

# **Large-flowered Skullcap**

***(Scutellaria montana)***

## **Recovery Plan**



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

**Recovery Plan**

**for**

**Large-flowered Skullcap (*Scutellaria montana*)**

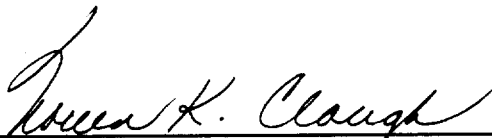
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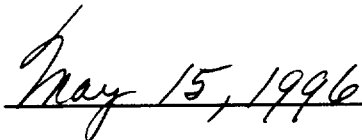
for

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

Approved:

  
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Date:

  
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### **Literature citations should read as follows:**

U.S. Fish and Wildlife Service. 1996. Large-flowered Skullcap Recovery Plan.  
Asheville, North Carolina. 31 pp.

### **Additional copies of this plan may be purchased from:**

Fish and Wildlife Reference Service  
5430 Grosvenor Lane, Suite 110  
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## **ACKNOWLEDGMENTS**

Thanks to Leo Collins, Tennessee Valley Authority; Graham Hawks and Jim Brown, Tennessee River Gorge Trust; Tom Patrick, Georgia Department of Natural Resources (Freshwater Wetlands and Heritage Inventory); Milo Pyne and Andrea Shea, Tennessee Natural Heritage Program; Keith Woster, Chattahoochee National Forest; and Andrew Kemp for their contributions to this recovery plan.

## EXECUTIVE SUMMARY

**Current Status:** *Scutellaria montana* is listed as an endangered species. There are 17 extant populations (12 in Tennessee and five in Georgia) that vary greatly in size. Three populations are presumed extirpated due to habitat alterations, including development and clear-cutting. At the time of listing there were 10 known populations of *S. montana*, with most individuals occurring on only two sites. Habitat destruction (as a result of logging, wildfire, grazing, and residential development) threatens the species.

**Habitat Requirements and Limiting Factors:** *Scutellaria montana* occurs in slope, ravine, and stream-bottom forests in northwestern Georgia and adjacent southeastern Tennessee. Habitat loss and lack of information on appropriate management are the factors limiting the number of viable populations.

**Recovery Objective:** Delisting

**Recovery Criteria:** Large-flowered skullcap will be considered for delisting when there are 15 protected and managed self-sustaining populations. Populations must be distributed throughout the range and must be maintained for 10 years.

### Actions Needed:

1. Search for additional populations and conduct a status survey.
2. Protect known populations.
3. Conduct long-term demographic studies.
4. Study the effects of management and disturbance regimes.
5. Maintain seeds and plants *ex situ*.

### Cost (\$000s):

YEAR	NEED 1	NEED 2*	NEED 3	NEED 4	NEED 5	TOTAL
FY 1	16.5	9.0	9.0	10.5	1.4	46.4
FY 2		4.5	4.5	6.0	.4	15.4
FY 3		4.5	4.5	6.0	.4	15.4
FY 4			4.5	6.0	.4	10.9
FY 5			4.5	6.0	.4	10.9
FY 6			4.5	6.0	.4	10.9
<b>TOTAL</b>	16.5	18.0	31.5	40.5	3.4	109.9

\*Does not include land acquisition.

**Date of Recovery:** By 2012, if necessary funds are provided and all recovery criteria are met.

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## PART I

### INTRODUCTION

Large-flowered skullcap (*Scutellaria montana* Chapman) is an herbaceous representative of the mint family (Lamiaceae) with 17 known populations in northern Georgia and southeastern Tennessee. In 1986 the taxon was listed as endangered by the U.S. Fish and Wildlife Service (Service) (U.S. Fish and Wildlife Service 1986). At that time, there were seven populations known in Georgia and three in Tennessee. The taxon was threatened by habitat loss due to timbering or development. Over 90 percent of the 7,000 individual plants known in 1986 occurred at only two sites, neither of which was completely protected from known threats. *Scutellaria montana* is listed as endangered in Tennessee (Tennessee Natural Heritage Program) and as threatened in Georgia (Georgia Department of Natural Resources, Freshwater Wetlands and Heritage Inventory).

#### History of the Taxon

- 1878 - *Scutellaria montana* was described by Chapman (1878).
- 1890 to 1973 - Collections were made from several sites, including Hamilton County, Tennessee, and possibly Catoosa County, Georgia.
- 1924 - Penland reduced the taxon to varietal status (Penland 1924).
- 1927 - Leonard treated *Scutellaria montana* at specific rank (Leonard 1927).
- 1942 - Epling described *Scutellaria pseudoserrata* as distinct from *Scutellaria montana*.
- 1974 - Leo Collins rediscovered populations of *Scutellaria montana* in the Marshall Forest in Georgia.
- 1975 - Service published a notice in the *Federal Register* accepting a report on endangered, threatened, or extinct plants by the Smithsonian Institution as a petition for the listing of *Scutellaria montana* (U.S. Fish and Wildlife Service 1975).
- 1980 - Service published a notice in the *Federal Register* indicating *Scutellaria montana* was a category 1 candidate species (U.S. Fish and Wildlife Service 1980).
- 1983 - Leo Collins submitted information gathered from several years of research on the species to the U.S. Fish and Wildlife Service.
- 1983 - Service published a notice in the *Federal Register* indicating a change from category 1 to category 2 candidate for *Scutellaria montana* (U.S. Fish and Wildlife Service 1983).

- 1984 - Survey of the Tennessee River Gorge located an additional population in Marion County, Tennessee (Hawks 1985).
- 1985 - Service proposed listing *Scutellaria montana* as an endangered species (U.S. Fish and Wildlife Service 1985) and requested comments on the proposal.
- 1986 - Service listed *Scutellaria montana* as endangered (U.S. Fish and Wildlife Service 1986). The Service had information on 10 locations from Georgia and Tennessee.
- 1986 - Marion County populations were surveyed and determined to contain over 50,000 plants (Tennessee Natural Heritage Program, no date); Tennessee Valley Authority botanical surveys added populations north of the previous range.
- 1993 - Marion County populations were resurveyed (Faulkner 1993); Lookout Mountain was surveyed (McKerrow and Pyne 1993).

**Description** (modified from Bridges 1984b, Kral 1983, Collins 1976, Epling 1942)

*Scutellaria montana* is a perennial herb with solitary, erect, square stems, usually from 30 to 50 centimeters (cm) tall (Figure 1). The leaves are lanceolate to ovate, on 1 to 2 cm petioles, with blades 5 to 8 cm long and 3 to 5 cm wide, crenate to serrate margins, and hairy on both surfaces. The inflorescence is a terminal, leafy-bracted raceme, with or without paired lateral racemes at the base. The calyx is two-lobed (characteristic of the genus *Scutellaria*). The corolla is relatively large, 2.6 to 3.5 cm long, blue and white, and lacking a fleshy ridge (annulus) within the corolla tube near the top of the calyx. Flowering occurs from mid-May to early June and fruits mature in June and early July.

Bridges (1984b) stated, "The genus *Scutellaria* can be easily recognized by its distinctive calyx, with a protrusion, or 'cap' on the upper lobe." Within the genus there are other species with which *Scutellaria montana* could be confused. Bridges (1984b) listed some important characters that a specimen must have to be characterized as *Scutellaria montana*: (1) a terminal inflorescence; (2) a large corolla (at least 2.5 cm long); (3) tapering or truncate leaf bases, never cordate; (4) a midstem with at least some stipitate glandular hairs; (5) no sessile glands on the upper leaf surface, (6) a fairly densely pubescent lower leaf surface, often with glandular hairs; and, (7) a corolla tube lacking an annulus within.

In the field, *Scutellaria montana* is most likely to be confused with *S. pseudoserrata*, which has transparent sessile glands on the upper leaf surface and hairs only on the veins and leaf margins. In contrast, *S. montana* has a fine, even-mixed glandular and nonglandular "velvety"



pubescence on the upper and lower leaf surfaces. Two other skullcaps that can occur in the same region are *S. elliptica* and *S. ovata*. *Scutellaria elliptica* tends to have leaf margins with rounded teeth and noticeably longer hairs on the leaf. *Scutellaria ovata* has strongly cordate leaf bases, and it flowers later in the season. The Appendix includes a key used to distinguish these species.

## **Distribution**

*Extant Populations.* Large-flowered skullcap is known to occur in two counties in Tennessee and four counties in Georgia, within a limited area of the Ridge and Valley and Cumberland Plateau provinces (Figure 2). There are 17 extant populations (12 in Tennessee, five in Georgia) that vary greatly in size (Table 1). Detailed population data is available for the Marshall Forest and the Hicks Gap sites (Faulkner 1993, Kemp 1983).

*Extirpated Populations.* Three populations, one from Tennessee (Hamilton County) and two from Georgia (Gordon and Floyd Counties) are presumed extirpated due to habitat alterations.

## **Habitat**

Bridges (1984b) described the habitat of *Scutellaria montana* as follows:

...rocky, submesic to xeric, well-drained, slightly acidic slope, ravine and stream bottom forests in the Ridge and Valley and Cumberland Plateau provinces of Northwestern Georgia, and adjacent southeastern Tennessee (and probably Alabama).

Bridges (1984b) listed distinguishing characteristics of the forests where large-flowered skullcap are found as: (1) a history of some natural pine occurrence; (2) a canopy dominated by oaks and hickories; (3) a mostly deciduous shrub layer with some evergreen *Vaccinium*; (4) a moderately dense herb layer with mesic and xeric species; and (5) the site occurring on well-consolidated paleozoic to precambrian strata, often with some exposed rock.

Forest composition data has been collected on sites in the Marshall Forest and the Marion County populations (Faulkner 1993; Collins, unpublished; Lipps 1966). Data from the sites where *Scutellaria montana* was first studied indicate that it occurred in late-successional forests. Additional sites suggest that it is more of a mid- to late-successional species (Bridges 1984a; Collins, unpublished; Lipps 1966). At the Marion County site, Faulkner (1993) observed large-flowered skullcap persisting in an area where timbering activities had occurred and where the plants had been subjected to low-intensity ground fires. He concluded that while individual plants that are established prior to the disturbance may survive, recruitment into disturbed sites is not likely.

Bridges (1984b) noted that large-flowered skullcap sites occur on a variety of geologic strata, including shale, chert, limestone, and sandstone from Cambrian to Pennsylvanian age. Most of the Tennessee sites occur on the Upper Mississippian Pennington Formation and Lower Pennsylvanian sandstones and shales. Plants found on Lookout Mountain occur on some of the Mississippian Formations that underlie the Pennington (McKerrow and Pyne 1993). Georgia sites occur predominantly on Mississippian Formations, including Rome, Red Mountain, and Rockwood (Collins, unpublished).

## **Life History**

*Phenology.* Collins (unpublished) described the phenology of the species as follows:

Nutlets are released from mid-June to mid-July, overwinter, and apparently germinate in late March. Mature individuals that have perennated as root stocks begin shoot growth in late March. By early April, plants are 5-10 cm tall and are pushing through the leaf litter. Anthesis typically begins during mid-May and continues through early June. Pollination is principally exclusively by Hymenoptera of the superfamily Apoideae (bees). The corolla shrivels somewhat and falls from the calyx one or two days after pollination, presumably within 24 hours of fertilization. The calyx closes around the developing fruit immediately after corolla abscission. During the next two to four weeks, the calyx and the enclosed nutlets enlarge and mature. The calyx then dehisces by the loss of the upper lip and the nutlets are released.

A different course is followed if fertilization does not occur. The corolla shrivels markedly and may or may not remain united to the calyx. The entire calyx, still open at the mouth, falls leaving the pedicel bare.

*Seed Dispersal and Germination.* Collins (unpublished) states the following:

A method for long distance dispersal, here meaning any distance over two miles, is not known for *Scutellaria montana*. Nonetheless, its opportunity for such dispersal seems as great as for its wide-ranging relatives in that nutlet morphology and calyx dehiscence are virtually identical throughout the section. Thus, the limited distribution of *Scutellaria montana* should not be attributed to an insufficient means of dispersal without further study.

Conditions required for germination and establishment have not been studied to date.

*Reproductive Biology.* Field observations of the Marshall Forest population were made by two students from Shorter College (Kemp 1983, Stirling 1983). The reproductive potential they observed seemed low when compared to observations on related species (Collins, unpublished). Stirling found that fewer than 40 percent of the flowers formed fruit, while Kemp observed fewer than 10 percent producing fruit. Some of the difference in fruiting rate

Figure 2. Generalized Range of *Scutellaria montana*.

Table 1. Extant populations of *Scutellaria montana* in Georgia and Tennessee.

COUNTY (SITE)	OWNERSHIP	POPULATION SIZE	LAST SEEN	THREATS
<b>GEORGIA:</b>				
1. Floyd County (Blacks Bluff)	TNC	250	1986	Lack of information for management.
2. Floyd County (Marshall Forest)	TNC	1,300	1986	Lack of information for management.
3. Walker County (Missionary Ridge)	Private	5	1986	Small population size.
4. Walker County (Hawkins Ridge)	Private	60	1988	Development.
5. Gordon County (Armulchee)	Private	35	1983	Development.
<b>TENNESSEE:</b>				
6. Hamilton County (White Oak Mountain)	Private	5	1981	Small population size.
7. Hamilton County (Chestnut Ridge)	Private	100	1993	Development.
8. Hamilton County (Walden Ridge)	Private	10,000	1993	Development.
9. Hamilton County (Murphey Hill, Chickamauga Reservoir)	TVA	135	1986	Unauthorized use of the area. Invasive plants.
10. Hamilton County (Ware Branch, Chickamauga Reservoir)	TVA	30	1986	Heavy recreational use.

Table 1 (continued)

COUNTY (SITE)	OWNERSHIP	POPULATION SIZE	LAST SEEN	THREATS
<b>TENNESSEE (continued):</b>				
11. Hamilton County (Fairview Slopes, Chickamauga Reservoir)	TVA	190	1986	Informal recreational use.
12. Hamilton County (Booker T. Washington)	TDEC (Parks)	Few	1986	Heavy recreational use.
13. Hamilton County (Big Ridge, Chickamauga Reservoir)	TVA	130	1987	Lack of management plan and inventory.
14. Hamilton County (Signal Mountain)	Private	2,000	1986	Development.
15. Hamilton County (Hunters Road)	Private	6	1989	Small population size. Invasive plants.
16a. Hamilton County (Lookout Mountain)	NPS and Private	238	1993	Lack of information for management.
16b. Hamilton County (Lookout Mountain)	NPS	39	1993	Dissected habitat and recreational use.
16c. Dade County, Georgia (Lookout Mountain)	NPS	8	1993	Small population size.
17a. Marion County (Bill McNabb Gulf)	TDF	Included below	1993	Lack of information for management.
17b. Marion County (Kelly's Ferry Slope)	TRGT	Included below	1993	Lack of information for management.

Table 1 (continued)

COUNTY (SITE)	OWNERSHIP	POPULATION SIZE	LAST SEEN	THREATS
TENNESSEE (continued):				
17c. Marion County (Hicks Gap)	TDF and TDEC (SNA)	50,000	1993	Lack of information for management.

Key to acronyms under "Ownership" column:

NPS - National Park Service  
 SNA - State Natural Area  
 TDEC - Tennessee Department of Environment and Conservation  
 TDF - Tennessee Division of Forestry  
 TNC - The Nature Conservancy  
 TRGT - Tennessee River Gorge Trust  
 TVA - Tennessee Valley Authority

may be due to climatic factors, but the low rate needs to be studied. Observations over several years are necessary before the factors affecting flowering and seed set can be determined.

*Predation, Competition, and Disease.* Predation of mature plants prior to seed set may reduce the reproductive capacity on a site. Plants have been observed that have been eaten to within inches of the ground (Woster, Chattahoochee National Forest, personal communication, 1993; McKerrow, personal observation, 1993). This damage was most likely caused by deer. In addition, *Desmodium* sp. and vines have been seen growing on *Scutellaria montana*, causing the plant to lose some of its flowers prior to seed set (McKerrow, personal observation, 1993). Some individual plants have been affected by disease, but this appears to affect only a few individuals and not be a significant threat to the species.

Invasive species, such as Japanese honeysuckle (*Lonicera japonica*) and privet (*Ligustrum vulgare*), are currently a problem for some populations of *Scutellaria montana*. These species are likely to continue to be a problem where disturbance allows these species to become established, such as on some smaller public areas and on privately owned sites.

### **Conservation Measures**

The most effective conservation measure to date has been the protection of habitat. This has been accomplished in large part through land acquisition (Kellys Ferry Slopes, Marshall Forest) and the management of public land as natural areas (Hicks Gap, Bill McNabb Gulf, Chickamauga Reservoir, Booker T. Washington, and Lookout Mountain). Continued success (i.e., the ability to sustain populations of *Scutellaria montana*) depends on the size of the populations, the degree of isolation of the site, and future management practices. Several populations on public land are "islands" surrounded by water and residential development.

Hicks Gap was designated a Class II State Natural-Scientific Area in 1989 (Tennessee Natural Heritage Program, no date). Management activities other than hunting are being delayed until guidelines for the management of the area are developed in cooperation with the Tennessee Department of Environment and Conservation (Division of Ecological Services) and the Tennessee River Gorge Trust (Tennessee Division of Forestry 1990).

In addition to habitat protection, intensive surveys of the Marion County, Marshall Forest, and Lookout Mountain sites have been conducted (Faulkner 1993, McKerrow and Pyne 1993, Kemp 1983). At all three of these sites, long-term monitoring has been proposed (Rob Sutter, The Nature Conservancy, Southeast Regional Office, personal communication, 1993; Faulkner 1993; Kemp 1983).

In Georgia, plants have been successfully transplanted from a site slated for development and have been relocated to two sites in the Chattahoochee National Forest (Woster, personal communication, 1993). The plants were collected while they were flowering and were held by the Atlanta Botanical Garden over the winter. They were placed on slopes facing both east and west, where they have been monitored for two field seasons.

### **Recovery Strategy**

Long-term monitoring of *Scutellaria montana* on protected land is an important strategy for the recovery of the species. Monitoring should include permanent plots on areas with different management histories and forest compositions. By following individual plants and plots through several years, trends in recruitment, mortality, and reproductive capacity can be determined. With plots in a variety of forest types and management histories, the effects of disturbance and management activities on reproductive capacity can be followed.

Life history studies, including studies of pollination and germination requirements, phenology, and seed dispersal, could be a component of a monitoring program. Determination of germination requirements will require laboratory studies.

The Tennessee River Gorge, Hicks Gap, and Marshall Forest sites offer the greatest potential for gains in studying this species over a range of conditions. Lookout Mountain would be another important site for study; it provides a fairly large and relatively undisturbed area, where monitoring would be useful.

The protection of sizeable populations that occur on private land is another important component of the recovery of *Scutellaria montana*. Currently, the second and third largest populations occur on private land. These sites support populations considerably larger than several publicly owned and protected sites.

A search for additional populations of *Scutellaria montana* throughout southeastern Tennessee, northwestern Georgia, and northeastern Alabama will also be conducted to try to increase the number of known extant populations.

Management plans should be developed for public land that is managed for recreation. The plans should include limiting access to areas of habitat for *Scutellaria montana* and the removal of invasive plant species that threaten populations on those sites. Additional management needs should be incorporated into the management plans as the needs are identified.

Propagation methods should be tested, and seeds should be placed in long-term storage. Propagation from cuttings has shown some success and should be investigated further (Patrick, Georgia Department of Natural Resources, Freshwater Wetlands Heritage Inventory, personal communication, 1993).



PART II

RECOVERY

**A. Recovery Objectives**

*Scutellaria montana* (large-flowered skullcap) will be considered for delisting when there are 15 adequately protected and managed self-sustaining populations. Populations must be distributed throughout the range and must be maintained for 10 years. A population will be considered adequately protected when it is legally protected and all needed active management is provided. A population will be considered "self-sustaining" if monitoring data support the conclusion that it is reproducing successfully and is stable or increasing in size. The minimum number of individuals necessary for a self-sustaining population should be considered to be at least 100 until otherwise determined by demographic studies. If numbers of discrete populations increase to 25 (because of the discovery/establishment of additional populations) or the number of protected and managed self-sustaining populations becomes 10 or more (distributed throughout the known geographic range), the species will be considered for downlisting to threatened status.

## B. Narrative Outline

1. Search for additional populations of *Scutellaria montana* and prioritize sites for protection. Since the species was listed, several additional populations have been discovered through thorough inventories of specific areas. Without a focused effort, the potential for increasing the known number of populations is slim. The ability to prioritize and protect the highest-quality sites will depend on having complete information on extant populations of the species.
  - 1.1 Search for additional populations. A search should be conducted in southeastern Tennessee, northwestern Georgia, and the northeastern corner of Alabama, where the physiographic characteristics are consistent with the known habitat for *S. montana*. The short flowering season for the species may mean this search will need to be conducted over two field seasons or that the search area will need to be divided among individuals.
  - 1.2 Conduct status survey. Since the time of listing, information has become available on additional populations and field observations have been made by many individuals. In conjunction with a search for additional populations, a status survey report should be written to synthesize new information.
  - 1.3 Prioritize sites. Privately owned sites should be ranked according to population size, plant vigor, and habitat condition. High-priority sites should be protected. New information from the search for additional populations and the status survey report should be incorporated as it becomes available. Genetically diverse populations should be given priority over those with low diversity (see Task 5).
2. Protect known populations. Of the 17 populations currently known, eight are protected through public ownership or by the Tennessee River Gorge Trust and The Nature Conservancy. Eight populations, including the second and third largest, are privately owned. One population in Hamilton County, Tennessee, occurs on public and private land. The protected sites need management plans in order to effectively protect *Scutellaria montana*.
  - 2.1 Contact landowners. Determine and provide appropriate level of protection. Landowners should be contacted, informed that *S. montana* is on their land, and told about potential threats to the species. If possible, negotiations should begin to achieve the desired level of protection. Types of protection include management agreements, conservation easements, and acquisition. Registry as a natural area is possible, but the limitations to this type of protection need to be recognized--it is temporary, nonbinding protection. The cost of this task will vary, depending on the type of protection possible and the amount of buffer land that is necessary to adequately protect the site.

- 2.2 Develop management plans for each protected population. Management needs for *S. montana* need to be determined before this task can be completed (see Task 4). Preliminary plans should be developed that deal with threats (e.g., invasive species, trampling by unauthorized use, and incidental damage through recreational use). The sites affected by these plans need to be monitored so the effectiveness of the protective measures can be determined, and management changes can be made when necessary.
3. Conduct long-term monitoring of known populations. All populations should be monitored annually for the first 5 years to check the number of individuals and to determine threats to the populations. For the larger protected populations, this should include permanent plots (see Task 4).
4. Determine the effects of potential management techniques. Observations by individuals in the field can help direct studies to document the effects of potential management techniques on populations of *S. montana*. This work should incorporate knowledge about site management, disturbance history, and forest composition.

Bridges (1984b) had the following recommendation with respect to monitoring *S. montana*. In small populations, every plant could be identified and followed. In larger populations, quadrats could be placed randomly or systematically throughout the population. Areas of varying densities, competitive differences, and microhabitats should be sampled. Measurements should include height, number of flowers, number of fruit set, plant vigor and condition, cover, and competition within a radius of 1 foot. In addition, predation and disease should be noted.

- 4.1 Investigate the effects of past disturbances. Long-term trends and effects of different management and disturbance regimes need to be studied. Faulkner (1993) observed plants that had survived in an area where timbering activities had occurred and where the plants had been subjected to low-intensity fires. Until long-term trends are measured on areas of different disturbance and management regimes, the effects of these factors on the survival and reproductive capacity of the species will not be known.

Permanent plots with many different management histories should be established. Each treatment should be replicated within a site and between sites when feasible. The Tennessee River Gorge Trust/Hicks Gap area, Marshall Forest, and Lookout Mountain seem to be the areas where different site histories would be available for study.

- 4.2 Investigate the effects of differences in canopy cover (i.e., light level) on the reproductive capacity of the species. Data on canopy cover and light reaching the forest floor should be collected from the permanent plots and tested for a correlation between light level and some measure of reproductive success.
- 4.3. Determine the effects of various timbering methods. If active timber management is conducted on a site with *S. montana*, the effect on the population should be monitored through the placement of permanent plots prior to treatment. The plots should be revisited in subsequent blooming seasons to determine the effects of timbering on the plants. Some common practices of the Tennessee Division of Forestry should be considered as possible treatments to be tested. For Prentice Cooper State Forest, these include intermediate selection, hardwood group selection, and salvage (Tennessee Division of Forestry 1990). Even-aged management and pine group selection are not likely to provide any benefit to the species and should therefore be avoided.
- 4.4 Test management options for controlling invasive species. Invasive species are threatening some populations of *S. montana*. Manual removal seems to be the most reasonable method for the removal of invasive species that are in direct competition with *S. montana*. Herbicides could adversely affect *S. montana*, and fire is likely to increase competition from vines (Bridges 1984b). If the invasive species are not in direct competition with *Scutellaria* but are encroaching on the site, mowing, burning, and herbicide application could be tested. The response of the population should be documented as a part of the long-term site monitoring.
5. Examine genetic diversity within and between populations. A study of the species' genetic diversity should be conducted, and populations that are genetically diverse should be identified. This information should then be used to help set priorities for the preservation of genetic diversity. Information on genetic variability will help determine the number of populations and population size necessary to successfully maintain the species.

On the two sites where *S. montana* and *S. pseudoserrata* both occur (Lookout Mountain and the Tennessee River Gorge), genetic studies to identify the isolating mechanisms could be pursued. This could include field observations of phenotypic differences that make the species appear distinct to potential pollinators (character displacement), along with genetic studies that would indicate the mechanisms that could serve to maintain the distinct species.

6. Maintain plants and seeds *ex situ*. To protect against the loss of a population, attempts at propagation, using cuttings, should be attempted. In addition, seeds should be maintained at a long-term seed storage facility.
  - 6.1 Maintain plants *ex situ*. Plants from several populations should be propagated, and living collections should be maintained. The Atlanta Botanical Garden has been doing some of this work and should therefore be a good resource for future activities.
  - 6.2 Maintain seeds *ex situ*. Seed collection from distinct populations should be maintained in long-term storage. Viability of the seeds should be checked periodically; seeds should be replaced with fresh collections as needed.

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PART III  
IMPLEMENTATION SCHEDULE

Priorities in column 1 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 species population/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**

ABG - Atlanta Botanical Garden  
CPC - Center for Plant Conservation  
FWS - U.S. Fish and Wildlife Service  
TE - Endangered Species Division, U.S. Fish and Wildlife Service  
NPS - National Park Service  
SHP - State Natural Heritage Programs in Tennessee, Georgia, and Alabama  
TDF - Tennessee Division of Forestry  
TNC - The Nature Conservancy  
TRGT - Tennessee River Gorge Trust  
TSP - Tennessee State Parks  
TVA - Tennessee Valley Authority  
R4 - Region 4 (Southeast Region), U.S. Fish and Wildlife Service



LARGE-FLOWERED SKULLCAP IMPLEMENTATION SCHEDULE

Priority	Task Number	Task Description	Task Duration	Responsible Agency		Cost Estimates (\$000's)			Comments
				FWS	Other	FY1	FY2	FY3	
2	1.1	Search for additional populations.	1 year	R4/TE	SHP	13.5			Three states; 6 weeks.
2	1.2	Conduct status survey.	1 year	R4/TE	SHP	3.0			One person; 1 month.
2	1.3	Prioritize sites.	1 year	R4/TE	SHP				Included in status survey (Task 1.2).
2	2.1	Contact landowners. Determine and provide appropriate level of protection.	Ongoing	R4/TE	SHP	4.5	4.5	4.5	Three states; 2 weeks. Acquisition cost not included.
2	2.2	Develop management plans.	1 year	R4/TE	TRGT, TDF, TNC, TSP, SHP	4.5			Six weeks.
2	3.0	Conduct long-term monitoring.	Ongoing	R4/TE	TRGT, TDF, TNC, TSP, NPS, SHP	9.0	4.5	4.5	Set up two states--one person; 6 weeks.
2	4.1	Investigate the effects of past disturbance.	3 years	R4/TE	TRGT, TDF, THP	3.0	1.5	1.5	Set up-- 1 month.
2	4.2	Investigate the effects of differences in canopy cover.	3 years	R4/TE	TRGT, TDF, THP	3.0	1.5	1.5	Set up-- 1 month.
2	4.3	Determine the effects of various timbering methods.	3 years	R4/TE	TDF, TRGT, THP	3.0	1.5	1.5	Set up-- 1 month.
2	4.4	Test management options for controlling invasive species.	3 years	R4/TE	TVA	1.5	1.5	1.5	Two weeks.
3	5.0	Examine genetic diversity within and between populations.	1 year	R4/TE		5.0			
3	6.1	Maintain plants <i>ex situ</i> .	Ongoing	R4/TE	ABG, CPC	1.0			
3	6.2	Maintain seeds <i>ex situ</i> .	Ongoing	R4/TE	CPC	0.4	0.4	0.4	

## PART IV

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# PART V

## APPENDIX

The following key is provided for use in the Upland provinces of Georgia, Alabama, and southeastern Tennessee for *Scutellaria* with few, erect stems, leaf bases truncate or tapered (never strongly cordate), and crenate or serrate leaf margins. (Key from Bridges 1984b.)

1. Second internode below the base of the inflorescence (midstem) with at least some stipitate-glandular hairs, usually densely hairy.....2
  2. Lower leaf surfaces hairy only along the veins.....3
    3. Upper surfaces of the leaves with sessile glands (Corolla 24-33 mm long)  
*S. Pseudoserrata* Epling
    3. Upper leaf surfaces without sessile glands, usually sparsely hairy (Corolla 14-18 mm long)  
*S. elliptica* Muhl.
  2. Lower leaf surfaces with soft, appressed, often glandular hairs distributed over the surface, also pilose along the main veins (Corolla 26-35 mm long)  
*S. montana* Chapm.
1. Second internode below the base of the inflorescence (midstem) hairy or glabrous, but with no stipitate-glandular hairs.....4
  4. Lower leaf surfaces evenly pubescent with short curled or spreading hairs  
*S. incana* Biehler var. *incana*
  4. Lower leaf surfaces glabrous, or pilose only along the main veins.....5
    5. Stems glabrous or glabrate; leaves sparsely hairy or glabrous..... 6
      6. Upper leaf blades largest, only 4-6 pairs of relatively thin leaves below the inflorescence, (corolla > 21 mm long)  
*S. serrata* Andr.
      6. Median leaf blades largest, usually 8-15 pairs below the base of the inflorescence (corolla < 21 mm long)  
*S. incana* Biehler var. *punctata* (Chapm.) Mohr
    7. Base of stems with stipitate-glandular hairs  
*S. alabamensis* Alex.
    7. Base of stem hairy, but without stipitate-glandular hairs.....8
      8. Stem hairs relatively short and curving  
*S. elliptica* Muhl. var. *elliptica*
      8. Stem hairs 1-2 mm long, spreading  
*S. elliptica* Muhl. var. *hirsuta* (Short) Fern.