

Harper's Beauty

(*Harperocallis flava*)

Recovery Plan



HARPER'S BEAUTY RECOVERY PLAN

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LITERATURE CITATIONS SHOULD READ AS FOLLOWS:

U.S. Fish and Wildlife Service. 1983. Harper's Beauty Recovery Plan.
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PART I

INTRODUCTION

Harper's beauty (Harperocallis flava McDaniel) is known only from the Apalachicola region of the Florida panhandle. It was first discovered in 1965 and described in 1968 by Dr. Sidney McDaniel. This represented not only a new species, but also a new genus within the family Liliaceae. And while the Apalachicola region contains many endemic species, this new monospecific genus is its only endemic genus.

The Smithsonian Institution Report, January 9, 1975, made to Congress under Section 12 of the 1973 Endangered Species Act, included Harper's beauty among those plants considered threatened with extinction. The Director of the U.S. Fish and Wildlife Service subsequently treated the Smithsonian Report as a listing petition, and this ultimately led to the lily receiving Endangered status under the Endangered Species Act, effective November 1, 1979, (44 FR 56862-56863). Although not officially listed by the State of Florida, Harper's beauty is considered Endangered by the Florida Committee on Rare and Endangered Plants and Animals (1980).

Harper's beauty is known from three populations. Because most of the population occurs along roadsides, this species is vulnerable to any collecting, vandalism or vehicle parking on road shoulders. Without aggressive efforts at management and protection, it could be reduced considerably in abundance, if not lost from the wild. The objective of this recovery plan is to outline recommendations on protection, management and research which are needed to insure the recovery of Harper's beauty.

Description

Harperocallis flava is a perennial herb that increases by shallow, slender, swollen noded rhizomes. The leaves are basal, linear, equitant, 5-21 centimeters long and 2-3 millimeters wide. The stems are short and usually sheathed at a base of fibrous old leaf bases. A single flower is borne on a stalk much longer than the leaves, and has 2-3 widely separated bracteal leaves persisting in a cup. Tepals 6, (calyx and corolla appearing alike), persisting as in rushes, spreading in anthesis, erect in fruit, oblanceolate, acute, 9-15 millimeters long, yellowish above, greenish beneath, with several lengthwise nerves. Stamens 6, arising around the base of the ovary, ascending-erect, the filaments slender, tapering apically, 6-7 millimeters long, the anthers oblong, attached at the base, 2-3 millimeters long, with a short, peglike apex. The ovary is ovoid, 3-lobed, 7.0-8.5 millimeters long, minutely and copiously bumpy, the lobes each narrowing into separate, button-like stigmas. The fruit is surrounded by erect, greenish, purple-margined tepals, ellipsoidal, 8-9 millimeters long, 3 chambered, with a warty surface. Seeds are narrowly fusiform, pale yellow, 2-3 millimeters long, straight or curved and often twisted. (McDaniel, 1968; Kral, 1982).

Harperocallis flava is most closely related to the genera Pleea, Tofieldia and Narthecium and some species of the first two genera may occur in the vicinity of Harperocallis. The leaves of Harperocallis are almost identical to those of Narthecium and some species of Tofieldia, which makes identification difficult when the species are in the vegetative condition. Harperocallis is distinguished from all other genera of this group by its solitary flower, tuberculate ovary, and calyculus of three (or four) separate bracts in a series below the flower (McDaniel, 1968).

Distribution

When first discovered, Harper's beauty was known from only one population* in Franklin County, Florida. Since then, two additional populations have been found, both in Liberty County. All populations occur along a 32 km stretch of SR-65 (Fig.1). Most of the plants are found in the SR-65 right-of-way, which is maintained and mowed by the Florida Department of Transportation (DOT). Only two of the three populations are thought to be currently extant. In 1982, Leonard and Baker (in press) searched County Road 379 and many of the Forest Service roads in the Wilma-Sumatra vicinity. Although they found "favorable" habitat, they did not locate any additional colonies of Harper's beauty. A brief description of each population follows:

Population 1: This is the originally discovered population. It is found south of Sumatra, Florida in northern Franklin County. It consists of three colonies.

Colony** 1-1: This is the type locality, a titi bog .8 km south of the intersection of SR-65 and FS-101 (2.2 miles south of Sumatra). When originally discovered, this colony contained about 70 plants. However, in May 1978, Levester Pendergrass and Andrew Robinson visited the area and observed only one plant growing on an ant mound in the bog. Pendergrass visited the same locality in May 1981, and had no success in finding the plant previously observed on the ant mound. In 1982, after a brief search, Leonard and Baker (in press) found but two plants within the bog.

*"Population" is used here quite loosely. In its stricter application, "population" would be reserved for those plants which are genetically isolated from other groups of the same species. Since neither the pollinators nor vectors of Harper's beauty are known, the limits of its genetic populations are uncertain. It is entirely possible that all existing and past plants are part of one genetic population. In this text, "population" is used for convenience to differentiate between groupings of plants which occur at some distance from each other.

**"Colony" is used here to indicate major clumpings within populations.

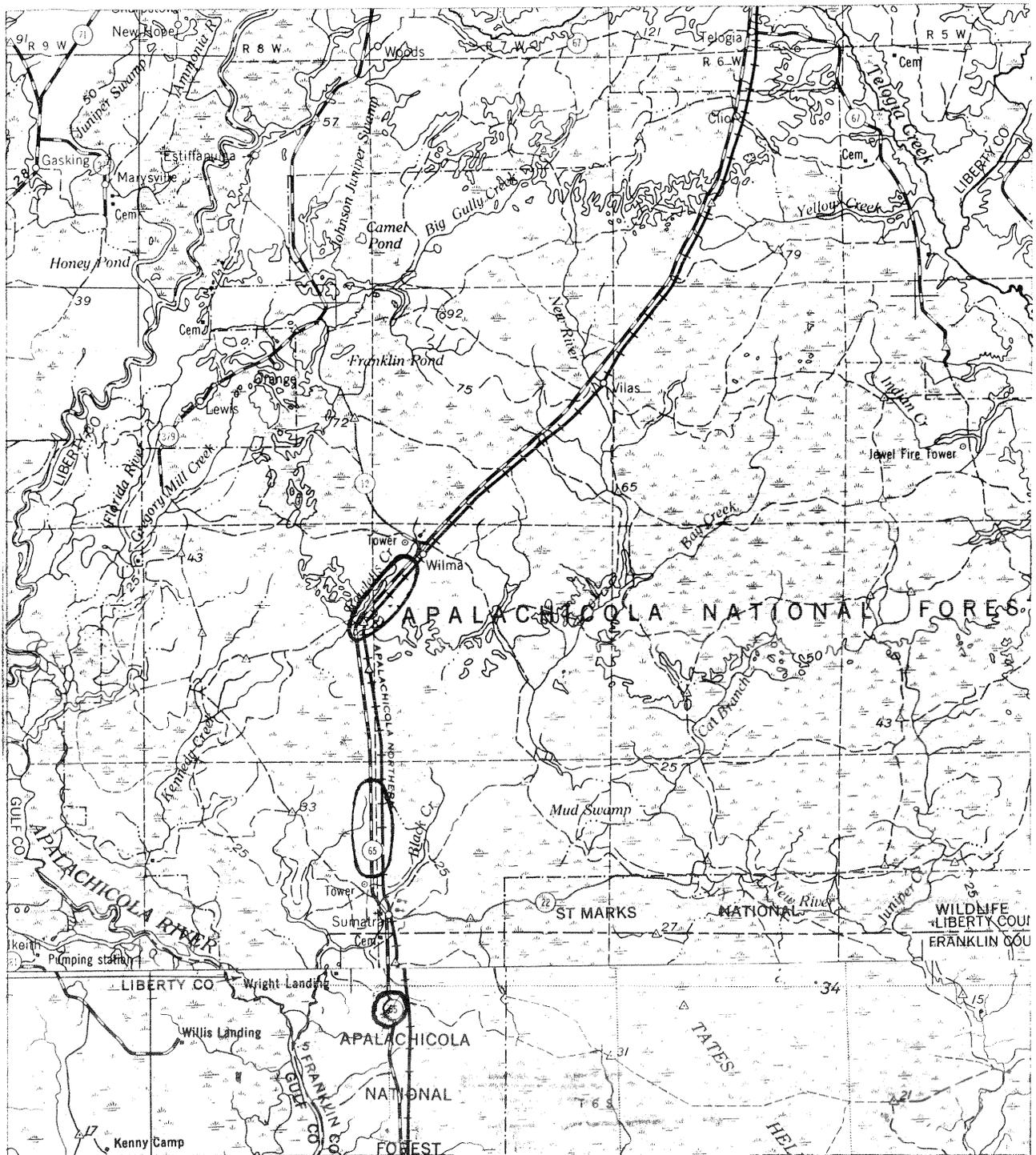


Figure 1. Vicinity map for Harper's beauty. General locations where plants were found in 1982 are circled.

Colony 1-2: This colony is located on the roadside adjacent to the bog. It is within the maintained right-of-way of SR-65. In their May 1978 survey, Pendergrass and Robinson observed several plants growing in this area. Leonard and Baker found approximately 200 flowering and fruiting plants growing here in 1982.

Colony 1-3: This also is a roadside site. This was the colony McDaniel initially found in 1968. No plants were found here in 1982 by Leonard and Baker. It is located .2 km south of Colony 1-1.

Population 2: This population occurs from 1-15 km north of the intersection of County Road 379 and SR-65, just north of Sumatra in Liberty County. This population is a new discovery, having first been found by Leonard and Baker on May 4, 1982, and independently of them, by Pendergrass and Don Bethancourt on May 12, 1982. This population also contains three colonies.

Colony 2-1: This colony is composed of clumps of plants occurring along both sides of SR-65 from 1-5 km north of the above-mentioned intersection. It is estimated to contain 1500 plants.

Colony 2-2: This colony is located to the east of SR-65 in an abandoned telephone right-of-way which parallels the Apalachicola Northern Railroad. This colony is estimated to have 120 plants.

Colony 2-3: The third colony is composed of clumps of plants occurring along both sides of SR-65 from 11-15 km north of the abandoned intersection. The number of plants growing here is estimated to be 4000.

Population 3: The third population is located "several miles north of Wilma" in Liberty County. It is based on a student collection made in April of 1975. Attempts by botanists to relocate this population have been unsuccessful (Leonard and Baker, in press).

Population Status

The number of plants at the type locality has decreased considerably, from 70 plants when first discovered, to only a few in 1982. This decline could be due to drought, competition, or other factors. Without research to determine the reasons for decline, and management to reverse it, this colony may soon be extirpated. Population 3 is presumed extirpated as no one has been able to relocate it. In respect to total numbers of plants, however, the population of Harper's beauty is definitely increasing. When listed in 1979, the total population was around 100 plants, now there are around 6000. However, this increase in the number of plants along the roadside of SR-65 should not be taken as evidence of a recovered state. There are still only two extant populations, both of which have a precarious occurrence along the roadside. There are no healthy populations or colonies occurring in natural bog habitat. No plants have been found outside the historic 32 km range. For these reasons, Harper's beauty should remain classified as an Endangered species.

Reproductive Status

Harper's beauty flowers in May and bears seeds in July. Vegetative reproduction is by rhizomes. The pollinator(s) and vector(s) are unknown. The spread of Harper's beauty along SR-65 could be caused by either a natural vector or the action of the mowers in spreading seeds from previously established areas.

Habitat Description

Harper's beauty, as observed in the past three to four years, has occurred infrequently in and adjacent to open bogs, such as the type locality. It has been most prolific on roadsides in full sun, with a moderate ground cover of savanna species, but distinctly not "grassy," and between the lowest

part of the roadside ditch and the highway pavement (Leonard and Baker, in press). Soil pH at the only colony tested by Leonard and Baker was found to be strongly acidic (+ 4.5). Associated vegetation at the type locality consists of rosebud orchid (Cleistes divaricata), parrot pitcher plant (Sarracenia psittacina), tracey's sundew (Drosera traceyi), and rush featherling (Pleea tenuifolia) occurring beneath isolated individuals of buckwheat-tree (Cliftonia monophylla) and odorless wax-myrtle (Myrica inodora). A dense thicket of buckwheat-tree and slash pine (Pinus caribbaea) surround the bog. The entire bog and thicket are surrounded by sandy, occasionally-burned longleaf pine (Pinus palustris) woods.

Very little is actually known of the autecology of Harper's beauty. Most of the plants are presently found in an artificial habitat: a maintained road right-of-way. The "natural" habitat is presumed to be bog areas, such as the type locality. It is unknown what aspects of these two different habitats meet the environmental requirements of Harper's beauty.

Suspected and Known Limiting Factors

As stated above, the autecology of Harper's beauty is poorly known. The factors which are most limiting to the maintenance and expansion of the species cannot be ascertained without a considerable amount of research effort. The population may be limited in part by site requirements and/or by competition with other plant species. The bog vegetation associated with Harper's beauty is adapted to occasional fire (Godfrey, 1976), and it is reasonable to assume that Harper's beauty is as well. Pendergrass noted that the bog (Colony 1-1) was dry during his visit in May 1981. The absence

of Harper's beauty in this location, at that time, may have been the result of drought as plants growing under moist conditions in the adjacent roadside were doing well. Drought could affect Harper's beauty either through direct water stress to the plants or through environmental changes allowing successional species to out-compete Harper's beauty. Leonard and Baker (in press) speculated that elimination of competitive shrubs, some degree of soil surface disturbance (to prevent formation of a grass mat), and probably fire (to remove competitors and release nutrients) are favorable conditions for perpetuation of Harper's beauty. The latter observation has been supported by the Forest Service's burning activities in the area. It is also possible that the mowing practices of the Florida DOT have eliminated competition, thus allowing Harper's beauty to spread and increase its population.

Threats to Future Existence

Many individuals and societies collect and cultivate lilies. Because Harper's beauty is unusual in being a monotypic genus of the lily family, and because it has a very restricted distribution, it would be of considerable interest to lily enthusiasts. Because of its occurrence along roadsides, the plant is vulnerable to loss from collectors as well as vehicles pulling off the road, road maintenance vehicles, trampling, and vandalism, etc. Publishing detailed location maps could present a threat to the existence of the plant.

The Endangered Species Act of 1973, as amended, prohibits import and export, interstate or foreign commerce, sales or offers to sell Endangered plants in interstate and foreign commerce, and the removal and reduction to possession of any plant species from areas under Federal jurisdiction. Forest Service

regulations prohibit removing, destroying, or damaging any plant that is classified as a Threatened, Endangered or sensitive species. Harper's beauty is not listed by the State of Florida, although it was included by the Florida Committee on Rare and Endangered Plants and Animals as an Endangered species.

Parties Presently Conducting Recovery Actions or Actions Proposed for Such

The Florida DOT maintains and mows SR-65, including the Harper's beauty locations. Correspondence and personal communications with Gary L. Evink, State ecologist for Florida DOT, has provided the following information regarding State actions:

- (1) Inspections of the SR-65 right-of-way were initiated in May 1980, to determine the location of Harper's beauty. This was done with the assistance of Dr. Robert Godfrey and several local biologists. Population 1 was observed along SR-65.
- (2) The mowing schedule has been modified on SR-65 to allow the plants to flower and seed. Also, the use of herbicides has been restricted on this route.
- (3) An annual inspection of the SR-65 right-of-way has been conducted to monitor the plants to determine if any other successful areas are present. It was during this monitoring that Leonard and Baker (in press) discovered the additional population (Population 2).

The Forest Service has designated the area containing the Franklin County plants as a reserved area and have undertaken the following precautions for the perpetuation of Harper's beauty: (1) Burning periodically, (2) Searching similar habitats for new plants, (3) Sending seed for experimental

germination procedures to the North Carolina Botanical Garden, the University of Georgia Botanical Garden, the National Arboretum, and the Henry Foundation for Botanical Research, (4) Planting seeds in five locations of varied habitats that appear to be conducive for Harper's beauty, and (5) Sending seeds to the Macon Tree Seed Laboratory for storage.

PART II

RECOVERY

A. Recovery Objective

Harper's beauty may be considered for delisting when a minimum of five secure wild populations, with a minimum of three colonies each, have been found or established in habitat similar to that of the type locality so as to reestablish colonies away from the roadside. Colony 1-1, the type locality, should be one of these colonies. Criteria regarding minimal percent frequency and cover for each colony needs to be set, but will require prior research. Before a colony can be considered secure it must be protected and managed in such a way as to insure its continued survival. Steps to insure this are outlined below. Harper's beauty could be considered for downlisting to Threatened when five populations have two colonies each or when three populations have three colonies each.

B. Step-down outline

1. Protect habitat and existing colonies of Harper's beauty.
 11. Secure sites on Forest Service lands.
 12. Encourage the State to list Harper's beauty.
 13. Secure sites on State right-of-ways.
 14. Secure sites on other lands.
2. Conduct searches for new colonies.
 21. Identify potential bog habitat.

22. Conduct ground investigations of potential habitat.
 23. Train personnel on how to identify Harper's beauty.
3. Preserve existing germ plasm.
 31. Propagate Harper's beauty, maintaining colonies representative of each natural one.
 32. Deposit seeds from each natural colony in a seed bank.
 33. Deposit pollen from each natural colony in a pollen bank.
 34. Make seed available to academic institutions interested in research.
 35. Make excess seed available to greenhouse owners who are interested in propagating the species.
4. Establish additional colonies.
 41. Select sites for establishing colonies.
 42. Plant seed or young plants.
 43. Secure as in Step 1.
 44. Manage as in Step 5.
5. Monitor and manage colonies to assist and maintain recovery.
 51. Collect baseline data.
 511. Map vegetation at natural sites.
 512. Establish permanent plots, grids, transects, or photo-points.
 52. Conduct autecological research.
 521. Identify pollinators or vectors of dissemination.
 522. Identify limiting factors.
 5221. Study hydrology.
 5222. Study light relations.

- 5223. Examine effects of competition.
- 5224. Identify soil requirements.
- 53. Monitor colonies.
 - 531. Gather data on colony size and reproduction.
 - 532. Check sites periodically for evidence of disturbance, poaching, disease, etc.
- 54. Determine effective management options and implement them.
 - 541. Do experimental burns.
 - 542. Do experimental mowing.
 - 543. Test removal of competing vegetation by mechanical or manual techniques.
 - 544. Determine effects of herbicide usage.
 - 545. Prepare management recommendations.
- 6. Determine appropriate means of public education.

C. Narrative

1. Protect habitat and existing colonies of Harper's beauty.

Protecting existing individuals in the colonies and the habitat upon which they depend probably represents the first and best opportunity for assuring survival of Harper's beauty. This will require careful monitoring and management. Efforts should be made to encourage natural regeneration in the current localities, and to determine the habitat factors essential to maintain and expand the species.

11. Secure sites on Forest Service land.

The type locality for Harper's beauty is found on land belonging to the U.S. Forest Service. The Forest Service has the responsibility under Section 7 of the Endangered Species Act, as amended, to insure that all actions authorized, funded, or carried out by them are not likely to jeopardize the continued existence of a listed species. All management practices are subject to Section 7 review. Management recommendations determined in Step 5 should be followed. A cooperative agreement or memorandum of understanding between the U.S. Fish and Wildlife Service and the U.S. Forest Service should insure protection for Harper's beauty after it is recovered.

The Forest Service has designated 45 acres south of FS-101 and west of SR-65 as reserved for the perpetuation of Harper's beauty. This reserved area has been referred to several times as the "Harperocallis Botanical Area." However, this was a proposal that was never sanctioned by the Regional Forester, and the area is classified as "Reserved."

12. Encourage the State to list Harper's beauty.

The plant is not listed at this time by the State, even though it is included on an unofficial list by the Florida Committee on Rare and Endangered Plants and Animals as an Endangered species.

13. Secure sites on State right-of-ways.

The majority of all plants presently occur on the right-of-way to SR-65 which, although owned by the Forest Service, is maintained by Florida Department of Transportation (DOT). Florida DOT is adjusting their maintenance programs and mowing schedules to protect Harper's beauty. As more information regarding management options and techniques becomes available (Step 5) this new information should be used to modify existing practices. To secure these plants on a long-term basis, a cooperative agreement or memorandum of understanding should be developed between the Fish and Wildlife Service, Florida DOT, and perhaps the Forest Service.

14. Secure sites on other lands.

At present, only one colony occurs on other than Forest Service land. Colony 2-2 is on land owned by the St. Joseph Paper Company. Every effort should be made to secure a cooperative agreement or memorandum of understanding with St. Joseph's to insure that management practices are beneficial to Harper's beauty. If any new colonies are found to occur off of Federal lands, then similar agreements should be reached with these landowners. County Highway Departments should be notified of the possible existence of Harper's beauty along county roads.

2. Conduct searches for new colonies.

Since Harper's beauty was reported (1968), it has only been searched for sporadically. There needs to be a thorough systematic effort to search for new colonies of this taxon. Since it's habitats are scattered throughout the area, it is possible that other colonies could be found, as additional sites were found by Leonard and Baker in 1982. Initial searches should be concentrated in Liberty and Franklin Counties in Florida.

21. Identify potential bog habitat.

Potential habitat can be identified using aerial photos, geologic maps, and soil survey maps. Sources for these materials include the Forest Service, Agricultural Stabilization and Conservation Service, Florida DOT, Army Corps of Engineers, and the Soil Conservation Service.

22. Conduct ground investigations of potential habitat.

Priority should be given to searching suitable sites in the vicinity of reported colonies, since the reported known sites are within close proximity to one another.

23. Train agency personnel in how to identify Harper's beauty.

Since most of the reported sites of Harper's beauty occur within Forest Service administered lands, training field personnel to identify this species would greatly enhance the possibility of finding new colonies. Training County and State DOT field personnel would aid in finding new colonies along road right-of-ways.

3. Preserve existing germ plasm.

A well developed plan for cultivation will ensure that Harper's beauty does not become extinct. Through the refinement of techniques for mass propagation of vegetative material and the dissemination of this material to the private and public sectors, the program will be greatly enhanced. The establishment of pollen and seed banks is very important to the preservation of this taxon. It should be noted that the cultivation program is secondary to efforts aimed at maintaining and expanding the existing colonies through natural regeneration, but it is potentially valuable, nevertheless. If, by some accidental means, the existing colonies of Harper's beauty are destroyed before the establishment of new colonies, future attempts at reestablishment would require the use of cultivated material. Also, to minimize disturbance to the natural

colonies, seed for establishing new and experimental colonies should be obtained from cultivated stock.

31. Propagate Harper's beauty, maintaining colonies representative of each natural one.

Seeds from each of the known colonies should be used to establish populations representative of each natural one. Because of the small number of individuals in Population 1, care should be taken to avoid overcollecting seeds, thereby diminishing the population's chances for survival. Care should also be taken to avoid cross-pollination between the representative populations so as to maintain the genetic distinctions between them.

32. Deposit seeds from each natural colony in a seed bank.

Seed banks established by the Forest Service and/or other agencies will facilitate the conservation of Harper's beauty. The Forest Service has already established a cold storage seed bank in Macon, Georgia. Seeds should be sent to this repository as they become available. As a general rule, when seeds are requested for research and for establishing new colonies to meet the recovery objective, the older seeds should be dispensed first. Each planting should receive seeds from a single population in order to maintain any genetic distinctions. A log should be kept, recording inflow and outflow of seed, dates, names of individuals and agencies, location of colonies represented, and amount of seed.

33. Deposit pollen from each natural colony in a pollen bank.

To further insure genetic diversity and prevent extinction, pollen from extant individuals of flowering age should be deposited in pollen banks. The Forest Service maintains such a bank for tree pollen.

34. Make seed available to academic institutions interested in research.

Institutions electing to do research on Harper's beauty may be interested in starting their own plants. Seed should be made available to do this. The departments of botany and/or horticulture at the following institutions are examples of academic groups with the faculties and facilities to do this type of research: the North Carolina Botanical Garden, the University of Georgia Botanical Garden, the National Arboretum and the Henry Foundation for Botanical Research, to name a few.

35. Make excess seed available to greenhouse owners who are interested in propagating the species.

If seed is plentiful, some could be dispensed to greenhouse owners who desire to grow it. Growers should receive seed from a single population in order to maintain any genetic distinctions, and careful records should be kept identifying who has what seed. Cultivation is not considered critical to recovery, but this does offer a secondary avenue for assuring at least temporary survival of the taxon.

4. Establish additional colonies.

New colonies need to be established, within the historical range of

the species, in order to meet the recovery objective. Many natural bogs occur on Forest Service lands in the vicinity of the present colonies. Some of these sites could be used for establishing new colonies. This would save the cost of acquiring land specifically for this purpose. Monitoring and maintaining the new populations might be easier utilizing staff that is already managing public lands.

41. Select sites for establishing colonies.

Initially, it would be most appropriate to select sites close to the presently known area of occurrence in Franklin and Liberty Counties. Areas located in Step 2 should be the most suitable areas.

42. Plant seed or young plants.

New colonies can be started either from seed or by transplanting young plants. Working with seed should be the most cost effective procedure. Transplant only if seed germination does not work. Populations should be kept genetically distinct.

43. Secure as in Step 1.

All new colonies should be protected on a long-term basis in the same way that present colonies are.

44. Manage as in Step 5.

To insure their initial and long-term survival, all new colonies should be managed using the best available management procedures. Research, as provided for in Step 5, should give this information.

5. Monitor and manage colonies to assist and maintain recovery.

Since ecosystems are dynamic, populations can be expected to undergo

some natural changes. Populations also change in response to human-related causes. Changes due to both nature and man need to be monitored both before and after recovery. Some active management will probably be necessary to insure that the recovery objective can be met. Management techniques used should be based on sound research.

51. Collect baseline data.

For future monitoring to have any significance, it is essential to gather baseline data on each colony and its habitat.

511. Map vegetation at natural sites.

Mapping vegetation patterns at the sites for each colony, both those currently extant and those to be established, will teach us more about habitat requirements for Harper's beauty and about successional patterns in the bogs.

512. Establish permanent plots, grids, transects or photo-points.

The purpose of permanent sampling stations is to monitor changes in the colonies. Therefore, any increase or decrease in the size of a colony, and the number of individuals, flowers and/or seedlings will be detected. Photo-points should be one of the easiest ways to monitor general changes through time. Pictures should be taken at least annually, possibly seasonally, repeating at the same time each year. The height and compass direction for each photo should be constant at each site. More specific information such as the numbers of individuals, flowers, or seedlings and percent cover and frequency will have to be determined using other means.

52. Conduct autecological research.

Autecological research on Harper's beauty is lacking and is very much needed for successful management and recovery.

521. Identify pollinators or vectors of dissemination.

The pollinators and/or vector(s) of dissemination are presently unknown. Determining their identities may explain the reason for the limited distribution of Harper's beauty.

522. Identify limiting factors.

Management of this species would be greatly helped if growth limiting factors were known. Limiting factors may be chemical, physical or biological.

5221. Study hydrology.

Since this species occurs in open wet areas, it is very important to obtain knowledge relative to the role of water in the occurrence of Harper's beauty. A chemical analysis of the water in the ditch might also determine if anything is being leached from the road surface area. It may be that the road and accompanying roadside ditch are adversely affecting the habitat carrying capacity or micro-climate of the adjacent type locality. This should be researched.

5222. Study light relations.

Since Harper's beauty seems to occur in open areas, an evaluation of the light relations would add information relative to light as a limiting factor in the growth of the plant.

5223. Examine effects of competition.

Determining how large a role competitive vegetation plays should be the bases for new experimental strategies. Testing common associates is a recommended method.

5224. Identify soil requirements.

Determine soil series and soil chemistry to help with identification of potential habitat.

5. Monitor colonies.

Careful and frequent monitoring of colonies can detect problems at an early stage when they are hopefully easier and less costly to correct.

531. Gather data on colony size and reproduction.

With the use of measures outlined in Step 512, information can be gathered relative to colony fluctuations. Decline in reproductive levels can be used as early indicators that habitat improvement work might be necessary.

532. Check sites periodically for evidence of disturbance, poaching, disease, etc.

Site monitors should be assigned to briefly examine each colony on a frequent basis and report damages to the appropriate official.

54. Determine effective management options and implement them.

The most practical research that can be done concerns experimenting with management techniques, especially those techniques which will allow Harper's beauty to thrive in its natural bog habitat. The best present information suggests that maintenance of this species is dependent primarily on: (a) continuance of some openings in the titi-pineland bog transition, (b) maintenance of the habitat's historical

hydrology, and (c) occasional ground fires to reduce competing grass-sedge and woody vegetation. Studies are needed to resolve the uncertainties as to the type and frequency of habitat management which should be applied. When effective management techniques have been identified, they should be implemented as soon as possible. This experimental management should be done on colonies established for this purpose and not on natural colonies.

541. Do experimental burns.

Godfrey (1976) notes that the vegetation associated with Harper's beauty is adapted to occasional fires, and suggests that it be determined whether the bog should be burned periodically. The Forest Service has been burning the Harper's beauty bog habitats to keep back competition due to natural succession. However, the fire did not reach the roadside ditch where most of the Harper's beauty plants are currently growing. Experimental burning needs to be done to see if fire is indeed important to Harper's beauty, and if it is, to determine how and when burning should take place.

542. Do experimental mowing.

The most abundant population of Harper's beauty occurs along the roadside where Florida DOT mows the roadside periodically. Mowing may be removing competition, allowing the plants to grow. Mowing should be done after seed set (August-September). Whether or not this is a practical management technique in the natural bog habitat is doubtful.

543. Test removal of competing vegetation by mechanical or manual techniques.

The habitat may be improved by periodic selective removal of all or some of the associated taxa. Hand removal might prove better than burning or mowing for monitoring Harper's beauty while suppressing succession. Bush-hogging, or other mechanical methods, while not selective, could be looked at as an alternative method of controlling competing vegetation.

544. Determine effects of herbicide usage.

Florida DOT is currently restricting the use of herbicides on the right-of-way where Harper's beauty is found. Considering the habitat type that Harper's beauty is found in, some research into the types of herbicides used in the area that may affect Harper's beauty through runoff should be done.

545. Prepare management recommendations.

Using the above autecological and managerial research, recommendations should be made concerning the best way(s) to maintain Harper's beauty and its habitat. These recommendations should be made available to all agencies or individuals with management authority over the species and its habitat, and should be made a part of all management agreements.

6. Determine appropriate means of public education.

The recovery effort should include a positive education program. Brochures and/or interpretive exhibits at Forest Service Ranger Stations or nearby nature centers could be very beneficial in describing the plant in its unique habitat, and in describing the dangers it faces and ways the public can help conserve it. Articles in appropriate magazines and/or newspapers may also be helpful.

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PART III

IMPLEMENTATION SCHEDULE

Priorities (column 4) have been assigned according to the following:

- Priority 1 Those actions absolutely necessary to prevent extinction of the species.
- Priority 2 Those actions necessary to maintain the species current population status.
- Priority 3 All other actions necessary to provide for full recovery of this species.

IMPLEMENTATION SCHEDULE

Harper's beauty

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes	
					FWS	Region	Program	Other*	FY 1	FY 2		FY 3
01, 3	Secure sites on FS land	11	1	Cont.				FS				
A3	Secure sites on state right of-ways	13	1	Cont.	4			DOT				
A3	Secure sites on other lands	14	1	Cont.	4							May involve negotiations with private landowners
03	Encourage state to list	12	3	1 yr.	4			FDA				
I6	Conduct searches for new colonies	2	3	2 yrs.	4			FS, DOT	4000	4000		FS and DOT currently doing some searching
01	Train personnel in identification	23	3	1 yr.				FS, DOT	500			
M1	Maintain representative colonies	31	3	Unk.				FS		2500	2500	
M1	Deposit seeds in seed bank	32	3	Cont.	4			FS				FS has an established seed bank
M1	Deposit pollen in pollen bank	33	3	Cont.	4			FS				
R14	Make seeds available for research	34	3	Cont.	4			FS				FS has already sent some seeds for germination studies
R7	Make seeds available for propagation	35	3	Cont.	4			FS				
M2	Establish additional colonies	4	3	2-5 yrs	4			FS		3000	3000	
16	Collect baseline data	51	1	1 yr.				FS	2000			
R14	Identify pollinators and/or vectors	521	1	1 yr.				FS		2000		

IMPLEMENTATION SCHEDULE

Harper's beauty

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency		Estimated Fiscal Year Costs	Comments/Notes
					FWS Region	Program		
R3	Study hydrology	5221	1	2 yrs.	4	FS	10000	Funding included in 5221
R3	Study light relations	5222	1	2 yrs.	4	FS	10000	Funding included in 5221
R10	Study competition	5223	1	2 yrs.	4	FS		Funding included in 5221
R3	Identify soil requirements	5224	1	1 yr.	4	FS		Funding included in 5221
I1	Monitor colonies	53	1	Cont.		FS, DOT	500	
M3	Do experimental burns	541	1	2-5 yrs.		FS	300	
M4	Remove competition manually/mechanically	543	1	2-5 yrs.		FS	700	
M3	Do experimental mowing	542	1	2 yrs.		DOT		DOT has already done most of what needs to be done
R12	Determine effects of herbicides	544	1	2-5 yrs.	4	FS, DOT	500	
M7	Prepare management recommendations	545	1	2-5 yrs.		FS, DOT		
01	Public education	6	3	Cont.	4	FS, DOT		

*Abbreviations:

FS - U.S. Forest Service
 DOT- Florida Department of Transportation
 FDA- Florida Department of Agriculture and Consumer Services

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.

APPENDIX

List of Reviewers

U.S. Forest Service
Fisheries, Wildlife and Range Staff
1720 Peachtree Road, N.W., Suite 828
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Koger Office Executive Center
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Florida Department of Transportation
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Haydon Burns Building
605 Suwannee Street
Tallahassee, Florida 32301-8064

Mr. Doyle Conner, Commissioner
Department of Agriculture and
Consumer Services
State Capitol
Tallahassee, Florida 32301

Florida Natural Areas Inventory
The Nature Conservancy
254 East Sixth Avenue
Tallahassee, Florida 32303

Dr. Sidney McDaniel
Mississippi State University
Mississippi State, Mississippi 39762

Dr. Robert K. Godfrey
Florida State University
Tallahassee, Florida 32306

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