaw (Asimina reticulata), dwarf oak (Quercus minima), rusty lyonia (Lyonia fruticosa), and tarflower (Befaria racemosa). Gopher tortoises and indigo snakes inhabit the sites. The plant is found on poorly drained soil series (Immokalee, Punta, and Myakka), with the water table within 10 inches of the surface for 1-3 months of the year. Nevertheless, the sites are sufficiently high that they do not develop sheet flow during the rainy season (Wunderlin et al. 1981, Kral 1960, Repenning 1985, U.S. Department of Agriculture 1984a, 1984b). Sheet flow is widespread in interior portions of these counties.

Deeringothamnus rugelii occurs near the Atlantic coast north of Cape Canaveral west of New Smyrna Beach. Seven known sites are within one mile of the intersection of Interstate 95 and Road 44, and an eighth site is 12 miles southwest of New Smyrna Beach and two miles northeast of Lake Ashby. These eight sites contain fewer than 500 individual plants (Norman and Brothers 1981).

Deeringothamnus rugelii occurs in slash pine flatwoods with an understory consisting of grasses and sedges such as: wiregrass (Aristida stricta), broomsedge (Andropogon virginicus), Paspalum species, Lachnocaulon anceps, and Cyperus polystachyos. The shrub layer includes: gallberry, wax myrtle, rusty lyonia, shiny lyonia (Lyonia lucida), tarflower, saw palmetto, and pawpaws (Asimina reticulata and Asimina pygmaea). The soils are spodosols of the Myakka and Immokalee series, with seasonally fluctuating water tables. The sites are on gentle ridges left by ancient shorelines. The "ridges" are strips of poorly drained soils bordered by swamps. One site in Volusia County is on a soil of the Satellite series, with vegetation characteristic of excessively drained sand including sand pine, rusty lyonia, sand live oak (Quercus geminata), and Asimina pygmaea, (Norman and Brothers 1981). Sites with extant populations of Deeringothamnus rugelii are used as cattle pastures, road edges, and a power line right-of-way.

Reproductive Status

Asimina tetramera has flowers, and probably pollinator relations, similar to those of A. pygmaea. "Both have

TABLE 1. Summary information on the three pawpaws

	Four petal pawpaw *Asimina tetramera*	Beautiful pawpaw *Deeringothamnus pulchellus*	Rugel's pawpaw *Deeringothamnus rugelii*
Description	Shrub up to 3 m (10 ft) tall. Leaves deciduous, 5-10 cm long. Flowers with 4 sepals; 6 petals in two sets of three with the outer petals longer. Petals pink to maroon. Flower odor fetid. Berries fleshy, with edible flesh, peanut-shaped, up to 9 cm long. Seed dark brown, shape & size like kidney bean.	Low shrub 0.1-0.2 m tall. Leaves leathery but deciduous, 4-7 cm long. Flowers with 3 sepals; 6-10 (rarely 12) petals. Petals creamy white (or pink), 2-3 cm long, straight when the flowers open, curving back later. Flower odor pleasing. Berries fleshy, 4-7 cm long. Seed brown, shape & size like a bean.	Low shrub, similar to *Deeringothamnus pulchellus*. Flowers similar to *D. pulchellus*. Petals canary yellow, broader than those of *D. pulchellus* and not curving back. Flower odor lacking. Berry and seed like *D. pulchellus*.
Distribution	Eastern Palm Beach & Martin Counties, Florida, from north of West Palm Beach to a few miles north of Stuart, at the Savannas State Reserve.	Charlotte & Lee Counties, Florida, from south of Punta Gorda and west of Fort Myers; eastern Orange County, in south-eastern Orlando.	Southern Volusia County, Florida, west of New Smyrna Beach.
Habitat	Sand dunes near Atlantic Coast. Excessively drained sand soil. Sand pine scrub vegetation with sand pine and evergreen oaks. Infrequent, intense fires (perhaps every 20-80 years; the longer the interval between fires, the more intense the fire).	Poorly drained flatwood soils that are nevertheless slightly drier than most soils in the area. Longleaf pine or south Florida slash pine flatwoods with wiregrass understory. Frequent low-intensity fires (every few years).	Poorly drained flatwoods soils, except for one site on dry sand soil. Slash pine flatwoods with wiregrass understory. Frequent low-intensity fires (every few years).
Phenology	Flowering late March-early June. Fruit with ripe seed collected mid July-early Aug. Fresh seed on ground in late Sept. (Moyroud 1988)	Flowering April-June (later if plants are disturbed).	Flowering April-June (later if plants are disturbed).

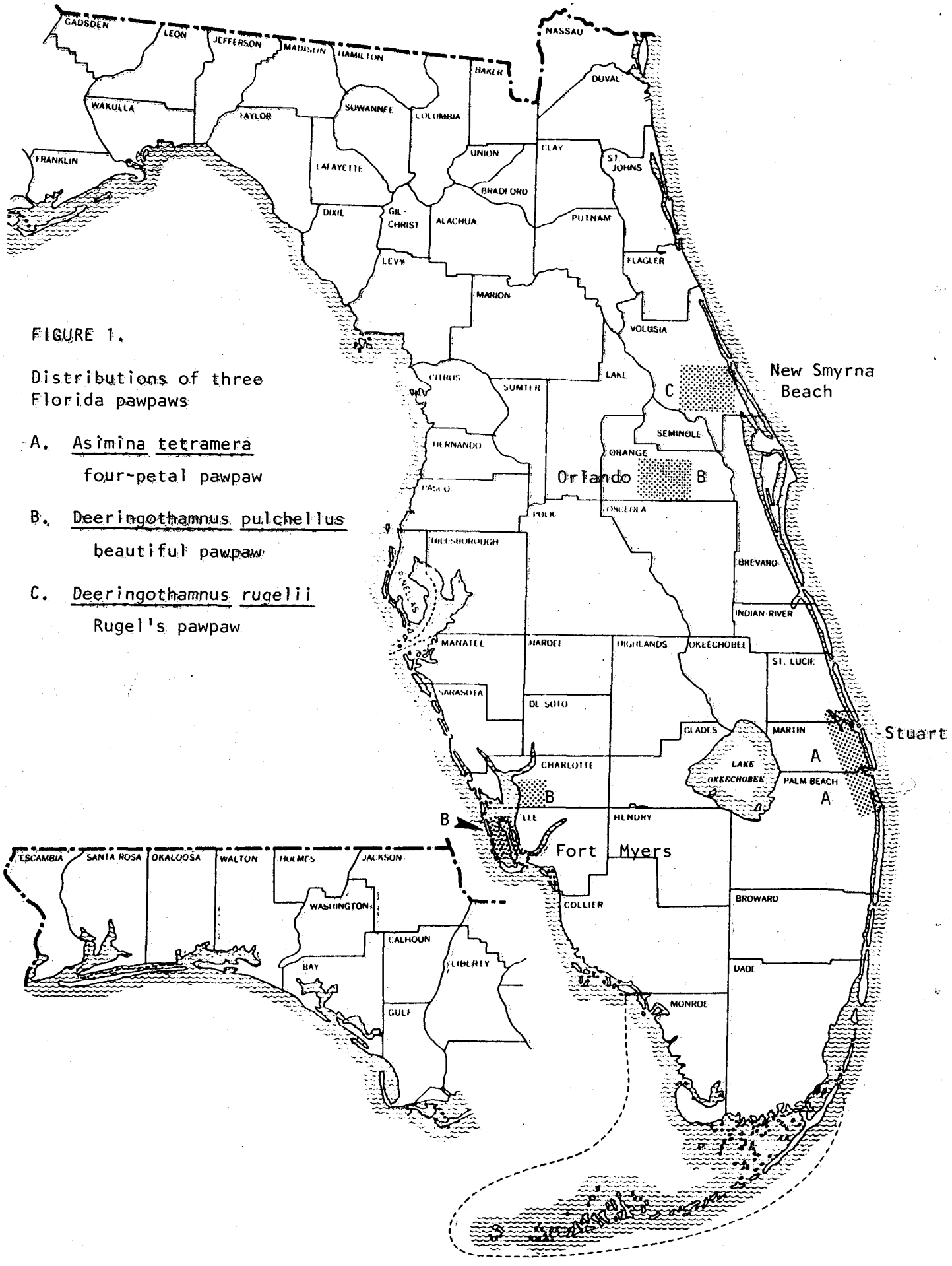

FIGURE 1.

Distributions of three Florida pawpaws

A. Asimina tetramera
four-petal pawpaw

B. Deeringothamnus pulchellus
beautiful pawpaw

C. Deeringothamnus rugelii
Rugel's pawpaw

maroon-pigmented, fetid smelling flowers with the same general petal outline" (Kral 1960, p. 260). Flowers and fruit are borne most abundantly on young sprouts that grow from cut or burned-back stumps (Kral 1960), so most reproduction probably occurs after fires. Gopher tortoises are abundant at some Asimina tetramera sites, and have been observed eating the fruits, thus perhaps assisting in seed dispersal (Moyroud 1986). Some fruits, however, merely fall to the ground. Germination has not been observed in the wild; seed lying on the ground under shrubs usually has holes bored by insects. The large seeds have oily endosperm and thus a short period of viability. An attempt to propagate this pawpaw from seed showed that seed collected from fresh, ripe fruits germinated well, but older seed (with or without insect holes) did not germinate. Stored seeds failed to germinate. Growth was slow, with development concentrated in the root system, which is sensitive to transplanting disturbance. One plant flowered when it was two years old (Moyroud 1985).

Deeringothamnus pulchellus has white flowers, with a "faint but very pleasant" odor (Kral 1983). The flowers and fruit of D. rugelii are similar.

Both species of Deeringothamnus are adapted to frequent ground fires. Such fires limit the growth of larger shrubs that would otherwise compete with these miniature pawpaws. The above-ground stems of Deeringothamnus can bear seed and fruit the first year after a fire, and appear to live for only one or two years (Wunderlin et al. 1981).

For all three species, fire may release nutrients needed for reproduction and seedling establishment. Mowing or brush removal may not substitute satisfactorily over the long term for periodic burning, which releases nuturients that can support flowering and fruiting.

Limiting Factors

Little is known about some of the factors that may be important in limiting these species, including predation by insects and diseases.

Most of the sand pine scrub vegetation to which Asimina tetramera is restricted has been destroyed by urban development. Thus habitat loss is the major limiting factor. Within the remaining scrub vegetation, the frequency of fire probably constitutes a secondary limiting factor. Relatively frequent fires may favor Asimina tetramera in competition with scrub oaks, which can grow

larger and taller. Seed predation by hole-boring insects seems to be severe (Moyroud 1988).

Deeringothamnus pulchellus is restricted to grassy flatwoods in a limited geographic area in peninsular Florida. It apparently does not co-occur with Asimina reticulata (Steve Kiefler, pers. comm. 1988). Urban development, especially on Pine Island and in Fort Myers, has limited the amount of available habitat for Deeringothamnus pulchellus. Within the remaining habitat, the frequency of fire or of equivalent mowing is critical to this pawpaw. Fires or mowing at intervals of 1-3 years benefit Deeringothamnus.

Deeringothamnus rugelii is limited by loss of much of its flatwoods habitat to urban development and pine plantations. Kral (1983, pp. 455-456) notes that "any site preparation that involves shearing at the ground level would tend to increase it, having an effect similar to fire in reducing competition. Discing has been demonstrated to increase this sort of species, in that new shoots can arise adventitiously from the cut roots, but deep plowing or mounding or the bulldozing of all vegetation into windrows would eliminate the species." Modification of the flatwoods into cattle pastures by controlling shrubs and planting bahia grass has little effect on Deeringothamnus, which is unpalatable to cattle (Norman and Brothers 1981).

Threats to Future Existence

The primary threats to the future existence of these pawpaws are further destruction of the vegetation in which they occur, and successional changes in vegetation that occur in the absence of fire or equivalent mowing or grazing.

PART II. RECOVERY

A. Recovery Objective

Asimina tetramera, Deeringothamnus pulchellus and D. rugelii could be considered for reclassification to threatened status if 10 self-sustaining populations of each species were secured. Delisting could be considered if 20 such populations were secured. There is good reason to expect that more populations of the two species of Deeringothamnus can be discovered if searches are made. Opportunities to secure populations may occur in a variety of ways.

B. Step-down Outline

1. Protect habitat of the listed pawpaws.
   - 11. Search for additional populations.
   - 12. Determine population size and viability of known populations.
   - 13. Improve understanding of ecological requirements.
   - 14. Implement necessary management.
     - 141. Protect sites from destructive alteration.
     - 142. Conduct prescribed burns or equivalent vegetation management.
     - 143. Apply other management measures as needed.
   - 15. Monitor success of all populations; change management practices if so indicated.
2. Enforce available protective legislation.
   - 21. Initiate Section 7 consultation when applicable.
   - 22. Enforce take and trade prohibitions.
3. Provide public information about the pawpaws.
   - 31. Provide information to public agencies.
   - 32. Inform and enlist the assistance of private organizations.
4. Augment natural populations of listed pawpaws.
   - 41. Develop reintroduction procedures.
   - 42. Identify potential reintroduction sites.
   - 43. Hand pollinate flowers.
   - 44. Collect seed.
   - 45. Propagate plants.
   - 46. Reintroduce plants; monitor introduction success and modify procedures as necessary.
5. Conserve germ plasm.

C. Outline Narrative

1. Protect habitat of the listed pawpaws. The three pawpaws appear to have always had very limited geographic ranges.

Asimina tetramera has lost most of its presumed historic habitat to urban development. Deeringothamnus pulchellus has lost habitat to urban development and to subdivisions where streets are laid out but houses are not developed. Deeringothamnus rugelii has lost habitat to pine plantations, sod farming, and urban development. Without protection and proper management, the remaining sites for these plants will deteriorate or be developed.

11. Search for additional populations. The probable range of Asimina tetramera has been searched, but individual plants are difficult to find among scrub oaks, and can be confused with Asimina reticulata. An update is needed on the status of known, unprotected populations. Searches for the two species of Deeringothamnus in pine flatwoods habitats in Lee, Charlotte, eastern Orange, and southern Volusia Counties may prove productive. The C. M. Webb Wildlife Management Area in Charlotte County should be searched, since Deeringothamnus was collected there in the 1920's. The Area may have become wetter due to diversion of water from nearby areas, but it otherwise still appears to be suitable habitat for Deeringothamnus. Searches should be conducted when the plants are in flower. Special efforts should be made to search recently-burned tracts of suitable flatwoods, since fires stimulate flowering and make the pawpaws more visible.
12. Determine population size and viability of known populations. Such evaluations should be conducted during the spring growing season for Deeringothamnus; for Asimina tetramera, map and label individual plants for future monitoring.
13. Improve understanding of ecological requirements. Reliable information on the phenology of flowering and fruiting for all three species would be valuable. The habitat requirements of Asimina tetramera are relatively well understood; however, observation of the relation of flowering to fire, pollination, seed production, and seedling biology would help to guide reintroduction efforts (Task 4). Because seed production by Deeringothamnus appears to be sparse, further study of pollination and seed production could help with seed production for germ plasm conservation (See Tasks 4 and 5).
14. Implement necessary management. D. pulchellus and D. rugelii appear to require habitat maintenance by burning or mowing, at intervals of

several years. Asimina tetramera appears to benefit from burning at irregular intervals of a decade or more.

141. Protect sites from destructive alteration. Asimina tetramera is dependent on its sand pine scrub habitat. A few privately-owned remnants of this habitat remain; it may be possible to arrange for management practices to conserve the pawpaw on some of these sites. A Palm Beach county park with this species appears to require special efforts to control Brazilian pepper and to ensure that public use is compatible with maintaining the native flora.
The two species of Deeringothamnus are not known to be present on any public lands, except for road rights-of-way. Uses of D. rugelii habitat that appear to be compatible with the survival of the species include power line right-of-way management by Florida Power and Light Company and cattle pasture management. The State of Florida completed a Florida State Land Acquisition Plan that advocates incentives for private landowners to protect unique resources on their lands, in cooperation with public environmental agencies (N. Smith, Deputy Director for Park Support Services, Florida Department of Natural Resources, pers. comm. January 1987). Such a program could protect pawpaw sites.

142. Conduct prescribed burns or equivalent vegetation management. In Asimina tetramera habitat, Jonathan Dickinson State Park has a vegetation management plan incorporating prescribed fire for sand pine scrub. Hobe Sound National Wildlife Refuge is preparing a vegetation management plan that probably cannot incorporate fire, due to smoke management problems. Because the flammability of scrub vegetation varies greatly depending on weather conditions and fuel loads, prescribed burning is difficult in this vegetation, although it is not impossible (Doren et al. 1987). Small tracts of scrub such as the one at the Florida Power and Light Company office in Juno Beach could be mechanically cleared at irregular intervals of 10-30 years to simulate the effects of fire (and perhaps to reduce wildfire hazard). The two species of Deeringothamnus are presently known to occur mostly in areas where

there is little opportunity for prescribed fire. Cattle grazing and/or mowing can substitute in some cases.

143. Apply other management measures as needed. Fencing may be needed for some sites, and clearing and mulching around individual Asimina tetramera plants has been suggested.

15. Monitor success of all populations; change management practices if so indicated. Multi-year monitoring of populations is the most effective way to assess the effectiveness of management practices. Permanent plots may be adapted to the varied vegetation and land uses. For Deeringothamnus, population monitoring should not take precedence over searches for new populations.

2. Enforce available protective legislation. State, Federal, and local regulations and programs should be used to protect the listed pawpaws and the ecosystems upon which they depend.

21. Initiate Section 7 consultation when applicable. Section 7 of the Endangered Species Act applies to Federal activities which might affect listed species, especially on Federal lands (Hobe Sound National Wildlife Refuge).

22. Enforce take and trade prohibitions. The three pawpaws are protected by the Endangered Species Act, by the Preservation of Native Flora of Florida Act, by state park regulations, and by U.S. Fish and Wildlife Service regulations on Hobe Sound National Wildlife Refuge. Since Deeringothamnus is inconspicuous and difficult to cultivate, take for commercial purposes and trade are nonexistent. For Asimina tetramera, take has not been a problem. Cutting of branches merely stimulates new growth. One commercial nursery has produced seedlings, and has found that the potential horticultural value of this plant is minimal, due to slow seedling growth and apparent difficulty of transplanting.

3. Provide public information about the pawpaws. Public support may be crucial to the recovery of these species.

31. Provide information to public agencies. Counties, Regional Planning Councils, the Florida Department of Natural Resources, Florida Game and Fresh Water Fish Commission, and other governmental agencies may have jurisdiction over land or activities affecting the pawpaws.

32. Inform and enlist the assistance of private organizations. Conservation groups, including The Nature Conservancy, garden clubs, the Florida Native Plant Society and its member nursery owners, the Hobe Sound Nature Center, and the local press should be kept informed of conservation activities and needs concerning these pawpaws. Some of these private groups may be able to produce suitable education materials; others may be able to arrange for habitat protection.

4. Augment natural populations of listed pawpaws. For Asimina tetramera, augmentation of populations on protected land is appropriate because there is little prospect for protecting additional sites. For Deeringothamnus, augmentation procedures represent a potential future alternative that can be employed after other measures are exhausted.

41. Develop reintroduction procedures. For Asimina tetramera, it will be worthwhile to consider how large the seedlings should be before transplanting. June or July may be the best time of year for transplanting, due to good prospects for rain. A trial reintroduction may be advisable before attempting a full scale project.

42. Identify potential reintroduction sites. Survey native range of Asimina tetramera for suitable reintroduction sites. Ensure adequate protection of those sites. Hobe Sound National Wildlife Refuge may have a suitable site at the recently-acquired Sand Hill tract. Reintroduction sites should be in Palm Beach, Martin, and perhaps St. Lucie Counties.

43. Hand pollinate flowers. For the two species of Deeringothamnus, hand pollination may help produce more seed.

44. Collect seed. The best collection sites would be from sites where long-term survival of the pawpaw is doubtful.

45. Propagate plants. A south Florida nursery produces containerized seedlings of Asimina tetramera using modern production methods, and has demonstrated that the seedlings transplant successfully into native habitat. The propagation method permits the seedlings to develop stout taproots.

46. Reintroduce plants; monitor introduction success and modify procedures as necessary. Young plants of Asimina tetramera develop massive root systems before they grow substantial above-ground stems or flower, so monitoring of individual plants or permanent

plots may have to continue at annual or two-year intervals for 5-10 years before conclusions can be drawn.

5. Conserve germ plasm. Collections of living plants may be established in botanical gardens or arboreta under the auspices of the Center for Plant Conservation. The feasibility of propagating Deeringothamnus has not yet been demonstrated. Long term storage of seed for any of the three pawpaws appears to be impossible (Moyroud 1986).

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PART III. IMPLEMENTATION SCHEDULE

Priorities in Column 4 of the following Implementation Schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

Note: All three species of plants are addressed collectively in the Implementation Schedule due to their similar recovery requirements, although task priorities are indicated by species when different.

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES*

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

* (Column 1) - Primarily for use by the U.S. Fish and Wildlife Service.

IMPLEMENTATION SCHEDULE

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency FWS Region	Division	Other	Estimated Costs FY1	FY2	FY3	Comments/Notes
R-1	Search for additional populations	11	1(D) 3(At)	1 yr	4	FWE	FDNR	5K			
R-1	Determine population size and viability	12	2	1 yr	4	FWE	FDNR	5K			
R-2	Study ecological requirements	13	3	2 yrs.	4	FWE/RF	Univ.	3K	3K		
M-3	Protect sites from destructive alteration	141	1	Ongoing/ Continuous	4	FWE/RF	FDNR				
M-3	Conduct prescribed burns or equivalent	142	2	Ongoing/ Continuous	4	FWE/RF	FDNR, GFWFC				
M-3	Apply other management	143	3	Ongoing/ Continuous	4	FWE/RF					
I-1, M-3	Monitor populations; alter management practices if indicated	15	2(At) 3(D)	Ongoing/ Continuous	4	FWE					
O-2	Enforce available protective legislation	2	3	Ongoing/ Continuous	4	FWE					

IMPLEMENTATION SCHEDULE

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency FWS Region	Division	Other	Estimated Costs FY1	FY2	FY3	Comments/Notes
O-1	Inform public agencies	31	1	2 yrs.	4	FWE		1K	1K		
O-1	Inform and enlist private organizations	32	3	2 yrs.	4	FWE					
M-2	Develop reintroduction procedures	41	2(At) 3(D)	1 yr.	4	FWE		1K			
I-13	Identify reintroduction sites	42	2(At) 3(D)	1 yr.	4	FWE/RF GFWFC					
M-1	Hand pollinate flowers	43	3	2 yrs.	4	FWE					
M-1	Collect seed	44	2(At) 3(D)	2 yrs.	4	FWE					
M-1	Propagate plants	45	2(At) 3(D)	Ongoing/ Continuous	4	FWE		5K	2K	2K	
M-2	Reintroduce plants; monitor success; modify procedures	46	2(At) 3(D)	10 yrs.	4	FWE GFWFC		1K	1K	1K	
M-7	Conserve germ plasm	5	3	Ongoing/ Continuous	4	FWE	CPC, USDA				

LIST OF ABBREVIATIONS

At = *Asimina tetramera* (for priorities)
CPC = The Center for Plant Conservation, including member botanical gardens
D = *Deeringothamnus pulchellus* and *D. rugelii*
FDNR = Florida Department of Natural Resources, Division of Recreation and Parks
GFWFC = Florida Game and Fresh Water Fish Commission
Indiv. = Individuals/Landowners
RF = National Wildlife Refuges, U.S. Fish and Wildlife Service
FWE = Fish and Wildlife Enhancement, Division of Endangered Species, U.S. Fish and Wildlife Service
TNC = The Nature Conservancy
Univ. = Universities or Colleges
USDA = U.S. Department of Agriculture

IV. APPENDIX
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