

**Potential Species of Conservation Concern for the
Nantahala and Pisgah NFs Plan Revision
Including Botanical and Animal Species**

April 24, 2014

Potential Plant Species of Conservation Concern

The Species of Conservation Concern is a list of rare plant species, other than federally listed species, that occur within the plan area for which the Regional Forester has determined there is a substantial concern regarding the species' capability to persist in the plan area over the long-term. Within the directives, two separate categories were identified for development of the list. Based on selected criteria, certain species must be included on the list of potential species of conservation concern (SCC). Other species could also be included with consideration of additional criteria. Based on initial review with the Regional Forester the potential list is restricted to species with occurrence records on either of the two forest units within the last 50 years. In order to be consistent with other forests within the region all the botanical taxonomy is consistent with the NatureServe web site, April 2014.

Process for Species Inclusion

All species with a global rank of G1, G2, T1, T2 or variations such as G1G2 (G/T 1-2) must be included on the potential list. This list of appropriate plant species was derived from three separate data sources. The GIS Biotics database, maintained by the North Carolina Natural Heritage Program, was queried for all the rare plant species with the appropriate global rank within the 18-county area surrounding the Nantahala and Pisgah NFs. This list was further filtered to exclude federally listed species and species that do not occur on either of the two national forests. In addition, a query of all the G/T 1-2 globally ranked plant species in North Carolina was completed in the NatureServe Explorer online database. The resulting species list was further filtered to only include those species with occurrences within the Nantahala and/or Pisgah NFs, and those species not federally listed. Finally, a search was completed within the 2012 Natural Heritage Program List of Rare plant species publication focusing on any G/T 1-2 watch list species that may not have been within the other two databases. All three queries were compiled and combined for the potential SCC list. The resulting SCC list includes a total of 44 plant species including eight lichens, 11 liverworts, six mosses, and 19 vascular plants.

In addition, all species that have been petitioned for Federal listing and for which a positive "90-day finding" has been made must be on the potential SCC list. Within the appropriate planning area, eight plant species are currently on the petition list. Consultation was conducted with Dr. Mara Alexander from the US Fish & Wildlife Service Asheville field office regarding the status of these eight species. As a result, one liverwort and one vascular plant species, both with no clear idea on the final finding determination, were added to the potential SCC list.

All species that have been federally delisted within the last five years or which were previously delisted but which federal regulatory agency monitoring is still considered necessary must be on the potential SCC list. However, no plant species in the planning area meet these criteria.

Process used for Consideration of Other Species

Additional species for inclusion on the potential SCC plant list were also evaluated. This evaluation included species with global ranks of G3/T3, species that are listed as endangered or threatened in NC, species identified on another federal list (federal species of concern), and

species with state ranks of S1/S2. The species for evaluation were gathered from the Biotics database, NatureServe Explorer, and the 2012 NC Natural Heritage Program rare plant list.

A meeting was convened including the North Carolina Natural Heritage Program, the University of NC Herbarium and Botanical Garden, the US Fish & Wildlife Service, and the US Forest Service to review the resulting list. Vascular plant species were principally reviewed for this meeting. The NC Plant Protection Program provided input following the meeting. Input on liverworts and mosses have been provided by Dr. Paul Davison from the University of North Alabama. Consultation on inclusion of other lichens was provided by species experts from the NC Department of Natural Resources and the New York Botanical Garden, primarily Dr. James Lendemer. The NY Botanical Garden has recently completed lichen surveys across the Great Smoky Mountains National Park and other portions of the southern Appalachians.

Criteria used for including species on the potential SCC list were a) identification of significant threats to populations or habitats within or off the plan area, b) identification of declining trends in populations or habitat, c) low population numbers or few populations, d) presence of disjunct populations, e) presence of endemics, and f) where the planning area provides the vast majority of the species populations known across its range and therefore can dramatically secure its persistence.

Additional species for consideration within the potential SCC list includes 16 federal species of concern, 18 state endangered species, 28 state threatened species, 105 S1 ranked species, 40 S2 ranked species, and five G3 ranked species.

The NC Natural Heritage Program maintains a watch list of rare species as well the official rare plant list. This includes plant species which appear to be rare or otherwise threatened but for which current information does not justify placement on the official rare plant list. These watch list species include G3, S1, or S2 ranked species with documented occurrences on the Nantahala and Pisgah NFs. The majority of these species, 102 in total, were excluded from the potential SCC list since they were not currently considered to be “rare” across the larger landscape. A NatureServe query of all NC G/T 3 ranked species resulted in 47 plant species with known occurrences on the Nantahala and Pisgah NFs, however, they did not meet the criteria for inclusion on the potential SCC list.

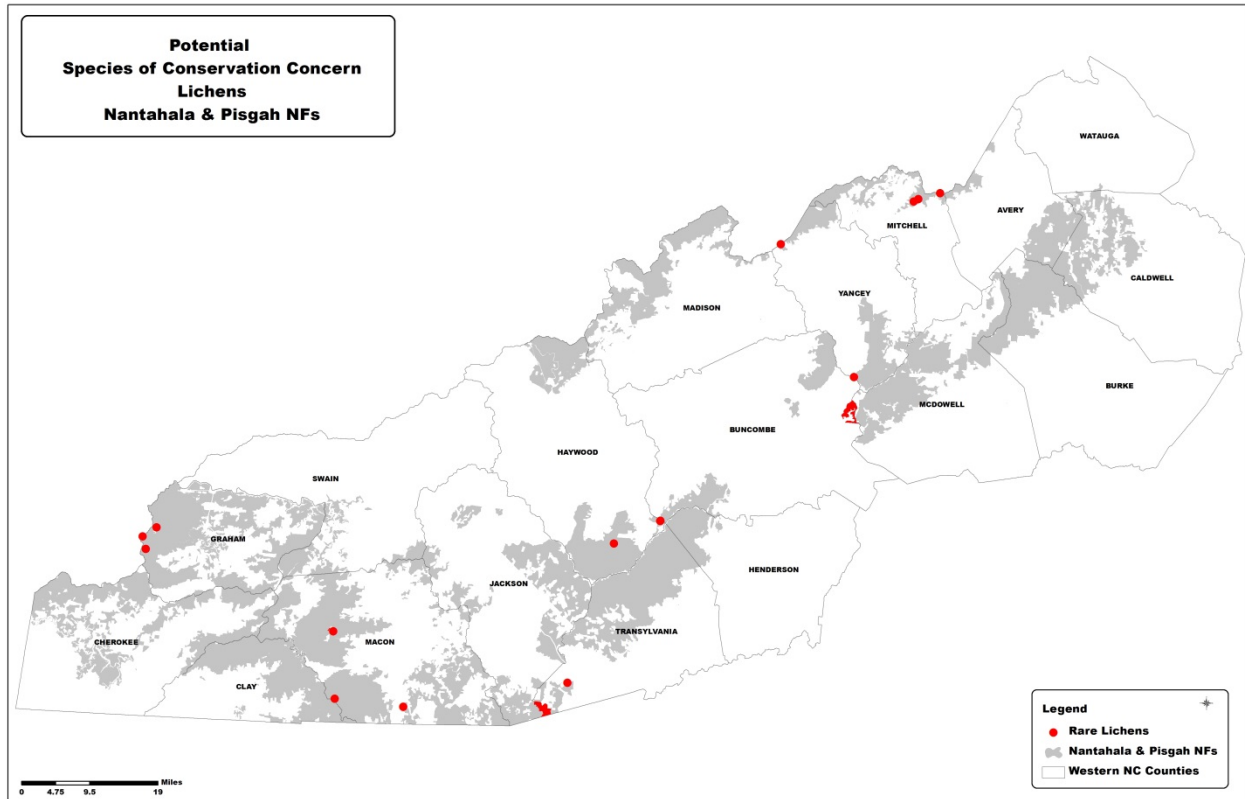
As a result of the evaluation, the potential list includes a total of 258 species consisting of 17 lichens, 23 liverworts, 51 mosses, and 167 vascular plants. A discussion on the individual plant groups with the associated list by group is included below.

Lichens

Lichens are organisms with symbiotic relationships between a fungus and green algae or cyanobacteria. Their growth forms have been variously classified as crustose (crust tightly adhering to substrate), foliose (leafy), fruticose (shrubby), squamulose (composed of tiny scales), or umbiliculate (central point of attachment). Most lichens tend to be very slow growing; measured in millimeters annually. The map below indicates the documented occurrences of the SCC lichen species across the two Nantahala and Pisgah NFs (Figure 1). Species are primarily concentrated within high elevation forests. Threats to lichen SCC include trampling, primarily

from recreationists including rock climbers, desiccation as a result of climate change, or habitat change from pests such as balsam wooly adelgids. Approximately 60% of these occurrences occur within currently designated areas.

Figure 1. Distribution of Potential Lichen Species of Conservation Concern on the Pisgah and Nantahala National Forests.



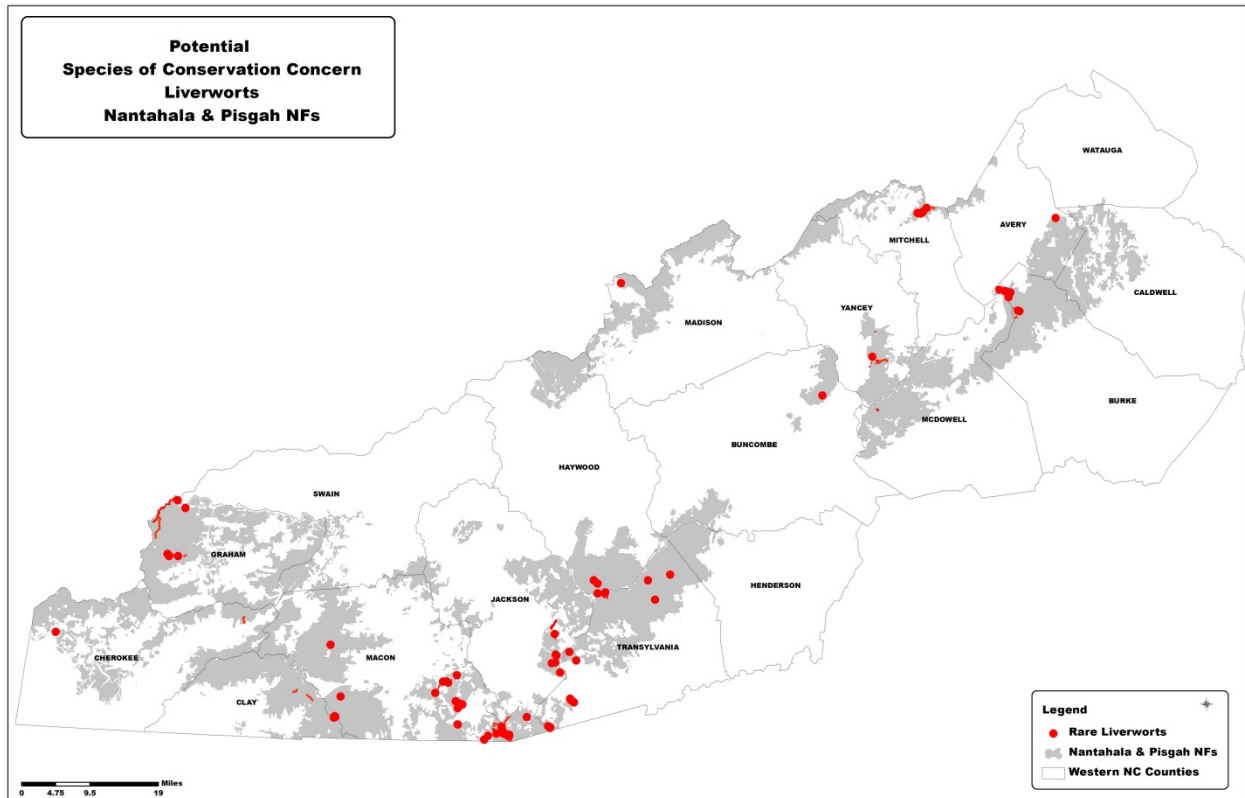
Seventeen lichens are on the potential species of conservation concern list. None of the seventeen species have more than four documented occurrences across the two forest units and six of the species have only been documented within one site. Eight of the species are required to be on the list. Two of these, although currently with low global ranks, are not recommended to remain on the species of conservation concern. *Canoparmelia amabilis* has been located across a much wider range than would prompt a G1 rank and may not be a valid species since it has been found to intergrade with the more common *Canoparmelia carolinana* (Dr. James Lendemer, NY Botanical Garden lichenologist, pers. comm. October 2013, Consortium of North American Lichen Herbaria.) *Ephebe americana* is believed to be more common than currently distributed since records may be confused with a wider ranging congener, *E. lanata*. Habitats at collection sites are diverse and generally do not seem to be unique or limiting (Dr. Lendemer, pers. comm. January 2014).

Liverworts

Liverworts are small non-vascular moss-like plants, which differ from mosses by possessing flattened distinct upper and lower leaves that lie close to the surface from which they grow. In

comparison, mosses have spirally arranged leaves. Liverworts have either a thalloid or leafy growth form. The vast majority of liverworts have leafy growth forms. Only one species on the potential SCC liverwort list has a thalloid growth form. Liverworts can develop without being rooted in soil; therefore, they can grow on many substrates such as tree bark, decaying wood, or rocks. Most have the ability to desiccate and rehydrate when sufficient rainfall is available again. The map below indicates the documented occurrences of the SCC liverwort species across the Nantahala and Pisgah NFs (Figure 2). Species are concentrated within the Escarpment Gorges, Panthertown Valley, Linville Gorge Wilderness, Santeetlah Creek, and Cheoah River watersheds, as well as within the high elevation spruce-fir ecozone. Threats to liverwort SCC include trampling, changes in hydrological flows, habitat changes as a result of climate change, or pests such as adelgids and non-native plant species. Approximately, 70% of these occurrences occur within existing designated areas.

Figure 2. Distribution of Potential Liverwort Species of Conservation Concern on the Pisgah and Nantahala National Forests.



Twenty-three liverworts are on the potential species of conservation concern list. Most species have very few documented occurrences on the two forest units. Eight species have three or fewer occurrences across the two forest units. Three species are known from a single site, two of which represent the only occurrence within North Carolina. Four species are documented in more than 11 sites across the two national forests. Twelve of the species are required to be on the initial potential list due to current global rank or consideration for inclusion on the federal endangered species list as a result of a recent petition. Of these, one is recommended for removal from the final species of conservation concern list. *Aneura sharpii* is on the potential list given its G1G2 global rank. However, it has been recommended for removal from the list since it is not

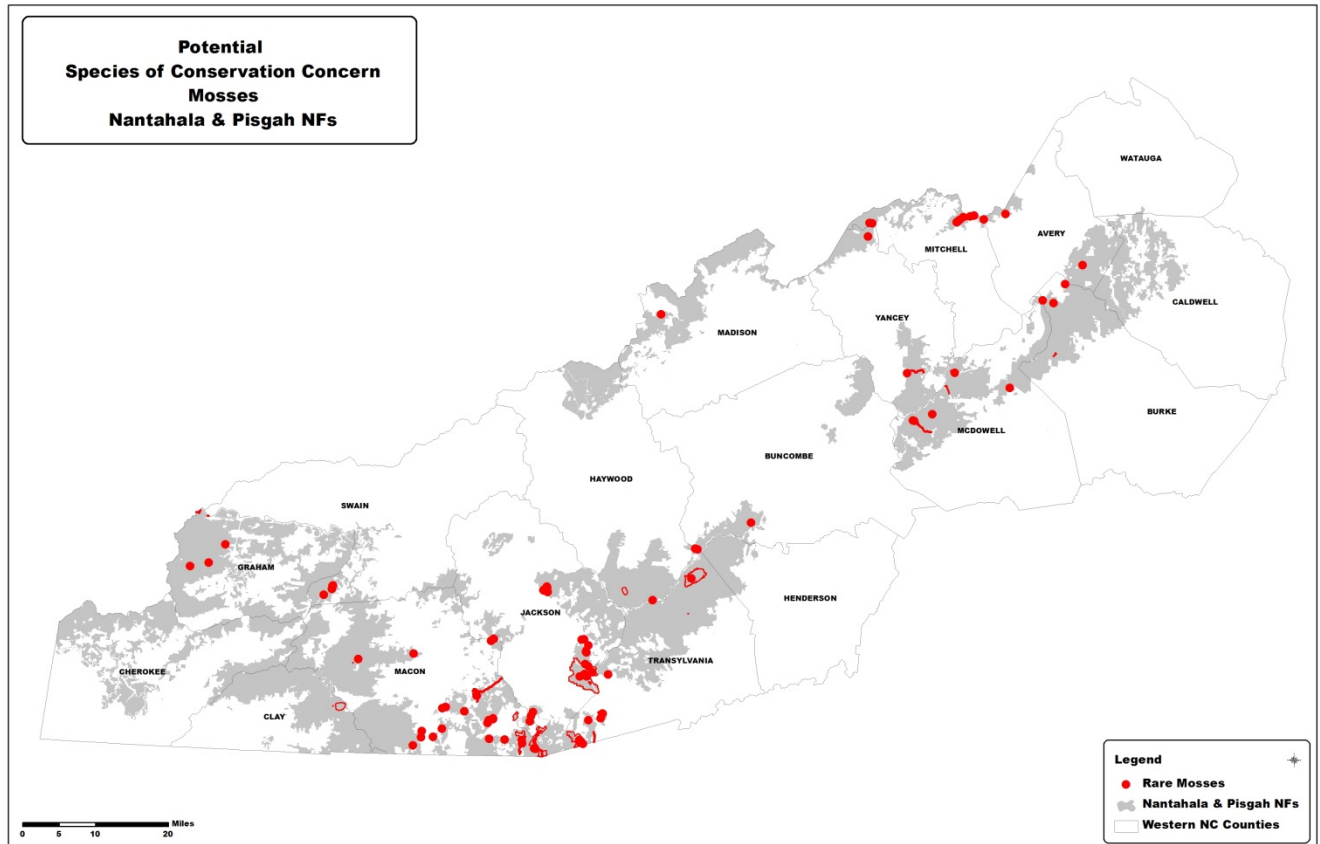
considered distinct from the more common *A. maxima*, with a global rank of G4, is an environmental variant (Dr. Paul Davison, University of N. Alabama bryology professor, pers. comm. January 2013).

Mosses

Mosses are small non-vascular photosynthetic plants, which have various growth forms simply divided into three types. Apocarps have simple or rarely branched stems that are arranged in tight tufts. In comparison, pluerocarps have freely branched stems that can intertwine together and forming dense prostrate mats. In addition, *Sphagnum* mosses have erect stems in branches in threes and typically a mop-like head. All three are represented in the potential SCC moss list. Because mosses can grow without being rooted in soil, they can grow on many substrates such as tree bark, decaying wood, or rocks. Most have the ability to desiccate and rehydrate when sufficient rainfall is available again. The map below indicates the documented occurrences of the SCC moss species across the Nantahala and Pisgah NFs (Figure 3). Similar to rare liverwort distribution, moss species are concentrated within the Escarpment Gorges, Panthertown Valley, Santeetlah Creek watershed, and within the high elevation habitats, primarily the spruce-fir and northern hardwood ecozones. Threats to moss species of conservation concern include trampling, changes in hydrological flows, habitat changes as a result of climate change, or pests such as adelgids and non-native plant species. Approximately, 56% of these occurrences occur within currently designated areas.

Fifty-one mosses are on the potential species of conservation concern. Of these, 22 have a single occurrence across the two forests. Ten of these represent the only known occurrence within North Carolina. All except three species have five or fewer documented occurrences across the two forest units. Six of the species are required to be on the potential list due to current global rank. All of these species are recommended to remain on the species of conservation concern list.

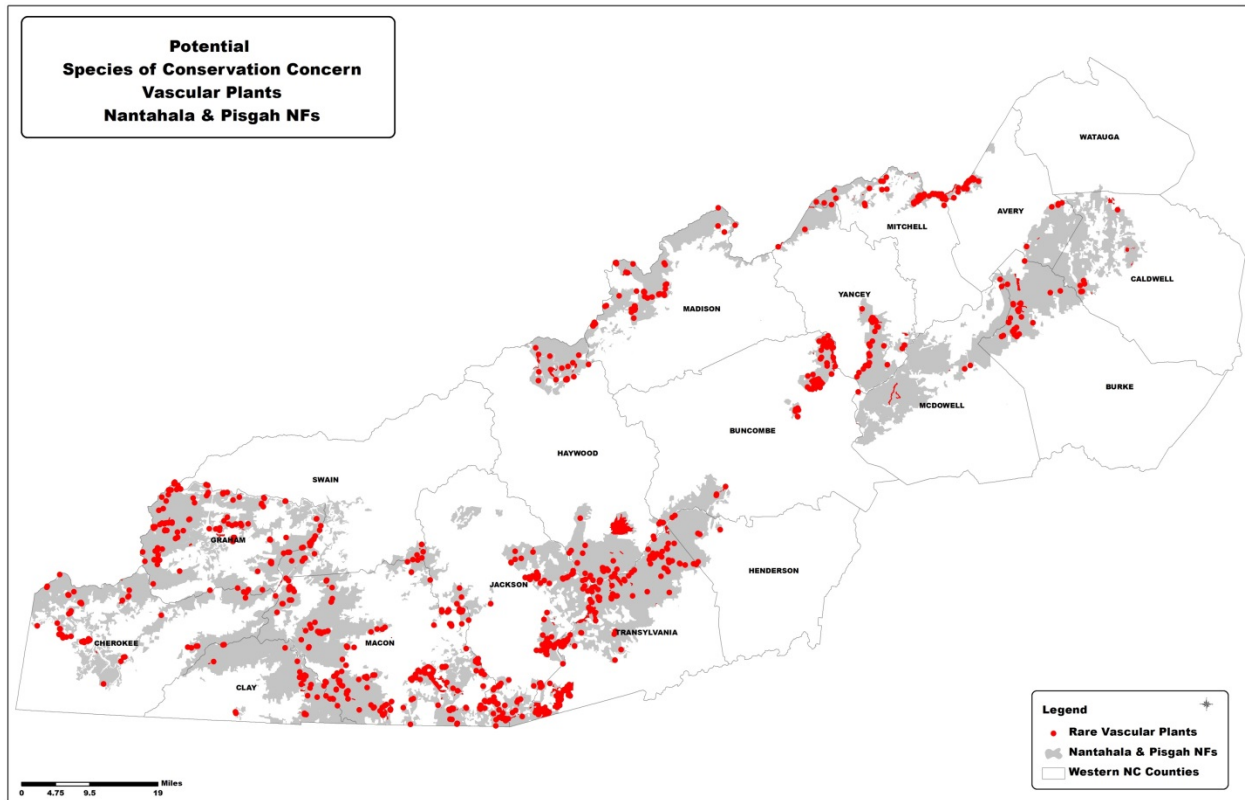
Figure 3. Distribution of Potential Moss Species of Conservation Concern on the Pisgah and Nantahala National Forests.



Vascular Plants

Vascular plants are the most diverse group of the potential species of conservation concern. Included are 19 fern or fern-like plants, three trees, 15 shrubs, 30 grasses and sedges, nine orchids, and 91 herbaceous plants with concentrations within the aster family. The map below indicates the documented occurrences of the SCC vascular plant species across the Nantahala and Pisgah NFs (Figure 4). Species are distributed across all eleven eozones and within many of the rare habitats. A greater concentration occurs within the Cheoah, Nantahala, Pisgah, and Appalachian Ranger Districts. Threats to vascular plant species of conservation concern include habitat manipulation and competition from non-native plant species, changes in hydrological flows, inappropriate activities such as herbicide applications in open habitats, fungal diseases, woody plant succession, fire suppression, and habitat changes as a result of climate change. Approximately 35% of these occurrences occur within currently designated areas.

Figure 4. Distribution of Potential Vascular Plant Species of Conservation Concern on the Pisgah and Nantahala National Forests.



One hundred sixty-seven vascular plants are on the potential species of conservation concern list. One hundred and twenty-seven species have five or fewer documented occurrences on the two forest units. Fifty-seven of these have a single occurrence in the Nantahala or Pisgah NFs. Of these species, ten species have the only known occurrence in North Carolina. Seventeen species are documented in more than 10 sites across the two national forests. Twenty of the species are required to be on the potential list due to current global rank or potential consideration for inclusion on the federal endangered species list as a result of a recent petition. Of these, both trees are recommended to be removed from the final species of conservation concern list. *Abies fraseri*, while definitely under threat from balsam wooly adelgid, is maintained and conserved within plant communities at the forest level rather than scattered individuals, which can occur within adjacent ecozones such as northern hardwood and high elevation red oak forests. This also holds true for *Tsuga caroliniana*, which is being impacted by hemlock wooly adelgid. The forest will preserve the species at the community level within its rare bluff or forest habitats where it is better conserved; rather than scattered individuals which often occur in adjacent dry oak and pine/oak-heath ecozones.

Potential Aquatic and Terrestrial Animal Species of Conservation Concern

Sixty-nine aquatic and terrestrial animal species are being initially proposed as species of conservation concern. This proposal is summarized in Table 1. Table 5 contains more detail about the species and existing occurrence information. This proposal comes after an initial screening using the criteria identified in Forest Service Handbook 1909.12, and includes all species meeting the three “must include” criteria.

Table 1. Summary of the 69 aquatic and terrestrial animal species initially proposed as Species of Conservation Concern.

Species Group	Number of Species Initially Proposed
Amphibians	10
Aquatic Insects	2
Arachnids	3
Birds	9
Crustaceans	4
Fish	13
Insects	2
Mammals	11
Mollusks	14
Reptiles	1

A group of aquatic and wildlife professionals was consulted and it was decided that species listed as threatened or endangered by the state of North Carolina (NC), or the Eastern Band of Cherokee Indians (EBCI), or identified as high priority for concern (e.g. Federal Species of Concern (FSC), etc.) by the U.S. Fish and Wildlife Service (USFWS), should be proposed. Additionally, several bat species are included because of the threat of white-nose syndrome (WNS) or the level of social concern expressed at the public meetings held during the assessment phase of this forest plan revision. These discussions also resulted in a list of seventy-three species that could be proposed as SCC in the future, based on the remaining criteria in FSH 1909.12.

Associated habitat and occurrence information for proposed species of conservation concern are summarized below. Habitat descriptions are from NatureServe 2013 unless noted otherwise. Occurrence information is from the North Carolina Natural Heritage Program 2013, unless noted otherwise.

Amphibians

Ten amphibians are being proposed as species of conservation concern, including one aquatic salamander, five riparian-associated terrestrial species, and four upland-associated terrestrial species.

Aquatic Salamanders

Eastern hellbenders (*Cryptobranchus alleganiensis alleganiensis*) occupy clear, well-oxygenated streams and rivers with rocky substrate and an abundance of large shelter rocks or submerged logs. Hellbenders are largely nocturnal and usually avoid water temperatures greater than 20°C. Males prepare nests and attend eggs beneath large flat rocks or submerged logs. The species is slow to mature and reproduce, making it vulnerable to local extirpation.

The principal threat is degradation of habitat, including impoundments, channelization, gravel mining, silt and nutrient runoff, other water pollution, and den site disturbance due to recreational uses of rivers overexploitation (collection and illegal or unintentional harvest) is also a threat to declining populations.

Approximately 36% of the known occurrences of hellbenders in North Carolina are on the Nantahala and Pisgah National Forests. Approximately 28% of these occurrences (nearly 10% of all North Carolina occurrences) are within permanently protected areas (e.g. designated wilderness, inventoried roadless area). Additionally, since they are aquatic, all hellbender populations will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Terrestrial Salamanders: riparian

Seepage salamanders (*Desmognathus aeneus*) are widely distributed within the Hiwassee River and its tributaries, and are also known from Northern Georgia, north-central Alabama and South Carolina. This semiaquatic species inhabits margins of small streams and seeps. Generally, species in this genus, except strictly subterranean species, tend to be able to traverse upland habitat when conditions are wet, and generally they can pass through wetland and aquatic habitats to reach another patch of suitable habitat. Seepage salamanders inhabit leaf litter or surface debris on the floors of mixed hardwood forests near small creeks, springs, and seepage areas. They also occur in damp shaded ravines. Eggs are laid under moss or in small protected depressions. Southern populations are vulnerable to intensive forest management practices such as clearcutting (Petranka 1998) and may be threatened by conversion of hardwood forest to pine.

This species appears to be stable throughout most of its range, although some populations in Alabama may have been extirpated after intensive logging. Approximately 91% of the known occurrences of seepage salamanders in North Carolina are on the Nantahala National Forest, 15 (53%) of which is associated with a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since they are often associated with riparian areas and floodplains, all mole salamander populations on the forests will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Dwarf black-bellied salamanders (*Desmognathus folkertsi*) are widely distributed within the Hiwassee River and its tributaries, and also known from south of the Blue Ridge Divide in the Chattahoochee River drainage. This semiaquatic species inhabits margins of small streams and seeps. Generally, species in this genus, except strictly subterranean species, tend to be able to traverse upland habitat when conditions are wet, and generally they can pass through wetland and aquatic habitats to reach another patch of suitable habitat. While total adult population size is

unknown, dwarf black-bellied salamanders are often abundant where collected (Camp et al. 2002).

This species appears to be endemic to the Hiwassee River drainage, or at least have a very restricted geographic range. All of the occurrences of this species in North Carolina are on the Nantahala National Forest and are within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since dwarf black-bellied salamanders inhabit stream margins and seeps, all known populations on the forests will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Northern pygmy salamanders (*Desmognathus organi*) can be found in higher elevation forest habitats (generally above 3,600') and at lower elevations on north-facing slopes, with the highest densities occurring at elevations above 4,900' (Organ 1961). In forests, individuals can be found under moss, leaf litter, logs, bark on stumps, or rocks and may ascend trees to at least two meters above ground during wet or foggy weather. During winter, adults can be found under rocks and crevices in seeps and other wet areas.

Localized populations appear stable. However, threats to the northern pygmy salamander include fragmentation of spruce-fir forest through logging and increased recreational development, and factors that open the forest canopy such as acid rain and forest pests (e.g. spruce budworm, balsam wooly adelgid).

Approximately 65% of the known occurrences of northern pygmy salamanders in North Carolina are on the Pisgah National Forest. Approximately 85% of these occurrences (approximately 55% of all North Carolina occurrences) are within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since they are associated with riparian habitats, all northern pygmy salamander populations on the forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Southern pygmy salamanders (*Desmognathus wrighti*) can be found in spruce-fir and hardwood (but in lower abundance) forests, and sometimes lower elevation mature cove forests (Petranka 1998). In forests, individuals can be found under moss, leaf litter, logs, bark on stumps, or rocks and may ascend trees to at least two meters above ground during wet or foggy weather. During winter, adults can be found under rocks and crevices in seeps and other wet areas.

Localized populations appear stable. However, threats to the southern pygmy salamander include fragmentation of spruce-fir forest through logging and increased recreational development, and factors that open the forest canopy such as acid rain and forest pests (e.g. spruce budworm, balsam wooly adelgid).

Approximately 50% of the known occurrences of northern pygmy salamanders in North Carolina are on the Nantahala and Pisgah National Forests. Approximately 64% of these occurrences (approximately 30% of all North Carolina occurrences) are within a permanently protected area

(e.g. designated wilderness, inventoried roadless area). Additionally, since they are associated with riparian habitats, all southern pygmy salamander populations on the forests will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Junaluska salamanders (*Eurycea junaluska*) occupy a small range in eastern Tennessee and western North Carolina, and prefer hiding under rocks and other objects along stream edges. They are often seen on roads at night. Rangewide, the species is considered stable; however, populations in the Cheoah River and Snowbird Creek may be extirpated.

Potential threats include siltation resulting from activities that can negatively impact water quality (Braswell 1989). Due to a widely disjunct distribution, it is unlikely that migration will be sufficient for recolonization of populations that experience declines or local extinctions (Ryan 1998). Additionally, aggressive sampling and site disruption during spring may cause undue stress to brooding females and result in the abandonment of clutches (Bruce and Ryan 1995).

Approximately 87% of the known occurrences of Junaluska salamanders in North Carolina are on the Nantahala National Forest. Approximately 15% of these occurrences (approximately 13% of all North Carolina occurrences) are within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since they are associated with riparian habitats, all Junaluska salamander populations on the forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Terrestrial Salamanders: upland

Green salamanders (*Aneides aeneus*) are often found in damp crevices in shaded rock outcrops and ledges. They are also found beneath loose bark and in cracks of standing or fallen trees, often in cove hardwoods or older forests, and in or under logs on ground. The species often occurs at high densities in logged areas where tree tops are left behind (Wilson 2003).

Recently observed declines in green salamander populations may have resulted from habitat loss (e.g. land development), overcollecting, and epidemic disease (Mitchell et al. 1999, Corser 2001). Severe drought and other extreme weather may exacerbate other threats. For example, Snyder (1991) attributed a decline in Blue Ridge populations to mortality associated with prolonged cold periods in winter.

Approximately 33% of the known occurrences of green salamanders in North Carolina are on the Nantahala and Pisgah National Forests. Approximately 51% of these occurrences (approximately 17% of all North Carolina occurrences) are within a permanently protected area (e.g. designated wilderness, inventoried roadless area).

Tellico salamanders (*Plethodon aureoles*) occur in mountainous and lowland habitats, including second-growth forests (Beamer and Lannoo 2005). High densities have been found in bottomlands with an abundance of leaf litter, rotting logs and an organic soil layer (Wilson

1995). Individuals likely shift between underground sites when conditions are cold or dry to surface sites when conditions are mild and damp/wet (Beamer and Lannoo 2005).

The species occupies a small range in forested areas of southeastern Tennessee and southwestern North Carolina. Historical and current distributions appear to be the same (Beamer and Lannoo 2005). All of the known occurrences of Tellico salamanders in North Carolina are on the Nantahala National Forest, with approximately 44% of these occurrences within a permanently protected area (e.g. designated wilderness, inventoried roadless area).

Chattahoochee slimy salamanders (*Plethodon chattahoochee*) occur in wooded areas, generally under or in rotting logs, stumps, and leaf litter, or under rocks, during the day. The species goes underground during dry or freezing weather. Eggs are laid in rotting logs, underground, or in rock crevices.

The species occupies a small range in forested areas of northwestern Georgia and southwestern North Carolina (Highton et al. 1989). Most of the range of this species is within the Chattahoochee National Forest in Georgia. It is known from one location on the Nantahala National Forest. This location is not within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Because of relatively recent taxonomic changes within plethodontid salamanders, long-term population trends are unknown.

Cheoah Bald salamanders (*Plethodon cheoah*) occur in mesic forest, under leaf litter, logs, or mossy rocks. It is a terrestrial breeder. The species occupies a very small range in western North Carolina, although it is common where habitat is suitable. Like most plethodontid salamanders, this species is known to be sensitive to forest management. However, a large amount of the habitat occupied by this species is second-growth forest, so it seems capable of surviving logging and similar forms of habitat disturbance. This species, and other *Plethodon* species, can persist in relatively small patches of habitat (Beamer and Lannoo 2005).

All of the known occurrences of Cheoah Bald salamanders in North Carolina are on the Nantahala National Forest, and are within permanently protected areas (e.g. designated wilderness, inventoried roadless area). Because of relatively recent taxonomic changes within plethodontid salamanders, long-term population trends are unknown.

This brief summary of some of the rare amphibians on the Nantahala and Pisgah National Forests highlights the need to further discuss rarity and management concern because of endemism or restricted range in future parts of the forest plan revision process. Additionally, terrestrial amphibians, specifically the green salamander, may be one of the species groups most sensitive to climate change.

Aquatic Insects

Two aquatic insects, one caddisfly and one dragonfly, are proposed as a species of conservation concern.

Rhyacophila amicus (a **caddisfly**) are free-living larvae that move about actively with no case until just before pupation. They tend to occupy cool running waters and are sometimes found in intermittent streams.

This species occupies a small range in southwestern North Carolina and southeastern Tennessee. The species is known from three streams in North Carolina, all of which are on the Nantahala and Pisgah National Forests. One of these occurrences (33%) is within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since they are aquatic, *R. amicus* populations will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Ophiogomphus edmundo (Edmund's snaketail) occupy clear, moderately flowing mountain streams and rivers. This species likely overwinters as larvae, emerging in late spring or early summer. *O. edmundo* is extremely rare and is particularly sensitive to changes in streamflow, including natural flooding and scouring.

The species is known from two streams in North Carolina, one of which (50%) is on the Pisgah National Forest. This occurrence is within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since they are aquatic, *O. edmundo* populations will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Arachnids - Spiders

Three spiders are proposed as species of conservation concern. All of these species are associated with caves or dark moist habitats.

Lampshade weavers (*Hypochilus sheari*) construct irregular webs on the underside of overhanging ledges, often near streams or in caves (Breene et al. 2003; Platnik 2013). The web may resemble a lampshade. Three species of *Hypochilus* are known to occur in western North Carolina, with *H. sheari* being the only one known to occur on the forests. *Hypochilus coylei* is the known only from the Hickory Nut Gorge area, not on or adjacent to the forests. *H. pococki* is found further west, and with a much wider distribution than the other two species, which occupy very small geographic ranges.

All of the known occurrences of *H. sheari* in North Carolina are on the Pisgah National Forest, with approximately 67% of these occurrences being within a permanently protected area (e.g. designated wilderness, inventoried roadless area). This species prefers riparian and cave habitats. Streamside habitats will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan. Cave and abandoned mine habitats receive additional protection through a closure order that prohibits people from entering caves and abandoned mines to slow the spread of white-nose syndrome in bats.

Linville Caverns spiders (*Nesticus carolinensis*) build small space webs, typically in cool, moist, and dark microenvironments (Hedin 1997). At lower elevations in the Appalachian Valley and the Cumberland Plateau, *Nesticus* spiders are found almost exclusively in caves. At higher elevations, mostly in the Blue Ridge, species are typically found in north-facing micro-

environments associated with boulder fields, cove forests, and rocky gorges (Gertsch 1984; Coyle and McGarity 1992). Most species are characterized by restricted geographic distributions, often to single cave systems or mountain ranges, with seven described species known only from single populations (Gertsch 1984). Species of this genus are thought to be allopatric – individuals of different species have never been collected in the same effort (Gertsch 1984; Coyle and McGarity 1992).

Nesticus carolinensis is known from one site in North Carolina, which is on the Pisgah National Forest, within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, this species is associated with cave habitats, which receive additional protection through a closure order that prohibits people from entering caves and abandoned mines to slow the spread of white-nose syndrome in bats.

Lost Nantahala Cave spiders (*Nesticus cooperi*) build small space webs, typically in cool, moist, and dark microenvironments (Hedin 1997). At lower elevations in the Appalachian Valley and the Cumberland Plateau, *Nesticus* are found almost exclusively in caves. At higher elevations, mostly in the Blue Ridge, species are typically found in north-facing microenvironments associated with boulder fields, cove forests, and rocky gorges (Gertsch 1984; Coyle and McGarity 1992). Most species are characterized by restricted geographic distributions, often to single cave systems or mountain ranges, with seven described species known only from single populations (Gertsch 1984). Almost all species are strictly allopatric – individuals of different species have never been collected sympatrically (Gertsch 1984; Coyle and McGarity 1992).

Nesticus cooperi is known from two sites in North Carolina, both of which are on the Nantahala National Forest. One of the occurrences of *N. cooperi* (50%) is within a permanently protected area. Additionally, this species is associated with cave habitats, which receive additional protection through a closure order that prohibits people from entering caves and abandoned mines to slow the spread of white-nose syndrome in bats.

Birds

The USFWS lists 386 bird species as neotropical migrants under the Migratory Bird Treaty Act (MBTA, 50 CFR Part 10.13). Of the nine bird species proposed as Species of Conservation Concern for the Nantahala and Pisgah forest plan revision, four (38%) are protected by the MBTA. Conservation of habitat for and populations of all neotropical bird species is of management importance on the Nantahala and Pisgah National Forests. Additionally, conservation of habitat for and populations of all native resident bird species is of management importance on the Nantahala and Pisgah National Forests.

Neotropical Migrants

Peregrine falcons (*Falco peregrinus*) occupy open habitats ranging from forested areas to human population centers, especially where suitable nesting cliffs or structures are present. The species nests on ledges on vertical faces of rocky cliffs or crags, often with sheltering overhangs (Palmer 1988, Campbell et al. 1990), although nesting pairs have also been associated with tall buildings and artificial nesting platforms. Ideal locations include undisturbed areas with a wide view, near water, and close to plentiful prey. When not breeding, *F. peregrinus* occurs in areas

where prey concentrate, including farmlands, marshes, lakeshores, river mouths, tidal flats, dunes and beaches, broad river valleys, cities, and airports.

Threats to *F.peregrinus* include loss of wetland habitat of primary prey, poachers robbing nests, shooting by hunters, and food chain contamination from use of persistent pesticides. Today, pesticide-caused reproductive failure is rare or absent in most populations, though organochlorine levels in the environment are still high in some areas (e.g. New Mexico, Hubbard and Schmitt 1988). Populations in some areas of the eastern U.S. may be threatened by increasing human disturbance and use of nesting habitat (Byrd and Johnston 1991).

Approximately 47% of the known occurrences of peregrine falcons in western North Carolina are on the forests, with 86% of those occurrences (40% overall) being within a permanently protected area (e.g. designated wilderness, inventoried roadless area). The National Forests in North Carolina protects all nesting peregrine falcons through a closure of known nesting sites to rock climbing, rappelling, and hang gliding during nesting season.

Cerulean warblers (*Setophaga cerulea*) require heavily forested landscapes for nesting and, within Appalachian forests, primarily occur on ridge tops and steep, upper slopes. They are generally associated with oak-dominated stands that contain gaps in the forest canopy, have large diameter trees (>16 inches diameter at breast height), and have well-developed understory-and upper-canopy layers. Cerulean warblers use the mid- and upper-canopy, where they glean insects from the surface of leaves and conceal their open cup nests (Wood et. al. 2013). Because they are severely declining across much of their range, habitat management is a high priority (AMJV 2012).

Threats and limiting factors most frequently mentioned are destruction of both breeding and wintering habitat. Loss of suitable habitat for cerulean warblers may operate at different scales and by different mechanisms. First, as potential breeding habitat is lost, carrying capacity is reduced proportionally. While this threat is straightforward, it alone is not threatening the persistence of the species range-wide. Second, surrounding habitat loss affects the carrying capacity of the remaining habitat-- patches of habitat below a certain size do not support breeding birds (Robbins et al. 1989). And third, some evidence indicates that changes in stand composition and declining forest health affects habitat suitability for cerulean warblers (Robbins et al. 1992). Hands et al. (1989) list contaminants, predation, competition, diseases/parasites, weather, and human disturbance as additional potential limiting factors. Additionally, nest parasitism by cowbirds is at least part of the mechanism by which forest fragmentation affects breeding bird populations (Hamel 1992).

Approximately 46% of the known occurrences of cerulean warblers in North Carolina are on the Nantahala and Pisgah NFs, with 43% of those occurrences (20% overall) within a permanently protected area (e.g. designated wilderness, inventoried roadless area). The Nantahala and Pisgah NFs are actively working to enhance habitat for this species under the current Forest Plan.

Golden-winged warblers (*Vermivora chrysoptera*) require a diverse vegetation structure, often found in early successional patches within forested landscapes. Habitats used for nesting include young forest created by timber harvests, wind, wildfire, or other disturbance, abandoned

farmland, scrub barrens, managed shrublands, utility rights-of-ways, edges of reclaimed strip mines, grazing land, beaver glades, oak savannas, and swamp forests with partially open canopies (Bakermans *et al.* 2011). Golden-winged warbler nests are often located along forest edges, especially those between young forest patches and herbaceous openings where a mix of grasses, herbs, shrubs, and scattered trees are present along the forest edge. Golden-winged warbler habitats are disturbance-dependent; therefore, stands must be re-treated on short rotations or new young stands must be created continuously over time to ensure viable long-term breeding populations.

Females build nests within defended male territories. These territories include herbaceous nesting cover (e.g., grasses, goldenrod, etc.) and adjacent high density saplings (<4 inches dbh; 1350 - 3000 stems/acre) and shrubs (100 - 300/acre) for foraging (Bakermans *et al.* 2011). Predation on golden-winged warbler nests by animals (e.g. snakes and chipmunks), is the largest cause of nest failure. Song perches also are important components of harvested stands because they allow males to delineate territories. A study of song perches used by golden-winged warblers in Pennsylvania found that the majority of singing posts were located in retained trees and snags (Bakermans *et al.* 2011).

Approximately 73% of the known occurrences of golden-winged warblers in North Carolina are on the Nantahala and Pisgah NFs, with 50% of those occurrences (36% overall) within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Since golden-winged warblers are associated with high elevation open habitats, they are conserved through the implementation of current standards in the revised Forest Plan. Additionally, the Nantahala and Pisgah NFs are actively working to enhance habitat for this species under the current Forest Plan.

Resident Birds

Southern Appalachian northern saw-whet owls (*Aegolius acadicus pop. 1*) occupy dense coniferous or mixed forests, cedar groves, alder thickets, swamps, and tamarack bogs, often roosting in dense evergreens in winter, at various heights and usually close to the trunk. *A. acadicus* nests in old woodpecker holes or other existing tree cavity where the diameter of the hole is seven centimeters or more, but will also use nest boxes. During the breeding season, the species is most often found in or near nest hole. When not breeding, the species may be found in dense second growth, brushy areas, arid scrub, and open buildings.

Approximately 58% of the known occurrences of southern Appalachian saw-whet owls in North Carolina are on the Nantahala and Pisgah NFs, with 71% of those occurrences (42% overall) within a permanently protected area (e.g. designated wilderness, inventoried roadless area).

Ruffed grouse (*Bonasa umbellus*) is an important game species that is highly associated with early successional habitats, including young forest. Ruffed grouse occurs across the Nantahala and Pisgah NFs, although populations have been declining over the last several years. Refer to the wildlife section of the montane oak forest ecozone report for discussion related to ruffed grouse.

Bald eagles (*Haliaeetus leucocephalus*) are associated with areas close to (within 4 km) coastal areas, bays, rivers, lakes, reservoirs, or other bodies of water that reflect the general availability of primary food sources including fish, waterfowl, or seabirds. Bald eagles nest in tall trees or on pinnacles or cliffs near water. Bald eagles preferentially roost in conifers or other sheltered sites in winter in some areas; typically they select the larger, more accessible trees (Buehler et al. 1992). In winter, bald eagles may associate with waterfowl concentrations or congregate in areas with abundant food resources. Wintering areas are most often associated with open water, they will use habitats with little or no open water (e.g., montane areas) if upland food resources (e.g. rabbit or deer carrion) are readily available. Wintering eagles tend to avoid areas with high levels of nearby human activity (boat traffic, pedestrians) and development (buildings) (Buehler et al. 1992). However, the species has shown a high degree of adaptability and tolerance if the human activity is not directed toward them.

The bald eagle has a widespread distribution in North America, especially in Alaska and British Columbia, but suffered great decline in southern and eastern part of range earlier this century. Major threats include habitat loss, disturbance by humans, biocide contamination, decreasing food supply, and illegal shooting.

Bald eagles sightings are becoming more common in western North Carolina. There are six known nesting sites on the Nantahala and Pisgah NFs.

Southern Appalachian red crossbills (*Loxia curvirostra pop. 1*) occupy coniferous and mixed coniferous-deciduous forests. During migration and winter months, red crossbills may also occur in deciduous forest, and more open scrubby areas.

This species almost always occurs in low numbers. Local population dynamics reflect variations in local conifer cone crops. Low cone availability results in emigration of crossbills to other areas. Because net reduction in mature forest (i.e. overall cone availability) could result in an overall decline in the crossbill population, forestry practices and widespread regional tree mortality due to insect outbreaks may be detrimental to crossbills, at least temporarily. To conserve the diversity of red crossbills, Benkman (1993) recommended protecting mature and old-growth stands, increasing rotation ages throughout the range of each of the required conifers, and leaving mature trees in cutover areas.

This species is very uncommon in North Carolina. Approximately 50% of the known occurrences of southern Appalachian red crossbill in North Carolina are on the Nantahala and Pisgah NFs. All of these occurrences are within a permanently protected area (e.g. designated wilderness, inventoried roadless area).

Southern Appalachian black-capped chickadees (*Poecile atricapillus practica*) inhabit deciduous and mixed deciduous/coniferous forest and woodland, willow thickets, cottonwood groves, old fields, and wooded suburban areas. The species nests in tree cavities dug by both sexes, especially dead trees or rotten branches, sometimes in existing natural cavities, old woodpecker holes, bird boxes, or similar sites (Grubb and Bronson 1995).

This species is very uncommon in North Carolina. Approximately 27% of the known occurrences of southern Appalachian black-capped chickadee in North Carolina are on the Nantahala and Pisgah NFs. Approximately 67% of these occurrences are within a permanently protected area (e.g. designated wilderness, inventoried roadless area).

Crustaceans

Among crustaceans listed as endangered or threatened in the United States, 54% are from the southeast (Schuster 1997). Four crustaceans are proposed as species of conservation concern, including three crayfish and one scud.

Crayfish

Small native ranges of many crayfish species is a primary factor in their vulnerability to habitat loss and competition. Other threats to crayfish include pollution and impoundment, but competition with nonindigenous species is the primary threat to many species (Taylor et al. 1996).

Chauga crayfish (*Cambarus chaugaensis*) occupy lotic habitats with a rocky substrate in creeks and small streams (Hobbs 1981; Simmons and Fraley 2010). Chauga crayfish is endemic to the headwaters of the Savannah River drainage in North Carolina, South Carolina, and Georgia.

The principal threat to headwater crayfish populations is degradation of habitat, including impoundments, channelization, gravel mining, silt and nutrient runoff, and other water pollution. Overexploitation (collection and illegal or unintentional harvest) is also a threat to declining populations. It is likely that the industrial pollution occurring at the Savannah River site is having an impact on chauga crayfish habitat downstream of the forests. Furthermore, the creation of Hartwell Lake has likely eliminated significant amounts of potential habitat.

Approximately 54% of the known occurrences of *C. chaugaensis* in North Carolina are on the Nantahala and Pisgah NFs, with approximately 71% of these occurrences (approximately 38% of all North Carolina occurrences) being within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since they are aquatic, all *C. chaugaensis* populations on the forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Little Tennessee crayfish (*Cambarus georgiae*) occupy streams of medium to low gradient and are relatively tolerant of moderate levels of wastewater pollution and sedimentation (McLarney 1993). *C. georgiae* has been found in fast flowing streams with sandy bottoms of a depth of no more than 1 meter (Hobbs 1981). It is associated with debris in slower parts of swift streams and areas lacking other crayfish competitors. *C. georgiae* seems to be unable to compete with *C. bartonii* in riffle areas, where it hides in trapped leaf debris.

The principal threat is degradation of habitat, including impoundments, channelization, gravel mining, silt and nutrient runoff, and other water pollution. Overexploitation (collection and illegal or unintentional harvest) is also a threat to declining populations.

In North Carolina, *C. georgiae* is restricted to the Little Tennessee and Tuckasegee River systems upstream from Fontana Reservoir, but is absent from the Nantahala and Oconaluftee River systems (Simmons and Fraley 2010). Approximately 36% of the known occurrences of *C. georgiae* in North Carolina are on the Nantahala and Pisgah NFs, with approximately 11% of these occurrences (approximately 4% of all North Carolina occurrences) within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since they are aquatic, all *C. georgiae* populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Hiwassee headwaters crayfish (*Cambarus parrishi*) occupy very swift, clear water flowing over sand, gravel, and cobble (McGrath 1998). *C. parrishi* appears to occupy the same niche as another species endemic to the Hiwassee River drainage, *Cambarus hiwasseeensis*. *C. parrishi* appears to replace *C. hiwasseeensis* in smaller headwater tributaries. The two species have never been found together at any locality (McGrath 1998).

The principal threat is degradation of habitat, including impoundments, channelization, gravel mining, silt and nutrient runoff, and other water pollution. Overexploitation (collection and illegal or unintentional harvest) is also a threat to declining populations.

C. parrishi is endemic to the Hiwassee River drainage, and has a very small geographic range (extent <250 sq. km). Approximately 77% of the known occurrences of *C. parrishi* in North Carolina are on the Nantahala and Pisgah NFs, with approximately 10% of these occurrences (approximately 8% of all North Carolina occurrences) within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since they are aquatic, all *C. parrishi* populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Scuds

Yancey sideswimmers (Carolina seep scud) (*Stygobromus carolinensis*) are subterranean obligates that occupy seeps at Mount Mitchell in Yancey County. Very little is known about specific habitat requirements for this species.

S. carolinensis is endemic to seeps at Mount Mitchell. It is known from one site in North Carolina, which is on the Pisgah NF. This site is not within a permanently protected area (e.g. designated wilderness, inventoried roadless area); however, since *S. carolinensis* inhabits high elevation springs and seeps, all known populations on the forest will be conserved through the through protection of rare habitats the revised Forest Plan.

Fish

Twenty-eight percent of southeastern freshwater and diadromous fishes have a status of extinct, endangered, threatened, or vulnerable, which represents a 125% increase in 20 years (Warren et al. 2000). North Carolina ranks third among southeastern states in number (21) and percentage (11.5%) of imperiled fishes (Warren et al. 1997).

Causes of declines among all aquatic taxa are widely attributed to habitat destruction and degradation, and the introduction of nonindigenous species (Williams et al. 1993, Taylor et al. 1996, Etnier 1997, Warren et al. 1997). Fishes inhabiting medium-sized rivers and creeks rely on coarse substrates that are relatively silt-free; however, these streams are often heavily impounded and have altered substrates. Etnier (1997) identifies habitat alteration from nonpoint source pollution and flow alteration as the primary cause of population declines for 72% of southeastern fishes considered imperiled.

Thirteen fish species have been proposed as species of conservation concern. All of the fish species discussed below are within one or more aquatic significant natural heritage area, as identified by the North Carolina Natural Heritage Program. All fish species will be protected and conserved through the implementation of existing (and proposed) riparian (streamside forest) standards, as well as implementation of the Clean Water Act and North Carolina Sediment and Pollution Control Act.

Large and Medium-sized River Species

Most of the species discussed below have very limited distributions in North Carolina, often straddling the North Carolina/Tennessee border. While the species itself may not be rare or threatened across its range, North Carolina populations are likely at the upstream edge of their natural range, which contributes to local rarity. This does not alleviate the need to maintain or restore species habitat and viability on the forests, but rather aids in identifying appropriate future restoration standards and guidelines.

Banded sculpin (*Cottus caroliniae*) typically occur in small to moderate-sized clear, cool to warm streams (Lee et al. 1980); gravel and rubble riffles of headwaters, creeks, and small rivers; also springs and their effluents; caves in some areas (Page and Burr 2011). Sculpin are usually found under rocks during daylight, and are often seen on top of rocks at night (Greenberg and Holtzman 1987). Eggs are deposited possibly singly or are broadcast indiscriminately over gravel; no nests have been found.

Despite the habitat description above, in North Carolina, *C. caroliniae* is known only from the lower French Broad River mainstem (but includes the mouths of two tributaries), where its distribution overlaps significantly with the mottled sculpin (*C. bairdi*). Within the rest of this watershed, and across the Nantahala and Pisgah National Forests, *C. bairdi* is the only sculpin known to occur. Within its limited North Carolina distribution, 67% of the known occurrences of banded sculpin are on the Nantahala and Pisgah NFs. Approximately 83% of these occurrences (approximately 56% of all North Carolina occurrences) are within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since they are aquatic, all banded sculpin populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Sharphead darters (*Etheostoma acuticeps*) typically occur in fast, deep, rocky riffles in small to medium rivers; strongly flowing water in riffles and chutes of large upland creeks and medium-sized rivers where substrate consists of coarse gravel, rubble, or boulders and the water is cool or warm, usually clear or slightly turbid, with a moderate gradient (Lee et al. 1980, Page and Burr

2011). This darter often occurs in and around patches of riverweed (*Podostemum*), and is most common in riffles near river islands (Kuehne and Barbour 1983, Burkhead and Jenkins 1991, Rohde and Arndt 1994). Eggs are buried in sand in riffle areas near the base of a large rock (Bryant 1979), apparently in the same areas of swift current that are inhabited during the nonspawning period (Burkhead and Jenkins 1991).

Despite the habitat description above, in North Carolina, *E. acuticeps* is known only from the Nolichucky River mainstem. Within its limited North Carolina distribution, 13% of the known occurrences of sharphead darters are on the Nantahala and Pisgah NFs, none of which are within a permanently protected area (e.g. designated wilderness, inventoried roadless area). However, since they are aquatic, all sharphead darter populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Sicklefin redhorse (*Moxostoma sp. 2*) likely historically inhabited most or all of the large creeks and rivers in the Blue Ridge section of the Little Tennessee and Hiwassee basins. However, the current occupied range of sicklefin redhorse includes several streams and small rivers within the Little Tennessee and Hiwassee river basins (including Hiwassee and Fontana Lakes). The species is currently a candidate for federal listing under the Endangered Species Act.

In North Carolina, sicklefin redhorse is known only from the Little Tennessee and Hiwassee River systems, including Hiwassee Lake. Approximately 40% of the known occurrences of mooneye in North Carolina are on the Nantahala and Pisgah NFs, none of which with approximately 50% of these occurrences are within a permanently protected area (e.g. designated wilderness, inventoried roadless area). However, since they are aquatic, sicklefin redhorse populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Stonecats (*Noturus flavus*) occupy small to large rivers, and are most often found in fast flowing, clear water reaches over sand, gravel, and rubble. The species moves to deeper water in winter and quiet water to feed. *N. flavus* spawns in streams or in shallow rocky areas of lakes where eggs are deposited beneath stones. This species is threatened by pollution and impoundments.

In North Carolina, *N. flavus* is known only from the Little Tennessee River. Approximately 61% of the known occurrences of stonecats in North Carolina are on the Nantahala and Pisgah NFs, but none are within a permanently protected area (e.g. designated wilderness, inventoried roadless area). However, since they are aquatic, stonecat populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Stream and Small River Species

Smoky dace (*Clinostomus funduloides ssp. 1*) occur in small to medium streams with clear to turbid water and moderate current (Lee et al. 1980), and rocky flowing pools of headwaters,

creeks, and small rivers. This species is most common in small clear streams (Page and Burr 2011). It spawns on gravelly riffles and sometimes uses the nests of chubs. Eggs are scattered.

In North Carolina, smoky dace is known from throughout the Little Tennessee and Hiwassee River basins. Approximately 47% of these occurrences are on the Forests, with approximately 31% of these occurrences (approximately 15% of all North Carolina occurrences) being within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since they are aquatic, all smoky dace populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Turquoise darters (*Etheostoma inscriptum*) occur in small to medium streams with clear to turbid water and moderate current (Lee et al. 1980), and rocky flowing pools of headwaters, creeks, and small rivers. This species is most common in small clear streams (Page and Burr 2011). It spawns on gravelly riffles and sometimes uses the nests of chubs. Eggs are scattered.

In North Carolina, *E. inscriptum* is known only from the Horsepasture and Toxoway Rivers. Approximately 42% of these occurrences are on the Forests, all of which are within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since they are aquatic, all turquoise darter populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Wounded darters (*Etheostoma vulneratum*) occur in fast rocky riffles of small to medium rivers (Page and Burr 2011). This species is sensitive to habitat alterations (Braswell 1991). It has disappeared from much of its former range due to the prevalence of impoundments on most rivers in the upper Tennessee River drainage (Etnier and Starnes 1993), and is moderately threatened by residential development in North Carolina.

In North Carolina, *E. vulneratum* is known from the Little Tennessee, Tuckasegee River, Oconoluftee, and Cullasaja Rivers. There is one record of *E. vulneratum* from the lower French Broad River. Approximately 31% of these occurrences are on the Nantahala and Pisgah NFs, only 3% of which (approximately 1% of all North Carolina occurrences) are within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Since they are aquatic, all wounded darter populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Rosyface chubs (*Hybopsis rubrifrons*) occur in creeks and small rivers. The species is typically associated with pools or edges of riffles in small streams, or near banks in eddy currents in larger streams with sand or gravel substrate. *H. rubrifrons* avoids areas with heavy siltation (Lee et al. 1980, Page and Burr 2011). Spawning occurs over clean gravel in moderately fast riffles.

In North Carolina, *H. rubrifrons* is known only from the Horsepasture and Toxoway Rivers. Approximately 33% of these occurrences are on the Nantahala and Pisgah NFs, all of which are within a permanently protected area (e.g. designated wilderness, inventoried roadless area).

Additionally, since they are aquatic, all rosyface chub populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

American brook lampreys (*Letheron (Lampetra) appendix*) typically occur in riffles and runs of creeks and small to medium rivers with strong flow (Page and Burr 2011). The species prefers cool, clear water. Larvae burrow into sand and silt, and are often found in pools and stream margins. Eggs are laid in nests in gravel/sand riffles and runs with strong flow.

In North Carolina, *L. appendix* is known only from Spring Creek, a larger tributary to the lower French Broad River. All of the known occurrences of American brook lamprey in North Carolina are on the Nantahala and Pisgah NFs, with approximately 89% of these occurrences (approximately 89% of all North Carolina occurrences) being within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Since they are aquatic, American brook lamprey populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Logperch (*Percina caprodes*) habitat ranges from creeks to small rivers, but the species is also known from deep waters of lakes and reservoirs. In streams, this species prefers clean riffles and runs over substrates of mixed sand and gravel. It is often associated with bottom debris. During spawning, logperch move from deeper water to shallows, where eggs are laid in sand or gravel, often in riffles. Young logperch are often associated with dense beds of vegetation.

In North Carolina, *P. caprodes* is known from larger tributaries to the lower French Broad River. There is one record of the species from the Pigeon River. Approximately 62% of these occurrences are on the Nantahala and Pisgah NFs, of which approximately 50% (approximately 31% of all North Carolina occurrences) are within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Since they are aquatic, all logperch populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Brook trout (*Salvelinus fontinalis*) is an important game species and the only salmonid (trout and charr) native to the Nantahala and Pisgah National Forests. The species is distributed across the Nantahala and Pisgah National Forests, generally at elevations above 3,000 feet. The range of this species has been greatly affected by past land use and the introduction of exotic salmonids. *S. fontinalis* is also sensitive to climate change and acidic deposition. Refer to the coldwater ecozone discussion in the 2014 Assessment for Plan Revision for more details about *S. fontinalis*

Aquatic Habitat Generalists

Southern (mountain) blotched chub (*Erimystax insignis eristigma*) inhabits rocky riffles, runs, or pools (above or below riffles) of clear, moderate to high gradient, cool and warm, medium to large streams and small rivers with clean gravel, rubble, or bedrock bottoms, usually in water less than 1 meter deep (Lee et al. 1980, Page and Burr 2011). Adults tend to be at the head of riffles in moderate to swift current, seldom in torrents or slow-moving pools (Boschung and Mayden 2004). Young initially occupy shallow areas with little or no current (Harris 1986).

In North Carolina, *E. insignis eristigma* is known from throughout the French Broad, Nolichucky, and Hiwassee River basins. Approximately 23% of these occurrences are on the Nantahala and Pisgah NFs, with approximately 29% of these occurrences (approximately 6% of all North Carolina occurrences) being within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since they are aquatic, all southern blotched chub populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Olive darters (*Percina squamata*) inhabit small to medium rivers, as well as high gradient streams with swift current over rubble and boulders (Burr and Warren 1986; Etnier and Starnes 1993). Narrow habitat requirements (e.g. reliance on large reaches of swift current) may contribute to population numbers. Presently, little is known about how far individuals are capable of traveling through unsuitable habitat (e.g., extensive low gradient runs, pools, or impoundments) to reach preferred sites, but it is plausible that an area with poor habitat for a considerable distance would hinder dispersal.

Because of strict habitat requirements, olive darter distribution has been dramatically reduced by storage reservoirs, in the Tennessee River drainage (Etnier and Starnes 1993). Within the Tennessee Valley, this species is very threatened by siltation, channelization, impoundment, and agricultural and urban runoff (Braswell 1991).

In North Carolina, *P. squamata* is known from throughout the Hiwassee, Little Tennessee, and lower French Broad River systems, always in low numbers. Approximately 62% of these occurrences are on the Nantahala and Pisgah NFs, with approximately 61% of these occurrences (approximately 11 of all North Carolina occurrences) being within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since they are aquatic, all olive darter populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Insects

Tawny crescents (*Phycoides batesii maconensis*) occupy openings, glades, open woods, and roadsides within forested areas, but its habitat is perhaps better characterized as woodland-hardwood than as forest. Larvae eat the foliage of *Aster* species.

The species is considered extirpated over a significant part of its eastern range; however, there is a lack of status information in most of the US range, and there is doubt about causes of eastern decline. Likely threats in the next few decades include climate change in the US part of the range. However, the species appears to be secure in a large part of central and western Canada, perhaps even common in some regions, and is secure in some parts of the United States. Gypsy moth spraying and residential development are the main threats to this species in the Appalachians. Also, several invasive plants could become threats in the Appalachians if left uncontrolled.

Approximately 81% of the known occurrences of tawny crescents in North Carolina are on the Nantahala and Pisgah National Forests. Approximately 54% of these occurrences (44% of all North Carolina occurrences) are within a permanently protected area (e.g. designated wilderness, inventoried roadless area).

Mary Alice’s small-headed fly (*Eulonchus marialiciae*) is a rare parasite of the folding trapdoor spider (*Antrodiaetus unicolor*). The species is known from cool, humid, mixed forests at elevations above 1,200 meters in southwestern North Carolina (Adler *et al.* 1997). Smooth blackberry (*Rubus canadensis*) is a known nectar source. Both host spiders and nectar sources of this fly are abundant.

Approximately 20% of the known occurrences of Mary Alice’s small-headed fly in North Carolina are on the Nantahala and Pisgah NFs, with all of these occurrences being within a permanently protected area (e.g. designated wilderness, inventoried roadless area).

Mammals

Bats

Five species of bats have been proposed as Species of Conservation Concern (Table 2) largely because of the threat white-nose syndrome (WNS) poses to the persistence of these animals across their ranges. For example, the northern long-eared bat (*Myotis septentrionalis*) was proposed for federal listing as endangered in October 2013 based largely on the effects WNS has had on the species across its range (reference T&E section of this assessment). Other cave-associated bat populations across the Nantahala and Pisgah National Forests have experienced dramatic declines in recent years. The National Forests in North Carolina maintains a closure order on all caves and mines and strictly adheres to all USFWS and NCWRC decontamination protocols when biologists or other staff and must enter caves or mines to help prevent the spread of WNS.

Table 2. Bat species proposed as species of conservation concern (SCC) as part of the Nantahala and Pisgah National Forest plan revision process.

Common Name	Scientific Name
Rafinesque’s big eared bat	<i>Corynorhinus rafinesquii rafinesquii</i>
Big brown bat	<i>Eptesicus fuscus</i>
Eastern small-footed bat	<i>Myotis leibii</i>
Little brown bat	<i>Myotis lucifugus</i>
Tri-colored bat	<i>Perimyotis subflavus</i>

White-nose syndrome is caused by the fungus *Pseudogymnoascus destructans*, and is responsible for unprecedented mortality in some hibernating insectivorous bats. For example, the northern long-eared bat has experienced a sharp decline since the onset of WNS in 2006, which is estimated to be approximately 99 percent in the northeastern part of the species’ range. This

species, *Myotis septentrionalis*, is now proposed for federal listing under the Endangered Species Act.

Since its discovery in New York in 2006, WNS spread rapidly throughout the northeast and is expanding through the Midwest and Canada. As of February 2014, WNS has been confirmed in 22 states, including North Carolina, and five Canadian provinces, and is suspect in four additional states due to the presence of *P. destructans*.

All five of the bats in Table 2 are known to occur across the Nantahala and Pisgah National Forests, in a variety of forest habitats. Two of the bat species, Rafinesque's big-eared bat and eastern small-footed bat, would have been proposed as SCC even without the threat of WNS due to their rarity.

Appalachian woodrat (*Neotoma magister*) occupies rocky cliffs, talus slopes with boulders and crevices, and caves. It occasionally uses abandoned buildings but generally avoids humans. It generally occurs at higher elevations (to about 3,200 feet) and is rarely found in lowlands or open areas. Associated forest is varied, including cove hardwoods, hemlock-birch, oak-pine, and various combinations of upland hardwoods. Understory species such as grape, mountain laurel, rhododendron and ferns are frequently present. A large house of sticks, leaves, and miscellaneous debris is built, usually within a cave, crevice, or other well-protected place.

In North Carolina, Appalachian woodrat is known from twenty locations, 15 (75%) of which are on the Nantahala and Pisgah National Forests. Of these locations, nine (60%, or 45% of all NC locations) are within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since they are associated with rocky areas and caves, all Appalachian woodrat populations on the Forest will be conserved through the implementation of rare habitat standards and guidelines in the revised Forest Plan.

Southern water shrew (*Sorex palustris punctulatus*) occupies riparian forests along mountain streams, especially shaded sections in northern hardwood and subalpine conifer forests. It is closely associated with swift, rocky streams, often with moss-covered rocks and rhododendron on the banks, and yellow birch, red spruce, red maple, sugar maple, beech, and yellow poplar in the overstory (Handley 1991). Very few individuals have ever been collected, suggesting small population sizes.

Threats to southern water shrew include acidification of habitat due to precipitation and indirectly, declining availability of aquatic prey resulting from this acidification. Other threats include fragmentation of suitable habitat, warming and siltation of headwater streams and ponds, resulting from logging, clearing for agriculture, and road building; and habitat loss and pesticide poisoning following infestations of gypsy moths (Handley 1991).

In North Carolina, the southern water shrew is known from fifteen locations, nine (60%) of which are on the Nantahala and Pisgah National Forests. Of these occurrences, six (67%, representing 40% of all NC occurrences) are within a permanently protected area (e.g. designated wilderness, inventoried roadless area). Additionally, since they are aquatic, all southern water shrew populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Appalachian cottontail (*Sylvilagus obscurus*) are highly associated with dense cover and conifers at higher elevations, shrubby heaths, especially where *Kalmia sp.* and *Vaccinium sp.* are present, higher elevation areas maintained with periodic fire, and 6-7 year-old clear cuts adjacent to deciduous growth (Chapman et al. 1992). In parts of its range, *S. obscurus* uses areas with dense understory vegetation within mature mixed-oak forest or patches of recent clearcuts. The species generally avoids steep slopes. Populations of Appalachian cottontail are likely small and isolated in the portion of the species' range in the Appalachian Mountains. These populations are experiencing a loss of habitat due to human land use and the range expansion of the eastern cottontail (*S. floridanus*).

In North Carolina, *S. obscurus* is known from eighteen locations, nine (50%) of which are on the Nantahala and Pisgah National Forests. Of these occurrences, all (representing 50% of all NC occurrences) are within a permanently protected area (e.g. designated wilderness, inventoried roadless area).

Mollusks

Fourteen mollusks have been proposed as Species of Conservation Concern: one aquatic snail, five freshwater mussels, and eight land snails.

Aquatic Snails

Generally speaking, knowledge levels and understanding of North Carolina freshwater snails is low. Basic survey and distribution information is lacking for most species and endemism concerns are high.

Christy's elimia (*Elimia christyi*) occupies large streams to rivers in Hiwassee Basin. Distribution of this, and other freshwater gastropods, has been highly affected by river impoundments. Two of the three known locations of this species in North Carolina are on the Nantahala National Forest. Additionally, since they are aquatic, all *Elimia christyi* populations on the Forest will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Freshwater Mussels

A recent status review of the mussel fauna in the United States revealed significant nationwide decline (Williams et al. 1993), with many species being even more depleted than federal lists indicate. For example, in North Carolina, over 50% of the freshwater mussel species occurring in the state are imperiled (federally- or state-listed as endangered, threatened, or special concern) (North Carolina Scientific Council 1990).

Table 3 lists five freshwater mussel species proposed as Species of Conservation concern for this plan revision process. This in no way means other freshwater mussels are not important, it simply means that aside from federally-listed mussel species, these are currently the most at risk.

Table 3. Freshwater mussel species proposed as species of conservation concern (SCC) as part of the Nantahala and Pisgah National Forest plan revision process.

Common Name	Scientific Name
Brook floater	<i>Alasmidonta varicosa</i>
Slippershell mussel	<i>Alasmidonta viridis</i>
Tennessee pigtoe	<i>Fusconaia barnesiana</i>
Tennessee clubshell	<i>Pleurobema oviforme</i>
Mountain creekshell	<i>Villosa vanuxemensis</i>

These species occur very sporadically across the Nantahala and Pisgah National Forests, within cool- and warmwater streams and rivers. All will be conserved through the implementation of riparian and streamside forest standards and guidelines in the revised Forest Plan.

Land Snails

Research on and survey of land snails and their ecological significance have largely been overshadowed by more charismatic fauna. This has resulted in a substantial information deficiency for the species group in general, but especially for diminutive snail taxa (<5mm) (Dourson 2010). Overlooking tiny snails from past collections, and a general lack of broad-ranging scientific interest (until more recently) has resulted in significant knowledge and distributional gaps. Consequently, many states, including North Carolina, have listed a number of terrestrial gastropods as rare or uncommon.

Recent studies in Kentucky (Dourson 2010) have shown that where there are comprehensive snail inventories designed to include diminutive snail taxa, many species records are added. This type of comprehensive survey has not been done in North Carolina, which has resulted in relatively old, patchy known occurrences of tiny land snails.

Eight land snails are proposed as Species of Conservation Concern (Table 4), all of which identify moist leaf litter on wooded hillsides as suitable habitat. While there is no doubt distribution of these species is patchy at best, it is very likely that their distributions exceed the low number of occurrences identified by the NC Natural Heritage Program. Simply put, we have not looked for land snails enough across the Nantahala and Pisgah National Forests to accurately identify occupied habitat.

Table 4. Land snail species proposed as species of conservation concern (SCC) as part of the Nantahala and Pisgah National Forest plan revision process.

Common Name	Scientific Name
fragile glyph	<i>Glyphyalinia clingmani</i>
spiral coil	<i>Helicodiscus bonamicus</i>
talus coil	<i>Helicodiscus triodus</i>
velvet covert	<i>Inflectarius subpalliatius</i>
high mountain supercoil	<i>Paravitrea andrewsae</i>

Common Name	Scientific Name
sculpted supercoil	<i>Paravitrea ternaria</i>
open supercoil	<i>Paravitrea umbilicaris</i>
Roan supercoil	<i>Paravitrea varidens</i>

Nekola (1999) associates land snail richness and shell abundance with a variety of geological and ecological factors such as carbonate cliffs and other calcareous sources, gradient, elevation, vegetation, and soil cations (particularly calcium). Calcium carbonate is required by land snails for regulation of bodily processes and reproduction, but most importantly shell-building (Hickman et al. 2003). Land snail scarcity is associated with low soil pH, declining soil cations, and increasing elevation. And while acidic soils typically support lower snail diversity, species endemism is generally higher, especially in river gorges and higher mountain ranges (Dourson 2010). Most land snails are associated with steeper gradients, and indirectly, leaf litter moisture (Petranka 1982).

Reptiles

Bog turtles (*Glyptemys muhlenbergii*) inhabit slow, shallow, muck-bottomed rivulets of sphagnum bogs, calcareous fens, marshy/sedge-tussock meadows, spring seeps, wet cow pastures, and shrub swamps; the habitat usually contains an abundance of sedges or mossy cover. The turtles depend on a mosaic of microhabitats for foraging, nesting, basking, hibernation, and shelter (USFWS 2001). Additionally, riparian systems that perpetuate open-canopy are needed (USFWS 2001). In Virginia, selected habitats included wet meadow, smooth alder edge, and bulrush; dry meadow and streams were avoided (Carter et al. 1999).

Bog turtles in North Carolina have a spotty distribution, and when combined with specialized habitat requirements, are especially vulnerable to local extirpation. Decline is due primarily to loss, degradation, and fragmentation of habitat and excessive (or illegal) collecting for the pet trade. Additionally, filling, draining, and dredging of wetlands, water impoundment or diversion, and other hydrologic alterations threaten the species. In some areas, successional changes (e.g., reforestation) and exotic plant species have reduced habitat quality (Morrow et al. 2001). Habitat fragmentation has made it difficult for turtles to cope with successional changes and ecosystem changes caused by humans. Though flooding caused by beavers may be a threat in particular sites at a particular time, over the long term and on a broad geographic scale, beaver activities (e.g., cutting of woody plants and periodic flooding) can be an important factors in the creation or maintenance of suitable habitat for bog turtles.

Approximately 15% of the known occurrences of bog turtles in North Carolina occur on the Nantahala and Pisgah NFs, with approximately 40% of these occurrences (approximately 6% of all North Carolina occurrences) being within a permanently protected area (e.g. designated wilderness, inventoried roadless area).

Potential Species of Conservation Concern for the Nantahala and Pisgah NFs Plan Revision

Table 5. Proposed list of potential species of conservation concern for the Nantahala and Pisgah NFs plan revision. Status and rank information is current as of January 13, 2014 (NCNHP 2014, NatureServe 2014).

Type	Scientific Name	Common Name	NC Status	USFWS	NC SRank	Global GRank	Threats
Aquatic Salamander	<i>Cryptobranchus alleganiensis alleganiensis</i>	hellbender	SC	FSC	S3	G3G4	sediment, hydrological modification, heavy recreational use of occupied habitat
Salamander	<i>Aneides aeneus</i>	green salamander	E	FSC	S2	G3G4	loss of forested habitat , over collecting, disease
Salamander	<i>Desmognathus aneneus</i>	seepage salamander	SR	FSC	S3	G3G4	loss of forested habitat , conversion of hardwood to pine forest
Salamander	<i>Desmognathus folkertsi</i>	dwarf black-bellied salamander	SR		S1	G2	hydrological modification, road kill (roads within riparian corridors), endemism
Salamander	<i>Desmognathus organi</i>	northern pygmy salamander	SR	FSC	S2	G3	loss of forested habitat , over collecting, climate change, invasive species, heavy recreational use
Salamander	<i>Desmognathus wrighti</i>	southern pygmy salamander	SR	FSC	S2S3	G3G4	loss of forested habitat , over collecting, climate change, invasive species, heavy recreational use
Salamander	<i>Eurycea junaluska</i>	Junaluska salamander	T	FSC	S2	G3	sedimentation, loss of forested habitat , road kill (roads within riparian areas), endemism
Salamander	<i>Plethodon aureolus</i>	Tellico salamander	SR		S2?	G2G3	loss of forested habitat , over collecting, endemism
Salamander	<i>Plethodon chattahoochee</i>	Chattahoochee slimy salamander	SR		S1?	G2G3Q	loss of forested habitat , over collecting, intensive forestry, endemism
Salamander	<i>Plethodon cheoah</i>	Cheoah Bald salamander	SR		S1	G2	loss of forested habitat , over collecting, intensive forestry, endemism
Caddisfly	<i>Rhyacophila amicus</i>	a caddisfly	SR		S2	G2	sedimentation, hydrological modification, toxic runoff
Dragonfly	<i>Ohplogomphus edmundo</i>	Edmund's snaketail	SR		S1	G1G2	sedimentation, hydrological modification, toxic runoff
Spider	<i>Hypochilus sheari</i>	a lampshade weaver			S2S3	G2G3	climate change (as it affects cave conditions), recreational use of caves
Spider	<i>Nesticus carolinensis</i>	Linville Caverns spider	SR		S1	G1?	climate change (as it affects cave conditions), recreational use of caves
Spider	<i>Nesticus cooperi</i>	Lost Nantahala Cave spider	SR	FSC	S1	G1	climate change (as it affects cave conditions), recreational use of caves
Bird	<i>Aegolius acadicus pop. 1</i>	Southern Appalachian northern saw-whet owl	T	FSC	S2B,S2N	G5TNR	climate change, endemism
Bird	<i>Bonasa umbellus</i>	ruffed grouse	game		S4	G5	loss of forested habitat, loss of diverse forest structure/habitat
Migratory bird	<i>Falco peregrinus</i>	peregrine falcon	E		S1B,S2N	G4	poaching, exposure to/persistence of pesticides, recreational use of nesting locations (particularly rock climbing/rappelling)
Migratory bird	<i>Setophaga cerulea</i>	cerulean warbler	SC	FSC	S2B	G4	loss of forested habitat, loss of diverse forest structure/habitat
Migratory bird	<i>Vermivora chrysoptera</i>	golden-winged warbler	SC	FSC	S3B	G4	loss of forested habitat, loss of diverse forest structure/habitat

Potential Species of Conservation Concern for the Nantahala and Pisgah NFs Plan Revision

Type	Scientific Name	Common Name	NC Status	USFWS	NC SRank	Global GRank	Threats
Resident bird	<i>Haliaeetus leucocephalus</i>	bald eagle	T		S3B,S3N	G5	poaching, exposure to/persistence of pesticides, recreational use of nesting locations (particularly boating and noise)
Resident bird	<i>Loxia curvirostra pop. 1</i>	Southern Appalachian red crossbill	SC	FSC	S3B,S3N	G5	loss of mature forest structure (particularly in conifer forests), insects/pests,
Resident bird	<i>Poecile atricapillus practica</i>	Southern Appalachian black-capped chickadee	SC	FSC	S3	G5T3	loss of forest structure that includes snags, endemism
Amphipod	<i>Stygobromus carolinensis</i>	Yancey sideswimmer	SR	FSC	S1	G1G2	climate change (as it affects high elevation seeps), endemism
Crayfish	<i>Cambarus chaugaensis</i>	Chauga crayfish	SC		S2	G2	hydrological modification, sedimentation, toxic runoff, gravel mining, , endemism
Crayfish	<i>Cambarus georgiae</i>	Little Tennessee crayfish	SC		S2S3	G2	hydrological modification, sedimentation, toxic runoff, gravel mining, , endemism
Crayfish	<i>Cambarus parrishi</i>	Hiwassee headwaters crayfish	SC	FSC	S1	G2	hydrological modification, sedimentation, toxic runoff, gravel mining, , endemism
Fish	<i>Clinostomus sp. 1</i>	Smoky dace	SC	FSC	S3	G3Q	hydrological modification, sedimentation, gravel mining
Fish	<i>Cottus carolinae</i>	banded sculpin	T		S1	G5	hydrological modification, sedimentation, gravel mining
Fish	<i>Erimystax insignis eristigma</i>	southern blotched chub	SR	FSC	S2	G4TNR	hydrological modification, sedimentation, gravel mining
Fish	<i>Etheostoma acuticeps</i>	sharphead darter	T	FSC	S1	G3	hydrological modification, sedimentation, gravel mining
Fish	<i>Etheostoma inscriptum</i>	turquoise darter	T		S1	G4	hydrological modification, sedimentation, gravel mining
Fish	<i>Etheostoma vulneratum</i>	wounded darter	SC	FSC	S1	G3	hydrological modification, sedimentation, gravel mining
Fish	<i>Hybopsis rubrifrons</i>	rosyface chub	T		S1	G4	hydrological modification, sedimentation, gravel mining
Fish	<i>Lampetra appendix</i>	American brook lamprey	T		S1	G4	hydrological modification, sedimentation, gravel mining
Fish	<i>Moxostoma sp. 2</i>	sicklefin redhorse	T	C	S1	G2Q	hydrological modification, sedimentation, gravel mining
Fish	<i>Noturus flavus</i>	stonecat	E		S1	G5	hydrological modification, sedimentation, gravel mining
Fish	<i>Percina caprodes</i>	logperch	T		S1	G5	hydrological modification, sedimentation, gravel mining
Fish	<i>Percina squamata</i>	olive darter	SC	FSC	S2	G3	hydrological modification, sedimentation, gravel mining
Fish	<i>Salvelinus fontinalis</i>	brook trout	game		S5	G5	hydrological modification, sedimentation, gravel mining
Butterfly	<i>Phyciodes batesii maconensis</i>	tawny crescent	SR	FSC	S2	G4T2T3	climate change, pesticide use (particularly gypsy moth control)
Fly	<i>Eulonchus marialiciae</i>	Mary Alice's small-headed fly	SR		S1S3	G1G3	pesticide use
Bat	<i>Corynorhinus rafinesquii rafinesquii</i>	Rafinesque's big-eared bat (mtn subspecies)	T	FSC	S2	G3G4TNR	climate change (as it affects cave conditions), disease (white nose syndrome)

Potential Species of Conservation Concern for the Nantahala and Pisgah NFs Plan Revision

Type	Scientific Name	Common Name	NC Status	USFWS	NC SRank	Global GRank	Threats
Bat	<i>Eptesicus fuscus</i>	big brown bat			S5	G5	climate change (as it affects cave conditions), disease (white nose syndrome)
Bat	<i>Myotis leibii</i>	eastern small-footed bat (myotis)	SC	FSC	S3	G3	climate change (as it affects cave conditions), disease (white nose syndrome)
Bat	<i>Myotis lucifugus</i>	little brown bat (myotis)			S4	G3	climate change (as it affects cave conditions), disease (white nose syndrome)
Bat	<i>Perimyotis subflavus</i>	tri-colored bat			S5	G3	climate change (as it affects cave conditions), disease (white nose syndrome)
Rabbit	<i>Sylvilagus obscurus</i>	Appalachian cottontail		FSC	S3	G4	loss of forested habitat, loss of diverse forest structure/habitat
Rodent	<i>Neotoma magister</i>	Appalachian woodrat	SC	FSC	S2S3	G3G4	loss of forested habitat, loss of diverse forest structure/habitat, disturbance by high recreation use
Rodent	<i>Sorex palustris punctulatus</i>	southern water shrew		FSC	S3	G5T3	acid deposition, climate change, sedimentation, loss of forested habitat (particularly loss of permanent vegetation)
Aquatic Snail	<i>Elimia christyi</i>	Christy's elimia	E	FSC	S1	G2	hydrological modification, sedimentation, gravel mining , endemism
Freshwater mussel	<i>Alasmidonta varicosa</i>	brook floater	E	FSC	S1	G3	hydrological modification, sedimentation, gravel mining , toxic runoff
Freshwater mussel	<i>Alasmidonta viridis</i>	slippershell mussel	E		S1	G4G5	hydrological modification, sedimentation, gravel mining , toxic runoff
Freshwater mussel	<i>Fusconaia barnesiana</i>	Tennessee pigtoe	E		S1	G2G3	hydrological modification, sedimentation, gravel mining , toxic runoff
Freshwater mussel	<i>Pleurobema oviforme</i>	Tennessee clubshell	E	FSC	S1	G2G3	hydrological modification, sedimentation, gravel mining , toxic runoff
Freshwater mussel	<i>Villosa vanuxemensis</i>	mountain creekshell	T		S1	G4	hydrological modification, sedimentation, gravel mining , toxic runoff
Terrestrial snail	<i>Glyphyalinia clingmani</i>	fragile glyph	E	FSC	S1	G1	climate change (as it affects leaf litter (microhabitat) conditions), endemism
Terrestrial snail	<i>Helicodiscus bonamicus</i>	spiral coil	SC		S1	G1	climate change (as it affects leaf litter (microhabitat) conditions), endemism
Terrestrial snail	<i>Helicodiscus triodus</i>	talus coil	SR		S1?	G2	climate change (as it affects leaf litter (microhabitat) conditions), endemism
Terrestrial snail	<i>Inflectarius subpalliatu</i>	velvet covert	SC		S2	G2	climate change (as it affects leaf litter (microhabitat) conditions), endemism
Terrestrial snail	<i>Paravitrea andrewsae</i>	high mountain supercoil	SC		S2	G2	climate change (as it affects leaf litter (microhabitat) conditions), endemism
Terrestrial snail	<i>Paravitrea ternaria</i>	sculpted supercoil	T	FSC	S1	G1G2	climate change (as it affects leaf litter (microhabitat) conditions), endemism
Terrestrial snail	<i>Paravitrea umbilicaris</i>	open supercoil	SC		S2	G2	climate change (as it affects leaf litter (microhabitat) conditions), endemism
Terrestrial snail	<i>Paravitrea varidens</i>	Roan supercoil	T	FSC	S1S2	G1G2	climate change (as it affects leaf litter (microhabitat) conditions), endemism
Turtle	<i>Glyptemys mühlenbergii</i>	bog turtle	T	T(S/A)	S2	G3	loss of forested habitat , over collecting, climate change, invasive species, heavy recreational use

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Type	Scientific Name	Common Name	NC Status	USFWS	NC SRank	Global GRank	Threats
Lichen	<i>Anzia americana</i>	A Foliose Lichen	SR-T		S1	G3G5	microhabitat manipulation, spruce -fir decline from adelgids or climate change
Lichen	<i>Canoparmelia amabilis</i>	Worthy Shield Lichen	SC-V	FSC	S1	G1	prescribed fire
Lichen	<i>Cetrelia cetrarioides</i>	Sea Storm Lichen	SR-P		S2	G4	air pollution, spruce -fir decline from adelgids or climate change
Lichen	<i>Ephebe americana</i>	A Fructicose Lichen	SR-T		S1	G2G3	trampling in rare rock outcrop communities
Lichen	<i>Fellhanera hybrida</i>	Piedmont Crustose Lichen	SR-D		S1	G2?	microhabitat manipulation
Lichen	<i>Heterodermia appalachiensis</i>	Appalachian Fringe Lichen	SR-O		S1S2	G2?	microhabitat manipulation
Lichen	<i>Heterodermia erecta</i>	A Centipede Lichen	W7		S1?	G1?	microhabitat manipulation
Lichen	<i>Hypotrachyna sinuosa</i>	A Foliose Lichen	SR-D		S1	G3G5	microhabitat manipulation
Lichen	<i>Hypotrachyna virginica</i>	Virginia Loop Lichen	SR-T		S1S2	G1G2	microhabitat manipulation
Lichen	<i>Lobaria scrobiculata</i>	Textured Lungwort	SR-P		S2?	G4	air pollution, spruce -fir decline from adelgids or climate change
Lichen	<i>Melaniella stygia</i>	A Foliose Lichen	SR-D		S1S2	G4G5	trampling in rare high elevation rocky summit
Lichen	<i>Pannaria conoplea</i>	A Foliose Lichen	SR-D		S1	G3G4	habitat manipulation, climate change
Lichen	<i>Pertusaria appalachensis</i>	Appalachian Wart Lichen	W7		S1?	G2?	habitat manipulation
Lichen	<i>Punctelia reddenda</i>	Speckled Shield Lichen	W7		S2	G5	climate change, spruce -fir decline from adelgids or climate change
Lichen	<i>Sticta limbata</i>	Powdered Moon Lichen	SR-D		S1	G3G4	air pollution, climate change
Lichen	<i>Usnea angulata</i>	Old Man's Beard	SR-P		S1	G3G5	trampling in rare high elevation rocky summit, prescribed fire
Lichen	<i>Xanthoparmelia monticola</i>	A Rock-shield Lichen	SR-L		S2?	G2?	trampling in rare high elevation rocky summit
Liverwort	<i>Acrobolbus ciliatus</i>	A Liverwort	SC-V		S1	G3?	trampling, habitat decline due to adelgid or climate change
Liverwort	<i>Aneura sharpii</i>	A Liverwort	SR-T		S1	G1G2	Species has been documented with broader taxonomic clarity, and is not recommended as an SCC.
Liverwort	<i>Barbilophozia hatcheri</i>	A Liverwort	SR-D		S1	G5	desiccation, trampling in rare rock outcrop
Liverwort	<i>Bazzania nudicaulis</i>	A Liverwort	SR-T		S2	G2G3	habitat decline due to balsam wooly adelgid or climate change
Liverwort	<i>Cephaloziella spinicaulis</i>	A Liverwort	SR-P		S1	G3G4	desiccation, trampling in rare high elevation rocky summit
Liverwort	<i>Cheilolejeunea evansii</i>	A Liverwort	SR-L		S1	G1G2	habitat decline due to hemlock wooly adelgid
Liverwort	<i>Drepanolejeunea appalachiana</i>	A Liverwort	SC-V		S1	G2?	microhabitat manipulation, (ex. high severity burns and road building)
Liverwort	<i>Lejeunea blomquistii</i>	Blomquist Leafy Liverwort	SC-V		S1	G1G2	trampling in Spray Cliffs
Liverwort	<i>Leptoscyphus cunefolius</i>	Wedge Flapwort	SR-D		S2	G4G5	indirect effects from adelgid impacts to spruce-fir, climate change
Liverwort	<i>Lophocolea appalachiana</i>	A Liverwort	SC-V		S1	G1G2Q	trampling in Spray Cliffs
Liverwort	<i>Lophocolea muricata</i>	A Liverwort	SC-V		S1	G5	habitat decline due to hemlock wooly adelgid
Liverwort	<i>Mylia tayorii</i>	A Liverwort	SR-D		S1	G5	trampling in Spray Cliffs
Liverwort	<i>Plagiochila austinii</i>	A Liverwort	SR-T		S1S2	G3	trampling in montane acidic cliff communities
Liverwort	<i>Plagiochila caduciloba</i>	Gorge Leafy Liverwort	SR-T		S2	G2	habitat change resulting from hemlock wooly adelgid, trampling in Spray Cliffs

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Type	Scientific Name	Common Name	NC Status	USFWS	NC SRank	Global GRank	Threats
Liverwort	<i>Plagiochila corniculata</i>	A Liverwort	SR-D		S2	G4?	habitat change due to balsam wooly adelgid or climate change
Liverwort	<i>Plagiochila echinata</i>	A Liverwort	SR-L		S1	GNRT2	habitat change from hemlock wooly adelgid, trampling in Spray Cliffs
Liverwort	<i>Plagiochila sharpii</i>	Sharp's Leafy Liverwort	SR-L		S2	G2G4	desiccation, trampling in rare rock outcrops
Liverwort	<i>Plagiochila sullivantii</i> var. <i>sullivantii</i>	Sullivant's Leafy Liverwort	SR-T	FSC	S2	G2T2	habitat change at high and low elevation from either hemlock wooly adelgid or balsam wooly adelgid, trampling
Liverwort	<i>Porella wataugensis</i>	A Liverwort	SR-L		S1	G1G2Q	trampling in Spray Cliffs
Liverwort	<i>Ptilidium ciliare</i>	A Liverwort	SR-D		S1	G5	habitat decline due to adelgid or climate change
Liverwort	<i>Radula voluta</i>	A Liverwort	SR-D		S1	G3	trampling in Spray Cliffs
Liverwort	<i>Riccardia jugata</i>	A Liverwort	SR-L		S1?	G1G2	habitat decline due to hemlock wooly adelgid
Liverwort	<i>Sphenobolopsis pearsonii</i>	A Liverwort	SR-O	FSC	S2	G2?	habitat decline due to balsam wooly adelgid or climate change
Moss	<i>Bartramidula wilsonii</i>	Dwarf Apple Moss	SR-D		S1	G4?	trampling in Spray Cliffs and rare rock outcrops
Moss	<i>Brachydontium trichodes</i>	Peak Moss	SR-D		S1	G2G4	habitat decline due to balsam wooly adelgid or climate change
Moss	<i>Brachythecium rotaeanum</i>	Rota's Feather Moss	SR-D		S1	G3G4	Habitat decline due to loss of eastern hemlock
Moss	<i>Bryoerythrophyllum ferruginascens</i>	A Moss	SR-D		S1	G4	climate change in high elevation forest
Moss	<i>Bryoxiphium norvegicum</i>	Sword Moss	SR-O		S1	G3G4	trampling in Spray Cliffs
Moss	<i>Campylopus atrovirens</i> var. <i>atrovirens</i>	Black Fish Hook Moss	SR-D		S1?	G4G5TNR	trampling on rock outcrops
Moss	<i>Cirriphyllum piliferum</i>	A Moss	SR-P		S1	G5	trampling in Spray Cliffs
Moss	<i>Dichodontium pellucidum</i>	A Moss	SR-P		S2	G4G5	trampling in Spray Cliffs
Moss	<i>Dicranella varia</i>	Variable Fork Moss	SR-O		S1?	G5	trampling on rock outcrops
Moss	<i>Dicranum undulatum</i>	Bog Broom-moss	SR-D		S1	G5	hydrological changes and woody encroachment in Southern Appalachian Bogs
Moss	<i>Ditrichum ambiguum</i>	Ambiguous Ditrichium	SR-P		S1	G4?	eastern hemlock decline in habitat, climate change high elevation forest
Moss	<i>Ditrichum rhynchostegium</i>	Golden Tread Moss	SR-T		S1?	G3G5	trampling in open areas along streams
Moss	<i>Encalypta procera</i>	Extinguisher Moss	SR-D		S1	G4G5	desiccation, trampling in rare montane calcareous cliff
Moss	<i>Entodon compressus</i>	Flattened Entodon	SR-P		S1	G4	desiccation, trampling in rare montane calcareous cliff
Moss	<i>Entodon sullivantii</i>	Sullivant's Entodon	SR-O		S2	G3G4	trampling in Spray Cliffs
Moss	<i>Fissidens appalachensis</i>	Appalachian Pocket Moss	W7		S2S3	G2G3	sedimentation
Moss	<i>Fontanalis sphagnifolia</i>	A Water Moss	SR-O		S1?	G3G5	sedimentation
Moss	<i>Herzogiella turfacea</i>	Flat Stump Moss	SR-P		S1?	G4G5	loss of eastern hemlock
Moss	<i>Homalia trichomanoides</i>	Lime Homalia	SR-P		S1	G5	trampling in Spray Cliffs, loss of eastern hemlock
Moss	<i>Homaliadelphus sharpii</i>	Sharp's Homaliadelphus	SR-P		S1	G3?	desiccation, trampling in rare montane calcareous cliffs
Moss	<i>Leptodontium excelsum</i>	Grandfather Mountain Leptodontium	SR-L		S1	G2	habitat decline due to balsam wooly adelgid or climate change

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Moss	<i>Leptohymerium sharpii</i>	Mount Leconte Moss	SR-L		S1	G1	habitat decline due to balsam wooly adelgid or climate change
Moss	<i>Macrocoma sullivantii</i>	Sullivant's Manned-moss	SR-D		S2	G3G5	prescribed burns
Moss	<i>Palamocladium leskeoides</i>	Palamocladium	SR-D		S1	G3G5	desiccation, trampling in rare montane calcareous cliff
Moss	<i>Pilosium chlorophyllum</i>	A Moss	SR-D		S1?	GNR	logging, habitat decline with loss of eastern hemlock
Moss	<i>Plagiomnium carolinianum</i>	Carolina Star-moss	SR-L		S2	G3	habitat decline with loss of eastern hemlock
Moss	<i>Plagiomnium ellipticum</i>	Marsh Magnificent Moss	SR-P		S1?	G5	trampling on rock outcrops
Moss	<i>Plagiomnium rostratum</i>	Long-beaked Thread Moss	SR-P		S1?	G5	trampling on rock outcrops
Moss	<i>Platyhypnidium pringlei</i>	Pringle's Eurhynchium	SR-D		S1	G2G3	trampling in Spray Cliffs
Moss	<i>Pogonatum dentatum</i>	Hair-like Hair-cap	SR-P		S1?	G3G5	trampling, trail reconstruction
Moss	<i>Pohlia lescuriana</i>	Spherical Bulb Nodding Moss	SR-T		S1?	G4?	trampling, trail reconstruction
Moss	<i>Pohlia melanodon</i>	Pink-fruited Thread Moss	SR-D		S1?	G4?	trampling, trail reconstruction
Moss	<i>Pohlia rabunbaldensis</i>	A Moss	NONE		SNR	G1	trampling, trail reconstruction
Moss	<i>Polytrichastrum alpinum</i>	Alpine Hair Moss	SR-D		S1?	G4G5	trampling on rock outcrops, loss of eastern hemlock in habitat
Moss	<i>Racomitrium aciculare</i>	Dark Mountain Fringe Moss	SR-P		S1	G3G5	trampling on rock outcrops, loss of eastern hemlock in habitat
Moss	<i>Rhabdoweisia crenulata</i>	Himalayan Ribbed-weissia	SR-D		S1	G3G4	habitat decline with loss of eastern hemlock
Moss	<i>Rhytidiadelphus subpinnatus</i>	A Moss	SR-T		S1?	GU	hydrological changes and woody encroachment in swamps, trampling in spray cliffs
Moss	<i>Rhytidium rugosum</i>	Golden Tundra-moss	SR-P		S2	G5	desiccation, trampling in rare high elevation rocky summit, climate change
Moss	<i>Schlotheimia lancifolia</i>	Highlands Moss	SR-O		S1	G2	microhabitat manipulation with loss of eastern hemlock
Moss	<i>Scopelophila cataractae</i>	Agoyan Cataract Moss	SR-D		S1	G3	trampling, road reconstruction
Moss	<i>Scopelophila ligulata</i>	Copper Moss	SR-O		S1	G5?	trampling, road reconstruction
Moss	<i>Sphagnum angustifolium</i>	Narrowleaf Peatmoss	SR-D		S1	G5	hydrological changes and woody encroachment in Southern Appalachian Bogs
Moss	<i>Sphagnum capillifolium</i>	Northern Peatmoss	SR-P		S1	G5	hydrological changes and woody encroachment in Southern Appalachian Bogs
Moss	<i>Sphagnum flexuosum</i>	Flexuous Peatmoss	SR-P		S1	G5Q	hydrological changes and woody encroachment in Southern Appalachian Bogs
Moss	<i>Sphagnum pylaesii</i>	Simple Peatmoss	SR-D		S1	G4	trampling in Spray Cliffs, desiccation of vernal pool
Moss	<i>Sphagnum russowii</i>	Russow's Peatmoss	SR-D		S1	G5	hydrological changes and woody encroachment in Southern Appalachian Bogs
Moss	<i>Sphagnum squarrosum</i>	Squarrose Peatmoss	SR-P		S1	G5	trampling in Spray Cliffs, habitat decline due to balsam wooly adelgid or climate change
Moss	<i>Sphagnum tenellum</i>	Delicate Peatmoss	SR-D		S1	G5	desiccation, trampling in rare high elevation granitic dome
Moss	<i>Taxiphyllum alternans</i>	Japanese Yew-moss	SR-O		S1	G3?	trampling in Spray Cliff
Moss	<i>Tortula ammonsiana</i>	Ammon's Tortula	SR-O		S1	G1G3	desiccation, trampling in rare montane mafic cliffs
Moss	<i>Warnstorfia fluitans</i>	Floating Sickie-moss	SR-D		S1	G5	trampling in Spray Cliffs
Vascular Plant	<i>Abies fraseri</i>	Fraser fir	W5A	FSC	S2	G2	balsam wooly adelgid, climate change
Vascular Plant	<i>Aconitum reclinatum</i>	Trailing Wolfsbane	SR-T		S3	G3	canopy openings, invasive plant species

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Vascular Plant	<i>Adlumia fungosa</i>	Climbing Fumitory	SC-V		S2	G4	loss of canopy shade surrounding rock outcrops
Vascular Plant	<i>Agrostis mertensii</i>	Arctic Bentgrass	E		S1	G5	balsam wooly adelgid, climate change
Vascular Plant	<i>Alnus viridis ssp crispa</i>	Green Alder	SC-V		S1	G5T5	woody plant encroachment
Vascular Plant	<i>Arabis glabra</i>	Tower Mustard	E		S1	G5	decline in habitat due to loss of eastern hemlock
Vascular Plant	<i>Arabis patens</i>	Spreading Rockcress	SR-T		S1	G3G4	trampling on rare rock outcrops
Vascular Plant	<i>Arethusa bulbosa</i>	Bog Rose	E		S1	G4	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Arisaema triphyllum ssp. stewardsonii</i>	Bog Jack-in-the-Pulpit	SR-P		S1	G5T4	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Asplenium bradleyi</i>	Bradley's Spleenwort	SR-P		S2	G4	trampling on rare rock outcrops
Vascular Plant	<i>Asplenium monanthes</i>	Single-Sorus Spleenwort	E		S1	G4	trampling on rock outcrops and spray cliffs, loss of eastern hemlock in habitat
Vascular Plant	<i>Asplenium pinnatifidum</i>	Lobed Spleenwort	SR-P		S1	G4	trampling on rock outcrops
Vascular Plant	<i>Asplenium ruta-muraria</i>	Wall-rue	SC-V		S1	G5	trampling on rare rock outcrops
Vascular Plant	<i>Berberis canadensis</i>	American Barberry	SC-V		S2	G3	fire exclusion
Vascular Plant	<i>Betula cordifolia</i>	Mountain Paper Birch	SC-V		S1	G5	balsam wooly adelgid, climate change
Vascular Plant	<i>Botrychium lanceolatum var. angustisegmentum</i>	Lance-leaf Moonwort	F1		S1	G5TNR	loss of canopy
Vascular Plant	<i>Botrychium matricariifolium</i>	Daisy-leaf Moonwort	SR-P		S1	G5	woody plant encroachment, transitional habitat with recurrent disturbance needed
Vascular Plant	<i>Botrychium multifidum</i>	Leathery Grape Fern	SR-P		S1	G5	woody plant encroachment
Vascular Plant	<i>Botrychium oneidense</i>	Blunt-lobed Grape Fern	SR-P		S2	G4Q	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species, climate change
Vascular Plant	<i>Botrychium simplex var. simplex</i>	Least Moonwort	SR-P		S2	G5T5	woody plant encroachment
Vascular Plant	<i>Bouteloua curtipendula var. curtipendula</i>	Sideoats Grama Grass	SR-P		S1	G5T5	fire exclusion
Vascular Plant	<i>Bromus ciliatus</i>	Fringed Brome	SR-P		S1	G5	woody plant encroachment, trail construction/maintenance
Vascular Plant	<i>Buckleya distichophylla</i>	Piratebush	T		S2	G3	loss of canopy, loss of eastern hemlock
Vascular Plant	<i>Calamagrostis canadensis var. canadensis</i>	Canada Reedgrass	SR-P		S1	G5T5	woody plant encroachment
Vascular Plant	<i>Calamagrostis porteri</i>	Porter's Reedgrass	SR-P		S1	G4	fire exclusion, woody plant encroachment
Vascular Plant	<i>Campanula aparinoides</i>	Marsh Bellflower	SR-P		S2	G5	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Cardamine clematitidis</i>	Mountain Bittercress	SR-T	FSC	S2	G3	loss of canopy , invasive plant species
Vascular Plant	<i>Cardamine rotundifolia</i>	Mountain Watercress	T		S2	G4	hydrological changes and woody encroachment in seeps, invasive plant species
Vascular Plant	<i>Carex baileyi</i>	Bailey's Sedge	SR-P		S2	G4	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Carex careyana</i>	Carey's Sedge	T		S1	G4G5	loss of canopy
Vascular Plant	<i>Carex cherokeensis</i>	Cherokee Sedge	E		S1	G4G5	loss of canopy, road and trail reconstruction, invasive plant species
Vascular Plant	<i>Carex hitchcockiana</i>	Hitchcock's Sedge	SC-V		S1	G5	road and trail reconstruction, loss of canopy

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Vascular Plant	<i>Carex oligocarpa</i>	Rich-woods Sedge	T		S1	G4	loss of canopy
Vascular Plant	<i>Carex oligosperma</i>	Few-seeded Sedge	E		S1	G5?	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Carex pedunculata</i>	Longstalk Sedge	SC-V		S2	G5	loss of canopy
Vascular Plant	<i>Carex projecta</i>	Necklace Sedge	SR-P		S1	G5	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Carex purpurifera</i>	Purple Sedge	SC-V		S2	G4?	loss of canopy , invasive plant species
Vascular Plant	<i>Carex radfordii</i>	Radford's Sedge	T	FSC	S1	G2	loss of canopy
Vascular Plant	<i>Carex roanensis</i>	Roan Sedge	SR-T		S2	G2G3	road and trail reconstruction, loss of canopy
Vascular Plant	<i>Carex utriculata</i>	Beaked Sedge	SR-P		S1	G5	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Celastrus scandens</i>	American Bittersweet	E		S2?	G5	hybridization with aggressive exotic congener, dense woody plant encroachment
Vascular Plant	<i>Chamerion platphyllum</i>	Purple Willowherb	E		S1	G5	woody plant encroachment
Vascular Plant	<i>Cheilanthes alabamensis</i>	Alabama Lip-fern	SR-P		S1	G4G5	trampling on rare rock outcrops
Vascular Plant	<i>Chelone cuthbertii</i>	Cuthbert's Turtlehead	SC-V	FSC	S3?	G3	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Chelone obliqua var. erwiniae</i>	Mountain Purple Turtlehead	SR-T		S1	G2T2T4Q	hydrological changes and woody encroachment in Southern Appalachian Bogs and seeps, invasive plant species
Vascular Plant	<i>Cleistes bifaria</i>	Small Spreading Pogonia	W1		S2	G4?	fire exclusion, woody encroachment
Vascular Plant	<i>Corallorhiza wisteriana</i>	Spring Coral-root	SR-O		S2	G5	Loss of canopy, loss of eastern hemlock
Vascular Plant	<i>Coreopsis grandiflora var. grandiflora</i>	Large-flowered Tickseed	SR-O		S1	G5T4T5	trampling on rock outcrops, invasive plant species
Vascular Plant	<i>Corydalis micrantha</i>	Slender Corydalis	T		S1	G5	trampling on rock outcrops
Vascular Plant	<i>Crocianthemum bicknellii</i>	Plains Sunrose	SC-V		S1	G5	trampling on rare rock outcrops, woody encroachment
Vascular Plant	<i>Crocianthemum propinquum</i>	Creeping Sunrose	T		S1	G4	trampling on rock outcrops, woody encroachment
Vascular Plant	<i>Croton monanthogynus</i>	Prarie-tea Croton	E		S1	G4	trampling on rare rock outcrops
Vascular Plant	<i>Cypripedium parviflorum var. parviflorum</i>	Small Yellow Lady's-slipper	SR-T		S1S2	G5T3T5	loss of canopy, poaching for horticultural use
Vascular Plant	<i>Cystopteris fragilis</i>	Fragile Fern	SR-P		S1	G5	trampling on rare High Elevation Rocky Summit, climate change
Vascular Plant	<i>Dalibarda repens</i>	Robin Runaway	E		S2	G5	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Danthonia epilis</i>	Bog Oatgrass	SR-T	FSC	S3	G3G4	shading of smaller rock outcrops, hydrological changes affecting seepage in rock outcrops
Vascular Plant	<i>Delphinium exaltatum</i>	Tall Larkspur	E	FSC	S2	G3	dense shrub encroachment, road reconstruction
Vascular Plant	<i>Deschampsia cespitosa ssp. glauca</i>	Tufted Hairgrass	T		S1	G5T5	fire exclusion, mining
Vascular Plant	<i>Diarrhena americana</i>	Eastern Beakgrass	E		S1	G4?	loss of canopy
Vascular Plant	<i>Diervilla rivularis</i>	Riverbank Bush-honeysuckle	T		S1	G3	loss of eastern hemlock in habitat
Vascular Plant	<i>Dodecatheon meadia</i>	Eastern Shooting Star	T		S2	G5T5	trampling in rock outcrop and rare plant community, woody encroachment

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Vascular Plant	<i>Draba ramosissima</i>	Branching Draba	SC-V		S2	G4	trampling on rare rock outcrops, woody encroachment
Vascular Plant	<i>Echinacea purpurea</i>	Purple Coneflower	SC-V		S1	G4	fire exclusion, road or trail reconstruction/maintenance
Vascular Plant	<i>Elymus trachycaulus</i> ssp. <i>trachycaulus</i>	Slender Wheatgrass	T		S1	G5T5	fire exclusion, mining
Vascular Plant	<i>Epilobium ciliatum</i>	Purpleleaf Willowherb	SR-P		S2	G5	hydrological changes and woody encroachment in Southern Appalachian Bogs and seeps, invasive plant species
Vascular Plant	<i>Erigenia bulbosa</i>	Harbinger-of-spring	SR-P		S1	G5	loss of canopy , invasive plant species
Vascular Plant	<i>Eupatorium incarnatum</i>	Pink Throughwort	T		S2	G5	closed canopy, fire exclusion?
Vascular Plant	<i>Euphorbia purpurea</i>	Glade Spurge	SR-T	FSC	S2	G3	road and trail reconstruction, loss of canopy
Vascular Plant	<i>Filipendula rubra</i>	Queen-of-the-Prairie	E		S1	G4G5	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Fothergilla major</i>	Large Witch-alder	SR-T		S3	G3	road and trail reconstruction, loss of canopy
Vascular Plant	<i>Frasera caroliniensis</i>	Columbo	SR-P		S2S3	G5	lack of successional change, road reconstruction/maintenance
Vascular Plant	<i>Gentiana saponaria</i> var. <i>latidens</i>	Balsam Gentian	W7		S2S3	G5T2T3	trail and road reconstruction/maintenance, hydrological changes
Vascular Plant	<i>Gentianopsis crinita</i>	Fringed Gentian	T		S1	G5	fire exclusion, mining
Vascular Plant	<i>Geum geniculatum</i>	Bent Avens	SC-V	FSC	S1S2	G1G2	loss of canopy, climate change
Vascular Plant	<i>Glyceria laxa</i>	Lax Mannagrass	SR-P	FSC	S1	G5	hydrological changes and woody encroachment in seeps, invasive plant species
Vascular Plant	<i>Glyceria nubigena</i>	Smoky Mountain Mannagrass	SR-L	FSC	S2	G2	road and trail reconstruction, loss of canopy , invasive plant species
Vascular Plant	<i>Helenium brevifolium</i>	Littleleaf Sneezeweed	E		S1	G3G4	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Heuchera longiflora</i>	Long-Flower Alumroot	W7		S2	G4	loss of canopy
Vascular Plant	<i>Heuchera pubescens</i>	Downy Alumroot	SR-P		S1	G4?	trampling on rock outcrops
Vascular Plant	<i>Hexalectris spicata</i>	Crested Coralroot	SR-P		S2	G5	fire exclusion, too dense mid and overstory canopy
Vascular Plant	<i>Hexastylis contracta</i>	Mountain Heartleaf	E	FSC	S1	G3	loss of canopy
Vascular Plant	<i>Hexastylis rhombiformis</i>	French Broad Heartleaf	SR-L	FSC	S2	G2	loss of canopy , loss of eastern hemlock
Vascular Plant	<i>Huperzia porophila</i>	Rock Fir Clubmoss	SR-P		S2	G4	trampling in Spray Cliffs
Vascular Plant	<i>Hydrastis canadensis</i>	Goldenseal	SR-O		S2	G4	loss of canopy, poaching for medicinal value, invasive plant species
Vascular Plant	<i>Hymenophyllum tayloriae</i>	Gorge Filmy Fern	SR-O	FSC	S1S2	G2	habitat change from hemlock woolly adelgid, trampling in Spray Cliffs
Vascular Plant	<i>Juncus trifidus</i>	Highland Rush	SR-D		S1	G5	trampling on rare High Elevation Rocky Summit, climate change
Vascular Plant	<i>Liatris squarrulosa</i>	Earle's Blazing Star	SR-P		S2	G4G5	fire exclusion, woody plant encroachment
Vascular Plant	<i>Liatris turgida</i>	Shale-barren Blazing Star	SR-T		S1S2	G3	fire exclusion, woody plant encroachment
Vascular Plant	<i>Lilium grayi</i>	Gray's Lily	T	FSC	S3	G3	woody plant encroachment, plant disease, hybridization
Vascular Plant	<i>Lilium philadelphicum</i> var. <i>philadelphicum</i>	Wood Lily	E		S2	G5T4T5	woody plant encroachment

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Vascular Plant	<i>Liparis loeselii</i>	Fen Orchid	E		S1	G5	woody plant encroachment, road reconstruction
Vascular Plant	<i>Lonicera canadensis</i>	American Fly-honeysuckle	SR-P		S2	G5	loss of canopy, invasive plant species
Vascular Plant	<i>Lycopodiella inundata</i>	Bog Clubmoss	SR-P		S1	G5	hydrological changes and woody encroachment in seeps, invasive plant species
Vascular Plant	<i>Lysimachia fraseri</i>	Fraser's Loosestrife	E	FSC	S3	G3	road and trail reconstruction, loss of canopy , invasive plant species
Vascular Plant	<i>Melica nitens</i>	Three-flowered Melica	E		S1	G5	fire exclusion
Vascular Plant	<i>Micropolypodium nimbatum</i>	West Indian Dwarf Polypody	T	FSC	S1	G4?	trampling in Spray Cliffs
Vascular Plant	<i>Minuartia groenlandica</i>	Greenand Sandwort	T		S2	G5	trampling on rare rock outcrops
Vascular Plant	<i>Monarda media</i>	Purple Bee-balm	SR-P		S1?	G4?	woody plant encroachment
Vascular Plant	<i>Monotropsis odorata</i>	Sweet Pinesap	SC-V	FSC	S3	G3	road and trail reconstruction, loss of canopy
Vascular Plant	<i>Muhlenbergia glomerata</i>	Bristly Muhly	SC-V		S1	G5	fire exclusion, mining
Vascular Plant	<i>Oenothera perennis</i>	Perennial Sundrops	SC-V		S1	G5	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Packera millefolium</i>	Divided-leaf Ragwort	T	FSC	S2	G2	hybridization with aggressive native congener, trampling in rare rock outcrops
Vascular Plant	<i>Packera paupercula</i> var. <i>appalachiana</i>	Prairie Ragwort	T		S1	G5	trampling on rock outcrops, fire exclusion in serpentine opening
Vascular Plant	<i>Packera schweinitziana</i>	Schweinitz's Ragwort	T		S2	G5?	woody plant encroachment
Vascular Plant	<i>Parnassia grandifolia</i>	Large-leaved Grass-of-parnassus	T		S2	G3	road or trail reconstruction/maintenance, hydrological change, invasive plant species
Vascular Plant	<i>Pedicularis lanceolata</i>	Swamp Lousewort	T		S1	G5	hydrological changes, woody plant encroachment
Vascular Plant	<i>Phegopteris connectilis</i>	Northern Beech Fern	E		S2	G5	trampling in Spray Cliffs, loss of Fraser fir canopy shade surrounding rock outcrop in high elevation forests
Vascular Plant	<i>Phlox subulata</i>	Moss Pink	SR-P		S1	G5	trampling on rare rock outcrops
Vascular Plant	<i>Platanthera flava</i> var. <i>herbiola</i>	Northern Green Orchid	SR-P		S1?	G4T4Q	hydrological changes and woody encroachment in Southern Appalachian Bogs and seeps, invasive plant species
Vascular Plant	<i>Platanthera grandiflora</i>	Large Purple-fringed Orchid	T		S2	G5	woody plant encroachment, trail construction/maintenance, invasive plant species
Vascular Plant	<i>Platanthera peramoena</i>	Purple Fringeless Orchid	T		S2	G5	hydrological changes and woody encroachment in Southern Appalachian Bogs and seeps, invasive plant species
Vascular Plant	<i>Poa palustris</i>	Swamp Bluegrass	SR-P		S1	G5	woody plant encroachment
Vascular Plant	<i>Poa saltuensis</i>	A Bluegrass	T		S1	G5	fire exclusion, mining
Vascular Plant	<i>Polygala senega</i>	Seneca Snakeroot	SR-D		S2	G4G5	trampling on rock outcrops, dense shrub layer
Vascular Plant	<i>Pycnanthemum curvipes</i>	Stone Mountain-mint	SR-T		S1	G3	closed canopy, fire exclusion?
Vascular Plant	<i>Ranunculus fascicularis</i>	Early Buttercup	SR-P		S1	G5	fire exclusion, mining
Vascular Plant	<i>Rhododendron cumberlandense</i>	Cumberland Azalea	SR-P		S1	G4?	dense woody plant encroachment
Vascular Plant	<i>Rhododendron vaseyi</i>	Pink-shell Azalea	SR-L		S3	G3	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species, climate change

Potential Species of Conservation Concern for the Nantahala and Pisgah NFs Plan Revision

Type	Scientific Name	Common Name	NC Status	USFWS	NC SRank	Global GRank	Threats
Vascular Plant	<i>Rhynchospora alba</i>	Northern White Beaksedge	SR-P		S2	G5	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Robinia hispida var fertilis</i>	Fruitful Locust	SR-O		S1	G5T1Q	fire exclusion, too dense mid and overstory canopy
Vascular Plant	<i>Robinia hispida var kelseyi</i>	Kelsey's Locust	SR-O		S1	G5T1	fire exclusion?, too dense mid and overstory canopy
Vascular Plant	<i>Robinia viscosa var. hartwigii</i>	Hartwig's Locust	SR-L		S2	G3T2	woody plant encroachment
Vascular Plant	<i>Robinia viscosa var. viscosa</i>	Clammy Locust	SR-T		S3	G3T3	dense shrub encroachment, road reconstruction
Vascular Plant	<i>Rubus idaeus ssp. strigosus</i>	Red Raspberry	T		S2?	G5T5	loss of canopy
Vascular Plant	<i>Rudbeckia triloba var. pinnatifida</i>	Pinnate-lobed Black-eyed Susan	SR-T		S1	G5T3	road and trail reconstruction, v loss of canopy , invasive plant species
Vascular Plant	<i>Ruellia purshiana</i>	Pursh's Wild-petunia	SC-V		S2	G3	fire exclusion
Vascular Plant	<i>Sarracenia purpurea var. montana</i>	Southern Appalachian Purple Pitcher Plant	W7		S2?	G5T1T3	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Scutellaria ovata ssp. rugosa var. 1</i>	Appalachian Skullcap	SR-T		S1	G2T1?Q	loss of canopy
Vascular Plant	<i>Scutellaria saxatilis</i>	Rock Skullcap	SR-T		S1	G3	loss of canopy, invasive plant species
Vascular Plant	<i>Sedum glaucophyllum</i>	Cliff Stonecrop	SR-P	FSC	S2	G4	trampling in rare plant community, woody encroachment
Vascular Plant	<i>Shortia galacifolia var. brevistyla</i>	Northern Oconee Bells	E	FSC	S2	G2G3T2	poaching for horticultural use, loss of canopy with decline in eastern hemlock from hemlock wooly adelgid
Vascular Plant	<i>Shortia galacifolia var. galacifolia</i>	Southern Oconee Bells	SC-V	FSC	S2	G2G3T2T3	poaching for horticultural use, loss of canopy with decline in eastern hemlock from hemlock wooly adelgid
Vascular Plant	<i>Silene ovata</i>	Mountain Catchfly	SC-V	FSC	S3	G3	road and trail reconstruction, loss of canopy, fire exclusion (?), invasive plant species
Vascular Plant	<i>Solidago simulans</i>	Granite Dome Goldenrod	SR-L	FSC	S2	G2	trampling in rare granitic domes, hydrological changes to seepage on granitic dome
Vascular Plant	<i>Solidago uliginosa</i>	Bog Goldenrod	SR-P		S1S2	G4G5	hydrological changes and woody encroachment in Southern Appalachian Bogs and seeps, invasive plant species
Vascular Plant	<i>Solidago ulmifolia</i>	Elm-leaf Goldenrod	SR-D		S1?	G5	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Sparganium emersum</i>	Greenfruit Bur-reed	T		S1	G5	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Spartina pectinata</i>	Freshwater Cordgrass	SC-V		S1	G5	loss of eastern hemlock in habitat, trampling in rare spray cliffs
Vascular Plant	<i>Spigelia marilandica</i>	Pink root	T		S1	G4	loss of canopy
Vascular Plant	<i>Sporobolus heterolepis</i>	Prairie Dropseed	T		S1	G5	fire exclusion, mining
Vascular Plant	<i>Stachys clingmanii</i>	Clingman's Hedge-nettle	SR-T		S2	G2	road and trail reconstruction, loss of canopy , invasive plant species
Vascular Plant	<i>Stachys cordata</i>	Heartleaf Hedge-nettle	SR-P		S1	G5?	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Stenanthium leimanthoides</i>	Pinebarren Death-camas	T		S1	G4Q	woody plant encroachment
Vascular Plant	<i>Stewartia ovata</i>	Mountain Camellia	SR-P		S2	G4	trail and road construction/maintenance, loss of canopy, invasive plant species
Vascular Plant	<i>Streptopus amplexifolius</i>	White Mandarin	SC-V		S1	G5	loss of canopy, road reconstruction

Potential Species of Conservation Concern for the Nantahala and Pisgah NFs Plan Revision

Type	Scientific Name	Common Name	NC Status	USFWS	NC SRank	Global GRank	Threats
Vascular Plant	<i>Symphotrichum laeve</i> var. <i>laeve</i>	Smooth Blue Aster	SR-P		S1	G5T5	fire exclusion
Vascular Plant	<i>Symphotrichum oblongifolium</i>	Aromatic Aster	T		S1	G5	trampling on rare High Elevation Rocky Summit, climate change
Vascular Plant	<i>Symphotrichum rhiannon</i>	Rhiannon's Aster	T	FSC	S1	G1	fire exclusion, mining
Vascular Plant	<i>Symphotrichum shortii</i>	Short's Aster	SR-P		S1	G5	road and trail reconstruction, loss of canopy
Vascular Plant	<i>Thalictrum macrostylum</i>	Small-leaved Meadowrue	SR-L	FSC	S2	G3G4	fire exclusion, mining
Vascular Plant	<i>Thaspium pinnatifidum</i>	Mountain Thaspium	T	FSC	S1	G2G3	road and trail reconstruction, loss of canopy
Vascular Plant	<i>Thermopsis fraxinifolia</i>	Ash-leaved Golden-banner	SC-V		S2?	G3?	road and trail reconstruction, loss of canopy , invasive plant species
Vascular Plant	<i>Thermopsis mollis</i>	Appalachian Golden-banner	SC-V		S2	G3G4	road and trail reconstruction, loss of canopy, fire exclusion
Vascular Plant	<i>Triantha glutinosa</i>	Sticky Bog Asphodel	SC-V		S1	G4G5	hydrological changes and woody encroachment in Southern Appalachian Bogs, invasive plant species
Vascular Plant	<i>Trichomanes boschianum</i>	Appalachian Filmy-fern	E		S1	G4	trampling by recreationists in Spray Cliffs
Vascular Plant	<i>Trichomanes petersii</i>	Dwarf Filmy-fern	SR-T		S2	G4G5	loss of shade from eastern hemlock from hemlock wooly adelgid
Vascular Plant	<i>Trichophorum cespitosum</i>	Deerhair Bulrush	SR-D		S2S3	G5	trampling in rare rock outcrops
Vascular Plant	<i>Trichostema brachiatum</i>	Glade Bluecurls	SR-P		S1	G5	trampling on rare high elevation rocky summit, climate change
Vascular Plant	<i>Trientalis borealis</i>	Starflower	SR-P		S1	G5	loss of canopy
Vascular Plant	<i>Trillium discolor</i>	Mottled Trillium	T		S1	G4	loss of canopy
Vascular Plant	<i>Trillium simile</i>	Sweet White Trillium	SR-L		S2	G3	loss of canopy
Vascular Plant	<i>Tsuga caroliniana</i>	Carolina Hemlock	W5A	FSC	S3	G3	hemlock wooly adelgid, wildfires (?) in bluffs
Vascular Plant	<i>Vaccinium angustifolium</i>	Northern Lowbush Blueberry	SR-P		S1	G5	woody plant encroachment
Vascular Plant	<i>Vaccinium macrocarpon</i>	Cranberry	SR-P		S2	G4	hydrological changes and woody encroachment in Southern Appalachian Bogs
Vascular Plant	<i>Veronica americana</i>	American Speedwell	SR-P		S2	G5	hydrological changes and woody encroachment in Southern Appalachian Bogs and seeps, invasive plant species
Vascular Plant	<i>Viola appalachensis</i>	Appalachian Violet	SR-T		S2	G4	road and trail reconstruction, loss of canopy
Vascular Plant	<i>Woodsia appalachiana</i>	Appalachian Cliff Fern	SR-P		S1	G4	trampling on rare High Elevation Rocky Summit, climate change

- Highlighted species: Must Include on Potential List, G1-G2, T1-T2, USFWS – petitioned for Federal listing, species that are federally delisted
- **NC Status:** E - Endangered, T = Threatened, SC = Special Concern, SC-V = Special Concern Vulnerable, SR = Significantly Rare, SR-L = Significantly Rare Limited, SR-T = Significantly Rare Throughout, SR-D = Significantly Rare Disjunct, SR-P = Significantly Rare Peripheral, SR-O = Significantly Rare Other, W = Watch List
- **USFWS = US Fish & Wildlife Status:** FSC = Federal Species of Concern
- **G-Rank = Global Rank:** G1 = Critically Imperiled, G2 = Imperiled, G3 = Vulnerable, G4 = Apparently Secure, G5 = Secure, GH = Historical, _T_ = Subspecies Rank, _? = Uncertain Rank, _Q = Questionable Taxonomy
- **S-Rank = State Rank:** S1 = Critically Imperiled, S2 = Imperiled, S3 = Vulnerable, SH = Historical, SX = Presumed Extirpated, _T_ = Subspecies Rank, _? = Uncertain Rank, _Q = Questionable Taxonomy

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