Wildlife and Ecological Restoration in

The New Nantahala-Pisgah Forest Plan

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Summary

- The Southern Blue Ridge has been, and should remain, a refuge for species during times of changing climate
- Most of the locally endemic species in the Blue Ridge are disturbance sensitive, dispersal limited organisms associated with wet and moist environments
- There is a need to provide habitat for disturbance dependent and young forest associated wildlife on Nantahala and Pisgah National Forests while not negatively impacting disturbance sensitive, locally endemic species
- The conservation community has identified the key areas for the maintenance and recovery of rare and declining species that should be recognized in the Forest Plan
- GIS analysis shows that the areas of the forest needing the most active restoration largely do not overlap with conservation priorities such as Natural Heritage Natural Areas and Wilderness Inventory Areas
- The areas with the greatest need for restoration have been the most heavily managed in the recent past, have higher road density than the rest of the Nantahala-Pisgah, and have a lower density and alpha diversity of rare species
- Focussing active management on areas of forest with undesirable species composition can help to provide habitat for young forest associated wildlife, timber for local economies, and streamline project planning and implementation
- There appears to be more need for active restoration of forest ecosystems than can be accomplished during a single planning cycle, necessitating prioritization of management activities in the new Forest Plan.

Introduction

The conservation importance of the Southern Blue Ridge Ecoregion compared to other lands of the United States would be difficult to overstate. This ancient mountain range has long been a mixing zone of northern and southern species and has been a refugium for many lineages since at least the Miocene (Bond et al. 2009; Church et al. 2003; Lockstadt 2013; Schmidt 1994). As the largest single unit of conservation land in the Southern Blue Ridge, the Nantahala-Pisgah has special significance for maintaining clean water, providing access to recreation, and providing habitat for a unique assemblage of plants and animals.

Research from Gray's Fossil Site in northeast Tennessee reveals that the Southern Appalachian Mountains have harbored mesic temperate forests as far back as the Mio Pliocene > 3.5 mya, when the climate was warmer than today. In close proximity, fire and grazing adapted communities with abundant warm season grasses occurred (Desantis & Wallace 2008; Ochoa et al. 2012). This pattern persists today, with the Southern Blue Ridge continuing to be characterized by natural communities dominated plant species and animals with northern affinities, while other communities that are dominated by pyrophytic species occur in close proximity - determined by factors such as landform, aspect, elevation, geology, and disturbance history (Schafale & Weakley 1990). At a time when the climate is changing rapidly, it is worth noting that the Blue Ridge Ecoregion has been both a refugium and dispersal conduit during changing climates of the past. If we are to be successful as conservationists, it is important that the region serve these functions in the present and future, despite unprecedented human stressors caused by the largest population combined with the highest per capita resource use in history (Wieldman et al. 2020).

The Southern Blue Ridge is among the most biodiverse temperate ecoregions on Earth, and has the highest rate of endemism of all North American Ecoregions North of Mexico (Ricketts et al. 1999). Most of our planet's biodiversity is composed of specialist, endemic species, and these are the species most vulnerable to extinction (Pimm et al. 1995). Examining patterns of endemism and diversity in the Blue Ridge should help guide land managers in devising conservation strategies for maintaining the region's biodiversity.

There are reputed to be over 258 taxa endemic to the Southern Blue Ridge, many of which are plants and invertebrates (Rickets et al. 1999). Some of the animal lineages most noted for their endemism in the region are salamanders, land snails, fish, crayfish, and mussels – all residents of mesic and aquatic habitats that are not typically thought of as disturbance dependent. Indeed, these species are sensitive to disturbance and the refuge of the Southern Blue Ridge has allowed them to withstand the disturbances of the past; hence their extinction elsewhere and endemism in the Blue Ridge today. As an example, the only endemic mammal known from the Southern Blue Ridge is the Carolina northern flying squirrel, which finds its best habitat in mature to old-growth spruce and northern hardwoods forest. Because natural disturbances are stochastic, it is intuitive, and true, that disturbance dependent species must have the ability to disperse to areas where disturbance has recently occurred. Most are capable of flying or

walking very long distances. The opposite is true for the restricted endemic, disturbance sensitive species of the Blue Ridge. A list of the restricted endemic animal species of the Blue Ridge reveals that none are disturbance dependent and all are associated with closed canopy forest, moist conditions, and aquatic habitats (see Appendix 1).

In contrast to the restricted endemic species, it is well documented that many of the declining vertebrate species and the most departed ecosystems of the region are dependent on disturbances that have been altered by human activity, such as fire, flooding, and grazing (Hunter et al. 2001; Kelly 2013; Call et al. 2012). One of the challenges of managing Nantahala-Pisgah National Forest is to balance the needs of habitat for declining disturbance dependent species with the maintenance of natural communities that support locally endemic, extinction prone, disturbance sensitive species. Below, I offer some suggestions on accomplishing both of these goals.

Protect and Manage Rare and High Quality Habitats for Their Special Elements of Diversity

To maintain the biological and genetic diversity of native plants and wildlife on Nantahala-Pisgah National Forest, it is important to document, protect, and manage the rare species of the region that are prone to extinction and extirpation. As noted above, restricted endemic species are those that are most reliant on the Nantahala-Pisgah for their future survival. Other species that have large ranges, such as several species of bats, are also extinction prone because of range-wide habitat loss and the stressor of a non-native epidemic disease. Other than restricted endemics and species already listed as Endangered or Threatened, species on the periphery of their ranges are the most vulnerable to extirpation from the region.

We are fortunate that the North Carolina Natural Heritage Program (NCNHP) has inventoried many of the significant natural areas and rare species habitats of the Nantahala-Pisgah. A first step towards maintaining the full biodiversity of the forest is to manage these natural heritage areas in a way that emphasizes their special qualities. Natural areas identified by the NCNHP include information about the species and natural communities present there, which facilitates protection and management of those special elements. For instance, if a site is significant in part for a good quality yellow pine forest, that site should be burned regularly to maintain that community. Another site may be significant for an old-growth Northern Hardwoods Forest, forest herbs, and salamanders. Managing this site for large diameter trees and large woody debris would emphasize its special characteristics.

Maintaining and enhancing conditions for range edge species, especially rare ones, can act as a hedge against climate change. We know that precipitation intensity and storm intensity are increasing as the Earth's atmosphere warms (National Climate Assessment 2014). It is likely that our local climate will become warmer, with more severe and frequent drought and storm events. There is some chance that an increase in precipitation will help to moderate average

temperatures in the Blue Ridge. However, it is the particular severe weather events, like droughts, heatwaves, and floods that will most impact the persistence of species in the region, not averages. There is evidence that late-seral, unfragmented forests are refugia for native forest herbs during drought periods, and the same is likely true for salamanders and other moisture-loving taxa (Jackson et al. 2013).

The benefits of protecting and managing the most important biological sites on the N-P are numerous. Doing so focusses management in those areas on their special characteristics, making long-term maintenance of biodiversity more likely. Natural areas also provide excellent sites for nature study, hunting, fishing, hiking, and other forms of recreation. Finally, by identifying and maintaining natural areas for their special characteristics, issues that could impede planning and management in other areas would be addressed. At the Forest Plan level, protecting the known sites for rare species that are disturbance sensitive through a coarse filter approach may justify a fewer Standards and Guidelines for the protection of Species of Conservation Concern, for example (see George Washington National Forest 2014 RLRMP).

Identifying Suitable and Unsuitable Management Areas

The act of identifying suitable and unsuitable management areas – areas that do and do not prioritize timber production – can be directed by assessing which lands are most important for the maintenance and protection of disturbance sensitive species from human stressors, such as road building. Nantahala-Pisgah National Forest is fortunate to have been provided with excellent inventories of the key areas to protect in its Land and Resource Management Plan. The Nature Conservancy and Wilderness Society have provided rigorous, science based inventories of the least roaded, most intact portions of the Nantahala-Pisgah. The North Carolina Natural Heritage Program shares data with the Forest Service on all locations of rare species and high quality natural communities. The Western North Carolina Alliance (now MoutainTrue) shared GIS data on the distribution of existing old-growth forest identified through field inventory.

As a GIS exercise to investigate the implications of removing all of the conservation priorities listed above from consideration for road building and timber production, natural heritage areas, existing old-growth forests, Wilderness Areas, The Wilderness Society's Mountain Treasures (inclusive of all IRAs), and the proposed Management Area 4 scenery areas unveiled by the Forest Service in October 2014 were merged into a single layer and removed from consideration as part of the suitable timber base. In sum, these are the areas that have the highest level of controversy regarding timber harvest and the highest potential benefit for managing disturbance dependent species. Even though these areas will not be used to estimate potential commercial restoration opportunities, timber harvest to correct uncharacteristic vegetation (see below) is agreeable adjacent to existing roads in areas not designated as IRAs or Wilderness Study Areas. The total acreage of these conservation priority areas is approximately 570,000 acres (~483,000 outside of Wilderness and Scenic Corridors) and should be managed as unsuitable for timber production, with the goals of protecting and restoring backcountry

character, high quality natural vegetation, and rare species populations. The remaining potentially suitable area includes roughly 470,000 acres of Nantahala-Pisgah National Forest. Within this area, which I have termed “areas without known conflicts with timber harvesting”, are very large acreages of uncharacteristic vegetation. That said, some compromises for multiple uses may be necessary for social sustainability, and **MountainTrue fully supports the Management Area allocations endorsed by the Nantahala-Pisgah Forest Partnership.**

To examine how successfully such an approach would hypothetically protect disturbance sensitive species and Species of Conservation Concern (SCCs), the Natural Heritage database of rare species records was intersected with both the “areas without known conflicts with timber harvesting” and the proposed unsuitable portion of the Forest. The proposed area that is suitable for timber production, which makes up ~45% of the Nantahala-Pisgah, contains just 14.4% (294 records) of the species element occurrences tracked by the NC NHP. The approximately 55% of the forest proposed for emphasizing natural areas, unroaded areas, and scenery corridors contains 85.6% (1,751 records) of species element occurrences (NCNHP 2015). This would seem to demonstrate that moving towards a consensus area of Matrix and Interface Management Areas would both reduce conflict and reduce the likelihood that impacts to Species of Conservation Concern would be a factor at the project level.

In a similar exercise, road density was used as a proxy for connectivity, or lack there-of. The assumption being that greater road density leads to greater habitat fragmentation. The Forest Service roads layer was clipped to the “area of no known conflict” and the proposed unsuitable portion of the forest. This analysis shows that 2002 of 2723.6 miles of road (73.5%) in the Forest Service database occur in the 45% of the National Forest with no known timber conflicts, demonstrating that this part of the Nantahala-Pisgah has a disproportionately high percentage of roads. Analyzing the density of roads reveals that the proposed “Consensus Group 1 Manangement Area” has a road density of 2.7 miles/square mile while the proposed unsuitable areas have a road density of .8 miles/square mile.

Another parameter that should be used to evaluate management area allocation and timber suitability is slope. Steep slopes increase the risk of erosion and slope failure, and increase road building and timber harvest costs. Slopes over 40% are widely cited as being too steep for ground-based logging. Under Amendment 5 the Nantahala-Pisgah requires high-line cable logging on sustained slopes greater than 40%. An analysis of slope in the approximately 483,000 acres of land called out by MountainTrue and other groups as deserving greater protections from logging reveals that 36% (~172,000 acres) has slopes less than 40%, 50% has slopes between 40% and 70% (~244,000 acres), and 14% (~67,000 acres) has slopes over 70%. For other areas of the forest, excluding Wilderness, the totals are: 42% (209,934 acres) less than 40% slope, 49% with slopes between 40% and 70%, and just 9% (~38,000 acres) with slopes greater than 70%. So, the “Consensus Group 1 Management Area” has greater road density, fewer rare species, gentler terrain, and, as we shall examine, greater opportunities for commercial logging to play a role in restoration.

The Potential of Ecological Restoration to Meet the Needs of Disturbance Dependent Species

The Forest Service has taken a scientific approach to evaluating the current condition of the forest by analyzing the condition of the ecological zones present. By managing ecozones, rather than stands, the Forest Service has a greater chance to identify the management needs of specific sites. When managing the ecozones of the forest, there is broad agreement of the need to manage yellow pine forests and oak forests and good evidence that yellow-pine forests are the most "out-of-whack" ecozones of the plan area (Call et al. 2012; Kelly 2013; Nantahala-Pisgah DEIS 2020). Where yellow-pine forests can be managed with fire, they should be. In areas where yellow-pines have been replaced by hardwoods, there is good justification for silvicultural work.

Oak forests, in sum, compose the majority of Nantahala-Pisgah National Forest, so there is no lack of management opportunities there, as these communities can be found between an elevation range of roughly 1,000'-5,000'. Prioritizing management to address sites with the greatest structural and compositional deviance from the natural range of variation would help to identify where the most important sites for management are at the project level.

There is strong evidence through the decline of disturbance dependent species that more disturbance in the form of fire, floods, and grazing would benefit disturbance associated wildlife (Hunter et al. 2001). There are also opportunities for timber harvest to provide benefits for disturbance dependent species. However, to ensure that rare, disturbance-sensitive species are not impacted in the same stroke, natural heritage areas and backcountry areas – as identified by NC Mountain Treasures and the Potential Wilderness Inventory – should be off-limits to timber harvest, though not tree cutting, in all but the most compelling cases.

Uncharacteristic Vegetation

The most compelling case where timber harvest can help meet the needs of disturbance dependent wildlife and accomplish restoration goals is in addressing tree species composition in instances in which the characteristic dominant trees of an ecosystem have been replaced by uncharacteristic canopy dominants, a condition referred to as uncharacteristic vegetation (see Call et al. 2012). Uncharacteristic vegetation, also referred to as U-class vegetation, is common on Nantahala-Pisgah National Forest. Some excellent examples of U-class vegetation include: plantations, upland forests with > 30% dominance of white pine, poplar dominated oak ecozones, and low elevation pine-oak forests where yellow pines have been replaced by white pine and hardwoods. The acreages of these types of vegetation are significant and provide a low conflict opportunity for meeting the multiple use objectives of the forest.

To demonstrate that the quantity of restoration needed on the Nantahala-Pisgah is so great that priorities must be set, I undertook the following analysis (see Table 1). The FS veg database was queried to estimate the quantity of potential regeneration timber harvest related

to restoration available on Nantahala-Pisgah National Forest. Forest Types 3 (White Pine), 9 (Cove Hardwood –White Pine), 10 (Upland Hardwood – White Pine), 42 (White – Pine Upland Hardwood) were chosen to represent potential U-Class white pine forests while white pine mixtures with hemlock (Forest Types 4 and 41) were treated as likely characteristic vegetation. Potential U-Class poplar was estimated by Forest Type 50 (Poplar). Poplar dominance in cove forests is fairly characteristic, though the industrial logging of the early 1900's and the clearcutting of the 1980's has surely increased the prevalence of this condition. Poplar dominance in oak ecozones is not a characteristic condition, but is all too common in the Southern Appalachians. The final class of commercially viable timber harvest analyzed was the low elevation pine-oak ecozone. It has been observed that fire suppression, southern pine beetle, and other factors have led to the near extirpation of yellow-pine from much of this ecozone. These classes of vegetation were then analyzed more intensely in the High Consensus portion of the Nantahala-Pisgah to estimate the extent to which restoration-focused regeneration harvest could meet commercial and wildlife needs on the national forest over the next 20 years. The arbitrary minimum age for commercial viability was set as 60 years, implying that 40 year-old forests could be entering commercial viability by 2040.

Table 1: Analysis of Restoration Timber Harvest Opportunities on Nantahala-Pisgah National Forest

Forest Type	**U-Cl White Pine**	**U-Cl Poplar**	**Low Elev Pine-Oak Ecozone**	**Sum of Acres**
Total Acres	86,960	34,636	41,343	162,669
High Consensus Restoration Acres*	58,449	16,502	36,912	111,863
High Consensus Stands within ¼ Mile of a Road	54,153	15,107	30,705	99,965
% in High Consensus	67.4%	47.6%	89.3%	68.8%
Mean Age of High Consensus Stands	51.6	71.6	45.8	
Mean Site Index of Consensus Stands	77.8	98	73.3	
Acres ≥ **80 years in High Consensus Area**	20,923	8,553	17,372	46,848
Acres ≥ 60 and < **80** yrs in **Consensus Area**	4,197	6,448	4,810	15,455
Acres ≥ 40 and < **60** yrs in **Consensus Area**	7,876	1,386	4,914	14,176
Appalachian District Consensus Acres	6,939	1,835	2,433	11,207
Grandfather District Consensus Acres	18,684	910	9,745	29,399
Pisgah District Consensus Acres	3,085	1,755	1,284	6,124

Pisgah NF Acres	28,708	4,500	13,432	46,640
Cheoah District Consensus Acres	9,381	3,224	4,931	17,536
Nantahala District Consensus Acres	9,190	3,659	1,582	14,431
Tusquittee District Consensus Acres	11,168	5,120	16,930	33,218
Nantahala NF Acres	29,739	12,003	23,443	65,185

*High Consensus Restoration Acres occur outside of Mountain Treasures, existing Old-Growth, and NCNHP natural areas. Analysis based on FS VEG data and Ecozone Models in 2016.

The analysis above should not be construed as sufficient to guide project level management, nor should it be implied that the Forest Plan Revision should make project level decisions. Furthermore, I emphasize that not all of the stands in the above analysis are in uncharacteristic condition, or that stands not analyzed are in characteristic condition. *Obviously, restoration projects require site specific examination to describe the current condition, identify whether or not U-class vegetation exists, and to make a restoration prescription for specific stands.* ***This analysis is intended to demonstrate that the opportunities for restoration of U-class vegetation through commercial timber harvest likely exceeds the ability of the Forest Service to accomplish in the next 20 years*****, and to accentuate the need to have Plan Level Desired Conditions, Goals, and Standards and Guidelines that prioritize the restoration of characteristic vegetation.**

This analysis also validates the approach of removing areas that would prove controversial for road building and logging. The High Consensus Management Area 1 makes up 45% of the area of Nantahala-Pisgah National Forest but contains nearly 69% of the potential uncharacteristic vegetation, 73.5% of the roads, and only 14.4% of the rare species records. This is strong evidence that the most roaded portions of the Nantahala-Pisgah offer the greatest restoration opportunities, with the least NEPA burdens for planning in each of the economic, social, and biological dimensions. Conversely, it can be inferred that the process of road building and development for timber harvest has created more uncharacteristic vegetation than more passively managed portions of the forest.

Restoring Structural Diversity to Oak and Pine Ecozones

While removing canopy trees of uncharacteristic dominance holds promise to potentially create large acreages of early successional habitat *and* restore characteristic species, addressing uncharacteristic vegetation is not the only restoration need on Nantahala-Pisgah National Forest. Another need is to increase the percentage of open-canopy forests in pine and oak ecozones (Kelly 2013).

There is ample historical evidence that open-canopied, fire maintained woodlands were common prior to Forest Service fire suppression. In 1901, H.B. Ayers and W.W. Ashe described the condition of the Little Tennessee River basin:

> "Repeated forest fires, started with a view to improve the pasturage, have destroyed much timber on dry south slopes, and by continued suppression of the young growth have greatly reduced the density. Reproduction, however, is good, and if the open woods were protected there would soon be a fine young growth beneath the old trees." (Senate Document 84)

Contemporary views of fire have evolved, and fire is no longer seen as a phenomenon that was brought by European settlers, but rather a long-term process (Dellcourt & Dellcourt 1998). Fire was very likely over-applied by European settlers and there are many examples of damaging fires from the early period of industrial logging. However, it is broadly recognized that fire is an important ecosystem process that mediates assemblages of plant and wildlife communities (Abrams 1992; Aldrich et al. 2013; McEwan et al. 2013).

Observations from the Nantahala-Pisgah demonstrate fire can produce open-canopy conditions in wildfires (Dobson Knob for example) and prescribed fire (Bark Camp Burn and Leatherwood Burn). Using prescribed fire and managing wildfires to accomplish ecosystem objectives should be a focus of management on the Nantahala-Pisgah. Where pine and oak ecosystems occur in the low-conflict portions of the Forest identified in this document and its accompanying GIS files, mechanical techniques such as timber harvest or non-commercial thinning could be used in conjunction with fire to more rapidly attain open-canopy conditions. This work should be focused in the ecozones most departed from their natural range of variation.

Spruce-Fir Forest Restoration

Restoring spruce-fir forests could have a great impact in providing habitat for a host of rare and endemic species. However, restoring this high-elevation ecosystem must be done carefully in order to avoid impacts to other high-value ecosystems. Great effort must also be made to have lasting impact, which could be difficult given the likelihood that climate change will negatively impact spruce-fir forests.

I suggest several principles to suggest for spruce-fir restoration. First, restoration should be prioritized above 5,000 feet, or in riparian areas above 4,000 feet that have lost hemlocks to hemlock woolly adelgid. Second, spruce and fir planting should be concentrated in areas that have a clear history of deforestation due to logging and wildfire. Third, cutting hardwoods to release spruce seedlings should be focused in forests less than 80 years old. Finally, tree cutting in Inventoried Roadless Areas must comply with the Roadless Rule.

An analysis of the Nantahala-Pisgah has revealed three areas that rise above others for spruce-fir restoration (shapefile attached). The first is the Flat Laurel Creek watershed in the Pisgah Ranger District. Flat Laurel Creek is the highest elevation drainage of its size in the

Southern Appalachians. This portion of the Balsam Mountains was logged in the 1910's and early 1920's and then suffered wildfires in 1924 and again around 1940. Many areas are still tree-less, and areas that have reforested have regenerated in hardwoods more than spruce. Additionally, there are several spruce plantations that are overstocked and could benefit from thinning.

The second priority area for Spruce Restoration is the Bearwallow Inventoried Roadless Area. There are large acreages that were logged, burned, and have never reforested there. The primary activity in this restoration area should be planting red spruce (*Picea rubens*) and Fraser fir (*Abies fraseri*) in deforested settings.

The third priority area occurs in stream corridors above 4,000' in the Balsam Mountains in riparian areas where eastern hemlock has been killed by hemlock wooly adelgid. In these settings, red spruce could be planted as a long-term surrogate for hemlock and provide functionality such as: evergreen shade, thermal cover, and habitat for species associated with high-elevation conifers. This represents Nantahala National Forest's best spruce-fir restoration opportunity.

Wildlife Management

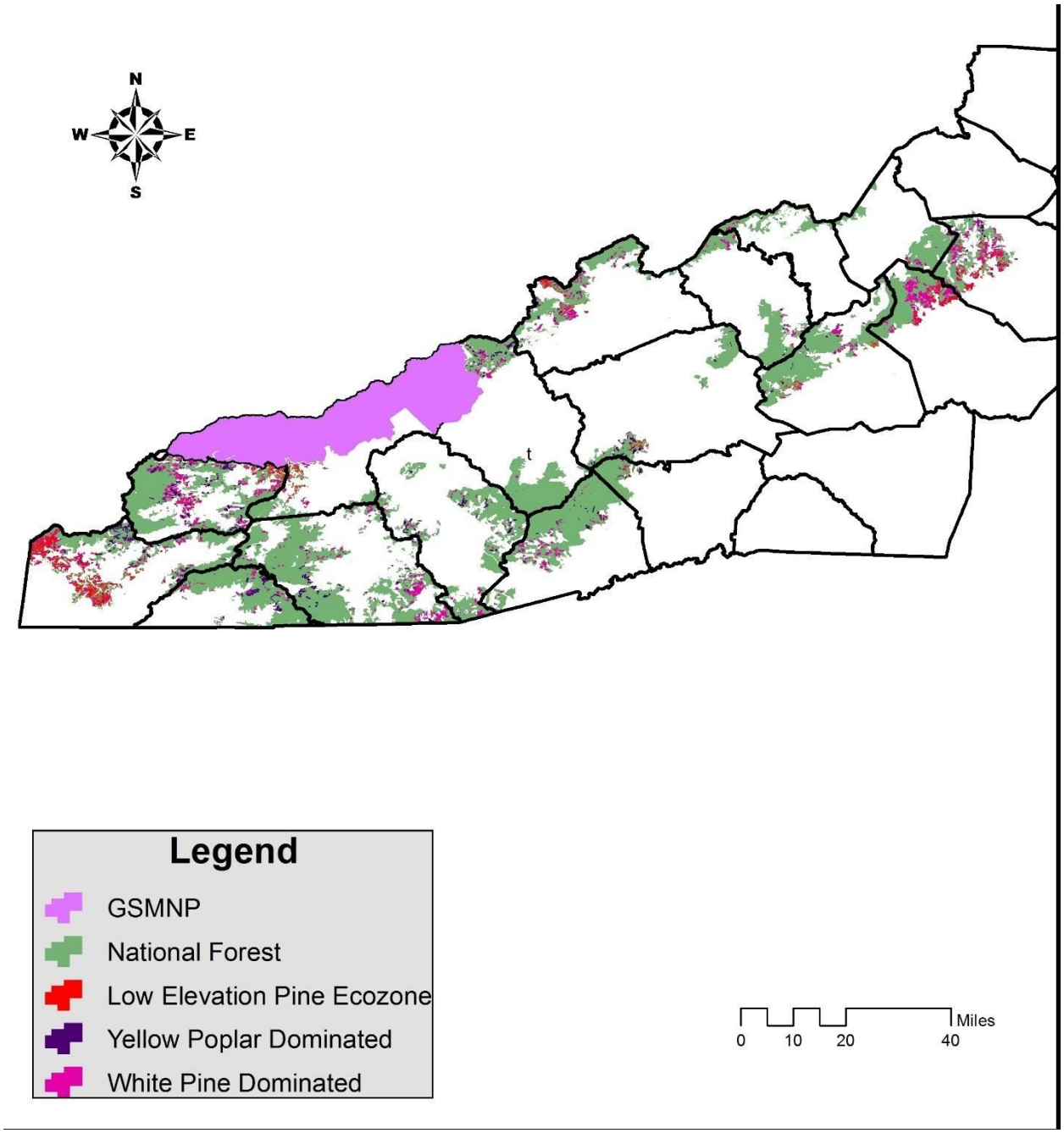
As discussed previously, Nantahala-Pisgah National Forest must balance the need to provide habitat for and protect disturbance sensitive species, especially restricted endemics, and to provide habitat for declining disturbance dependent species, several of which are demand species. There is clearly a great opportunity to accomplish both goals by focusing vegetation management on the ecozones that will benefit most. As demonstrated above, there is the opportunity to more than double current levels of early successional habitat during the next decade by focusing on removing uncharacteristic species like white pine, poplar, and red maple from upland hardwood and shortleaf pine forests. In addition, recent events confirm that prescribed fire and wildfire can also create and maintain early successional habitat, and there is strong support for prescribed fire from many quarters.

There are cases, however, where wildlife needs may be so localized that neither restoring species composition by removing uncharacteristic vegetation nor prescribed fire would be available to meet the needs of certain species. The best example of this case is the golden winged warbler (*Vermivora chrysoptera*), a declining species on the southern end of its range. Golden winged warbler has very high site fidelity, so management for the species should be in close proximity to known nesting locations (GWWA Management Guidelines). However, much GWWA management can be accomplished non-commercially without timber harvest or road building. Furthermore, if logging were prohibited from all Mountain Treasures, NCNHP natural areas, and existing old-growth forest, there would still be approximately 150,000 acres available for management of GWWA inside of GWWA focal areas above 3,000' in elevation, and that management could include the commercial timber harvest of characteristic forest.

Looking Towards the Future

This could be an inflection point in the history of the management of Nantahala and Pisgah National Forest. Never has the Forest Service had the potential for such a broad base of potential support of citizens and community organizations. Realizing that potential will require the Forest Service to recognize and serve the interests and needs of all stakeholders. MountainTrue believes that the best strategy to meet the needs of the native biodiversity of the Nantahala-Pisgah, while also providing for recreation, forest products, economic development, and cultural heritage is to follow the recommendations of the Nantahala-Pisgah Forest Partnership. The failure to follow a collaborative course would be tragic. Everything the Forest Service and and its stakeholders need to be successful in the next 20 years is in place. It's now up to the Forest Service to finalize a quality Forest Plan and get to work.

Figure 1: General Locations of Uncharacteristic Vegetation on Nantahala and Pisgah National Forests



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Appendix 1. A List of Restricted Endemic Animal Species* in the Southern Blue Ridge Ecoregion Relevant to Nantahala-Pisgah National Forest – all disturbance sensitive species.

Common Name (G Rank)	Scientific Name	Habitat Notes
Green Salamander (G3)	Aneides aeneus	Blue Ridge lineages may be distinct from other eastern lineages. Inhabits crevices in rock outcrops in mature forests along the Blue Ridge Escarpment. Forages in tree canopies.
Seepage salamander (G5)	Desmognathus aeneus	Seeps and small streams
Santeetlah Dusky Salamander (G3G4)	Desmognathus santeetlah	Seeps, small streams, and forests. Forages in leaf litter and decaying wood.
Carolina Mountain Dusky (G5)	Desmognathus caroliniensis	Seeps, small streams, and forests. Forages in leaf litter and decaying wood.
Ocoee Salamander (G5)	Desmognathus ocoee	Seeps, small streams, and forests. Forages in leaf litter and decaying wood.
Imitator Salamander (G4G5)	Desmognathus imitator	Seeps, small streams, and forests. Forages in leaf litter and decaying wood.
Dwarf Black-bellied Salamander (G2)	Desmognathus folkertsi	Seeps, small streams, and forests. Forages in leaf litter and decaying wood.
Southern Pygmy Salamander (G2)	Desmognathus wright	High elevation forests; often found in large woody debris
Northern Pygmy Salamander (G2)	Desmognathus organi	High elevation forests; often found in large woody debris
Weller's Salamander (G1G2)	Plethodon welleri	High elevation forests; often found in large woody debris
Tellico Salamander (G2G3)	Plethodon aureoles	Unicoi Mountains
Chattahoochee Salamander (G2G3)	Plethodon chattahoochee	Clay and Cherokee Counties
Southern Appalachian Salamander (G?)	Plethodon teyahalee	Seeps, springs, moss matts, and woody debris
Cheoah Bald Salamander (G1G2)	Plethodon cheoah	Restricted to Cheoah Bald
Red-legged Salamander (G4?)	Plethodon shermani	Seeps, springs, moss matts, leaf litter, and woody debris
Yonahlossee Salamander (G4?)	Plethodon yonahlossee	Seeps, springs, moss matts, leaf litter, and woody debris
Red-cheeked Salamander (G4G5)	Plethodon jordani	Seeps, springs, moss matts, leaf litter, and woody debris

Junaluska Salamander (G3)	Eurycea junaluska	Seeps, springs, moss matts, leaf litter, and woody debris
Carolina Northern Flying Squirrel (G1)	Glaucomys sabrinus coloratus	Spruce-Fir and Northern Hardwood Forests
Spruce-Fir Moss Spider	Microhexura montivaga	Moss on the trunks of trees in Spruce-Fir Forest
Sharphead Darter (G3)	Etheostoma acuticeps	Nolichucky and Holston River Drainages
Sicklefin Redhorse (G2)	Moxostoma sp.	Little TN and Hiwassee River drainages
Appalachian Elktoe Mussel (G1)	Alasmidonta raveneliana	Mountain streams with high water quality
Roan Covert (G1?)	Mesodon roanensis	Roan Mountain
Rock Loving Covert (G1?)	Fumonelix cherohalaensis	Huckleberry Knob, Graham County
Engraverd Covert (G1?)	Fumonelix orestes	Plott Balsam Mountain
Sawtooth Disch (G3)	Discus bryanti	Mesic Forests in Buncombe, Madison, & Mitchell Counties
Christy's Elimia (G2)	Elimia christyi	Hiwassee River and tributaries
Fragile Glyph (G1)	Glyphyalinia clingmani	Black Mountains
Thin Glyph (G2)	Glyphyalinia cryptomphala	Hardwood Forests along Bluffs and Ravines west of Jackson County
Dark Glyph (G2)	Glyphyalinia junaluskana	Cove hardwood forests, southwestern mountains
Pink Glyph (G2G3)	Glyphyalinia pentadelphia	Cove hardwood forests, southwestern mountains
Blue-footed Lancetooth (G2)	Haplotrema kendeighi	Southwestern mountains
Sprial Coil (G1)	Helicodiscus bonamicus	Nantahala Gorge
Smoky Mountain Covert (G2)	Inflectarius ferrissi	Spruce-Fir and Northern Hardwoods Forests in the Smoky and Plott Balsam Mountains
Balsam Globe (G3)	Mesodon andrewsae	High Elevation Forests
High Mountain Supercoil (G2)	Paravitrea andrewsae	Rocky cove forests
Ramp Cove Supercoil (G1)	Paravitrea lacteodens	Forests in Unicoi Mountains
Cherokee Supercoil (G?)	Paravitrea petrophila	Macon County, NC
Sculpted Supercoil (G2)	Paravitrea ternaria	Moist leaf litter in Madison County, NC
Open Supercoil (G2)	Paravitrea umbillicaris	Rocky cove forests
Roan Supercoil (G2)	Paravitrea varidens	High elevation forests
Dwarf Proud Globe (G3)	Patera clarki clarki	Forested mountain slopes
Noonday Globe (G1)	Patera clarki nantahala	Nantahala Gorge
Oak Tooth Bud (G2)	Pilsbryna nodopalma	Rock outcrops and glade

Honey Bud (G3)	Pilsbryna vanattait	Leaf litter near streams and seeps
Appalachian Gloss (G3)	Zonitoides patuloides	Southwestern Mountains

*This list is not comprehensive. Many of the taxonomic groups with high endemism are poorly known and new species are still being described across many phylogenetic groups in the Southern Blue Ridge