ROUGH-LEAVED LOOSESTRIFE

(Lysimachia asperulaefolia)

Recovery Plan

U.S. Fish and Wildlife Service
Southeast Region
Atlanta, Georgia

RECOVERY PLAN

for

Rough-leaved loosestrife (*Lysimachia asperulaefolia*)

Prepared by

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for

Southeast Region
U.S. Fish and Wildlife Service
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Date: April 19, 1995

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Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1995. Rough-leaved Loosestrife Recovery Plan. Atlanta, GA. 32 pp.

Additional copies may be purchased from:

Fish and Wildlife Reference Service
5430 Grosvenor Lane, Suite 110
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EXECUTIVE SUMMARY

Current Status: *Lysimachia asperulaefolia* is federally listed as an endangered species. It is currently known from nine population centers (eight in North Carolina and one in South Carolina).

Habitat Requirements and Limiting Factors: This rare herb is typically found growing in the ecotone between longleaf pine or oak savannas and wetter, shrubby plant communities growing on moist sand or peat. The open character of the habitat is maintained by periodic fires. It is threatened by fire suppression, residential development, road construction, herbicide use, hydrological alterations, conversion of habitat for agriculture, and intensive silviculture.

Recovery Objective: Delisting.

Recovery Criteria: Rough-leaved loosestrife will be considered for downlisting to threatened status when colonies within the nine population centers have been stable for 5 years and management plans are being implemented at all The Nature Conservancy or publicly owned sites. Delisting will be considered when, in addition to the above conditions having been met, a binding management agreement is in place for each population center.

Actions Needed:

1. Survey suitable habitat for additional populations.
2. Monitor and protect existing populations.
3. Conduct research on the biology of the species.
4. Establish new populations or rehabilitate marginal populations to the point where they are self-sustaining.
5. Investigate and conduct necessary management activities at all key sites.

Total Estimated Cost of Recovery (in $000's): It is not possible to determine costs beyond estimates for the first few years; future costs will depend on the results of research conducted early in the recovery process.

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Need 6
FY 1	6.0	34.5	20.0	10.5	21.0	92.0
FY 2	6.0	24.0	20.0	10.0	21.0	81.0
FY 3	6.0	23.0	20.0	10.5	20.0	79.5
TOTAL	18.0	81.5	60.0	31.0	62.0	252.5

Date of Recovery: Impossible to determine at this time.

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PART I

INTRODUCTION

Lysimachia asperulaefolia Poiret (rough-leaved loosestrife) is a rare perennial herb, endemic to the coastal plain and sandhills of North Carolina and South Carolina. It is associated with sandy or peaty soils and moist open habitat that was more abundant prior to the development of the coastal region of the Carolinas. Urban development, conversion of land to intensive agricultural and silvicultural uses, and associated drainage and fire suppression have greatly reduced this habitat.

Jean Louis Marie Poiret first described *L. asperulaefolia* in 1814, describing material from North Carolina. However, this was mistakenly attributed to an Egyptian collection. In 1817, Stephen Elliott described conspecific material collected by Herbemont in South Carolina, naming it *Lysimachia herbemonti*. *Trydinia herbemonti*, used by E. G. Steudel in his 1841 edition of *Nomenclator botanicus*, is the only other synonym for this species (Ray 1956). Of 17 historical sites documented at the time the species was federally listed, eight have been extirpated.

Lysimachia asperulaefolia was federally listed as endangered in 1987 (U.S. Fish and Wildlife Service [Service] 1987) due to the threatened condition of its habitat and the existence of only nine known populations. It is also listed as endangered by the State of North Carolina and as being endangered and of national concern by the State of South Carolina.

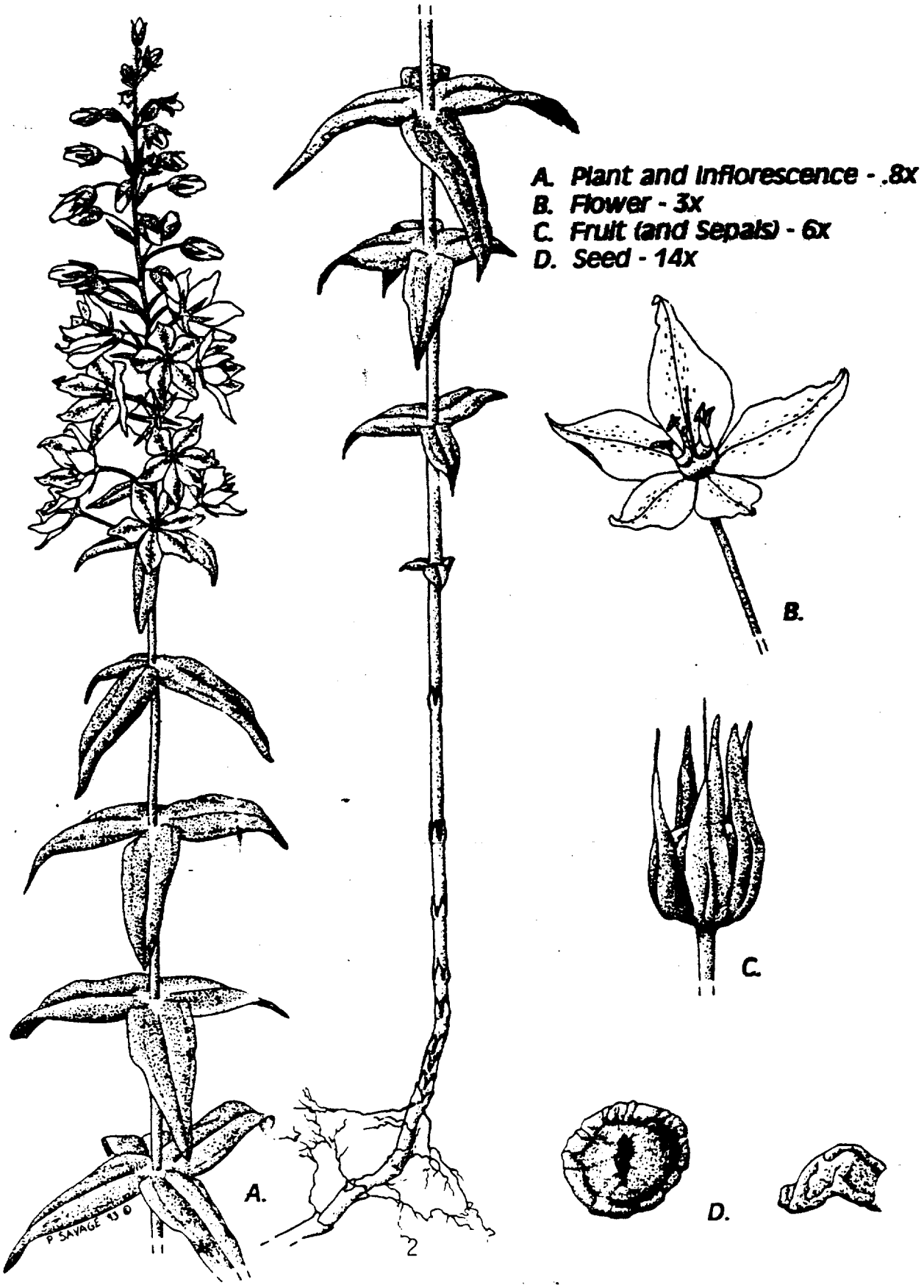
DESCRIPTION

Lysimachia asperulaefolia (Primulacae) is a perennial rhizomatous herb, with erect stems 30 to 60 centimeters (cm) tall. Leaves are sessile in whorls of 3 to 4, are broadest at the base (0.8 to 2 cm wide), and have three prominent veins. The upper surface is deep yellow-green or blue-green and lustrous; the leaf margins are entire and slightly revolute (Figure 1).

The yellow bisexual flowers are borne in a loose, cylindrical, terminal raceme, 3 to 10 cm long. The corolla is 1.5 cm across. There are usually five petals that have ragged margins near the apex and that have dots or streaks. The anthers are yellow-orange, and the style tapers to the simple stigma. The fruit is a capsule. Stipitate glands are usually present on most parts of the plant.

Flowering is from late May to early June. Seeds are formed by August, but capsules do not dehisce until October. Although the plants are dormant in the winter, they are easy to find in the fall because of the distinctive leaf pattern and the reddish color of the leaves.

FIGURE 1. ILLUSTRATION OF *Lysimachia asperulaefolia*.



There is only one other Southeastern *Lysimachia* with which *L. asperulaefolia* might be confused. *L. loomisii* also has whorled leaves and a terminal inflorescence, but it has narrower leaves (rarely 8 millimeters wide), is less rounded at the base, has smaller flowers, and glands are usually absent on leaves, bracts, flowers, and sepals (Kral 1983).

A much more detailed description is provided in *A Report on Some Rare, Threatened, or Endangered Forest-related Vascular Plants of the South* (Kral 1983). A good description is also found in *Aquatic and Wetland Plants of the Southeastern United States* (Godfrey and Wooten 1981).

DISTRIBUTION

The entire range of *L. asperulaefolia* includes only the southern coastal plain and sandhills of North Carolina and the sandhills of South Carolina (Figure 2).

Lysimachia asperulaefolia has been collected from 13 counties in North Carolina. It is believed to be extirpated from Richmond and Columbus counties. There are four records of populations in Cumberland County, one in Pamlico County, one in Onslow County, one in Brunswick County, one in Beaufort County, and two in Pender County that are either extirpated or can no longer be located.

Lysimachia asperulaefolia has been collected from Richland and Darlington Counties in South Carolina and is presently known to occur only in Richland County. Extensive searches have been conducted in the sandhills region of Chesterfield, Darlington, Kershaw, and Marlboro Counties, but no other populations were found (Smith 1992).

Current Range

In the early 1980s, the only known thriving populations were in the Green Swamp Nature Preserve, Croatan National Forest, and Sunny Point Military Ocean Terminal. A few stems were found in Bushy Lake at the Bushy Lake State Natural Area. Prior to 1985, extensive surveys (by knowledgeable biologists) in the Sandhills Gamelands and on military bases (other than Sunny Point) did not locate *L. asperulaefolia* sites.

In 1985, two sites were found on Fort Bragg and one in the Sandhills Gamelands by biologists who were conducting surveys for rare plant species and the endangered red-cockaded woodpecker (*Picoides borealis*). Since that time, several factors have changed that affect this species, its distribution, and our knowledge of it. Partly due to efforts to preserve and expand habitat for the red-cockaded woodpecker, military bases in the Carolinas have instituted or expanded prescribed burning programs. Burning is believed to have restored vast areas of *L. asperulaefolia* habitat; as a result, more recent searches have located additional colonies of this species.

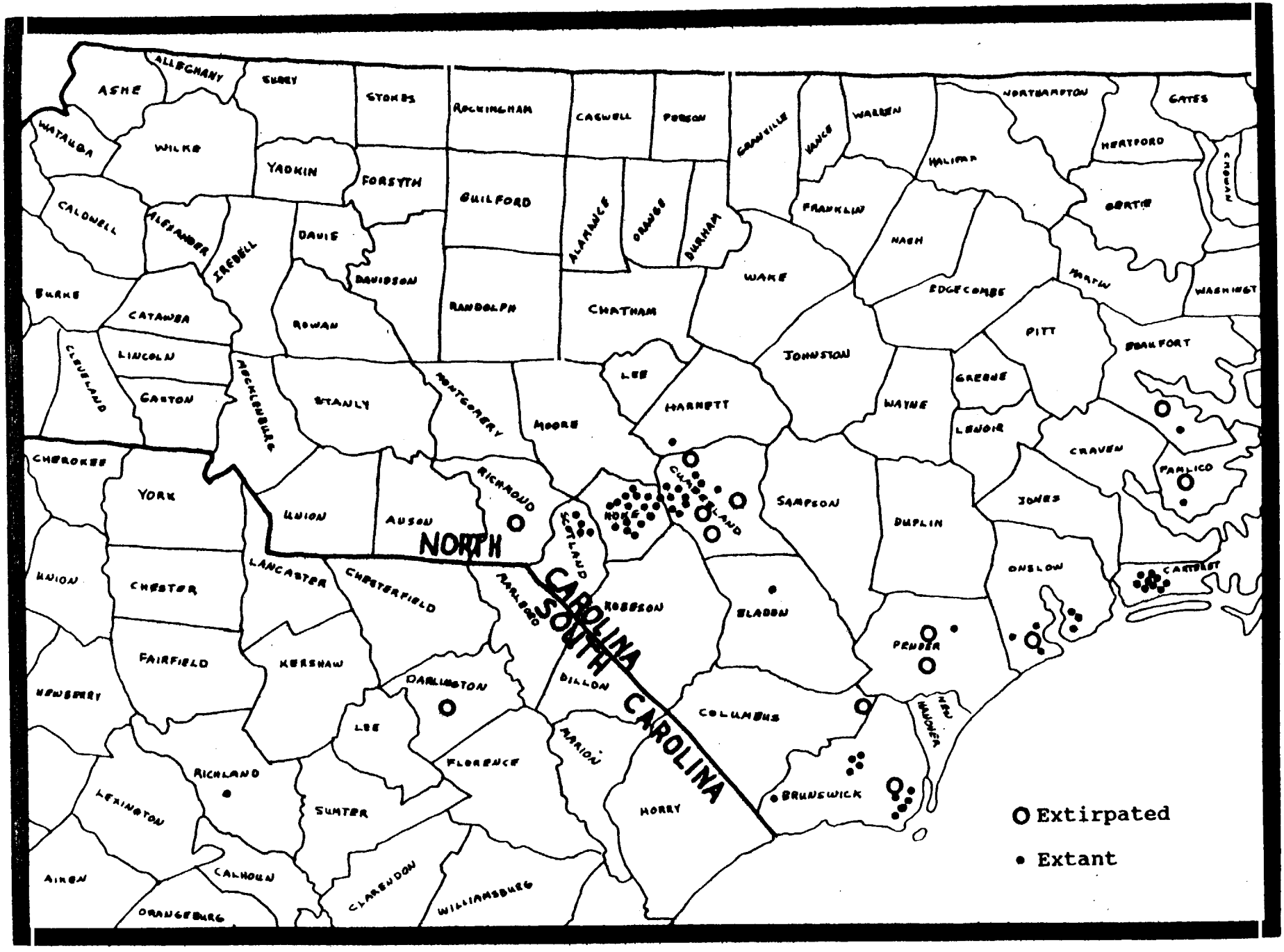


FIGURE 2. DISTRIBUTION O[illegible]ysimachia asperulifolia

In 1991, for example, more than 38,000 acres were burned at Fort Bragg (R. M. Danielson, U.S. Army, Fort Bragg, personal communication, 1993). Prior to the mid-1980's, fire suppression had been practiced for perhaps 30 to 50 years; the only areas burned were those where training activities caused fires that were confined and extinguished.

Federal legislation protecting wetlands and restricting the draining of wetlands is another factor affecting *L. asperulaefolia* habitat. Both fire and appropriate hydrologic conditions are critical for this species.

In 1988, The Nature Conservancy and the Department of Defense entered into an agreement, described in a Memorandum of Understanding (MOU), which provided that The Nature Conservancy and the natural heritage programs would assist the Department of Defense in planning for, monitoring, and managing significant natural resources on military bases. Partly as a result of this MOU, the North Carolina Natural Heritage Program conducted a pilot survey of portions of Fort Bragg. This project was continued by a more extensive survey of Fort Bragg, conducted by The Nature Conservancy. A rare plant survey of 25,000 acres on the Sandhills Gamelands, which the Army uses for training activities, will be completed by December 1994. In addition, Federal environmental funding is allocated to Fort Bragg for environmental purposes, including the management of listed species.

The North Carolina Natural Heritage Program has also conducted rare plant surveys on Camp Lejeune (where the species was found in 1988) and Cherry Point. The North Carolina Natural Heritage Program and The Nature Conservancy have also conducted surveys of the Croatan National Forest.

Since 1985, thorough searches for *L. asperulaefolia* have been undertaken, funded by the Department of Defense, on the following military bases located on the coast and in the sandhills: Camp Lejeune, Fort Bragg, Camp MacKall, and Sunny Point Military Ocean Terminal in North Carolina, and Fort Jackson in South Carolina. Numerous additional *L. asperulaefolia* sites have been found on these bases. In 1991, a very large population was found on Fort Jackson, in Richland County, South Carolina; this was the first population to be found in South Carolina in this century (J. Nelson, University of South Carolina, personal communication, 1993).

Current Sites and Ownership

At the present time, there are 58 *L. asperulaefolia* sites in North Carolina and one site in South Carolina. Nearly all sites are on publicly owned land, with the majority on federally owned land. The following list indicates the number of sites in each ownership category.

OWNERSHIP CATEGORY	NUMBER OF SITES
Military Bases	33
U.S. Forest Service	9
State of North Carolina	5
Private:	
The Nature Conservancy	5
Registered Natural Areas	1
Other	6
TOTAL	59

The term "site" in this plan corresponds to an element occurrence in the North Carolina Natural Heritage Program data base. Element occurrences indicate that plants occur in one or more locations within one-half mile or less, not separated by inappropriate habitat. Therefore, an element occurrence or site may indicate more than one cluster or colony of plants. The Heritage Program data base is used in order to have a standard for counting occurrences.

HABITAT

The habitat for *L. asperulaefolia* is generally in the ecotone between longleaf pine or oak savannas and wetter, shrubby areas, where moist, sandy or peaty soils occur and where low vegetation allows abundant sunlight in the herb layer. Fire is the principal factor that naturally maintains the low vegetation. *Lysimachia asperulaefolia* is associated with six natural community types: low pocosin, high pocosin, wet pine flatwoods, pine savanna, streamhead pocosin, and sandhill seep (Schafale and Weakley 1990). *Lysimachia asperulaefolia* has also been found in peaty pond margins and in disturbed sites, such as roadside depressions, power line rights-of-way, and firebreaks.

Low Pocosin

Low pocosins are nutrient-poor, seasonally saturated, and dominated by a dense shrub layer of *Lyonia lucida*, *Zenobia pulverulenta*, or *Cyrilla racemiflora*. They occur in the center of domed peatlands, where the deep peat is underlain by wet sands, and also in some Carolina bays. Because of the low-nutrient environment and periodic severe fires, shrubs remain small. *Lysimachia asperulaefolia* may occur in openings where sufficient light is available.

High Pocosin, Wet Pine Flatwoods, and Pine Savanna

Lysimachia asperulaefolia typically grows in the ecotone between high pocosin and wet pine flatwoods or pine savanna. Subtle elevation

gradients result in a system of savannas or flatwoods on sand ridges and pocosins in the depressions. Typical flatwoods and savanna soils are acidic, nutrient-poor, wet sands, and the diverse herb layer may be dominated by grasses (such as *Aristida stricta*, *Sporobolus teretifolius*, and *Andropogon glomeratus*), with shrubs characteristic of pocosins scattered throughout. Savannas and flatwoods are maintained by frequent fire, so shrubs are present as low sprouts.

Pocosin soils usually consist of deep peat over sand. Shrubs such as *Ilex glabra*, *Lyonia lucida*, and *Cyrilla racemiflora* dominate. While pocosins are very wet during part of the year, fires during the dry season or during a dry year may carry into the pocosin. Most natural pocosin fires occur during the growing season.

Lysimachia asperulaefolia is found at the savanna-pocosin or flatwoods-pocosin ecotone where the water table is near the surface during winter and early spring and where dry-season fires burn into the edge of the pocosin. Savanna grasses and pocosin shrubs are present, as well as associated herb species such as *Dionaea muscipula*, *Rhexia alifanus*, and *Rhexia lutea*. Results from sampling in the ecotone in the Green Swamp Nature Preserve indicate that the microhabitat occupied by *L. asperulaefolia* is dominated by shrubs, not savanna grasses (Frantz 1983). As long as fires are not suppressed, the ecotone remains open, with the characteristic grasses, herbs, and low shrub sprouts. If fire is suppressed, the shrubs already present in the ecotone will attain their full height. In a natural cycle of fire, *L. asperulaefolia* will be suppressed in flowering and vigor during years without fire and will increase after fire. Complete fire suppression may result in extirpation from a site, though current evidence suggests that it may persist for years or decades under a fairly dense shrub layer.

Streamhead Pocosin

Streamhead pocosins occur at the headwaters of small streams in the sandhills. Typical pocosin shrubs occur in the lower part of the stream basin. Where a pocosin borders an upland community, a distinct ecotonal zone often occurs where the more frequent fires of the drier uplands interact with the wetter soils of the pocosin. This ecotonal zone often resembles a pine savanna, with a high diversity of herbaceous plants. It is in this ecotone that *L. asperulaefolia* may occur (Schafale and Weakley 1990).

Sandhill Seep

Sandhill seeps occur on slopes in the sandhills, where wet sands are underlain by clay, allowing water to seep to the surface along the slope. Dense pocosin shrubs will dominate if fire is suppressed, but it is in the more frequently burned seeps, which contain a rich herbaceous layer, that *L. asperulaefolia* is most likely to occur.

LIFE HISTORY

The first spring shoots of *L. asperulaefolia* appear in late March or early April. Flowering begins in late May and extends through mid to late June. *L. asperulaefolia* is an obligate out-crossing species, pollinated by solitary bees; most of the pollinators are in the genus *Dialictus*. Pollinators were found to be scarce and inefficient, perhaps contributing to low natural fruit and seed set. Fruit and seed set were much higher when flowers were artificially pollinated (Frantz 1984). Another possible explanation for low fruit and seed set is that populations are highly clonal, with several shoots arising from one rhizome. Since self-fertilization does not occur, pollinator activity among ramets would not result in seed set.

Fruits are visible within 3 weeks of fertilization, but capsules do not dehisce until October. An average of 3.2 capsules are produced by flowering stems, with an average of less than two seeds per capsule. In one germination trial, 85 percent of the seeds germinated (Frantz 1984). While fruit and seed set are low, this is not unusual for a perennial species that apparently has a life strategy based largely on rhizomatous growth and therefore does not depend upon sexual reproduction and seedlings for short-term survival.

REASONS FOR LISTING

Drainage and conversion of habitat to agricultural uses and pine plantations, residential and industrial development, and fire suppression have all contributed to the decline in habitat for *L. asperulaefolia*. At the time of listing, 8 of 17 documented populations had been extirpated due to these factors.

Since listing, many additional sites have been discovered on the four military bases--Camp Lejeune, Fort Bragg, and Sunny Point Military Ocean Terminal in North Carolina, and Fort Jackson in South Carolina. Prescribed burning and training activities resulting in fire on the bases seem to be key factors in maintaining habitat conditions and thriving populations of *L. asperulaefolia*. However, military uses can also jeopardize its survival. Activities such as timber-harvesting, use of heavy equipment, and military training could be deleterious if not carefully conducted. It is suspected that erosion from such activities has negatively impacted at least one site.

Fire suppression poses two threats to populations of *L. asperulaefolia*. First, with the absence of fire, the shrubs that are always present in *L. asperulaefolia* habitat will increase in size, shading out *Lysimachia*. Second, the activities involved in controlling fire may include plowing fire breaks. Plow lines have traditionally been placed at pocosin-savanna and pocosin-sandhill ecotones, the primary habitat of *Lysimachia*.

Both the outer coastal plain and the sandhills region of the Carolinas are experiencing rapid population growth. Urbanization and suburbanization impact the habitat of *L. asperulaefolia* in both direct and indirect ways. Habitat is directly destroyed, and the proximity of developed areas to habitat makes it difficult or impossible to maintain the fire regime needed for the persistence of *L. asperulaefolia*.

CONSERVATION MEASURES AND CURRENT MANAGEMENT PRACTICES

Since most of the *L. asperulaefolia* sites are under management by a Federal or State agency or private conservation organization, the management practices of each agency are discussed below. The potential role of the North Carolina Botanical Garden in the conservation of this species is also discussed.

The Nature Conservancy, North Carolina Chapter - For many years much of the best *L. asperulaefolia* habitat and most of the thriving populations known were in the 15,000-acre Green Swamp Nature Preserve, which is owned and managed by the North Carolina chapter of The Nature Conservancy. The Nature Conservancy intentionally managed the preserve to benefit *Lysimachia* and has conducted research and monitoring activities for many years.

The Nature Conservancy did experimental work from 1987 through 1992, comparing the effects of different fire frequencies on *L. asperulaefolia*. In this preliminary study, the species increased in flowering and vigor each year following a burn until a peak during the fourth year, after which a decline began (unpublished report, North Carolina Chapter, The Nature Conservancy). While it is known that fire is an important part of the *Lysimachia* habitat, the effect of fire frequency requires more research. *L. asperulaefolia* also occurs on another Nature Conservancy preserve, Southwest Ridge. Locations of plants are mapped and monitored, but no research has been done. Monitoring and prescribed burning began in 1990 (M. Bucher, North Carolina Nature Conservancy, personal communication, 1994).

It is expected that The Nature Conservancy's stewardship program will continue to manage the preserves for the benefit of *L. asperulaefolia*, other rare species, and the natural community which is their habitat. Also, The Nature Conservancy will continue research and monitoring as long as funding is available.

U.S. Forest Service, Croatan National Forest - Funds are available for managing endangered species habitat. While management specifically for *L. asperulaefolia* has not occurred at the Croatan in the past, *Lysimachia* habitat will be under stricter management in the future. The Forest Service is planning a 3-year fire cycle and typically will allow fire to burn to a natural moisture boundary. Currently, ditches are not used as fire breaks. The North Carolina Natural Heritage Program has conducted surveys of some of the

61 management compartments on the forest, and surveys have been done as part of the biological evaluation for timber sales and other projects. However, much habitat remains to be surveyed, and *Lysimachia* sites are not marked (P. Robinson, Croatan National Forest, personal communication, 1993).

U.S. Army, Sunny Point Military Ocean Terminal - The Army conducted extensive surveys for *L. asperulaefolia* in 1988, mapped potential habitat, and set forth several actions to be taken, such as mapping and field marking sites, annual assessment of populations, etc. (*L. asperulaefolia* Survey, unpublished results, Sunny Point Military Ocean Terminal, 1988). While not all actions have been completed, military activities and pine straw harvesting are not permitted in *L. asperulaefolia* populations. The actions recommended in the 1988 survey report are expected to be completed within 3 years (T. Gaw, Sunny Point Military Ocean Terminal, personal communication, 1993). Sunny Point is currently developing a registry agreement with the North Carolina Natural Heritage Program that will cover most known sites on the base.

U.S. Army, Fort Bragg - A management plan is being prepared for the federally listed species that occur on Fort Bragg. *L. asperulaefolia* sites outside the impact areas are being marked, including a 200-foot-wide buffer area around each site. Biologists at Fort Bragg are managing endangered species using guidelines provided by the Service in past biological opinions. Guidance issued by the Army in January 1993 is consistent with those opinions. The Nature Conservancy is completing a contract with the Department of Defense for an extensive survey for listed species (B. Mihlbachler, U.S. Army, Fort Bragg, personal communication, 1993).

U.S. Army, Fort Jackson - John Nelson (University of South Carolina) completed a rare and endangered species survey of Fort Jackson in 1992. He located a large population (perhaps over 2 to 3 acres) of *L. asperulaefolia*, the only population found in South Carolina in this century. Fort Jackson has funds for the preparation of a management plan for this site and will also be funding a long-term monitoring program that will be used to update the management plan. While the site is not marked, it is in an impact area and is therefore off limits for training activities. Periodic munitions fires and management for fuel reduction result in burning of the *Lysimachia* site on nearly an annual basis. Detailed records are not available, but fuel management fires usually occur in winter and early spring (M. Dutton, U.S. Army, Fort Jackson, personal communication, 1993).

U.S. Marine Corps, Camp Lejeune - Endangered species biologists at Camp Lejeune are operating under a biological opinion issued by the Service in September 1988. This opinion contained five recommendations--burn sites every 2 to 3 years, protect sites from alteration of hydrologic conditions, protect sites from vehicular impacts, mark all sites with a 100-meter buffer, and monitor

populations. In 1992, the base was expanded by the acquisition of 38,000 to 40,000 acres. On this land, several *Lysimachia* sites were found under a power line where regular mowing had occurred for years. On the older part of the base, land outside the impact area (58,000 acres) is now being managed on a 3-year fire cycle. The natural resources staff has designed burn plans to specifically favor *L. asperulaefolia*. All *L. asperulaefolia* sites have been marked and are regularly inspected (J. Hammond, U.S. Marine Corps, Camp Lejeune, personal communication, 1993).

North Carolina State Parks - Bushy Lake Bay is in a State Natural Area and is not being managed specifically for *L. asperulaefolia*. The bay had been impacted by nearby ditching for agricultural use. However, the agricultural land has been acquired by the State, and the ditch has been filled in order to restore the original hydrologic conditions. It is not specifically known how this will affect the *Lysimachia* present there (C. Tingley, North Carolina Department of Environment, Health, and Natural Resources, personal communication, 1993). Additional land in and adjacent to the bay is being acquired, which will aid future management and protection of the site.

Sandhills Gamelands - The Sandhills Gamelands are owned and managed by the North Carolina Wildlife Resources Commission. No management is conducted specifically for the preservation of *L. asperulaefolia*, and the sites are not marked. The U.S. Army will be marking these sites in the near future as part of a contract to mark all endangered species sites on Fort Bragg. The Army uses the Sandhills Gamelands for training maneuvers. Burning is scheduled on a 3-year cycle, but most areas are actually burned less often. While plow lines at the edge of the savanna in the *L. asperulaefolia* habitat were used in the past to control fire, plow lines are no longer generally used, and *L. asperulaefolia* sites are avoided if plowing is done (H. Hall, North Carolina Wildlife Resources Commission, personal communication, 1993).

North Carolina Botanical Garden - The North Carolina Botanical Garden has undertaken limited seed germination and cultivation of *Lysimachia*. They have been successful in germinating seeds and have three pots of plants that have survived for 10 years. They are limited in their propagation efforts by the lack of available seeds. The garden is an affiliate of the Center for Plant Conservation, an organization dedicated to preserving rare plants. Participating botanical institutions engage in seed preservation, germination, and propagation to serve as a germ plasm bank for specific species. The North Carolina Botanical Garden has accepted this responsibility for *L. asperulaefolia*. While unable to carry out extensive field work, they are interested in growing plants for other agencies to reestablish and monitor in the field (R. Gardner, North Carolina Botanical Garden, personal communication, 1993).

Carolina Power and Light Company (CP&L) - CP&L currently manages three areas of rough-leaved loosestrife along power lines--one on Fort Bragg, one on Camp Lejeune, and one on private property in Brunswick County. These power line corridors are mowed on a 3-year cycle during fall or winter. While mowing provides certain favorable conditions for the survival of *L. asperulaefolia*, there is also some risk due to the need for maintenance and emergency repairs. CP&L has a management agreement with the North Carolina Department of Environment, Health, and Natural Resources for managing rare plants on power line rights-of-way.

RECOVERY SUMMARY

Recovery will require the preservation of sites in nine population centers. Management plans will be prepared for each population center. Reclassification as threatened will be considered when all population centers have been under management plans for 5 years and when all populations appear to be stable. Delisting will be considered when nine population centers are under binding management agreements that will provide for the preservation of sites within each population center in perpetuity.

Initial recovery activities will require sites to be mapped and marked in the field. As management plans are prepared, monitoring can be implemented. Long-term efforts will include research into habitat conditions and effects. The Service will negotiate permanent management agreements with the landowners, North Carolina Natural Heritage Program, North Carolina Plant Conservation Program, and South Carolina Department of Natural Resources.

PART II

RECOVERY

A. Recovery Objective

The recovery goal for *L. asperulaefolia* is delisting. Because this species can prosper under proper management, reclassification from endangered to threatened is recommended as a possible interim step.

B. Recovery Criteria

Lysimachia asperulaefolia may be considered for reclassification from endangered to threatened when: (1) management plans have been prepared and are being implemented for all publicly owned population centers and those owned by The Nature Conservancy, and (2) populations at these centers have been monitored for at least 5 years and are determined to be stable. The estimated year of reclassification is 2003.

Lysimachia asperulaefolia will be considered for delisting when the above conditions are met and a binding management agreement for each population center is in place.

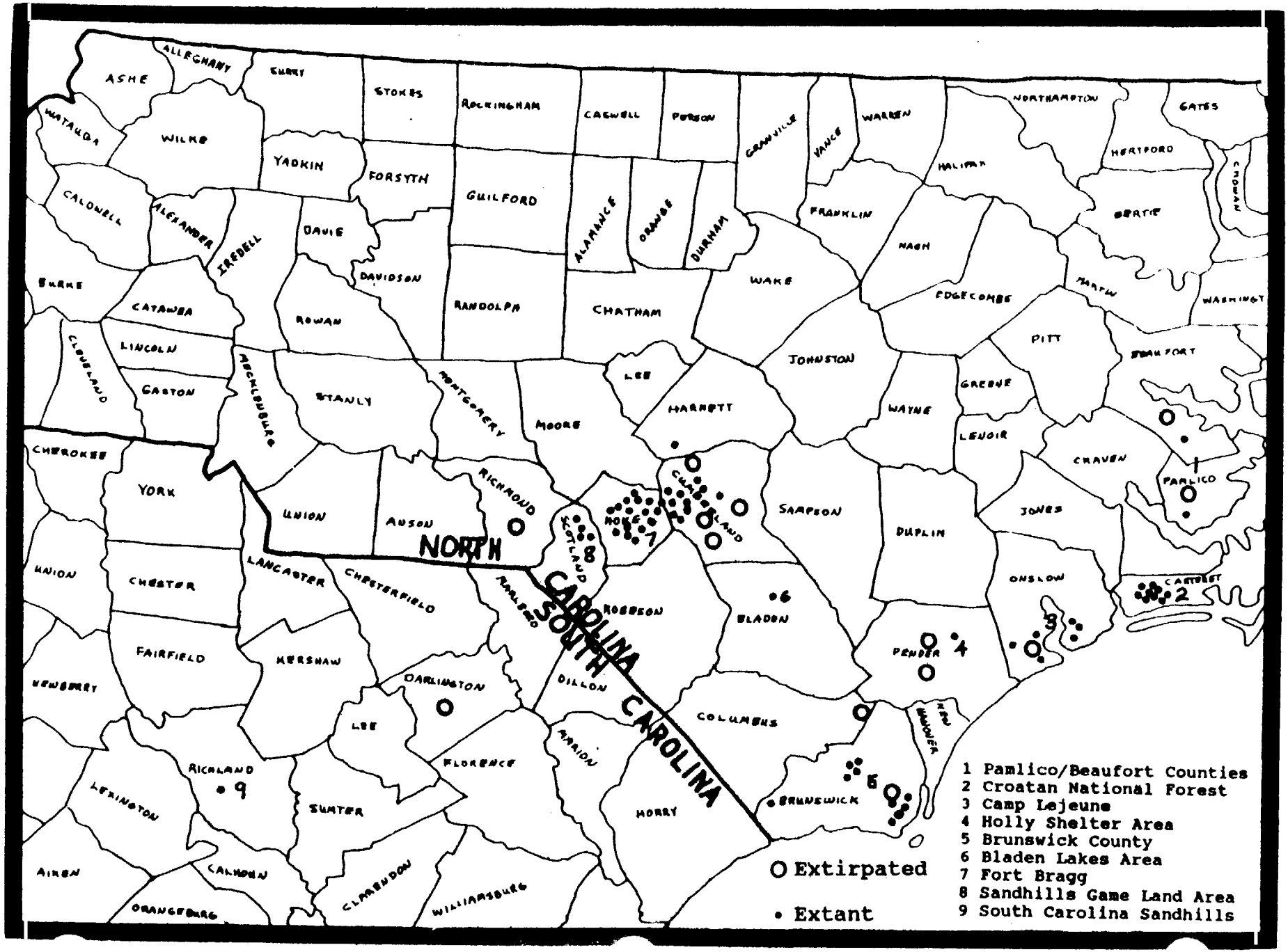
For the purpose of recovery planning, sites are grouped according to geographic population centers (Figure 3). Population centers are geographically dispersed and many are isolated. This isolation may have led to the evolution of genetic differences between populations. Thus, to maintain the maximum potential genetic variation within the species, it is important that each population center be preserved.

The currently known sites at the following population centers are to be managed, monitored, and preserved. Sites discovered in the future should be added, and all aspects of the recovery plan should be applied to the new sites.

1. Pamlico/Beaufort Counties
   Pamlico Community College
   Prescott Ridge

2. Croatan National Forest
   Compartment #24, SR 1124/Camp Sam Hatcher Road; NC 24/Nine Foot Road
   Compartment #29 and #30, 1 mile north of Ocean; Pringle Road
   Compartment #23, Hibbs Road
   Compartment #25, Hibbs Road
   Compartment #22 and #23, Hibbs Road
   Compartment #27 and #29, Pringle Road

FIGURE 3. POPULATION CENTERS FOR LYSIMACHIA ASPERULAEFOLIA



3. Camp Lejeune
   Training Area GD
   Training Area HE
   Training Area IA
   Training Area SRE
   Training Area SRM
   Training Area SRP
   Training Area SRV
   Training Area GE
   G-10 Impact Area (this colony contains only six to seven plants)
   Training Area HB
   Great Sandy Run Area

4. Holly Shelter Area
   Southwest Ridge Savanna

5. Brunswick County
   Sunny Point Military Ocean Terminal
   Green Swamp Nature Preserve
   Waccamaw Island Savanna
   Orton Plantation
   Boiling Springs Lake
   NC 133 sites

6. Bladen Lakes Area
   Two locations within Bushy Lake
   Mill Pond Bay

7. Fort Bragg
   MacRidge Impact Area 2
   MacRidge Danger Area - Bones Creek Tributary Natural Area
   MacRidge Danger/Impact Area - Little Rockfish Creek Natural Area
   McPherson Impact Area
   McPherson Danger/Impact Area 2, Training Area CC - Piney Bottom Creek Natural Area
   Northern Training Area II
   Nanchester Danger Area 2
   Coleman Impact Area
   Training Area DD3 - Little Rockfish Creek Natural Area 3
   Training Area DD2
   Training Area QQ
   Training Area CC
   Training Area HH4
   Training Area EE3
   Training Area X1
   Training Area W2
   Northern Training Area II
   Northern Training Area III
   NEA Bog Complex Natural Area

8. Sandhills Gamelands and Camp MacKall
   Camp MacKall - Training Area LL
   Sandhills Gamelands - Kinney Cameron Lake, Crawford Lake

9. South Carolina Sandhills
   Fort Jackson

10. Other sites or population centers discovered in the future.

Although in the last few years many new sites have been found for this species, outside of military bases and nature preserves, only seven sites remain. This indicates that only with habitat preservation and management can the species survive. As long as favorable management continues on military bases and nature preserves, *Lysimachia* will thrive. When management is ensured and in practice, reclassification can proceed. However, since delisting would remove the Endangered Species Act's mandate for management on Federal lands and since most sites for this species occur on Federal land, delisting can only occur when other provisions for management have been made.

Binding management agreements should be negotiated between the Service and the landowner at each population center. For the military bases and the Croatan National Forest, an agreement can be negotiated with the appropriate Federal agency. On federally owned or managed land, management will be in accordance with existing biological opinions for the respective site, subject to periodic review. Management for rare species is part of The Nature Conservancy's mission, but to implement protection guaranteeing survival of the species, binding agreements should be made between the Service and The Nature Conservancy for management of the Green Swamp and Southwest Ridge populations.

The Pamlico County population center should be managed by agreement with the Service. The single two sites in this center are significant because they are the northernmost locations and should be preserved in order to retain possible genetic variation. Two sites have been extirpated north of Pamlico Community College. There is an opportunity for reestablishment into appropriate habitat where the species formerly occurred.

Management of the privately owned sites should also be provided for by agreements with the landowners. Responsibility for monitoring the agreements and assuring proper management should be assigned to the North Carolina Plant Conservation Program and/or the North Carolina Natural Heritage Program, in addition to the Service. This responsibility could include providing consultation and advice to landowners, organizing the annual review of recovery progress, and determining the need for additional research or new strategies.

C. Narrative Outline

1. Protect significant sites and adjacent habitat.

1.1 Map all sites and mark sites in the field (except where there is ready public access and where signs would increase the threat of collecting); include in the marked area the adjacent habitat and buffer. Maps should indicate the present boundary of the site, an additional amount of appropriate adjacent habitat, and a buffer area around the protected habitat. The buffer will protect the site from adjacent activities that might impact the site, such as upslope disturbance resulting in sedimentation. A minimum buffer of 100 feet should be provided; a 200-foot-wide buffer is preferred. The outer buffer boundary should be marked in the field.

For sites that are being managed as nature preserves, with no anticipated disturbance, field-marking may be omitted.

1.2 Map and search appropriate habitat for new sites within each population center. Although extensive searches have already been carried out, there may still be some undiscovered populations. In unburned habitat, plants can survive for a time in a suppressed state, but they are extremely difficult to see. County soil survey maps and Service wetland inventory maps can be used to locate appropriate habitat. The Sunny Point *L. asperulaefolia* survey describes how search maps were created by overlaying Leon, Murville, and Torhunta soils and wetland ecotones to locate "high probability areas." Search maps should be created and thorough searches should be conducted if this has not already been done.

New sites should be evaluated to determine whether they should be assigned to one of the population centers listed above or designated as new population centers. New sites should be mapped and marked as indicated in Task 1.1.

1.3 Prepare a management plan for each population center. A management plan should be prepared for each of the nine population centers listed in the recovery objective section.

Each management plan should consist of at least the following:

1.3.1 Prepare maps of sites and adjacent habitat that is to be preserved, as indicated in Task 1.1.

1.3.2 Prepare survey maps and documentation of searches that have been conducted.

1.3.3 Identify threats at each site and include them in the monitoring plan (degree of threat, changes in threats, impacts of threats, and methods of avoiding or removing threats). Threats known to occur due to the type of habitat and use of the land on which *L. asperulaefolia* occurs are as follows: fire suppression; ditching and drainage; fire plow lines in ecotones; use of heavy equipment; agriculture; timber operations; erosion upslope, with sedimentation in *Lysimachia* habitat; use of explosives; construction; and road-building. Other threats may be identified at a specific site.

1.3.4 Develop a monitoring plan. Monitoring at each site should include both the monitoring of the plants and certain habitat conditions. Monitoring of the plants should consist of at least periodic stem and flowering counts and measurement of the area over which plants are distributed. Monitoring of the habitat should include at least the recording of fire occurrences and dates.

Criteria should be established for determining when more detailed monitoring is necessary; for example, generally a certain level of population decline would indicate the need for additional or more detailed monitoring in order to identify the cause. Using the criteria, an assessment should be made each year as to whether more extensive monitoring is necessary. Additional monitoring activities might include seedling searches, plant size categories, water table depth, associated species, and cover.

Monitoring should be carefully planned to limit the number of field visits and to minimize trampling of sites.

1.3.5 Implement habitat management plans. These plans should include prescribed burning programs, the protection of hydrologic conditions, and the removal of any other threats to essential habitat conditions.

1.3.6 Develop criteria for determining when a site could be removed from protection. While preservation of sites within each population

center is critical to recovery of the species, occasionally the value of a site might be questioned. Criteria need to be developed to allow only extremely marginal sites to be excluded from protection. For example, some considerations for exclusion might include the following: there are less than five plants, the site is extremely disturbed, the site is threatened by more than one detrimental impact, there is a low potential for restoration of the site, low genetic diversity, etc. A test should be devised which requires that several of these factors be involved before a site can be excluded from protection.

From time to time there may be efforts to remove sites on military bases from protection under the Endangered Species Act due to the complexity of protection. However, not enough is known regarding the species' habitat and population dynamics, future habitat disturbance, and other events that may affect the species or its habitat to guarantee the survival of any particular site. Therefore, all sites must be assumed to be significant, with the exception of extremely marginal sites that meet the criteria mentioned above.

1.3.7 Develop a methodology for determining when populations could be considered stable. Since the recovery criteria indicate that reclassification will be considered when populations are "stable," managers and agencies involved will need to agree upon what characterizes a stable population.

2. Conduct research to more fully understand habitat conditions, fire frequency effects, seedling recruitment, genetic diversity among and within sites and population centers, population dynamics, and reestablishment techniques. No research has been reported on seedling establishment or the establishment of new populations in suitable habitat. Insufficient information exists with regard to water table and hydroperiod effects. Genetic variation within sites should be determined; higher priority could be given to sites with more genotypes. The Nature Conservancy's study of fire frequency effects should be continued and expanded.

3. Enforce laws protecting the species and its habitat. Provisions of the Endangered Species Act of 1973, as amended, will be enforced. North Carolina regulations prohibit taking a protected species from private property without the

landowner's written permission and a State permit. However, at this time the collection of *L. asperulaefolia* plants is not the major threat to the species' continued survival.

In meeting their responsibilities under the Endangered Species Act, the military services involved have developed guidance directing certain actions with respect to listed species occurring on their bases. Implementation of these policies and directives should continue.

4. Reintroduce the species into historic habitat. In cooperation with the North Carolina Botanical Garden and the Center for Plant Conservation, plants should be propagated and a program of reintroduction should be initiated. Historic sites, such as the proposed Minnesott Ridge-Prescott Ridge Natural Area in Pamlico County, would be ideal sites for this program. Plants introduced into such an area should derive from the same population center, when possible, or from a nearby population source, unless genetic analyses indicate that inbreeding is a problem within populations. The genetic analysis will assist in determining appropriate reintroduction source material.

5. Negotiate binding management agreements. In order to ensure the survival of this species and proceed with delisting, permanent binding management agreements should be negotiated between the Service and landowners. The North Carolina Plant Conservation Program or North Carolina Natural Heritage Program should assist the Service in monitoring these agreements.

6. Conduct public information and education activities. News releases concerning the status and significance of the species and recovery efforts should be prepared and distributed to newspapers on the coastal plain and in the sandhills area. Cooperation with military bases should be sought; this would be a positive public relations opportunity for them. State agencies managing lands where *L. asperulaefolia* occurs should prepare/distribute brochures and offer educational hikes to sites where this would be appropriate.

7. Annually review the recovery efforts. The Service, North Carolina Plant Conservation Program, North Carolina Natural Heritage Program, and South Carolina Heritage Trust should meet annually with the managers of *L. asperulaefolia* sites to assess progress toward the recovery goals, review new information, assign any new sites to a new or existing population center, evaluate and coordinate programs planned for the coming year, and, if necessary, redirect monitoring or management actions.

D. Literature Cited

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PART III

IMPLEMENTATION SCHEDULE

Priorities in column one of the following Implementation Schedule are assigned as follows:

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

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

3. Priority 3 - All other actions necessary to meet the recovery objective.

Key to Acronyms Used in This Implementation Schedule

CPC - Center for Plant Conservation
FWS - U.S. Fish and Wildlife Service
R4 - Region 4 (Southeast Region), U.S. Fish and Wildlife Service
SCA - State Conservation Agencies - State plant conservation agencies of participating States. In North Carolina, these are the Plant Conservation Program (North Carolina Department of Agriculture) and the Natural Heritage Program (North Carolina Department of Environment, Health, and Natural Resources); in South Carolina, the Heritage Trust Program (South Carolina Department of Natural Resources).
TE - Endangered Species Division, U.S. Fish and Wildlife Service

ROUGH-LEAVED LOOSESTRIFE IMPLEMENTATION SCHEDULE

Priority	Task Number	Task Description	Task Duration	Responsible Agency FWS	Responsible Agency Other	Cost Estimates ($000's) FY1	FY2	FY3	Comments
1	1.1	Map, mark, and protect all sites.	5 years	R4/TE	SCA	10.0	10.0	10.0	
1	1.3.1	Prepare a management plan for each population center, mapping each site and the habitat to be preserved.	2 years	R4/TE	SCA	1.0	1.0	---	
1	1.3.3	Identify threats at each site and monitor.	Ongoing	R4/TE	SCA	2.0	2.0	2.0	
1	1.3.5	Implement habitat management plans.	Ongoing	R4/TE	SCA	20.0	20.0	20.0	
1	3	Enforce laws protecting the species and its habitat.	Ongoing	R4/TE	SCA	5.0	5.0	5.0	
1	5	Negotiate binding management agreements.	3-5 years	R4/TE	SCA	2.0	2.0	1.0	
2	1.3.4	Develop a monitoring plan.	1 year	R4/TE	SCA	0.5	---	---	
2	2	Conduct research on habitat, fire frequency effects, seedling recruitment, genotype diversity, population dynamics, and reestablishment techniques.	3-5 years	R4/TE	SCA	20.0	20.0	20.0	
3	1.2	Search for new populations.	3 years	R4/TE	SCA	5.0	5.0	5.0	
3	1.3.2	Prepare survey maps and document searches that have been conducted.	3 years	R4/TE	SCA	1.0	1.0	1.0	
3	1.3.6	Develop criteria for determining when a site could be removed from protection.	1 year	R4/TE	SCA	---	---	0.5	
3	1.3.7	Develop a methodology for determining when populations could be considered stable.	1 year	R4/TE	SCA	0.5	---	---	

ROUGH-LEAVED LOOSESTRIFE IMPLEMENTATION SCHEDULE (continued)

Priority	Task Number	Task Description	Task Duration	Responsible Agency FWS	Responsible Agency Other	Cost Estimates ($000's) FY1	FY2	FY3	Comments
3	4	Reintroduce the species into historic habitat.	5 years	R4/TE	SCA	10.0	10.0	10.0	
3	6	Conduct public information and education activities.	Ongoing	R4/TE	SCA, CPC	5.0	3.0	3.0	
3	7	Annually review recovery efforts.	Ongoing	R4/TE	SCA	1.0	0.5	0.5	

PART IV

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