

Mountain golden heather
(Hudsonia montana)

**5-Year Review:
Summary and Evaluation**



**U.S. Fish and Wildlife Service
Asheville ES Field Office
Asheville, North Carolina**

November 2012

†Please see Addendum 1 at the end of this, our original 5-year review, document. The Addendum provides the limited new information we have gathered for our second 5-year review for this threatened plant that was initiated in the Federal Register (August 6, 2018, 83 FR 38320) and the analysis we have shared to explain the basis for continuing to recommend no change in status for this species.

5-YEAR REVIEW
Mountain golden heather /*Hudsonia montana*

I. GENERAL INFORMATION

A. Methodology used to complete the review:

Public notice of this 5-year review was given in the Federal Register on July 28, 2006 (71 FR 42871-42872) and a 60-day comment period was opened. During the comment period, we did not receive any additional information about *Hudsonia montana* in response to the FR notice. However, the Service did receive additional information about the species in response to requests for specific information that were made (by the Service) directly to biologists familiar with the species. Additional information used in this report was gathered from published and unpublished reports in the Service's Asheville ES Field Office (hereafter, AFO) files. Updated records for the species were provided by the North Carolina Natural Heritage Program (hereafter, NC NHP). Once all data was gathered/obtained, the review was completed by the Service's lead recovery biologists for the species in Asheville, North Carolina (Carolyn Wells and Mara Alexander).

A draft of this five-year review was circulated to 10 persons for review. These persons were selected because of their familiarity with the species, their employment within applicable or affected natural resource agencies, or both. Responses were received from two of these 10 reviewers. A summary of the peer review process and comments received is provided in Appendix A.

B. Reviewers

Lead Region: Southeast Region, Atlanta, GA-Nikki Lamp (404-679-7118)

Lead Field Office: Asheville ES Field Office-Mara Alexander (828) 258-3939 ext. 238

C. Background:

1. **FR Notice citation announcing initiation of this review:** 71 FR 42871-42872; July 28, 2006
2. **Species status:** Stable. The aerial extent/size classes of *H. montana* between 2003 and 2009 have remained stable. Monitoring data obtained by the USFS in late 2009 indicates an increase in individuals from 2003-2004, but the overwhelming majority of these new plants are seedlings which can have a high mortality rate. Therefore, we need to monitor these seedlings to determine mortality rate.
3. **Listing history**
 - Original Listing
 - FR notice:** 45 FR 69360-69363
 - Date listed:** October 20, 1980
 - Entity listed:** Species
 - Classification:** Threatened

Revised Listing, if applicable: n/a

4. **Associated rulemakings:** Critical habitat was designated at listing, in the above-referenced FR notice (45 FR 69360-69363); October 20, 1980

5. **Review History:**

AFO files do not contain prior agency status reviews or prior five year reviews for the species. However, the AFO files do contain numerous other documents with relevant information on the species. Documents containing more comprehensive summaries of the species' status are briefly summarized here to illustrate the nature of available information. For brevity and to minimize redundancy, relevant findings or observations from these and other documents are incorporated as appropriate in Section II.C. ('Updated Information and Current Species Status').

Synopsis of relevant reviews/documents

Morse (1979a) provided the first characterization of the conservation status of *Hudsonia montana*. His work included qualitative characterizations of the species across four locations within Linville Gorge, North Carolina (the only area known to contain the species at that time), and he estimated the total range to include some 200 plants. Sanders (1980) followed with a more quantitative study which estimated the total range to include "thousands of plants" distributed across five sites (Sanders treated one of Morse's sites as two discrete locations).

Pharr (1982) conducted a complete census of all known plants within all known populations. Pharr counted a total of 2,901 clumps across five sites (which she referred to as "populations", and which she further split into 31 subpopulations). Pharr also conducted extensive searches for new populations, both east and west of the Linville River. She established permanent transects in each of the five sites, along which the locations of each *H. montana* plant were mapped. Pharr's work was conducted in collaboration with the NC PCP. Her system of transects was later largely abandoned in favor of other sampling methods on Shortoff Mountain (C. Frost, formerly with NC PCP, pers. comm., 2007). NC PCP continued to assume the principal role in monitoring efforts for the species until 2004, when this responsibility was turned over to the United States Forest Service (USFS) and the Service at a joint meeting of these agency partners. NC PCP was also the primary author of most documents describing recovery efforts from 1982 to 2004.

Following Pharr's work, the next major phase of recovery efforts consisted of a five-year (1985-1989) field experiment examining the relative effectiveness of different management techniques (clipping versus burning) in reducing competition and maintaining the long-term viability of *H. montana* through seedling recruitment (Frantz, 1985; Frantz and Sutter, 1987; Frost, 1988; Frost, 1989; Frost, 1990a). This management experiment was conducted exclusively on Shortoff Mountain (the largest of the Linville Gorge populations). The experiment involved three treatments: a single burn conducted in late March 1987 (burn plots), annual clipping of competing vegetation (clipped plots), and a control. The design consisted of 10 experimental blocks, within each of which there were three plots and a variable number of 1/4m² subplots.¹ Each treatment was randomly

¹ The total number of subplots is variously reported as 208, 210, and 212 in documents on file with the AFO. In reality, the design consisted of 210, 1/4m² subplots within which individual plants were followed by repeat

assigned to one of three plots within a block. Within plots, 1/4m² subplots were centered on established *H. montana* plants (randomly selected from all those occurring within the plot). These subplots were photographed annually for the duration of the experiment (1985-1989), annually each year from 1990 to 1997, and then in years 1999, 2001 and 2003. During the five year study undertaken by NC PCP, the area occupied by *H. montana* within each 1/4m² subplot was digitized from the set of annual photographs, for purposes of examining the species' response to the different management treatments. Seedling cohorts emerging within these subplots in 1987, 1988 and 1989 were followed at monthly intervals during the growing season.

In 1990 NC PCP, USFS, and USFWS jointly agreed to shift the emphasis from research to active management, based primarily upon results from the five year management study. A ten-year work plan was produced, which provided annual objectives and agency responsibilities at each population from 1990 through 1999 (Frost, 1990b). This work plan also included estimates of equipment and labor costs, as well as estimates of time required to perform specific tasks. The first four years (1990 through 1994) of management and monitoring activities are detailed in a series of short annual reports by NC PCP (Frost, 1991; 1992; 1993a; 1993b; Frost et al., 1995 and summaries in annual reports to the Service for accomplishments using Section 6 funding for those years). These activities included implementation of prescribed burns supplemented with manual clearing of competing vegetation, augmentation of existing populations, continued efforts to redirect recreational user impacts away from occupied habitat, and continued monitoring of the species.

A second comprehensive inventory of all existing populations was conducted in 1993 (Frost et al., 1995), for purposes of comparison to Pharr's 1982 census. The 1993 census revealed a 36% decline across all Linville populations, from 2,901 (Pharr, 1982) to 1,854 clumps. Fourteen of the 31 subpopulations (45%) recognized by Pharr were apparently extirpated.

Gross et al. (1998) modeled the effectiveness of various management tactics upon population growth rates, based upon prior years of monitoring data collected by NC PCP. These modeling efforts predicted that a combined approach including both burning and reductions in trampling impacts would be required to reduce or eliminate ongoing declines in existing populations.

Michener (2004) and Donaldson (2004) conducted the 3rd global census for the species during the 2003 and 2004 field seasons. Michener's report (Michener, 2004) includes a compilation of local precipitation data and fire histories (prescribed burns and natural ignitions) for each *H. montana* site. Donaldson (2004) provides supplemental counts for sites that Michener either did not relocate or counted incompletely, as well as GPS coordinates for all known extant (and some presumably extirpated) *H. montana* locations.² After corrections and supplemental counts from Donaldson are taken into

photographs over time. Two of these 210 subplots contained two (rather than one) plants that were each photographed over time, so these two 1/4m² subplots were each photographed twice (once for each plant). Therefore, the number of unique 1/4m² subplots is 210, but the number of photographs is 212 (Frost, pers. comm., 2007).

² Donaldson provided a master list of corrected GPS coordinates. This list includes corrections, with duplicate, erroneous or otherwise superfluous locations removed. It should be used in place of waypoints provided in Donaldson (2004).

account, the 2003-2004 census revealed the highest recorded estimates of plant numbers across the range of the species, with some 4,364 clumps estimated across all known sites.

On the whole, these increased numbers do not represent previously overlooked plants or changes in survey methods. As shown by annual survey and monitoring reports from NC PCP, these are increases in plant numbers possibly resulting from the experimental burns at Shortoff, Woods Mountain and Table Rock as well as hand clearing of competing vegetation in these sites and extensive recruitment of new plants at the Chimneys and Chimney Gap populations following the November 2000 wildfire there.

6. **Species' Recovery Priority Number at start of 5-year review:** 8 (species with a moderate degree of threat and high recovery potential)
7. **Recovery Plan or Outline**

Name of plan or outline: Mountain Golden Heather (*Hudsonia montana*) Recovery Plan

Date issued: September 14, 1983

Dates of previous revisions, if applicable: n/a

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy:

The DPS policy only applies to vertebrate species. Since mountain golden heather is a plant, the DPS policy does not apply.

B. Recovery Criteria

1. **Does the species have a final, approved recovery plan containing objective, measurable criteria?** No.

The species does have a final, approved recovery plan; however, the recovery criteria are only somewhat objective, and are not measurable. The limitations of the existing recovery criteria are addressed in Section 3, below.

2. **Adequacy of recovery criteria.**

- a. **Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?** No.
- b. **Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?** Yes.

3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

The 1983 Recovery Plan (USFWS 1983) for *H. montana* includes four recovery criteria. Each recovery criterion and the extent to which each has or has not been met is discussed below.

(1) *The five known populations are maintained at current levels or above and are self-sustaining.* The known populations have been relatively stable over time, though only through active land management.

(2) *Species biology and site dynamics are sufficiently understood to assure effective long-term management strategy.* Although we have learned a large amount of information about the species' biology and site dynamics so far, there are still many unknowns (e.g., water requirements and shade tolerance).

(3) *Protection and management policies of the U.S. Forest Service are proven effective.* More time and management work is required prior to deciding if the policies are effective.

(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.* *Hudsonia montana* and its habitat are not protected from human-related and natural threats. The USFS is unable to perform controlled burns within the habitat that is home to the largest populations of the species due to housing development proximity. The destruction of habitat due to recreation has not been completely eliminated even when trails and camping sites are closed to the public. The possible effects of climate change on this species are currently unknown, so it is not clear if protection can be provided to *H. montana* if climate change were to become a threat in the future.

Adequacy of these criteria

These criteria are inadequate in that they are subjective and only somewhat measurable. Section IV ('Recommendations for Future Actions') includes a recommendation to revise these criteria to be more measurable and to include populations discovered since the recovery plan was published (see Section II.C., 'Updated Information and Current Species Status'). These criteria also do not reflect the critical role of fire in long-term habitat management, knowledge that has been gained since the recovery plan was finalized and which has been documented in a series of reports by NC PCP (Frost, 1991; 1992; 1993a; 1993b; Frost et al., 1995 and summaries in annual Section 6 accomplishment reports submitted to the Service during those years).

Recovery criteria and the five listing factors

Each of these four recovery criteria implicitly addresses one or more of the threats identified in the final listing rule. The final listing rule determined the following three listing factors to be significant for this species: the present or threatened destruction, modification or curtailment of habitat (factor A); the inadequacy of existing regulatory mechanisms (factor D); and other natural or manmade factors affecting the species' continued existence (factor E). With respect to listing factor A, the following specific threats were identified: trampling, soil compaction, camp fires, trail construction and associated soil erosion, and rock climbing. With respect to listing factor E, competition

for light from surrounding vegetation (presumably resulting from fire suppression) was also identified as a threat to the species. All of these threats continue to affect the species.

The final listing rule determined that listing factor B (overutilization for commercial, recreational, scientific, or educational purposes) and factor C (disease or predation) were not applicable to the species. However, the recovery plan identifies predation of seeds by an unidentified insect as a "serious threat", and further states that "this problem is common throughout the species' range". Subsequent investigation (Palmer, 1985) failed to substantiate this threat and it is no longer widely regarded as a significant threat to the species (see Section C.2. below).

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Abundance and population trends (all sites)

Hudsonia montana was discovered by Thomas Nuttall on the summit of Table Rock, North Carolina in 1816 (Morse, 1979b). Nuttall described the species as "forming dense cespitose [growing in tufts or patches] patches; abundant on the romantic summit of Table Rock." The subsequent failure of several botanists to relocate the species at Table Rock or anywhere else within Linville Gorge throughout the 1960s and 1970s prompted many to presume the species extinct, until the species was rediscovered there in the late 1970s. In 1892, J.K. Small described the species from the southern end of Table Rock, an area where it no longer occurs (Frost, pers. comm., 2007).

Early estimates of population size varied widely, presumably due to differences in the intensity and spatial extent of any given survey effort. According to Smith (1978) and Pharr (1982), Morse initially estimated the total range to consist of some 200 plants distributed across four sites. Smith (1978) regarded Morse's estimates as far too low, but noted difficulties in obtaining comparable counts without a standardized monitoring program. Sanders (1980) counted significantly more plants (clumps) than observed by Morse (1979a, 1979b), estimating 1,500 plants from Shortoff Mountain alone, and speculating that across Linville Gorge the species was likely represented by "thousands of plants". No estimates of total population size (across all known sites) are provided in the 1980 final rule determining the species to be threatened under the Endangered Species Act (Act) (45 FR 69360-69363).

Pharr (1982) conducted the first comprehensive census of all known populations, counting 2,901 plants across five populations (and 31 subpopulations) in Linville Gorge. The five populations are: Table Rock, the Chimneys, Chimney Gap, Shortoff and the Amphitheatre/Carolina Wall.

Frantz and Sutter (1987) conducted a repeat census of all plants on Shortoff Mountain (the largest population) in 1985 and 1986. At Shortoff Mountain, the abundance of *H. montana* (measured as number of clumps) had decreased by 39%

(from 1,797 to 1,091 clumps) in those areas surveyed in 1982 and again in 1986. Frantz and Sutter (1987) interpreted this as a true decrease, one not likely attributable to surveyor error since Pharr accompanied Frantz in the field to standardize counting across the two survey periods. The reasons for the decline were not known, but drought was suspected to have played some role. These same authors reported the Table Rock population (the smallest known at that time) as having been extirpated (possibly due to recreation and camping) as of 1986. *H. montana* was extirpated from the top of Table Rock likely due to the elimination of fire which permitted woody expansion (trees and shrubs) to take over all former habitat for the species (Frost, pers. comm., 2007). In 1791, Andre Michaux described upper Table Rock as "very barren", in contrast with the dense growth of shrubs and trees found there today (Frost, pers. comm., 2007). Camping and trampling continued to impact the few plants surviving in the remaining open areas, which, paradoxically, were only kept open by camping, and when the plant was rediscovered there in the 1980s it was from fire-germinated seeds around a campfire site (Frost, pers. comm., 2007).

All known populations of the species remained in decline from 1985 through 1993 (Frost et al., 1995). In 1993, NC PCP conducted a repeat of Pharr's 1982 census of all known populations. The 1993 census revealed a 36% decline across the Linville populations, from 2,901 to 1,854 clumps. By the time of the 1993 census, one additional population had been located in adjacent McDowell County on Woods Mountain. In 1993, this population contained 120 clumps (roughly six percent of the total number of known plants across all populations).

The 2003-04 census of all known populations produced higher counts than any prior census (Donaldson, 2004; Michener, 2004). The total number of plants across all known populations was 5,053, compared with 1,967 in 1993 and 2,901 in 1982 (only the Linville Gorge populations were known at the time of the 1982 census). The number of plants counted within Linville Gorge in 2003-04 was 4,364, compared with 1,847 in 1993 and 2,901 in 1982. While some of these increases could be attributable to increased numbers of seedlings (either due to true increases in seedlings or more intensive searches for this stage class during the 2003-04 census), the magnitude and timing of these changes (e.g., occurring coincident with a period of active habitat management) suggest a legitimate increase in the number of known plants, well above the numbers known when the species was first federally listed. These changes are possibly attributable to the management actions implemented by NC PCP, USFS, and the Service, the results of which are described in the reports prepared by NC PCP (Frost, 1991; 1992; 1993a; 1993b; Frost et al., 1995).

A complete census of the subpopulations has been completed approximately every 10 years since 1982. An update to the census was completed in 2008 and early 2009 on Shortoff Mountain to document any changes as a result of the large stand replacement, duff-burning, lightning-set fire of 2007. The fire increased suitable habitat and more than doubled the previous high tally recorded for these 14 subpopulations. These increases are reflective of large increases in the smallest size class category recorded for the census. All of the remaining *H. montana* subpopulations were also censused in 2009. This includes the single subpopulation on Table Rock, and the two subpopulations at Woods Mountain. In contrast to the increasing population numbers recorded at Shortoff Mountain, there has been a 2-fold decline in *H. montana* clumps across the 19 subpopulations surrounding the Chimneys and Chimney Gap in Linville Gorge Wilderness. A four-fold decline in

abundance (from 191 clumps to 46 clumps) was recorded at Table Rock, while less of a decline (from 690 to 589 clumps) occurred at Woods Mountain during the last 5 years. Prior to this census, there had not been a prescribed burn within the surrounding plant communities for at least seven years.

In spring 2012, the USFS performed a prescribed burn surrounding both subpopulations on Woods Mountain in the Grandfather Ranger District of the Pisgah National Forest. In September 2012, a census of both subpopulations was completed. There was a decline in abundance in this population, decreasing from 589 clumps to 473. However, this census may have been too soon after the burn to see an increase in seedling growth, or the burn may not have been intense enough to positively affect *H. montana*. The USFS will continue to monitor effects of the burn in 2013.

b. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

The Service is not aware of any evaluations of genetics (including genetic variation within or among populations) conducted on this species.

c. Taxonomic classification or changes in nomenclature:

The Service is not aware of any such changes applicable to this species.

d. Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

Morse (1979a) described the known range as consisting of four locations: Table Rock, and three other sites (all within Linville Gorge) which he referred to as the "Campground Site" (discovered 1923), the "Lookout Site" (discovered 1975), and the "Flat Ledge Site" (presumably observed by Sargent in 1915, possibly the area seen by Nuttall in 1816). The version of Morse's report on file with the AFO does not contain maps or sketches of the four populations described, but Pharr (1982) includes a map which is titled "Distribution Map by Morse (1979)". This map depicts four general locations which are not labeled. It seems reasonable to assume that these locations correspond to the four locations described by Morse (1979a).

Sanders (1980) recognized five locations by name, again all within Linville Gorge: Table Rock, Flat Ledge, Chimney Gap, Campground and Campground II. He states that four of these were known to Morse, and that the fifth (Campground II) may have been known to Morse. Yet despite similar or even identical place names, comparisons with Morse's map reveal inconsistencies in the locations depicted by these two investigators (as noted later by Pharr, 1982). Regardless, Morse (1979a, 1979b) and Sanders (1980) are generally in agreement with respect to the distribution of the species throughout Linville Gorge, with concentrations of plants at Table Rock, The Chimneys, in between The Chimneys and Chimney Gap, and at Shortoff Mountain.

Pharr (1982) recognized five populations and 31 subpopulations across Linville Gorge: Table Rock (with no subpopulations); The Chimneys (four subpopulations);

Carolina Wall-Amphitheater (13 subpopulations); Chimney Gap Ledge (no subpopulations); and Shortoff Mountain (14 subpopulations). Pharr conducted extensive searches for new populations throughout the Linville Gorge area, including but not limited to "all exposed quartzite openings or ledges on Jonas Ridge from Gingercake Mountain to the southern end of Shortoff". Pharr also searched the western rim of Linville Gorge, but did not find the species there.

In 1987, a previously undocumented population was discovered outside of Linville Gorge, on Woods Mountain in adjacent McDowell County by a hiker (this population consists of two subpopulations, Singecat Ridge and Woods Mountain proper). As of 2012, no additional populations have been discovered for the species.

Donaldson (2004) reported that five of the 33 sites originally recognized by Pharr (1982) were extirpated as of 2004.³ Donaldson also notes that some of the subpopulations that Pharr treated as spatially discrete have since effectively merged, and are no longer discrete sites.⁴ Of all 33 sites originally counted by Pharr (1982) and counted again by Michener and Donaldson in 2003-04, 10 had declined relative to the 1982 census, 17 had increased, and five had been extirpated.

Donaldson provides GPS coordinates for 31 of the 33 sites recognized by Pharr (1982); for all 10 of the blocks associated with NC PCP's management experiment on Shortoff Mountain (Frantz, 1985; Frantz and Sutter, 1987; Frost, 1988; Frost, 1990a); and for additional sites discovered in 1987 on Woods Mountain and Singecat Ridge. In 2007 the NC NHP used Donaldson's GPS coordinates to update their Element Occurrence (EO) records for the species and followed Donaldson's recommendations regarding merged subpopulations. As of 2007 the NC NHP EO data for the species are a complete and accurate representation of the known distribution of the species.

e. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

See discussion of threats to habitat, below.

2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

a. Present or threatened destruction, modification or curtailment of its habitat or range:

Most available literature identifies fire suppression as the primary threat to the species, because it facilitates competition from other woody vegetation and suppresses seedling recruitment (e.g., Frost et al., 1995). The second source of endangerment is trampling from recreational users, who tend to camp and hike in the

³ The five extirpated sites are as follows: Chimneys subpopulations Shelter Rock and Chimney Top, and Carolina Wall - Amphitheater subpopulations Mini Ledges, Border Ledge, and Narrow Ledge. Further inspection of data on file with the AFO reveal that these sites were likely extirpated as far back as the 1993 census, since plants were not counted at these locations during that survey effort either.

⁴ Sites which Donaldson notes as having merged are as follows: Chimneys subpopulations Flat Ledge and Trail Side (both merged into one); Carolina Wall - Amphitheater subpopulations Upslope Ledge, Point Ledge, and Pocket Ledge (all three merged into one).

open areas in which the species occurs (Ibid). In general, campers are regarded as having greater impacts to the species and its habitat than day-hikers. In either case, continued fire suppression enables threats from competition, lack of seedling recruitment, and recreational user impacts. Paradoxically, recreational impacts (from campers) serve to slow further vegetation succession and occasionally expose mineral soils in these fire-suppressed habitats, thereby resulting in impacts to established plants while simultaneously facilitating seedling recruitment (Frost, pers. comm., 2007).

A five-year management experiment revealed that burning differentially benefitted *H. montana* by knocking back competing vegetation and encouraging recruitment of *H. montana* seedlings through exposure of mineral soils. Clipping was not an adequate substitute for fire, both because it failed to effectively reduce competition or stimulate seedling recruitment in *H. montana* (it was also labor intensive, requiring some 30 minutes of time per square meter in areas of dense shrub cover). NC PCP also compiled information on the frequency and severity of fires in the Linville Gorge prior to acquisition by the USFS. These data suggested a natural fire cycle of every 5 to 15 years. In nearly every report produced from 1987 through 2004, NC PCP recommended that this fire return interval be restored to the landscape, through adoption of a fire-use policy for wildfires, supplemented by prescribed fires.

In 1990, habitat restoration efforts shifted from an experimental to a management phase. At that time, the species and its habitat had been subject to decades of fire suppression, and all known populations were exhibiting pronounced declines (Frost et al., 1995). Although prescribed burns have been considerably more limited in frequency, scope, intensity, and severity than desired (by those familiar with the species), it appears that prescribed burning is having a beneficial effect. The species' population numbers were higher in 2003-04 than ever previously recorded and are suggestive of a legitimate reversal in the declines observed in prior years. However, it is difficult to assess the relative contribution of prescribed burning and efforts to curtail impacts from recreational users. The USFS has closed some sites entirely (Woods Mountain and Singecat Ridge), and continues to post "no camping" signs at others (Table Rock). The agency has also initiated an outreach program intended to inform the public of the species' presence within Linville Gorge and the need to stay on designated trails. Collectively, the prescribed burning program (although limited in scope) and these efforts to control recreational user impacts appear to be having a beneficial effect upon the species and its habitat.

The USFS initiated an Environmental Assessment (EA) scoping process to help continue prescribed burning in the Wilderness Area of Linville Gorge. The scoping letter was completed in May 2012. The goal is to expand potential habitat via large scale burning and exotic invasive species management.

In the summer of 2007, a wildfire burned virtually all of Shortoff Mountain (which supports the largest population of *H. montana* in Linville Gorge). The USFS monitored the effects of the 2007 wildfire upon the species, concluding the emergency consultation required after this fire. Habitat greatly improved (as described in section C.1). Following this wildfire, a Fire Use Policy was adopted by the Pisgah National Forest for the Linville Gorge Wilderness, which includes all of the *H. montana* populations with the exception of Woods Mountain. This policy was designed to inform decision makers on how to deal with future fires in terms of

suppression when working with fire dependent plant species including *H. Montana*. For example, the policy includes allowing lightning-caused fires to burn when beneficial to listed species and not a threat to other natural resources or public safety. The policy also includes using a USFS botanist to help fire crews avoid trampling the plants.

The USFS is continuing to coordinate with the USFWS on future controlled and prescribed burns that may affect *H. montana* habitat. The USFS completed a prescribed burn on Woods Mountain in spring 2012, which is expected to result in improved *H. montana* habitat. Monitoring of this population occurred in September 2012 (see earlier discussion under Section II.C.1) and will occur again in 2013 to examine the effects of the burn on the population. The USFS performs a complete census of all *H. montana* populations a minimum of every 5 years.

b. Overutilization for commercial, recreational, scientific, or educational purposes:

As described above, recreational user impacts (primarily camping) are regarded as perhaps the second-most severe threat to existing populations. The listing rule did not regard this factor as a significant threat to the species. The USFS closed some camping areas with populations of this species, but no designated camping areas have been created to further minimize disturbance to populations in Linville Gorge. The USFS also posted interpretative signs (about the species and its habitat, as well as the Wilderness Area designation and appropriate uses) along the main trail leading through Linville Gorge. However, periodic sign maintenance will be needed in the future to sustain user awareness, but these efforts appear to minimize the level of disturbance (Frost, 1991; 1992; 1993a; 1993b; Frost et al., 1995). Based on new information, it seems appropriate now to regard recreational use of the species habitat as a threat.

c. Disease or predation:

Not currently known to be a threat to this species.

d. Inadequacy of existing regulatory mechanisms:

The North Carolina Plant Conservation and Protection Act (NC State Code Article 19B, § 106-202.12) provides limited protection from unauthorized collection and trade of plants listed under that statute. However, this statute does not protect the species or its habitat from destruction in conjunction with development projects or otherwise legal activities. There are no other federal or state statutes that afford significant protections to *H. montana*. Therefore, inadequacy of existing regulatory mechanisms continues to threaten this species.

e. Other natural or manmade factors affecting its continued existence:

None known beyond those already addressed in Section II.B.3 (e.g., competition for light from surrounding vegetation).

D. Synthesis

Since *H. montana* was listed in 1980, the number of known sites has increased (to include one more population consisting of two subpopulations, Woods Mountain and Singecat Ridge). In addition, the number of known individuals has also increased from 2,901 clumps to 4,937 across the species' range. However, the overwhelming majority of the new plants observed between 2003 and 2009 are seedlings which can have a high mortality rate. Therefore, it will be important to monitor the fate of these seedlings in future census efforts. The increases in the number of known plants are largely (if not entirely) attributable to active efforts to manage habitat and control recreational user impacts. These efforts were largely spearheaded by the NC PCP until 2003, when the NC PCP turned over primary responsibility for management and monitoring to the USFS and the USFWS.

Fire suppression continues to be the primary threat to the species, one that exacerbates impacts from recreational use (primarily associated with camping rather than day-hiking), by facilitating woody vegetation encroachment and thereby limiting the amount of open habitat available. Although the USFS has continued efforts to manage woody vegetation (through slashing and burning) at the Woods Mountain/Singecat Ridge population, implementing prescribed burning regimes within the Linville Gorge (the majority of the species' known range) has been difficult. Trampling by recreational users (campers and day-hikers) continues to be a secondary threat to this species.

Although the number of known sites and individuals has increased since *H. montana* was listed as threatened, this species has an extremely narrow geographic range (two counties, six total populations) and continues to be threatened by fire suppression, impacts from recreational use, and the inadequacy of existing regulatory mechanisms. Therefore, *H. montana* continues to meet the definition of threatened under the ESA, and no change in the species' status is currently warranted.

III. RESULTS

A. Recommended Classification:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change is needed

B. New Recovery Priority Number: n/a

C. Listing and Reclassification Priority Number: n/a

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. Monitor effects from the 2012 prescribed burn on Woods Mountain. Lead agency: USFS.

This was initiated in 2012, but should be repeated in 2013 during the complete census for all known populations.

2. Begin a physical removal of duff layer on Woods Mountain to restore *H. montana* habitat and propagate *H. montana* for future introduction into restored area. Lead agency: USFS
3. Prepare and finalize individual fire-use and prescribed burn plans for each of the individual populations of the species. Lead agencies: USFS and USFWS.
4. Resume prescribed burns in Linville Gorge, with emphasis upon those populations with the longest lapse in burning. Lead agency: USFS.
5. Repeat census of all known populations in 2013. Lead agencies: USFS, USFWS.
6. Perform research to examine *H. montana* water requirements and shade tolerance. Lead agencies: USFS, USFWS.
7. Establish a system of interagency cross-checks to ensure that necessary actions are completed each year until restoration efforts are complete and required management is reduced to routine maintenance. Lead agencies: USFS, USFWS.
8. Obtain low altitude, high resolution aerial (or satellite) imagery sufficient for delineation of currently occupied and restorable habitat. Use this imagery to set measurable goals for future habitat restoration efforts. Lead agency: USFS.
9. Digitize photos from long-term photo monitoring project, or a subset of these, with intent of examining changes in spatial extent (and seedling recruitment) under varying management regimes (e.g., burning) and threat abatement strategies (e.g., closures). Lead Agency: USFWS.
10. Revise recovery criteria and/or the species' recovery plan. Lead agency: USFWS.

As stated in Section II.B.3., the first of the four recovery criteria addresses only those occurrences of the species known at the time (e.g., those occurring in Linville Gorge). An additional population of the species (at Woods Mountain) was identified after the recovery plan was written. The first recovery criterion should be revised to require that this additional population be subject to equal levels of protection and management prior to delisting the species.

The species' dependence upon fire to maintain its open habitat was suspected but undocumented in 1980, but is now well understood, documented, and corroborated by the large increase in plants seen after the November 2000 wildfire at Chimneys and Chimney Gap (Frost, pers. comm., 2007). The critical role of fire in the recovery of this species should be emphasized in any revisions of recovery criteria or the recovery plan itself.

11. Attempt to reintroduce the species to the southern end of Table Rock using seeds collected from elsewhere within the Table Rock population, or other sites within Linville Gorge. Lead agencies: USFS, USFWS, NC PCP.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Hudsonia montana*

Current Classification: Threatened

Recommendation resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Appropriate Listing/Reclassification Priority Number, if applicable:

Review Conducted By: Carolyn Wells and Mara Alexander, Asheville Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve  Date 10/16/12

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Approve  Date 1/14/13

APPENDIX A

Summary of Peer Review for the 5-Year Review of the Mountain golden heather (*Hudsonia montana*)

- A. Peer Review Method:** A draft 5-year review was sent to 10 reviewers, as an attachment to an email, requesting their review and any other changes or additions that should be included in the document. All reviewers have extensive knowledge of this and similar species. The following individuals responded to our peer review request:
1. David Danley, Botanist for the Pisgah National Forest, U.S. Forest Service, Asheville, North Carolina.
 2. Gary Kauffman, North Carolina State Botanist, U.S. Forest Service, Asheville, North Carolina.
- B. Peer Review Charge:** Reviewers were charged with providing a review of the document, including any other appropriate comments and/or additions. Reviewers were not asked to comment on the legal status of the species.
- C. Summary of Peer Review Comments/Report:** Reviewers responded by email. Both reviewers agreed that the information in the document provided to them was accurate.
- D. Response to Peer Review:** Recommendations from the reviewers were incorporated into the document as appropriate. These consisted primarily of additional information concerning the status of certain populations, threats to the species, and recommendations for future actions.

5-YEAR REVIEW OF MOUNTAIN GOLDEN HEATHER
(Hudsonia montana)

Addendum 1. Summary of new information obtained since the 2013 5-year review.

The *Federal Register* notice announcing the initiation of this 5-year review was published on August 6, 2018 (83 FR 38320). No comments were received during the 60-day public comment period following this notice. However, the U.S. Fish and Wildlife Service (Service) did receive additional information about the species, from biologists familiar with the species, in response to requests for specific information.

Updated information is presented below. Internal review was conducted by three members of the Service's Southeast Region. Additionally, the Service conducted independent peer review on new information (Appendix A). The Service sought review from four knowledgeable experts on this species and its habitats. Comments have been addressed and incorporated into this addendum as appropriate and necessary.

I. GENERAL INFORMATION

B. Reviewers

Lead Region: Southeast Region, Kelly Bibb, (404) 679-7132.

Lead Field Office: Asheville Ecological Services, Rebekah Reid, (828) 258-3939.

C. Background

- 1. Federal Register Notice citation announcing initiation of this review:** 83 FR 38320; August 6, 2018.
- 2. Species Status:** The long-term status trend, when evaluating the species as a whole, appears to be increasing as there has been an increase in the number of plants observed since 1982. However, at a population level, long-term trends include two increasing, two decreasing, and two stable populations. Short-term population trends include two increasing and four decreasing populations. Short-term trends were evaluated to determine if long-term increasing or stable trends could be at risk or if long-term decreasing trends could be rebounding (i.e. a short-term decreasing trend in a long-term increasing population could indicate the need for additional management to maintain the trend). Long-term trends were determined by comparing all monitoring events for a population and short-term trends were determined by comparing monitoring from 2008/2009 to the most recent monitoring event for the population (refer to Section II.C.1.a for more detail).

- 5. Review History:** The Service finalized a 5-year review for mountain golden heather (*Hudsonia montana*) in 2013. The review recommended the species remain classified as threatened due to an extremely narrow geographic range, and threats such as fire suppression and impacts from recreational use (Service 2013).

II. REVIEW ANALYSIS

B. Recovery Criteria

- 3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.**

- (1). *The five known populations are maintained at current levels or above and are self-sustaining.* The above recovery criteria was developed in 1983 prior to the discovery of the Woods Mountain/Singecat population; therefore, the recovery criteria references five populations; six populations are discussed throughout this review.

The Service has identified a short-term and long-term trend for each population based on previous monitoring data (Pharr 1982, Frantz and Sutter 1987, Frost et al. 1995, Donaldson 2004, Michener 2004, Fruchey 2017 and 2018c, Reid 2017 and 2018, Kauffman 2018a and 2018b, U.S. Forest Service (USFS), pers. comm.). Short-term trends include two increasing and four decreasing populations. Long-term trends include two increasing, two decreasing, and two stable populations. Populations that are stable or increasing (see II.C.1.a below) have maintained that status only through active land management and could not be considered self-sustaining.

- (2). *Species biology and site dynamics are sufficiently understood to assure effective long-term management strategy.* Although we are continuing to learn about species biology and site dynamics through monitoring and site observation, formal studies addressing these topics have not occurred since the last 5-year review.

- (3). *Protection and management policies of the U.S. Forest Service are proven effective.* Although regulations and policies are in place to aid in the protection of mountain golden heather (see Section II.C.2.d), lack of resources prevent monitoring of compliance and enforcement. As a result, the policies are not as effective as intended.

- (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.* The destruction of habitat and trampling of plants due to recreational use has not been eliminated even when trails and camping sites are closed to the public. The Service georeferenced a popular community-created Linville Gorge Wilderness (LGW) trail map (LGMaps 2018) and overlaid known, extant mountain golden heather locations (NC Natural Heritage Program (NHP) 2018). All populations in the LGW (five) and their associated element occurrence (EO) records contain plants that are within approximately 500 feet of a mapped trail. Additionally, at least four EOs are in areas mapped as camping sites or overlooks. The table

below summarizes the number of EOs and approximate distances from mapped trails in the LGW.

Table 1. Populations and distance from trails.

Population	Distance from Trail (in feet)						Total EOs in Population
	Trailside (<15)	15-100	101-200	201-300	301-400	401-500	
Table Rock	1	0	0	0	0	0	1
Chimneys	1	0	0	0	0	0	1
Carolina Wall	1	0	2	2	0	3	8
Chimney Gap	1	0	0	0	0	0	1
Shortoff	2	3	2	4	4	1	16

Three of the populations contain only one EO (Table Rock, Chimneys, and Chimney Gap). These populations are especially vulnerable to recreational impacts due to their trailside location. Social trails are also abundant in the LGW. These unofficial and unmapped trails lead to views, camping sites, climbing routes, and/or slacklining locations. Many of these locations currently or previously contained mountain golden heather and suitable habitat. The unintended consequence of social trails is impact to these areas.

The Woods Mountain/Singecat population includes two EOs also within close proximity to a trail system; within 500 feet of a designated trail. The exact distance could not be accurately determined with available maps and the population is not included in the table above. Trails in this area have been closed or re-routed to avoid mountain golden heather (NHP 2018); however, there is evidence of recreational use (i.e. presence of fire ring) in one location.

In addition to trampling, fire suppression has been a suspected cause of mountain golden heather decline (Frost 1990; Gross et al. 1998). Frantz and Sutter (1987) estimated that lightning-ignited fires once occurred in the LGW every five to 10 years. Lightning-ignition records from 1955-1971 and 1974-1985 indicate 17 lightning-ignited fires within the LGW or within proximities which would enable possible spreading into the LGW. Of the 17 fires, ten were on ledges burning near occupied mountain golden heather habitat suggesting a much shorter lightning-ignited fire return interval of 2.9 years (Kauffman 2019a, USFS, pers. comm.). Since the 1950s, fire prevention has successfully minimized and reduced forest fires (Frost 1990) and within the last 20 years, there have been four lightning-ignited fires in the LGW (Kauffman 2019a, USFS, pers. comm.). Periodic fire benefits mountain golden heather by reducing competing vegetation and stimulating germination of seeds (Gross et al. 1998).

Two discrete locations from the Chimneys population (EOs not designated by the NHP) and three discrete locations from the Carolina Wall population (mapped as two EOs and one undesignated location) have not been relocated since Pharr's (1982) original observation. Two additional Carolina Wall locations (mapped as one EO and one partial EO) have not been relocated since 2003/2004 (Donaldson 2004; Michener 2004). Although a specific cause cannot be proven, loss is suspected to be a result of recreational use and/or fire suppression.

C. Updated Information and Current Species Status

1. Biology and Habitat

- a. Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:** The recovery plan recognizes five extant populations of mountain golden heather (Service 1983). Currently, the Service recognizes six populations (Service 2013). The sixth population was discovered in 1987 after the species was listed (NHP 2018). The Service has identified long-term and short-term trends for each of the six populations based on the most complete sets of monitoring data for each population. Long-term trends were determined by comparing all monitoring events for a population (from the first monitoring event between 1982-1993 to the last between 2015 and 2018), and short-term trends were determined by comparing monitoring events from the 2008/2009 monitoring season to the most recent monitoring events, which were between 2015 and 2018. Populations that are stable or increasing have maintained that status only through active land management.

Table 2. Populations and trends.

Population	Short-Term Trend	Long-Term Trend
Table Rock	Decreasing	Decreasing
Chimneys	Increasing	Increasing
Carolina Wall	Increasing	Stable
Chimney Gap	Decreasing	Stable
Shortoff	Decreasing*	Increasing
Woods Mtn/Singecat	Decreasing	Decreasing

*short-term monitoring data for this population has been collected but has not been analyzed. The USFS has identified this population as decreasing based on personal observation and familiarity with the site (Kauffman 2019b, USFS, pers. comm.).

The Table Rock population contained 215 plants in 1982 (the most ever recorded) (Pharr 1982). As of 2016, only four plants remain (Kauffman 2018b, USFS, pers. comm.). This population contains one discrete location (mapped as one EO by the NHP) and is located adjacent to a heavily trafficked trail and overlook. Additionally, fire has not been present in this area since 1996. This population has a short- and long-term decreasing trend.

The Chimneys population contained 101 plants, in four discrete locations (mapped as three EOs by the NHP), in 1982 (Pharr 1982). In 2015, there were 1,356 plants in two locations (mapped as one EO). This represents the most plants ever recorded at this location; the other two locations have not been observed since 1982 (Kauffman 2018b and 2019a, USFS, pers. comm.). The remaining extant discrete locations have the following trends:

Table 3. Discrete locations and trends.

Discrete Location	Short-Term Trend	Long-Term Trend
1	Increasing	Increasing
2	Decreasing	Decreasing

In 2013, the Table Rock Fire, a wildfire suspected to be caused by a rekindled campfire, burned approximately 2,500 acres (Morrison 2014) including the Chimneys population. The plant counts in 2015 are likely inflated due to the increased presence of seedlings after the fire. This population has not been monitored since 2015. It is likely that current abundance is much lower; however, based on current data, this population as a whole has a short- and long-term increasing trend.

The Carolina Wall population contained 230 plants, in 13 discrete locations (mapped as 11 EOs by the NHP), in 1982 (Pharr 1982). In 2015, there were 241 plants in eight locations (mapped as seven EOs). Five locations (mapped as four EOs) have not been observed since the 1980s (Kauffman 2019a, USFS, pers. comm.). The remaining extant discrete locations have the following trends:

Table 4. Discrete locations and trends.

Discrete Location	Short-Term Trend	Long-Term Trend
1	Decreasing	Decreasing
2	Increasing	Increasing
3	Increasing	Increasing
4	Stable	Decreasing
5	Decreasing	Increasing
6	Increasing	Decreasing
7	Increasing	Increasing
8	Decreasing	Stable

One of the eight locations in the Carolina Wall population burned in the 2013 Table Rock Fire (Kauffman 2018b, USFS, pers. comm.). Despite the loss of five discrete locations, long-term abundance has remained stable in this population and since 2009, the number of plants has increased from 151 to 241 (Kauffman 2018b, USFS, pers. comm.). This population as a whole has a short-term increasing trend and long-term stable trend.

The Chimney Gap population contained 63 plants, in one discrete location (mapped as one EO by the NHP), in 1982 (Pharr 1982). In 2015, there were 69 plants (Kauffman 2018b, USFS, pers. comm.). This population is located adjacent to a heavily trafficked trail and burned in the 2013 Table Rock Fire (Kauffman 2018b, USFS, pers. comm.). Long-term abundance has remained stable in this population; however, since 2009 the number of plants has decreased from 144 to 69 (Kauffman 2018b, USFS, pers. comm.). This population has a short-term decreasing trend and long-term stable trend.

The Shortoff population contained 2,172 plants, in 14 discrete locations (mapped as 14 EOs by the NHP), in 1982 (Pharr 1982). In 2008/2009, there were 9,093 plants in 15 discrete locations (mapped as 15 EOs, one previously unknown location was found in 2003) (Kauffman 2018b, USFS, pers. comm.). The extant discrete locations in 2008/2009 have the following trends:

Table 5. Discrete locations and trends.

Discrete Location	Short-Term Trend	Long-Term Trend
1	Stable	Increasing
2	Unk ^a	Decreasing
3	Unk ^a	Increasing
4	Unk ^a	Stable
5	Unk ^a	Increasing
6	Unk ^a	Increasing
7	Unk ^a	Increasing
8	Unk ^b	Unk ^b
9	Unk ^a	Increasing
10	Unk ^a	Increasing
11	Unk ^a	Stable
12	Unk ^a	Increasing
13	Decreasing	Decreasing
14	Decreasing	Decreasing
15	Decreasing	Decreasing

Unk^a – Data from 2017 has not been analyze and the last monitoring event is from 2008/2009; therefore, a short-term trend since 2008/2009 cannot be assessed.

Unk^b – Only two monitoring events occurred –in 2003/2004 and 2008. The time period between these two monitoring event is not long enough to determine a long-term trend and the monitoring is not current enough to determine an accurate short-term trend.

In 2007, the Shortoff Fire, a wildfire suspected to be caused by lightning strike, burned approximately 4,500 acres including portions of the Shortoff population. Thirteen discrete locations had an increasing plant count during the next monitoring event after the fire; however, the majority of the increase was due to seedling recruitment and the presence of immature individuals (Kauffman 2019a, USFS, pers. comm.). In 2017, the White Creek Fire, another lightning-ignited fire, burned 5,500 acres including portions of this population (Kauffman 2018b, USFS, pers. comm.; Collaborative Forest Landscape Restoration Program (CFLRP) 2017). Fire intensity during the White Creek Fire was more subdued overall when compared to the 2007 Shortoff Fire (Kauffman 2019a, USFS, pers. comm.). In discrete locations where the surrounding vegetation burned with high severity in 2007, completely eliminating the surrounding duff (decomposed organic material) layer, there was a dramatic increase in mountain golden heather individuals. The 10-year separation between burns, which resulted in vegetation overtopping many surviving seedlings and immature plants, likely caused a decline in most discrete locations during the last monitoring event. It is speculated the fire return interval should have been on a two to three-year cycle to restore habitat and maintain the higher population counts (Kauffman 2019a, USFS, pers. comm.) The Shortoff population has been monitored since the 2017 fire; however, the monitoring data has not been analyzed and the short-term trend is based on visual observation. In 2018, a new discrete location of mountain golden heather was discovered at the LGW (Massey 2018, Wild South, pers. comm.; refer to Section II.C.1.d). This population as a whole has a short-term decreasing trend (Kauffman 2019b, USFS, pers. comm.) and long-term increasing trend.

The Woods Mountain/Singecat population contained 689 plants, in three discrete locations (mapped as two EOs by the NHP), in 2003/2004 (Donaldson 2004, Michener 2004). In 2018, there were 491 plants (Reid 2018). The discrete locations have the following trends:

Table 6. Discrete locations and trends.

Discrete Location	Short-Term Trend	Long-Term Trend
1	Decreasing	Increasing
2	Decreasing	Decreasing
3	Stable	Increasing

The Woods Mountain/Singecat population was burned by prescribed fire in April of 2018 (Fruchey 2018a, USFS, pers. comm.) and the 2018 monitoring occurred in June and September of that year. Monitoring may have been conducted too soon after the burn to capture the response to fire. The population as a whole has a short- and long-term decreasing trend.

In 2016, the North Carolina Botanical Gardens (NCBG), in collaboration with the Center for Plant Conservation, collected seeds from the Chimneys population as part of an effort to bank globally rare and restricted taxa (Kunz 2019, NCBG, pers. comm.). NCBG collected approximately 225 seeds from 24 plants. Twenty-one seeds were tested for viability and NCBG achieved a 90.5% germination rate. The remainder of the seeds were sent to the National Laboratory for Genetic Resource Preservation for long-term storage. Seeds collected from the Chimneys and Singecat, on various dates from 1995 to 2001, were also tested and found to have high viability (Kunz 2019, NCBG, pers. comm.).

- b. **Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation within or among populations, genetic drift, inbreeding, etc.):** The Service is not aware of any genetic research (including genetic variation within or among populations) conducted for this species since the 2013 5-year review.
- c. **Taxonomic classification or changes in nomenclature:** The Service is not aware of any changes in taxonomic classification or nomenclature since the 2013 5-year review.
- d. **Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors, etc.), or historical range (e.g., corrections to the historical range, change in distribution of the species within its historical range, etc.):** The known county range of mountain golden heather (Burke and McDowell Counties) has remained the same since the 2013 5-year review. In 2018, a Wild South (a non-profit organization) volunteer, found a new discrete location of mountain golden heather at the LGW (Massey 2018, Wild South, pers. comm.). This location contains 60 plants (Reid 2018, Fruchey 2018c) and represents a northern range expansion of the Shortoff population.
- e. **Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):** See discussion of threats to habitat (Section II.C.2.a) for updated information.

2. Five Factor Analysis (threats, conservation measures, and regulatory mechanisms)

- a. **Present or threatened destruction, modification or curtailment of its habitat or range:** Fire suppression, which facilitates threats from competing vegetation and suppresses seedling recruitment, and recreational user impact, were identified in the 2013 5-year review as primary threats to mountain golden heather. These threats are still present.

Decline of mountain golden heather has been attributed to fire suppression (Frost 1990; Gross et al. 1998). Gross et al. (1998) found that survival and population growth could only occur in a trample-free environment with a six to eight-year fire cycle. This coincides with the five to 10-year lightning-ignition cycle that has been suggested to characterize mountain golden heather habitat (Frantz and Sutter 1987) and also closely coincides with a five to seven-year cycle for the surrounding pine-oak/heath plant community (Lafon et al. 2017).

It is known that fire influences vegetation distributions, and that distributions have been altered by fire suppression (Frost 1998). While most fires are anthropogenic in origin, understanding the natural fire regime can provide forest managers with information needed for conservation of fire-adapted species affected by fire suppression. In his 2016 thesis, Denman sought to understand lightning-ignited fires in the Grandfather Ranger District of the Pisgah National Forest, in part, by investigating the climatic conditions that are optimal for lightning-ignited fires. Additional analysis was used to determine if spatial distribution of mountain golden heather is associated with spatial distribution of lightning-ignitions. It was hypothesized that mountain golden heather would be located in areas that burn more frequently due to naturally occurring fires (lightning-ignition).

Using a 20-year dataset of lightning-ignitions, Denman (2016) found lightning-ignition locations and mountain golden heather populations to be random at small scales and aggregated at large scales. This suggests lightning-ignitions and mountain golden heather populations are not spatially associated, and lightning-ignited fires would need to burn large areas to affect the plant species. Denman (2016) also found not all mountain golden heather locations were burned during the 20-year timeframe, indicating that lightning-ignited fires are not occurring at intervals needed to maintain viable populations. Despite the presence of lightning-ignited fires almost yearly, most fires burned relatively small areas due to changes in historic fuel loads, landscape fragmentation, and fire suppression. Denman (2016) suggests small fire size may be the main reason why lightning-ignitions are infrequently associated with known plant locations. Although lightning-ignition did not burn many mountain golden heather locations during the timeframe, the importance of lightning-ignitions for this species should not be undervalued. Denman (2016) concluded that managers will have to utilize prescribed burning to supplement lightning-ignited fires in order to burn mountain golden heather at suggested intervals.

Congress established the Collaborative Forest Landscape Restoration Program (CFLRP) to encourage the collaborative, science-based ecosystem restoration of priority forest landscapes and in 2012, the Grandfather Restoration Project was funded. The project is a

10-year effort with the goal of increasing prescribed burning and other management practices to more than 40,000 acres of the Grandfather Ranger District in Pisgah National Forest. The project aims to restore fire-adapted forest ecosystems and benefit a variety of native plants and wildlife; and control exotic, invasive species. A wide variety of partners are collaborating with the USFS on the project and the LGW has benefited as a result of the program and partnerships.

A prescribed fire was used in 2018 to reduce woody encroachment in the Woods Mountain/Singecat population (Fruchey 2018a, USFS, pers. comm.). The encroaching shrub and duff layer was visibly reduced after the fire. Post-fire monitoring was conducted at the site but may have been too soon after the burn to capture any response.

Although prescribed burning in the LGW remains difficult to achieve, the USFS's Fire Use Policy includes allowing lightning-ignited fires to burn when beneficial to listed species and not a threat to other natural resources or public safety (Service 2013). Approximately 70% of the mountain golden heather range is within the White Creek Fire boundary and in 2017, the fire was allowed to burn for resource benefit (CFLRP 2017). The affected population of mountain golden heather has been monitored since the 2017 fire; however, the monitoring data has not been analyzed to determine the response. Monitoring data after the 2007 fire and visual observations after the 2017 fire indicate an initial increase in seedling recruitment followed by mortality. Although some mortality is expected, it is speculated that fire should be returned to the landscape more often (every two to three years) to increase the chance of seedling survival (i.e. seedlings mortality is high when encroaching vegetation after a fire is unmanaged) (Kauffman 2019b, USFS, pers. comm.).

The USFS developed a fire priority model to prioritize burning for fire-adapted plant communities, including rare plants and animals (Kauffman 2019a, USFS, pers. comm.). Federally-listed species, as well as endemic species, received the highest weight for rare species. As such, the model indicates all areas with occupied mountain golden heather habitat are high priority areas for burning. In an effort to use prescribed fire in the LGW, the USFS will complete an environmental assessment (EA) for burning occupied mountain golden heather habitat or expand the document to include all fire-adapted communities in the LGW (Kauffman 2019a, USFS, pers. comm.). Strong public opposition to burning in the LGW has been difficult to overcome in the past and significant outreach will be needed to gain support from the surrounding community.

b. Overutilization for commercial, recreational, scientific, or educational purposes:

The LGW is a popular recreational destination and the USFS defines usage as "heavy" (USFS 2019). The 2013 5-year review identifies recreational user impacts, primarily camping, as a threat to the species. However, recreational activities of other kinds – hiking, rock climbing, slacklining, etc. – can also contribute to destruction of habitat and trampling, and should be included when discussing recreational user impact. Although difficult to quantify, anecdotal evidence indicates an increase in visitor use in recent years. Table Rock, Hawk's Bill, and Shortoff Mountain are popular destinations on the east side of the LGW; however, exact visitation numbers are not known (Wood 2017).

Wild South, a CFLRP partner, is exploring how to use crowd-sourced “activity” data from a popular social media-fitness mobile application to help quantify visitor use and identify usage patterns in the LGW (Massey 2019, Wild South, pers. comm.). If successful, use and pattern data could be compared with known locations of rare species. This information could be used to help prioritize sites for additional conservation or management, identify locations where use pattern could be changed, etc.

Visitors to the LGW often travel off-trail and Wild South has observed increased trampling of plants, especially in trailside populations. Initially focusing on the Chimneys population, they will experiment with the placement of large, immovable boulders along the trail in an attempt to passively change the use pattern. Ideally, these boulders will direct visitors away from mountain golden heather by making certain areas more difficult to traverse (Massey 2019, Wild South, pers. comm.). Additionally, they are exploring the feasibility of relocating common, native shrub species into specific areas to break the line-of-sight from the trail to the enticing off-trail location (often an unofficial overlook or rock feature). If successful, this method could be employed in other locations.

The USFS has proposed the Linville Gorge South End Trails Project (USFS 2017). This is a community and partner-driven project with the goal of providing access to rock climbing areas and overlooks while mitigating impacts to threatened and endangered plant species. The project includes relocating trails, away from rare plants, where feasible and providing official access to desirable locations while eliminating social trails that are unsustainable and difficult to maintain. This project will begin after review and approval by the USFS, with a projected start date in 2020.

A popular community-created LGW trail map (LGMaps 2018) identifies the unofficial names (often unique rock features or climbing route names) of many LGW features. The USFS has worked with Wild South to remove the names of lesser known features that contain mountain golden heather (Fruchey 2018b, USFS, pers. comm.). Ideally, less visitors will be drawn to these areas if they are not labeled on a map.

- d. **Inadequacy of existing regulatory mechanism:** In addition to the North Carolina Plant Protection Act referenced in the 2013 5-year review, there are other regulations and policies that protect plants on USFS property. USFS regulation 36 CFR 261.9 prohibits removing or damaging any plant that is classified as a threatened, endangered, sensitive, rare, or unique species. Additionally, Forest Service Manual 2600 establishes policy that prohibits the removal and collection of any threatened or endangered plants on lands under Federal jurisdiction except when authorized by permits. Although these regulations and policies should protect mountain golden heather in the LGW, lack of resources prevent monitoring of compliance and enforcement.
- e. **Other natural or manmade factors affecting its continued existence:** The listing rule and subsequent reviews do not identify exotic, invasive species as a threat to mountain golden heather (Service 1980, Service 2013); however, more than ten different species have been documented throughout the LGW (Wild South 2012). The three species that

pose the most serious threat are: *Paulownia tomentosa* (princess tree), *Miscanthus sinensis* (Chinese silver grass), and *Verbascum thapsus* (mullein). These species are prolific colonizers of disturbed land, and the area's high propensity for wildfire has made it especially susceptible to invasion. Kuppinger et al. (2010) studied the invasion of princess tree, a disturbance-dependent invasive plant, across three burns in the southern Appalachian Mountains, including a burn at the LGW. Following initial widespread establishment after fire, princess tree only persisted on more exposed and xeric sites – habitat also preferred by mountain golden heather (Kuppinger et al. 2010). The lack of competition within this habitat suggests that princess tree may be able to further reproduce and increase in dominance. Although mountain golden heather is dependent on fire to reproduce and maintain appropriate habitat conditions, additional burning could also increase the abundance and extent of princess tree (Kuppinger et al. 2010). The control of princess tree in habitat for mountain golden heather may require special attention from land managers.

A comprehensive exotic, invasive species survey was conducted in the LGW in 2010, after the Shortoff Fire in 2007 (Kauffman 2019a, USFS pers. comm.). This survey provided data to support the completion of an EA to manage exotic, invasive species in the LGW. Wild South, with guidance from the USFS, led multiple efforts to manage exotic, invasive species and three of the most recent and largest efforts were in 2012, 2014, and 2017.

In 2012, Wild South received a TogetherGreen grant for “an innovative conservation project”. They focused their efforts on removing exotic, invasive plants from the LGW by engaging community volunteers, veterans, wilderness therapy programs, and other conservation organizations (Wild South 2012).

After the Table Rock Fire in 2013, the USFS conducted a Burn Area Emergency Response (BAER) assessment indicating the need for exotic, invasive management and availability of funding for removal of exotic, invasive species seedlings, primarily princess tree. In 2014, the USFS Grandfather Ranger District entered into an agreement with Wild South to organize interns and volunteers to pull seedlings (Kauffman 2019a, USFS, pers.comm.). The effort was largely successful with 92 volunteers contributing 633 hours to exotic, invasive plant removal during one year of the effort (Massey 2019, Wild South, pers. comm.).

The White Creek Fire encompassed 70% of the known mountain golden heather range (CFLRP 2017) and in 2017, after the fire, a BAER assessment documented the need for exotic, invasive species management within the fire boundary, primarily princess tree and Chinese silver grass. CFLRP partners, using three separate participatory agreements, developed a strategy to survey and treat invasive species within the fire boundary. An extensive survey and treatment effort took place during the summer and fall of 2017, with partner organizations working together, under the guidance of the USFS, to survey and treat exotic, invasive species. Work focused on detection and removal or treatment of princess tree, Chinese silver grass, mullein, *Ailanthus altissima* (tree-of-heaven), and *Spiraea japonica* (Japanese spiraea). Tens-of-thousands of princess tree seedlings were

pulled from fall of 2017 to early 2018. Over 2,500 acres have been inventoried, mapped, and treated within the fire boundary (Massey 2019, Wild South, pers. comm.; Kauffman 2019a, pers. Comm.). Also in 2017, chemical treatment of scattered exotic, invasive species was completed on approximately 1,000 acres in the area adjacent and east of the LGW; the area is currently (2019) being retreated (Kauffman 2019a, USFS pers. comm.).

The work described above is critical not only to controlling existing populations of exotic, invasive species, but informing the USFS on how exotic, invasive species interact with wildfire and prescribed fire on a large scale.

The USFS is planning to complete an EA for treatment of exotic, invasive species across all Wilderness areas in their jurisdiction, including the LGW (Kauffman 2019a, USFS, pers. comm.). It is anticipated that development of the EA will begin in the winter of 2019/2020.

While the threats discussed above present challenges in the near term, accelerated climate change could exacerbate threats, such as exotic, invasive species, already affecting mountain golden heather. Although models of future climate scenarios are not yet available at a resolution conducive to site specific planning, it is reasonable to expect shifts in temperature and precipitation patterns that define the climatic conditions to which species such as mountain golden heather have become adapted. It remains to be seen whether or not these changes will exceed the adaptive capacity of this species.

D. Synthesis

Mountain golden heather should remain classified as threatened. One new discrete location was discovered in the LGW; however, the distribution of this narrow-ranging endemic has not appreciably changed. Five of the six populations are located at the LGW and within approximately four miles of each other, making the entire species vulnerable to catastrophic or stochastic events in the area. Although long-term abundance trends include two increasing, two decreasing, and two stable populations, short-term trends include two increasing and four decreasing populations. This indicates recent declines in multiple discrete locations (at least 11, representing all six population) despite more positive long-term trends. In increasing populations, abundance due to seedling recruitment after fire should not be interpreted as a true population increase until survivability of seedlings can be verified through additional census. The two primary threats identified in the 2013 5-year review, fire suppression and recreational user impacts, are still current threats. All known populations (six) of mountain golden heather are within 500 feet of a trail and three populations contain only one discrete location adjacent to a trail. Implementing prescribed fire in the LGW remains difficult, and burning relies heavily on wildfires, which by nature are unpredictable with regards to timing, location, and intensity. Populations that are stable or increasing have maintained that status only through active land management to maintain suitable habitat conditions and control visitor use. One new threat (exotic, invasive species) has been identified. Data and information outlined in this review highlight the need for continued management and monitoring throughout the range and shows mountain golden heather continues to meet the definition of a threatened species under the Endangered Species Act.

III. RESULTS

- A. Recommended Classification:** No change is needed.

IV. RECOMMENDATIONS FOR FUTURE ACTION

The 2013 5-year review included a list of recommendations to improve recovery of the species. These actions remain applicable to species recovery. Accomplishments toward these recommended actions are summarized below.

- The USFS aims to conduct a complete census of all mountain golden heather populations at least every five years. The table below shows each population and years a full census was conducted.

Table 3. Populations and years monitored.

Population	Monitoring Years
Table Rock	1982, 1993, 2003/2004, 2009, 2016
Chimneys	1982, 1993, 2003/2004, 2009, 2012, 2015
Carolina Wall	1982, 1993, 2003/2004, 2009, 2015
Chimney Gap	1982, 1993, 2003/2004, 2009, 2009, 2012, 2015
Shortoff	1982, 1986, 1993, 2003/2004, 2008, 2017
Woods Mtn/Singecat	2003, 2009, 2012, 2018

- The Woods Mountain/Singecat population was burned by prescribed fire in April of 2018. The encroaching shrub and duff layer was visibly reduced after the fire.
- In 2017, students from Warren Wilson College and Wild South developed and tested a low-impact method for surveying rare cliff habitats using a camera attached to a helium balloon (Wild South 2017). The goal of this project was to collect detailed images of rare plants and competing vegetation for use in monitoring and management. This project has been suspended and use of other methods to obtain low-altitude aerial photography remains difficult due to current Wilderness regulations.

In light of new information, additional future actions are recommended below:

- Work with the USFS to continue censusing populations every five years.
- Work with the USFS and support efforts to complete an EA for control of exotic, invasive species across all Wilderness areas, including the LGW.
- Work with and support the USFS, Wild South, and other CFLRP partners, to continue exotic, invasive species inventory and management projects at the LGW.
- Work with and support the USFS, Wild South, and other CFLRP partners to quantify visitor use and identify visitor use patterns to prioritize management that would help minimize recreational impacts at the LGW.

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- Coordinate with the USFS and an appropriate botanical garden to collect and bank seeds. Highest priority sites should be those with only one EO, adjacent to a trail, and no prior seed collection (Table Rock and Chimney Gap).
- Work with the USFS and support efforts to complete an EA for prescribed burning in occupied mountain golden heather habitat or all fire-adapted habitats within the LGW.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW OF MOUNTAIN GOLDEN HEATHER

Current Classification: Threatened.

Recommendation resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Review Conducted By: Rebekah Reid, Asheville Ecological Services Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve JANET MIZZI Digitally signed by JANET MIZZI
Date: 2019.09.24 08:31:27 -04'00'

Date _____

APPENDIX A
Peer Review

Summary of peer review for the 5-year review of mountain golden heather (*Hudsonia montana*).

- A. **Peer Review Method:** Peer review was coordinated by the U.S. Fish and Wildlife Service (Service) Raleigh Ecological Services Field Office in North Carolina. Four peer reviewers were selected by the Service for their knowledge of and expertise with mountain golden heather. Individual responses were received from two of the four reviewers. Additionally, internal review was conducted by three members of the Service's Southeast Region.
- B. **Peer Reviewers:** The peer review request included personnel from the U.S. Forest Service (USFS) – two representatives, Wild South, and the NC Natural Heritage Program (NHP).
- C. **Peer Review Charge:** Reviewers were asked to conduct a scientific review of technical information presented. Reviewers were not asked to review the legal status determination.
- D. **Summary of Peer Review Comments and Response:** One peer reviewer from the USFS and Wild South did not respond to the request for review. One peer reviewer from the USFS and the NHP provided comments. All substantive comments received were reviewed by the Service and incorporated into a revised version of this document, where appropriate. A brief summary of substantive comments is below.

The reviewer from the NHP suggested we clarify our definition of short-term and long-term trends. Additional language was added throughout the review to further define and clarify our use of these terms. They also enquired about enforcement of trail closures and the possibility of issuing fines for non-compliance. Additional language was added to Section II.C.2.d to address compliance and enforcement of existing regulations.

The reviewer from the USFS provided a wealth of additional information regarding fire history and the efforts to manage exotic, invasive species in the Linville Gorge Wilderness. This information greatly improves the document and was added throughout the review where appropriate. They suggested we add discrete location trends to Section II.C.1.a. to enhance the discussion of population trends. Additional trend data was added as requested. They also suggest two additional future actions. We support these actions and they are now included in Section IV.

