Mountain Golden Heather
(Hudsonia montana)
RECOVERY PLAN

MOUNTAIN GOLDEN HEATHER RECOVERY PLAN

prepared by

Levester Pendergrass, Ph.D.
Regional Botanist
U.S. Department of Agriculture - Forest Service
Southeast Region
January 1983

Revision by
U.S. Department of the Interior - Fish and Wildlife Service
Southeast Region
September 1983

Approved: Walter O. Stieglitz
Acting Regional Director, Southeast Region, U.S. Fish and Wildlife Service

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THIS IS THE COMPLETED MOUNTAIN GOLDEN HEATHER RECOVERY PLAN. IT HAS BEEN APPROVED BY THE U.S. FISH AND WILDLIFE SERVICE. IT DOES NOT NECESSARILY REPRESENT OFFICIAL POSITIONS OR APPROVALS OF COOPERATING AGENCIES. THIS PLAN IS SUBJECT TO MODIFICATION AS DICTATED BY NEW FINDINGS AND CHANGES IN SPECIES STATUS AND COMPLETION OF TASKS DESCRIBED IN THE PLAN. GOALS AND OBJECTIVES WILL BE ATTAINED AND FUNDS EXPENDED CONTINGENT UPON APPROPRIATIONS, PRIORITIES, AND OTHER BUDGETARY CONSTRAINTS.

LITERATURE CITATIONS SHOULD READ AS FOLLOWS:

U.S. Fish and Wildlife Service. 1983. Mountain Golden Heather Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 26 pp.

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TABLE OF CONTENTS

PART I

INTRODUCTION

Mountain golden heather (Hudsonia montana) was described from Table Rock Mountain, North Carolina in 1816 by Thomas Nuttall, who reported that it occurred there in "extensive caespitose patches" (Nuttall, 1818). Visitations to the Table Rock site by botanists in the 1960's and 1970's were followed by expressions of concern for the status of the species because of presumed threats from recreationists (Sanders, 1980). In his status report on the plant, Morse (1979) discussed trampling, soil compaction, and campfires as existing threats, and rock climbing and mineral development as potential threats to the survival of the species. Morse's evaluation of threats and population decline was based on four site visits from 1975 to 1978. Using Morse's information, as well as additional studies conducted by the U.S. Department of the Interior, Fish and Wildlife Service, the species was listed as Threatened under the Endangered Species Act by the Fish and Wildlife Service on October 20, 1980 (45 FR 69360). It is also listed as Threatened by the State of North Carolina (North Carolina Plant Conservation Program, 1981, the North Carolina Protected Plant List--unpublished list).

Description

Stems--Numerous, decumbent-based, often rooting at lower nodes, producing abundant spur shoots, the side branches arching upward, the whole plant forming low open clumps 8-15 cm high, occasionally forming patches 8-10 dm across, most often in clumps 15-20 cm across (Pharr, in prep.), the old shoot growth with bark a dark reddish-brown, with numerous irregular narrow cracks revealing paler inner bark, the newer shoots with epidermis more reddish, the newest growth pale reddish-brown or tan, pilose.

Leaves--Alternate, ascending and overlapping in tight spirals from base to tip of shoots and spur shoots, linear, mostly 3-8 mm long, sometimes curved, greenish, firm, somewhat thickened, toward the base above somewhat concave, toward the apex thicker, the tips with a conic callus, the surfaces at first pilose, later nearly smooth.

Inflorescence--Flowers few to several, solitary from the tips of shoots and spur shoots, on slender, erect or ascending, pilose-tomentose peduncles mostly 5-10 mm long.

Flowers--Bisexual, regular; calyx turbinate, 5-7 mm long, the 5 sepals unequal, fused at base to a cup, the 2 longest lobes linear-subulate, the others lance-ovate, acuminate, the outer surface pilose-tomentose; petals 5, distinct, pale yellow, spreading, twice as long as the sepals; stamens distinct, smooth, up to 25, ca. 3 mm long, the anthers broadly ellipsoidal, ca. 0.3 mm long. Ovary superior, 3-carpellate, pilose.

Fruit--Capsule ovoid, ca. 3 mm long, pilose to base, splitting into 3 firm valves, 1 with the persistent elongate style; seeds few, usually 2-3, asymmetrically oblong-ellipsoidal or ovoid, ca. 1 mm long, the surface covered low, papillose, gray-white bumps (U.S. Department of Agriculture, Forest

Service, Endangered and Threatened Species of the Southeastern United States. General Report SA-GA 7. 1982).

Taxonomy

Mountain golden heather was described by Nuttall (1818) in 1816 as Hudsonia montana. In 1972, Skag and Nickerson proposed that it be treated as a subspecies of Hudsonia ericoides (Hudsonia ericoides ssp. montana). This treatment was followed by the Smithsonian Institution in their 1975 report to the Congress and by subsequent Federal Register publications. Various authors however, have continued to recognize the taxon as a distinct species and morphological, cytological, and population studies confirm the distinctness of Hudsonia montana from Hudsonia ericoides (Morse, 1979).

Distribution

The five known populations* of mountain golden heather (Table Rock, the Chimneys, Chimney Gap, Shortoff, and the Amphitheater-Carolina Wall) occur in Pisgah National Forest, Burke County, North Carolina. These five populations are confined to 8 kms of Jonas Ridge along the eatern rim of Linville Gorge from Table Rock Mountain to Shortoff Mountain. (See Figure 1.) Mountain golden heather has not been found on the western side of the Gorge (Pharr, in prep.). The populations occur on chilhowee quartzite, a rock type apparently unknown elsewhere in the Blue

*"Population" in its stricter application is reserved for those plants which are genetically isolated from other groups of the same species. The limits of the genetic populations of mountain golden heather are uncertain. In this recovery plan "population" is used for convenience to differentiate between groupings of of plants which ocurr at some distance from each other.

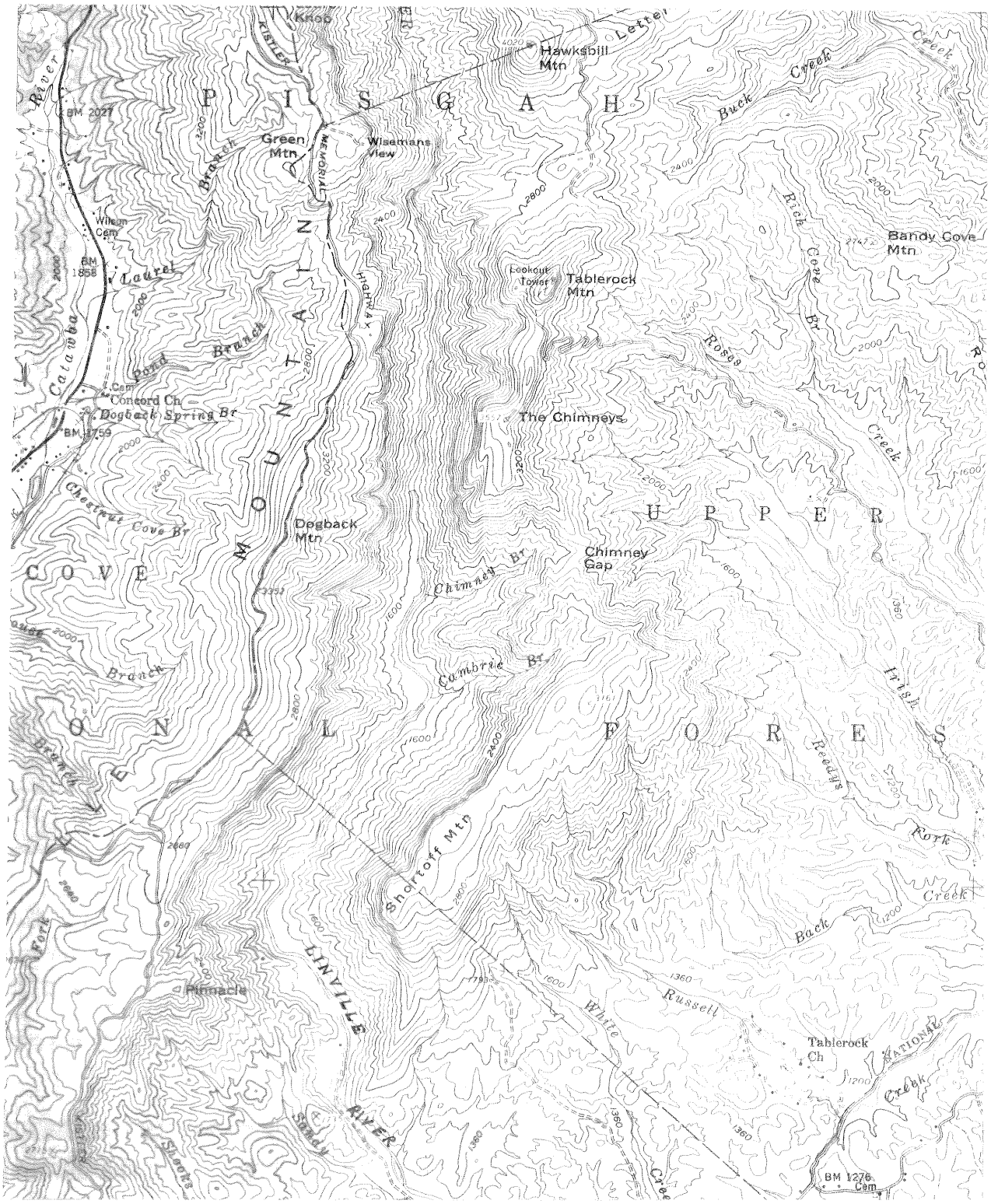

Figure 1. Vicinty map for Mountain golden heather.

Ridge (Morse, pers. comm.). Since the plants colonize the sandy soil produced by erosion of this rock, there is little probability of finding the species outside the Linville Gorge area (Table Rock thrust sheet).

Since its discovery in 1816, specimens have been collected at frequent intervals, most of them from Table Rock. It has been widely assumed that Table Rock was the only locality for the species, and mountain golden heather was presumed extinct when several botanists failed to find any plants on Table Rock in the 1960's and early 1970's (Morse, 1979). However, in 1978, this and other historically reported colonies were found to be extant (Morse, 1979). According to Morse (1979), the species occurred in four separate sites. Further investigations by Murdock and Sanders (Sanders, 1980) revealed an additional site. Pharr's 1982 work verified the existence of five populations. Inventorying is difficult in this rugged terrain, therefore, a few unexplored sites may still exist on both sides of the Gorge.

Habitat Requirements

Mountain golden heather is limited to the chilhowee quartzite ledges and outcrops found along Linville Gorge. The shallow sandy soils derived from this quartzite are interspersed with quartzite gravel. The soil at depths greater than 10 in. fits taxonomically into the Cleveland series, loamy mixed Mesic Lithic Dystrochrept. It contains 30-50 percent gravel (2 mm to 7.6 cm diameter). The fine earth fraction (2 mm diameter) is approximately 70 percent sand (2 mm to 50 microns), 25 percent silt (50 microns to 2 microns), and 5 percent clay (2 microns). Surface pH was 4.0 to 4.5, while subsurface pH was 4.5 to 5.0. Using a field test kit, the cation exchange capacity was 10+2 and the base saturation was

0-5 percent. This soil has a little more gravel than is normally found in Cleveland soil, and is often more shallow (10 in.). Where it is less than 10 in., it would fall into the Lithic Udorthent class, for which there is no named soil series in this area (J. Michael Ortosky, Jr., Soil Scientist with the Soil Conservation Service, U.S. Department of Agriculture in Pharr, in prep.). A soil analysis by the Agronomic Division of the North Carolina Department of Agriculture, gives pH ranges of 3.4 to 4.1, and classifies the soil as a mineral soil with 0.9 percent to 5.8 percent organic matter, base saturation ranges from 6-10 percent, and cation exchange capacity ranges from 4-9 to 11.2. Soil depths to bedrock range from 6 to 20 cm, with an average of 12.5 cm for all sites measured (Pharr, in prep.).

Most of the mountain golden heather sites are within the watershed of the Linville River, a tributary of the Catawba River. The only water source for the species is provided by rainfall (Pharr, in prep.). The characteristic ledge habitats are generally exposed to direct sunlight (Morse, 1980). Species frequently associated with mountain golden heather include Leiophyllum buxifolium, Gaylussacia baccata, Rhododendron minus, Selaginella tortipila, and Pinus pungens. The general aspect is that of an edaphically maintained ecotone between bare rock and a pine/ericaceous shrub community, with mountain golden heather as a local dominant in the ecotone (Pharr, in prep.). All known occurrences of mountain golden heather lie between 2800 and 3850 feet elevation (Pharr, in prep.).

Reproductive Status

According to Pharr (in prep.), the vegetative phenophase of mountain golden heather begins in May when the small, dull-green leaves appear in tufts. One season's vegetative growth ranges from 1 cm on a small young plant to 11 cm on a healthy mature plant. Flowering stems produce little vegetative growth. In October the leaves begin to yellow and then brown. Dead brown leaves persist, appressed and scale-like, on the other branches. The plant flowers in late May on warmer, sunnier sites. Each bud produces one flower, which lasts for approximately eight hours--from early morning until late afternoon. All flower parts are persistent except the petals, which wither and shed as evening approaches, unless the closing sepals entrap them. The peak of bloom is reached during the first ten days of June, with only scattered flowers appearing through June. Rarely will a flower be seen in July.

Similar in structure to other Hudsonia species, the flowers are self-compatible and may self-pollinate in the late afternoon as the flower closes, forcing the anthers and their loose pollen against the pistil. The plants have a well-formed pollen suggesting sexual rather than asexual reproduction. Pharr further stated that the fruiting phenophase occurs from late June through July. Morse, according to Pharr, has germinated a few seeds collected in July 1979. Pharr also noted that by early August few capsules remain intact and unopened. Seedlings have been found at some sites. (Morse, 1979; Pharr, in prep.).

Suspected and Known Limiting Factors

Factors limiting the maintenance and expansion of the population cannot be ascertained without considerable research. Indications are that soil is an important limiting factor as the species has been found only on soils derived from chilhowee quartzite. Light also appears to be limiting, as plants found in full shade are less vigorous. Fire also seems to be important and may be a factor in eliminating competition. Two other species of Hudsonia respond favorably to light fire.

Population Status

Morse (1980) and the U.S. Fish and Wildlife Service (1980) reported that mountain golden heather has declined at Table Rock since 1816. The plants are definitely not in extensive, caespitose patches as described by Nuttall in 1818. According to Morse (pers. comm.), the cause for it's decline on Table Rock is unknown; changes in fire frequency or construction of the observation tower may have been involved. Other factors may have included natural succession and increased visitor use.

An initial population status study conducted by the Forest Service from 1977 to 1980 (Sanders, 1980) estimated the total population size to be close to 2000 plants. Morse (1979) estimated the minimum population to be 200 plants.

Comparision between the results reported by Sanders and Morse is difficult since they employed different methods and standards. Morse, unlike Sanders, was estimating the lower limit to the population. Moreover, because of their

use of different methods, it is uncertain if the difference in numbers represents a difference in the number of total sites occupied, or a difference in the population density at each site. Since Sanders' study was more intensive than Morse's, it is probable that the difference is not density, but rather number of sites.

Threats

The most serious threat to mountain golden heather may be loss of suitable habitat because of competition with other species for light. Pharr (in prep.) states that gradual encroachment by larger shrubs, such as Leiophyllum buxifolium (sand myrtle), as soil pockets deepen, creates a dense low shade that limits mountain golden heather survival. Mountain golden heather plants that have become overtopped by sand myrtle usually consist of pale, sparse, elongated stems that do not flower. Pharr also reported that dead mountain golden heather plants are frequently found scattered under sand myrtle. Large healthy flowering clumps have been observed under the less dense high shade of pines and deciduous shrubs, but flowering was reduced when compared to plants growing in full sun (Pharr, in prep.). This problem of shading is common throughout the range of mountain golden heather and should be given immediate attention (Pharr, in prep.).

Extended drought could eliminate mountain golden heather from most of its exposed ledges, but moderately dry conditions may actually benefit the plant by limiting successional changes and reducing shading by larger shrubs. Pharr (in prep.) stated that natural erosion of the ledges apparently proceeds at a slow rate and does not seem to be threatening to the plants. However, erosion due to excessive run-off onto ledges by trails does pose a threat in some areas.

Another threat is visitor damage, or trampling, caused by rock climbers, hikers, campers, etc. While not the most serious threat to mountain golden heather, it is perhaps the most obvious general threat to the species in certain areas. The small, brittle stems of mountain golden heather break readily and direct trampling may eventually destroy the plant. This breakage and destruction of root sprouts and seedlings is the major damage resulting from trampling. Soil compaction by trampling, cited as a possible threat by Morse (1979), has been found to be non-selective and limited (Pharr, in prep.). Sanders (1980) suggested that soil disturbance favors seed germination in mountain golden heather, but Pharr (in prep.) found no evidence to support that theory. Trampling causes only minimal damage rangewide, but is significant in the most heavily used areas. The use of the steep to sheer cliffs of the Linville Gorge for climbing is becoming increasingly popular, and is leading to damage of vegetation on and near cliffs (Morse, 1979).

This increased visitor traffic along the east rim of Linville Gorge could pose serious threats to mountain golden heather, especially if this increase was accompanied by additional trail construction, more widespread camping, or easier access to the ledges. Most of the mountain golden heather lies within the boundaries of Linville Gorge Wilderness and its proposed Shortoff extension in Pisgah National Forest. At present, visitor use is more strictly regulated in wilderness areas than in other areas of the national forests, but enforcement and supervision are minimal. The Wilderness Management Plan should address the need for protection of the ledge flora as a priority.

Pharr (in prep.) discovered another possibly serious threat to mountain golden heather: predation of seeds by an unknown insect. This problem is common throughout the range of mountain golden heather and needs to be dealt with as soon as possible. The true extent of the problem and the identity of the insect are unknown and more research must be done before any management can be initiated.

Other possible threats include prospecting or mineral development in the habitat areas, and specimen collection by botanists/visitors. According to Pharr, in July 1982, four plants were carefully dug and removed from the Table Rock site. Also, there is an intrinsic threat to the survival of any species that occurs in low population numbers and is distributed in a restricted area. Restricted distribution and low population numbers lead to susceptibility to stochastic extinction, whether the immediate cause is man or nature.

Recovery Actions

Pharr (in prep.) under contract with the Plant Conservation Program, Plant Industry Division of the North Carolina Department of Agriculture, has completed research which included the establishment of permanent plots within populations of the species, studies of reproductive biology, and population status surveys.

PART II

RECOVERY

A. Recovery Objective

Mountain golden heather could be considered for delisting when the following criteria are met: (1) The five known populations are maintained at current levels or above and are self-sustaining, (2) Species biology and site dynamics are sufficiently understood to assure effective long-term management strategy, (3) Protection and management policies of the U.S. Forest Service are proven effective, and (4) The species and its habitat are protected from present and foreseeable human-related and natural threats that may interfere with the survival of any of the populations.

B. Step-down Outline

1. Secure all known populations.
2. Conduct searches for new colonies.
    21. Identify potential habitat.
    22. Train personnel on species identification.
    23. Conduct ground investigations of potential habitat.
3. Preserve existing germ plasm.
    31. Propagate mountain golden heather, maintaining populations representative of each natural one.
    32. Deposit seeds from each population into a seed bank.

4. Monitor populations and their habitats.

   41. Monitor population trends.

   42. Check sites periodically for evidence of problems.

5. Manage populations to insure recovery.

   51. Identify limiting factors.

      511. Study light relations.

      512. Examine effects of competition.

      513. Study fire relations.

      514. Study effects of trampling.

      515. Study predator relationships.

   52. Develop a management plan for the conservation of this species.

      521. Do experimental burning to remove competition.

      522. Do experimental removal of competition mechanically.

      523. Consider altering visitor use patterns.

      524. Develop a means of controlling predation.

      525. Determine appropriate means of public education.

C. Narrative

1. Secure all known populations.

All known populations occur on lands administered by the U.S. Forest Service. Section 7(a)(1) of the Endangered Species Act of 1973, as amended, requires all Federal agencies, including the Forest Service, to utilize their authorities in furtherance

of the purposes of this Act by carrying out programs for the conservation of Endangered and Threatened species. In addition, Section 7(a)(2) of the Act requires the Forest Service to insure that all activities authorized, funded, or carried out by that agency are not likely to jeopardize the continued existence of any Endangered or Threatened species or result in the destruction or adverse modification of its Critical Habitat. All managemant practices affecting mountain golden heather come under Section 7 review. Management affecting the species should follow the recommendations developed during Step 5. Should any populations be found on non-Federal lands, then a management agreement should be sought with the landowner to insure the protection of the species.

2. Conduct searches for new colonies.

Pharr (in prep.) has done extensive searching for mountain golden heather in the Linville Gorge area and found more colonies than previously reported. However, since inventorying is difficult in this rugged terrain, it is possible that other plants could be found. Forest Service personnel in the local area should be instructed on recognition of the species.

21. Identify potential habitat.

Potential habitat can be identified using aerial photos, geologic maps (showing bedrock), and soil survey maps. Sources for these materials include the Forest Service, Agricultural Stabilization Conservation Service, the U.S. Geological Survey, and the Soil

Conservation Service. The majority, if not all, of this work has been completed by Pharr (in prep.).

22. Train personnel on species identification.

Forest Service personnel should be provided with photographs showing flowers, vegetative stems and general habitat of this species, then instructed to report possible sitings to a knowledgeable individual for verification. Since all the reported sites of mountain golden heather occur on Forest Service administered lands, training field personnel to identify this species would greatly enhance the possibility of finding new plant sites.

23. Conduct ground investigations of potential habitat.

Priority should be given to searching suitable sites in the vicinity of reported colonies. Suitable areas both on and off Forest Service land should be searched.

3. Preserve existing germ plasm.

According to Morse (1980), there are no records of any plants of this species in cultivation. A well developed plan for cultivation would help ensure that mountain golden heather does not become extinct. It should be noted that the cultivation program is secondary to the efforts aimed at maintaining and expanding the existing population through natural regeneration. If the existing populations of the species are

destroyed, future attempts at reestablishment would require the use of cultivated material.

31. Propagate mountain golden heather, maintaining populations representative of each natural one.

Propagation has not been successfully accomplished for this species (Sutter and Pharr, pers. comm.). Research is needed to determine the possibility of propagating the species and of maintaining plants from each population by propagation. Hudsonia ericoides perhaps should be used for initial experimentation. Care should be taken to prevent cross-pollination between populations in order to preserve any genetic distinction among populations.

32. Deposit seeds from each population into a seed bank.

Seed banks established by the Forest Service and/or other agencies will facilitate the conservation of this species. The Forest Service has already established a cold storage seed bank at the National Tree Seed Laboratory in Macon, Georgia. Seeds should be sent to this repository as they become available. As a general rule, when seeds are requested, the older seeds should be dispensed first. A log should be kept recording inflow and outflow of seed, amount of seed, population represented, dates, and names of individuals and agencies. In order to maintain genetic distinctions, seeds from each population should be kept separately and dispensed separately.

4. Monitor populations and their habitats.

All presently known populations, as well as any new populations found, should be monitored since populations may change in size, number, and location. The status of mountain golden heather relative to successional changes and any human disturbances should be monitored before and after recovery.

41. Monitor population trends.

Pharr (in prep.) established permanent quadrats and transects in each population, and characterized and mapped the associated vegetation. This baseline data will make possible the continuous monitoring of population trends. Monitoring should be done frequently, at least once a year. Percent cover, number of clumps (See Pharr, in prep.) and presence of seedlings (unbranched single stems less than 2 cm long) are some of the data that should be collected.

42. Check sites periodically for evidence of problems.

Sites should be checked frequently, at least quarterly, for damage to the population from trampling, poaching, disease, predation, erosion, etc. Early detection of such problems will hopefully make their correction easier and less costly.

5. Manage populations to insure recovery.

Effective management will be required to bring about the recovery of mountain golden heather and to maintain the recovered state once it is achieved. Studies are needed to resolve the uncertainties as to the type and frequency of management techniques which should be applied.

Until such time as experimental populations can be established for research purposes, experimental practices on natural populations should be done with extreme care, so as to not further endanger the species. Some preliminary work may be done on Hudsonia ericoides.

51. Identify limiting factors.

Additional research is needed to determine those factors most limiting to the survival of mountain golden heather. Limiting factors may be chemical, physical or biological.

511. Study light relations.

Shading is known to be detrimental to mountain golden heather. It is necessary to know in more quantitive terms how limiting light is to the species' growth and reproduction.

512. Examine affects of competition.

Other than the effects of shading, it is unknown how competitive vegetation affects mountain golden heather. Further research needs to be done in this area.

513. Study fire relations.

More information is needed concerning the influence of fire on this species and its habitat. According to Morse (1979), there was resprouting and seed germination following a campfire in a mountain golden heather stand. It is possible that fire would improve the habitat by eliminating competitors such as sand myrtle, rhododendron, etc.

514. Study affects of trampling.

Identify those sites that are affected by trampling and determine extent of threat.

515. Study predator relationships.

Identify predator(s) and determine extent of threat. Research needs to be done to determine the exact predator involved and the true extent of the damage.

52. Develop a management plan for the conservation of this species.

The most effective management techniques for dealing with the various threats and limiting factors affecting mountain golden heather should be identified and implemented as quickly as possible. Based on the following research, recommendations should be made indicating the best methods available for managing mountain golden heather. Full implementation of any management technique will depend on the results obtained from studies conducted under Section 51. The Forest Service is currently developing a Land Management Plan for the Nantahala-Pisgah National Forests. The needs of mountain golden heather should be addressed in this plan.

521. Do experimental burning to remove competition.

This should be done with extreme caution, and possibly not at all, until the results of further study as outlined in Step 513 are known.

522. Do experimental removal of competition mechanically.

Hand removal of vegetation might prove to be better than burning. This should be explored as an alternative method

of controlling competing vegetation such as Leiophyllum buxifolium.

523. Consider altering visitor use patterns.

While not the most serious threat to mountain golden heather, trampling is still a threat. Some consideration needs to be given to ways to reduce visitor impact. The most drastic measure is the complete closure of those areas containing mountain golden heather to all hiking, climbing, and/or camping. Short of this are such options as reducing the number of visitors per day, terminating access roads and requiring longer hikes to discourage some people, and rerouting some trails. Strict enforcement of wilderness regulations is essential.

524. Develop a means of controlling predation.

If necessary, based upon the results of Step 515, determine a means to control predation.

525. Determine appropriate means of public education.

The recovery effort should include a positive education program. Interpretive exhibits of the uniqueness of this ridge and its fragile flora should be placed along the trails leading from the Table Rock parking lot. These exhibits should point out the dangers faced by this rare species and the consequences of disturbance. Mountain golden heather should not be specifically described nor locations revealed. Visitors should be reminded to stay

on trails, to camp only in designated areas, and to not pull up or break any plants. The fact that this is a Critical Habitat for Threatened species should be mentioned and the Federal penalities for taking listed plants from Federal land should be detailed. The design of these signs should be a cooperative effort between the Forest Service, the Fish and Wildlife Service, State biologists, and private researchers involved with mountain golden heather.

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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

Mountain golden heather

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	
02,3	Secure populations	1	2	Cont.	4		FS				
16	Conduct searches for new populations	2	3	1 yr.			FS, DA	1000			DA has completed a survey,
01	Train personnel in identification	22	3	1 yr.			FS	500			
M1	Maintain representative populations	31	2	Unk.			FS, DA	2000	1000	1000	
M1	Deposit seeds in seed bank	32	3	Cont.	4		FS, DA				FS has an established seed bank.
I1	Monitor populations	4	2	Cont.	4		FS, DA	1000	1000	1000	
R3	Study light relations	511	2	3 yrs.			FS, DA	1000	1000	1000	
R10	Study competition	512	2	2-5 yrs.			FS, DA	1000	1000	1000	
R3	Study fire relations	513	2	2-5 yrs.			FS, DA	1000	1000	1000	
R14	Study trampling	514	2	3 yrs.			FS, DA	1000	1000	1000	
R9	Study predation	515	2	3 yrs.			FS, DA	1000	1000	1000	
M7	Develop management recommendations	52	2	5 yrs.			FS, DA				
M3	Remove competiton by burning	521	2	2-5 yrs.			FS, DA				
M4	Remove competition manually/ mechanically	522	2	2-5 yrs.			FS, DA	700	700	700	
M7,03	Consider altering visitor use	523	2	2-5 yrs.			FS				*Abbreviations
M4	Control predation	524	2	2-5 yrs.			FS, DA				FS - U.S. Forest Service DA- North Carolina Department of Agriculture
01	Public education	525	2	Cont.	4		FS, DA	500	500	500	

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
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