

Biological Assessment
**Managing Recreational Uses on the Upper Segment of the Chattooga
Wild and Scenic River Corridor**
Sumter National Forest
Chattahoochee National Forest
Nantahala National Forest

I. INTRODUCTION

Three national forests, the Sumter (SNF) in South Carolina, the Chattahoochee (CONF) in Georgia, and the Nantahala (NNF) in North Carolina, are proposing a change in recreation management for the 21-mile section of the Chattooga Wild and Scenic River (WSR) upstream of the bridge traversing South Carolina (SC) 28. This upstream area is known as the upper segment of the- Chattooga WSR. Approximately 70% of the upper segment of the Chattooga WSR is bordered by South Carolina on the east bank and Georgia on the west bank. The northernmost portion (30%) of the upper segment of the Chattooga WSR is within North Carolina. This Biological Assessment (BA) was prepared to address potential project-related impacts to species listed as proposed, threatened, or endangered by the United States Fish and Wildlife Service (Service). It was prepared in accordance with USFS manual 2671.44 and 2672.42 and regulations set forth in Section 7(a) (2) of the Endangered Species Act.

II. PROPOSED ACTION

The proposal will:

1. Establish frontcountry and backcountry capacities as follows:

Frontcountry Areas	Groups at One Time ¹		People at One Time ²	
Grimshawes/Sliding Rock Bridge	25		65	
Bullpen Road Bridge Area	15		40	
Burrells Ford Bridge Area	80		205	
Highway 28 Bridge Area	35		85	
Backcountry Reach	Average Groups per Weekday	Average People per Weekday ²	Average Groups per Weekend Day	Average People per Weekend Day ²
Chattooga Cliffs	5	10	10	15
Ellicott Rock	10	35	20	110
Rock Gorge	15	40	30	95
Nicholson Fields	15	40	30	95

¹ The number of groups at one time equals the number of designated parking spaces in each frontcountry area.

² Average number of people per group varies by reach.

2. Allow non-commercial boating by issuance of a boating permit consistent with 36 C.F.R. § 261.77 on approximately 17 miles of the 21-mile main stem of the upper segment of the Chattooga WSR December 1 to April 30 from the Green Creek confluence downstream to a designated take out within one-quarter mile downstream of the Lick Log Creek confluence.
3. Allow boating from the time that flows reach 350 cfs or greater at the USGS Burrells Ford gauge during daylight hours. Daylight hours will be 30 minutes before official sunrise to 30 minutes after official sunset. Once boating is allowed, it may continue until 30 minutes after official sunset on that same day.
4. Specify that boating opportunities (see 2 and 3 above) will be a condition of the self-registration boating permit.
5. Require boaters to use tandem/single capacity hard boats or tandem/single capacity inflatable boats.
6. Require boaters to start or complete their trip only at specific boater put-ins and takeouts, which will be designated after site-specific NEPA analysis and will be a condition of the self-registration boating permit. In the interim, require boaters to start or complete their trip only at existing trails at the following locations:
 - a) Within one-quarter mile downstream of the Green Creek confluence;
 - b) Within 500 feet of the Norton Mill Creek confluence;
 - c) Within one-quarter mile of Bullpen Bridge;
 - d) Within one-quarter mile of Burrells Ford Bridge; and
 - e) Within one-quarter mile downstream of the Lick Log Creek confluence.
8. Specify that safety equipment for boaters will be determined at the district level as a condition of the self-registration boating permit.
9. Require backcountry group size limits as follows: maximum 12 people per group on trails, six people per group at designated campsites, except at designated large group campsites; six people per boating group; and four people per angling group. Require a minimum of two craft per boating group.
10. Establish a desired condition where the trail system (including portage trails) minimizes encounters and conflict while being environmentally sustainable and where redundant trails, trails where resource damage cannot be mitigated and trails that exacerbate encounters or conflict will be closed or rerouted. Trails will be designated based on future site-specific NEPA analysis.
11. Allow camping only in designated campsites. Allow campfires only in designated fire rings. Campsites and fire rings will be designated based on future site-specific NEPA analysis. Allow visitors to use existing campsites until site-specific NEPA analysis is complete.
12. Establish a desired condition where campsites accommodate no more than three tents per site, except at designated large, group campsites, are environmentally sustainable and limit encounters and conflict; where redundant campsites, campsites where resource damage cannot be mitigated and campsites that exacerbate encounters or conflict are closed or relocated.
13. Require agency approval for large woody debris (LWD) removal.
14. Adopt a monitoring plan to help determine whether my decision is producing the desired outcomes and avoiding unintended consequences. For *Gymnoderma*

- lineare* an annual assessment of the subpopulation along the main stem of the Chattooga River would be completed using a rapid assessment field form.
15. Incorporate the use of adaptive management to address any problems revealed through monitoring. If any unacceptable impacts were noted to the *Gymnoderma lineare* subpopulation corrective measures would be implemented including consultation with the Asheville office of the US Fish and Wildlife Service.

III. EXISTING CONDITION

The topographic character of the Chattooga River watershed is abrupt with a deeply dissected landform that forms a portion of the Blue Ridge Escarpment as it divides the Blue Ridge from the Foothills and Piedmont. Steep gorge walls, narrow chutes, waterfalls and small shaded rock outcrops are prominent features across this dissected portion of the watershed. The steep vertical relief along the river changes rather abruptly downstream of Ellicott Rock turning into a relative gentle gradient with only small falls, broader chutes or scattered rapids such as at Big Bend Falls and at Rock Gorge.

The geological dominants have greatly influenced the vegetation types. Both graywacke-schist and greywacke-schist-amphibolite comprise more than three-quarters of the watershed area (Hatcher 1971, USDA 1995). Mica gneisses, feldspathic gneisses, quartzite, and aluminum schist dominate the basin. The mafic derived rocks, amphibolites, are generally scarce and as such the soils tend to be less productive and plants within the heath family are particularly abundant across the watershed.

Various community classification reviews have been conducted within portions of the Chattooga River watershed during the past 30 to 35 years. Dumond completed a floristic and plant community study within the upper reaches of the watershed in 1970. A landscape ecosystem classification model was developed by Gattis (1992) and Carter (1994) for portions of the Highlands Ranger District and by Moffat (1993) for the Chattooga Ranger District. Patterson classified more complex vegetation patterns for the Ellicott Rock Wilderness in 1994. A land type phase model with incorporation of the diverse vegetation types each separated by soil characteristics was completed by the Chattooga Ecological Classification Team (USFS 1995). Permanent community classification plots within the escarpment area south of Highlands were established in 1997 by the North Carolina Vegetation Survey (Peet, et al. 1997).

Unique and high quality communities as well as rare species were characterized by Dellinger in 1992 throughout the Highlands Ranger District, by Gaddy in 1992 both within the Highlands area and within the Andrews Pickens Ranger District of the Sumter National Forest, by Zartman and Pittillo within spray cliffs in 1995 and by various bryologists in conducting a survey to determine the current status of those bryophytes formerly ranked as federal candidates (Anderson et. al. 1997). Previous bryology surveys had been completed by Anderson within a small portion of the watershed while characterizing moss diversity across the Blue Ridge Escarpment (Anderson and Zander 1973). All of these studies have expanded the knowledge of rare habitats and communities within the Chattooga River watershed.

There are about 178,700 acres in the Chattooga River Watershed. Table 1 indicates the ecological diversity across the watershed. Approximately two-thirds of the watershed, 126,300 acres, is national forest lands. The only ecological classification that has been modeled and mapped in a Geographic Information System throughout the Watershed includes the work completed by the USFS in 1995. Tables 1 and 2 lists the acreage managed by the three national forest units for the different ecological types present within the watershed and the lower and upper wild and scenic corridor. U.S. Highway 28 separates the lower and upper corridor. This database shows that about 47% of the watershed is dominated by hardwood types, primarily oaks, 25% is dominated by mixed yellow pine-oak types, 14% is dominated by hemlocks and hardwoods, and 10% by white pine and hardwoods. The remaining types, such as alluvial forest and rock outcrops are much less common within the watershed. As a result, they are difficult to map or model and may significantly deviate from the tally.

The upper (upstream of SC 28) and lower wild and scenic corridor differ in the abundance of these dominant types (Table 2). Within the upper corridor, white pine dominant types, hemlock hardwood, pitch and table mountain pine communities and dry oak-hickory are much more prevalent. In contrast, shortleaf pine types dominate the lower wild and scenic corridor and acidic cove forest and mesic oak-hickory forest are more abundant in comparison to the upper corridor.

Table 1. Comparison of Ecological Type abundance within the Chattooga River Watershed, and the Upper (north of SC 28) and Lower (south of SC 28) Wild and Scenic Corridor.

Natural Communities	Acres	% in Watershed	Upper Wild & Scenic Corridor (Ac)	% Upper Corridor	Lower Wild & Scenic Corridor (Ac)	% Lower Corridor
High Elevation Red Oak Forest	1882	1%	23	0.3%	0	0%
Montane Oak-Hickory Forest	10667	6%	156	2%	0	0%
Montane White Oak Forest	1529	1%	13	0.2%	0	0%
White Pine/Heath Forest	17293	10%	1331	19%	436	2%
Mesic Oak-Hickory Forest	34391	19%	636	9%	4916	25%
Table Mountain Pine-Oak/Heath Forest	246	0.1%	0	0%	0	0%
Pitch Pine-Oak/Heath Forest	16837	9%	955	14%	2257	12%
Acidic Cove Forest	6373	4%	423	6%	2323	12%
Eastern Hemlock/ Rhododendron maximum Forest	18252	10%	842	12%	92	0.5%
Alluvial Forest River Bar/Island	1788	1%	156	2.2%	628	3%
Chestnut Oak/Northern Red Oak/ Rhododendron	5243	3%	528	7%	367	2%
Chestnut Oak/Scarlet Oak/Heath Forest	12005	7%	604	9%	187	1%
Dry Oak-Hickory Forest	18574	10%	1048	15%	976	5%
Shortleaf Pine-Southern Red Oak-Blackjack Oak Forest	11533	6%	9	0.1%	1099	6%
Shortleaf Pine-Southern Red Oak Forest	18601	10%	141	2%	5721	29%
Heath Bald	447	0.3%	0	0%	0	0%
Swamp Forest/Bog	1164	1%	0	0%	0	0%
Rock Outcrops	234	0.1%	0	0%	0	0%
Urban	216	0.1%	0	0%	0	0%
Water	1104	1%	182	3%	496	3%
Unmodeled	325	0.2%	0	0	0	0
Totals	178704		7047		19498	

SC 28) and Lower (south of SC 28) Wild and Scenic Corridor.

Table 2. Comparison of Ecological Type Abundance in USFS management within the Chattooga River Watershed, and the Upper (north of US 28) and Lower (south of US 28) Wild & Scenic Corridors.

Ecological Types	USFS Acres	% on USFS	Upper Wild & Scenic Corridor (USFS Ac)	% Upper Corridor	Lower Wild & Scenic Corridor (USFS Ac)	% Lower Corridor
High Elevation Red Oak Forest	1183	1%	23	0.4%	0	0%
Montane Oak-Hickory Forest	7156	6%	155	2%	0	0%
Montane White Oak Forest	828	1%	13	0.2%	0	0%
White Pine/Heath Forest	14127	11%	1248	19%	361	4%
Mesic Oak-Hickory Forest	20554	16%	636	10%	1671	18%
Table Mountain Pine-Oak/Heath Forest	168	0.1%	0	0%	0	0%
Pitch Pine-Oak/Heath Forest	13561	11%	921	14%	710	8%
Acidic Cove Forest	4951	4%	423	6%	1735	18%
Eastern Hemlock/ Rhododendron maximum Forest	14005	11%	679	10%	24	0.3%
Alluvial Forest/Island/River Bar	1217	0.2%	156	2.4%	573	6%
Chestnut Oak/Northern Red Oak/ Rhododendron	4548	4%	486	7%	275	3%
Chestnut Oak/Scarlet Oak/Heath Forest	8275	7%	490	7%	157	2%
Dry Oak-Hickory Forest	14862	12%	1032	16%	498	5%
Shortleaf Pine-Southern Red Oak-Blackjack Oak Forest	6316	6%	9	0.1%	401	4%
Shortleaf Pine-Southern Red Oak Forest	13531	11%	141	2%	2773	29%
Heath Bald	347	0.3%	0	0%	0	0%
Swamp Forest/Bog	84	0.1%	0	0%	0	0%
Rock Outcrops	178	0.1%	0	0%	0	0%
Water	400	0.3%	117	2%	264	3%
Totals	126291		6531		9444	

IV. SPECIES CONSIDERED AND EVALUATED

All federally threatened or endangered plant or terrestrial wildlife species that occur or could occur on the Nantahala National Forest (NNF), Chattahoochee-Oconee National Forest (CONF) or the Sumter National Forest (SNF) were initially considered in this analysis. The list of federally listed species was compiled by reviewing: (1) U.S. Fish & Wildlife Service county occurrence records for known and potential species, (2) North Carolina Natural Heritage Program Element Occurrence (EO) records, (3) Georgia Nongame Conservation Section EO records, (4) South Carolina Department of Natural Resources EO records, and (5) U.S. Forest Service rare plant and animal inventory records. The initial wildlife list (Appendix A, Table 2) did not include some Piedmont species and Ridge and Valley species which are included on the CONF list and SNF list, but do not occur in the Southern Blue Ridge Subsection. One wildlife species, the southern bog turtle, while not formally listed is treated as threatened since it closely resembles the northern bog turtle, which is federally listed as threatened, and by treating it as listed it facilitates enforcement of poached listed northern members.

The initial list included 11 plants and six wildlife species (Appendix A, Tables 1 and 2). All the federally listed species are plants or terrestrial animals. There are no federally listed aquatic species known in the entire Chattooga River watershed or its tributaries. Of these 17 species, one endangered plant species, two threatened plant species, and the

southern bog turtle are known to occur on one of the three national forests within the Chattooga River Watershed (highlighted in bold in the two tables in Appendix A.) A geographic information system was used to examine the distribution of EOs on the three forests and general vicinity. These records and distribution maps were reviewed to determine areas of known populations of rare species within the proposed project area. Based on these information sources the potential affected rare species list for the upper Chattooga River project was filtered to derive those species with the greatest likelihood of occurrence. Species were eliminated based on range information such as only occurring at higher elevations in the NC or GA mountains, or in the foothills or Piedmont at lower elevations in SC or GA. Other species were excluded from further analysis because proper habitat did not occur within the proposed activity area. These habitats included Southern Appalachian Bogs, Swamp Forest Bogs, Rich Cove Forest, Pine-Oak/Heath Forest, and various Oak-Hickory Forests. Bog turtles were excluded for this reason since its preferred habitats, Southern Appalachian Bogs or wet pastures such as sites with mucky high organic content soils, did not occur within or near the proposed activity areas. Some species were eliminated from further analysis if they were known to occur within the project area but unlikely to be impacted by any project activities. Eastern cougar, was dropped from further consideration since it is believed to be extirpated from the Southern Appalachians. Suitable habitat for *Isotria medeloides* is incompletely known and problematic to eliminate from project review. The species does not occur under dense *Rhododendron maximum* thickets which occurs over the vast majority of the proposed activity area. However open understory portions of the analysis areas could not be completely excluded. *Isotria medeloides* tends to occur in plant communities with three or more associated orchid species. Surveys for this species were intensified in areas with these conditions.

The final filtered list of federally listed species that occurs within the Chattooga River corridor and might be affected by the proposed project included two plants, one nonvascular, *Gymnoderma lineare*, rock gnome lichen and one vascular, *Isotria medeloides*, small whorled pogonia. A field survey for this species was completed by a team of USFS botanists/ecologists (Robin Mackie from the Sumter NF, David Danley from the Pisgah NF, Dr. Wilson Rankin from the Nantahala NF, and Gary Kauffman from the National Forests in NC) and a botanical consultant, Dr. L. L. Gaddy, from mid August to early October 2007.

V. RESULTS

There were two documented populations of *Gymnoderma lineare* known within tributaries, Scotsman Creek and Fowler Creek, to the upper segment of the Chattooga River in North Carolina (see Appendix B). The survey work completed in 2007 relocated both of these populations in addition to finding a new subpopulation on the east bank of the Chattooga River. This new occurrence was documented in NC just upstream from the confluence of Fowler Creek about 1500 feet north of the SC and Ga border (Appendix B). No new populations of *Isotria medeloides* were encountered during the field review or any habitat with more than 2 orchid species. *Isotria medeloides* was eliminated from any further analysis following the field review.

VI. EFFECTS ANALYSIS

A) Species Biology and Distribution

Gymnoderma lineare is a squamulose lichen with a narrow strap-shaped olive-grey thallus which grades to a blackened base (Evans 1947). Apothecia, the fruiting bodies, occur on the squamule tips from July through September. Rock gnome lichen is a narrow Southern Appalachian endemic primarily occurring in the North Carolina mountains with peripheral populations in the mountains of Tennessee, Georgia, South Carolina, and Virginia (Natureserve 2011, Weakley 2011, F. Huber, USFS botanist personal communication). The lichen was federally listed as endangered in the Federal Register in 1995 (U.S. Fish & Wildlife Service 1995) and currently has a G2 global rank.

The lichen occurs both on sloping to vertical rock faces with some seepage at higher elevations, generally above 5000 feet. Typically it occurs on rock outcrops partially shaded by Spruce-Fir Forests and occasionally Northern Hardwood Forest. In portions of its range it occurs on partially shaded Rocky Summits. The species has also been located in riparian areas on boulders within and adjacent to streams. These streamside populations occur both within the very headwaters, some occurring above 5,500 feet, as well as larger 5th to 6th order streams. Populations vary in density from tiny dispersed clumps, barely one centimeter square, to dense colonies, greater than four meters square in extent.

Gymnoderma lineare occurs within the Chattooga River Watershed both in the CONF and the NNF. It has not been documented within the SNF. Within the Wild & Scenic Corridor, *Gymnoderma lineare* is restricted to NC, occurring on boulders within Scotsman Creek, Fowler Creek and the newly discovered site along the main stem of the Chattooga River upstream of the NC/SC/GA border. The populations on Fowler Creek and the east bank of the Chattooga River represent the lowest elevation, approximately 2,240 feet, located for the species across its range.

Gymnoderma lineare is assumed to have been restricted to the same geographic range as it presently occurs. Several populations are believed to have been extirpated or reduced in size during the last 25 years. It is not specifically known why certain populations of this lichen have declined although recreational use, pathogens impacting canopy trees previously providing shade, road construction, and high sulfur levels have been documented in the same areas (USFWS 1997, Martin and Noble 1996).

B) Direct and Indirect Effects

Direct effects are those occurring at the same time and place in the proposed action area. Indirect effects are those caused by the action, which occur after the activity has taken place or occur at a distance from the action area.

There are no visible direct impacts from any current recreational usage within the two *Gymnoderma lineare* populations, including the new subpopulation along the main stem of the Chattooga River, in the Wild and Scenic Corridor. Potential direct effects to the *Gymnoderma lineare* subpopulation along the Chattooga River from the proposed modification of recreational activities includes trampling by anglers traversing the river, scraping of rocks by boats traversing the river at different high flows, and portaging of

boats around log jams which are anticipated to increase with the decline and dropping of eastern hemlock from hemlock woolly adelgid.

The location of the new subpopulation along the Chattooga River bank is partially protected under a narrow rock shelf. The physical features of the site probably have previously and will continue to discourage access by anglers as well as any visitation from boaters when floating this section of the river. There is no hiking trail within the vicinity of this site nor is there any trail proposed for this area. The site is not flat enough to allow a rest opportunity for boaters. If adjacent Canadian hemlocks fell across the river at this site resulting in a possible portage, the natural area to traverse would be the flatter western bank where the species does not occur. For all these reasons there are no measurable direct effects anticipated with permitting seasonal boating along this stretch of the Chattooga River.

Potential indirect effects to the *Gymnoderma lineare* subpopulation from this recreational proposal are unknown. Given the relative remoteness of the site and the physical characteristics discouraging any stops by boaters, it is doubtful there will be increased visitation to this site if the recreation proposal is implemented. Nevertheless an indirect affect that may occur regardless of the proposed recreational activity is denser shading from dead hemlock trees that fall directly above and overtop the existing subpopulation. It is unknown how much shade tolerance this lichen can tolerate. Most occupied sites have a moderate amount of light with the intensity declining within sites to *Gymnoderma lineare* more exposed southern or western exposures (USFWS 1997). As such, it is suspected a subpopulation decline could result from a nearby fallen tree.

During a site visit in October of 2007 with U.S. Fish & Wildlife Service personnel (Asheville, NC and Columbia, SC offices) it was determined based on the previous discussion points that any increased recreational activity associated with the proposed project may affect but is not likely to adversely affect *Gymnoderma lineare*. It was also determined that periodic monitoring of the subpopulation along the main stem of the river is implemented to ensure that no impacts are occurring from implementation of this recreational proposal.

C) Cumulative Effects

Cumulative effects are those resulting from incremental impacts of the proposed action when added to other past, present and reasonably foreseeable future actions. Cumulative effects can result from individually minor, but collectively significant actions that take place over a period of time.

One rock gnome lichen population is known on the CONF and up to 15 populations, exact number varying depending on how they are delineated, across 23 sites are documented on the NNF. There are no known direct or indirect effects to populations of *Gymnoderma lineare* across the NNF or the CONF over the last decade that has resulted from implementation of projects within either forest. Intermittent monitoring has occurred within three of the sites on the NNF. A population decline was recorded within one of the sites while the remaining two sites have stable trends although one of the populations with a stable trend has not been resampled for many years. All except four

of the other occupied sites on the NNF and CONF have been revisited once in the last 15 years with cursory observations on presence and health recorded. Within these revisited sites all except one population or subpopulation was relocated. The one un-relocated population is considered to be extirpated as a result of sedimentation from new road construction by the Federal Highway Administration.

In the past 10-20 years there has been an increase in recreational use on the trails and on the river within the Wild and Scenic Corridor. These recreational trends are anticipated to continue in the future in the most accessible portions of the river corridor. However, as indicated above, it is doubtful there will be increased visitation to the occupied sites currently known in the Chattooga River Wild and Scenic Corridor. Within private property in the corridor and the watershed, recent home development, road construction and reconstruction has primarily contributed to the loss of suitable habitat for the forest associated species and to a lesser extent to the gorge river-associated species such as *Gymnoderma lineare*. Disturbances are small and less frequent in the gorge since a majority of the potential habitat is within public ownership.

There are no future projects on the CONF or the NNF that are anticipated to affect *Gymnoderma lineare*. The cumulative effects from these past and future actions on *Gymnoderma lineare* within the corridor are not anticipated to result in any measurable loss of this species. Periodic monitoring of the documented populations within the corridor will help to ensure this determination is true.

VII. DETERMINATION OF EFFECT

Gymnoderma lineare, federally endangered, was located within the main stem of the Chattooga River north of the confluence with Fowler Creek in an inaccessible area with minimal existing recreational use. Onsite informal consultation with the U.S. Fish and Wildlife Service was completed in early October, 2007. The population occurs in a protected shelf of the river. It is anticipated the introduction of boating along with other recreational activities within this area of the river is unlikely to result in trampling impacts. Therefore the proposed project may affect, but is **not likely to adversely affect *Gymnoderma lineare* in North Carolina.**

The proposed project will have no affect on *Gymnoderma lineare* in South Carolina and Georgia.

The proposed activities associated with this preferred alternative will have no effect on any other federally listed species.

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REFERENCES

Ayers, H. B. and W.W. Ashe. 1905. The Southern Appalachian Forests. U.S. Geological Survey Forestry Series. Professional Paper 37. Washington D.C.

Biotics Database. 2011. As maintained by the North Carolina Natural Heritage Program, Division of Parks and Recreation, Raleigh, North Carolina.

Brown, R. L. and R. K. Peet. 2003. Diversity and invisibility of southern Appalachian plant communities. *Ecology* 84(1):32-39.

Carter, R. E. 1994. Landscape ecosystem classification of successional Forest Types on Highlands Ranger District, Nantahala National Forest in North Carolina. MS Thesis, Clemson University, Clemson, SC. 73 p.

Dellinger, B. 1992. Inventory of Natural Areas and Rare Species of Highlands Ranger District, Nantahala National Forest. Unpublished report submitted to the Highlands Biological Station, North Carolina Natural Heritage Program and National Forests in North Carolina.

Dumond, D. M. 1970. Floristic and Vegetational Survey of the Chattooga River Gorge. *Castanea* 35:201-244.

Evans, A.W. 1947. A study of certain North American Cladoniae. *Bryologist* 50:14-51.

Franklin, Misty A., and John T. Finnegan. 2010. Natural Heritage Program List of Rare plant species of North Carolina. North Carolina Natural Heritage Program, N.C. Department of Environment and Natural Resources, Raleigh, North Carolina. 136 p.

Gaddy, L.L. 1992. Natural Areas of the Highlands Region, Inventory of Primary Natural Areas of the Highlands Township Region, in Macon and Jackson Counties, North Carolina. Report submitted to the N.C. Natural Heritage Foundation, Raleigh, NC. 127 p.

Gaddy, L.L. 1992. An inventory of endangered, threatened, and otherwise noteworthy plant species and natural and unique areas of the Andrew Pickens District of the Sumter National Forest. Report submitted for the Sumter NF, The Nature Conservancy, and S.C. Wildlife and Marine Resources Department. Columbia, SC. 54 p.

Gattis, J.T. 1992. Landscape ecosystem classification on the Highlands Ranger District, Nantahala National Forest in North Carolina. MS Thesis, Clemson University, Clemson, SC. 55 p.

Goff, F. Glen, Gary A. Dawson and John J. Rochow. 1982. Site Examination for Threatened and Endangered Plant Species. *Environmental Management* 6(4):307-316.

Kartesz, J. T. 1994. *A synonymized checklist and atlas with biological attributes for the vascular flora of the United States, Canada and Greenland. 1st edition.* In: Kartesz, J. T. and C. A. Meacham. *Synthesis of the North American Flora, Version 1.0.* North Carolina Botanical Garden, Chapel Hill, NC.

Martin, Juri, and Reginald D. Noble. 1996. A quantitative study on ecological status and trends in an endangered lichen, *Gymnoderma lineare* (Evans) Yoshimura and Sharp. Final Report. Prepared for the USDA Forest Service, National Forests in North Carolina, Asheville, NC, and USDI Fish and Wildlife Service, Asheville, NC. 30 p.

Moffat, S.O. 1994. Landscape ecosystem classification for the Chattooga Ranger District, Chattahoochee National Forest, Georgia. MS Thesis, Clemson University, Clemson, SC. 83 p.

NatureServe. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available <http://www.natureserve.org/explorer>.

Patterson, Karen D. 1994. Classification of Vegetation in Ellicott Rock Wilderness, Southern Blue Ridge Escarpment. MS Thesis, North Carolina State University, Raleigh, North Carolina. 91 p.

Peet, Robert K., Claire L. Newell, Gary L. Kauffman, J. Dan Pittillo, Michael P. Schafale, Alan S. Weakley and Thomas R. Wentworth. 1997. Vegetation of the Nantahala Mountains.

Radford, Albert E., H.E. Ahles and C.R. Bell. 1967. *Manual of the Vascular Flora of the Carolinas.* University of North Carolina Press, Chapel Hill, North Carolina.

Schafale, Michael .P. and Alan S. Weakley. 1990. *Classification of the Natural Communities of North Carolina: Third Approximation.* North Carolina Natural Heritage Program, Raleigh, North Carolina.

USFS. 1995. Ecosystem Classification, Mapping, and Inventory of the Chattooga River Watershed (draft manuscript). National Forests in North Carolina, Asheville, NC. 500+ p.

U.S. Fish and Wildlife Service. 1995. Endangered and Threatened Wildlife and Plants; determination of *Gymnoderma lineare* (rock gnome lichen) to be an endangered species. Federal Register 60(11):3557-3562.

U.S. Fish and Wildlife Service. 1997. Recovery Plan for Rock Gnome Lichen (*Gymnoderma lineare*) (Evans) Yoshimura and Sharp. Atlanta, Ga. 30 pp.

Zartman, C. E. 1996. Inventory and Ecological Analysis of Spray Cliff Plant Communities in the Chattooga Basin. MS Thesis, Western Carolina University, Cullowhee, NC. 90 p.

Zartmen, C.E. and J. Dan Pittillo. 1995. An inventory of Spray Cliff Communities in the Chattooga Basin. Unpublished report submitted to the National Forests in North Carolina, Asheville, NC. 99 p.

Weakley, Alan S. 2011. *Flora of the Southern and Mid-Atlantic States (Working Draft of 11 May, 2011)*. University of NC Herbarium, University of NC at Chapel Hill, Chapel Hill, North Carolina. 994 p.