

**Spruce-Fir Forest**  
**Southern Blue Ridge Mountains**

Spruce-fir forests occur on high mountaintops in western North Carolina, generally above 4,500 feet in elevation. These forests are considered Pleistocene relicts that have become isolated from boreal forests of the northern United States and Canada. Many of the species of plants and animals found in this community type are more common further north and have either evolved here, isolated from their northern cousins or remain in small areas where elevation provides similar conditions to more northern latitudes. Spruce-fir forests are often comprised of components of northern hardwood and northern red oak forests mixed with red spruce at elevations from about 4,500 feet to 5,500 feet, with spruce becoming dominant, followed by Fraser fir dominance above 6,000 feet.

These forests have been, and remain threatened due to impacts from human activities (including residential development, recreational development, and historic land use for logging or grazing), non-native insects (especially the balsam woolly adelgid), air pollution, and natural factors such as insects, isolation, and climate. Indeed, this habitat is listed as the second most endangered ecosystem in the United States (Noss *et al.* 1995).

Spruce-fir communities provide critical breeding habitat for many landbirds of conservation concern according to Partners in Flight (brown creeper, northern saw-whet owl, black-capped chickadee) that are likely endemic to these high peaks (Pashley *et al.* 2000, Rich *et al.* 2004, Johns 2004). Spruce-fir also provides critical habitat for a host of plant and animal species found nowhere else in North Carolina. Table 1 provides a list of priority species for which there is conservation concern.

**Table 1. Priority species associated with spruce-fir forest.**

<b>Group</b>	<b>Scientific name</b>	<b>Common name</b>	<b>State status* (Federal status)</b>
Birds	<i>Accipiter striatus</i>	Sharp-shinned Hawk	SR
	<i>Aegolius acadicus</i>	Northern Saw-whet Owl	T
	<i>Carduelis pinus</i>	Pine Siskin	
	<i>Certhia americana</i>	Brown Creeper	SC
	<i>Dendroica magnolia</i>	Magnolia Warbler	SR
	<i>Dendroica pensylvanica</i>	Chestnut-sided Warbler	
	<i>Loxia curvirostra</i>	Red Crossbill	SC
	<i>Picoides villosus</i>	Hairy Woodpecker	
	<i>Poecile atricapilla</i>	Black-capped Chickadee	SC
	<i>Wilsonia canadensis</i>	Canada Warbler	
Mammals	<i>Glaucomys sabrinus</i>	Northern Flying Squirrel	E (E)
	<i>Microtus chrotorrhinus</i>	Rock Vole	SC
	<i>Mustela frenata</i>	Long-tailed Weasel	
	<i>Sorex cinereus</i>	Masked Shrew	
	<i>Sorex dispar</i>	Rock Shrew	SC
	<i>Sorex fumeus</i>	Smoky Shrew	

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Group	Scientific name	Common name	State status* (Federal status)
Amphibians	<i>Desmognathus wrighti</i>	Pigmy Salamander	SR
	<i>Plethodon glutinosus sensustricto</i>	Northern Slimy Salamander	
	<i>Plethodon welleri</i>	Weller's Salamander	SC
*Abbreviations T Threatened E Endangered SC Special Concern SR Significantly Rare			

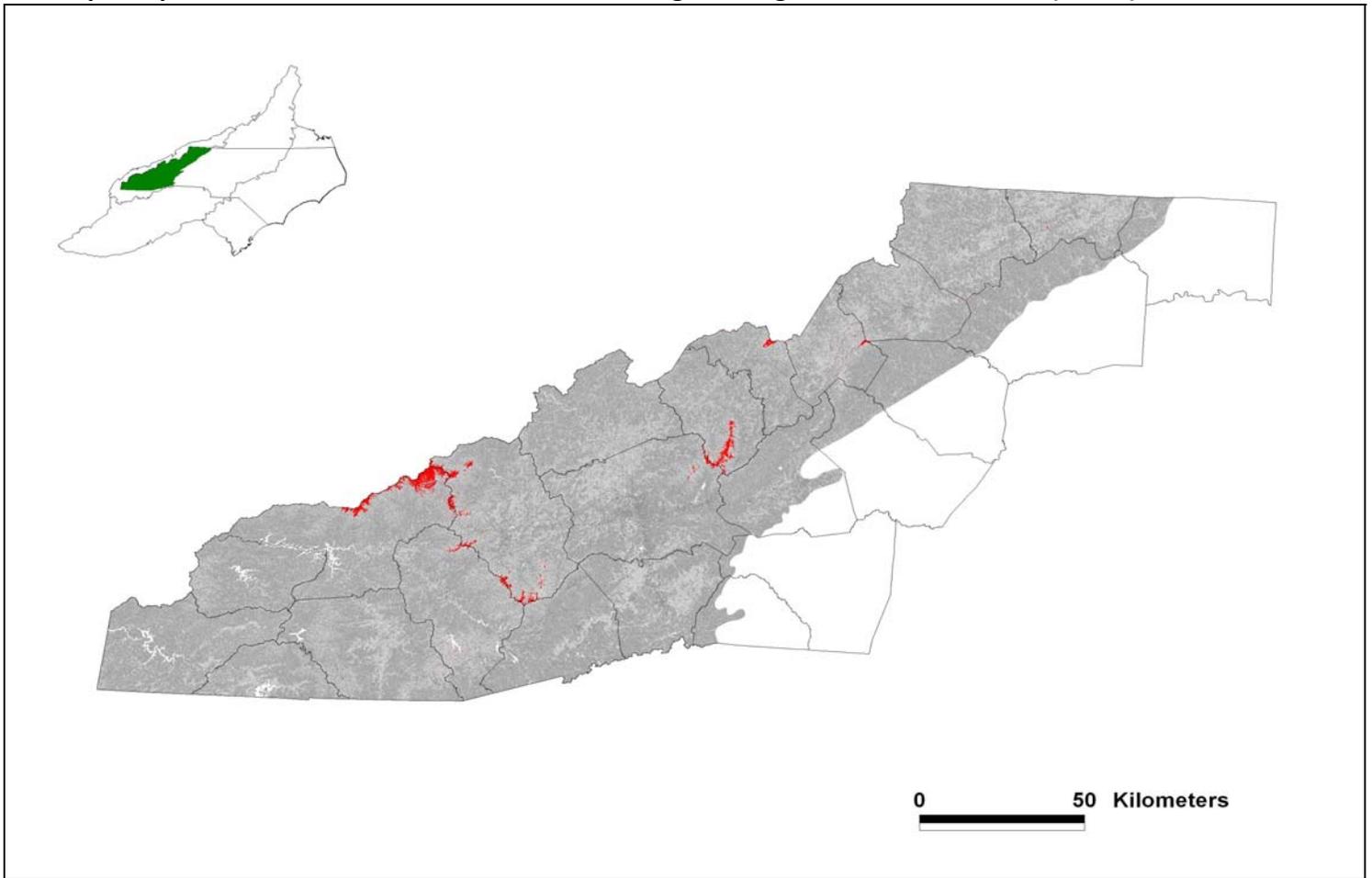
**Location and condition of habitat**

There are currently 6 significant areas of spruce-fir habitat in Western North Carolina, including portions of Grandfather Mountain, Roan Mountain, the Black/Craggy mountains, the Great Balsam mountains, the Plott Balsam mountains, and the Great Smoky mountains. Red spruce habitats of lesser size or with somewhat different ecological community associates occur in a few other locations, including Long Hope Valley, Beech Mountain, and Alarka Laurel. Map 1 depicts locations of spruce-fir forests in the Southern Blue Ridge ecoregion.

Estimates of the amount of spruce-fir habitat are quite variable depending upon a number of factors including the estimation methods and habitat definition. The Partners in Flight Bird Conservation Plan for the Southern Blue Ridge (Hunter *et al.* 1999) identifies over 66,000 acres of spruce-fir forest in the southern Blue Ridge physiographic province and the Southern Appalachian Assessment (SAMAB 1996) identifies over 75,000 acres in North Carolina and Tennessee. The vast majority of these areas occur in North Carolina at the locations listed above.

Most of the spruce-fir habitat in North Carolina is located on public land, or private lands with permanent conservation easements, with estimates of 90 to 95% in conservation ownership in the southern Blue Ridge physiographic province including North Carolina, Tennessee, and Virginia (Hunter *et al.* 1999, SAMAB 1996). However significant private ownership of spruce-fir habitat occurs in the Plott Balsams and Black/Craggy mountains, and to lesser extents in several other ranges.

**Map 1. Spruce-fir habitats in the Southern Blue Ridge ecoregion of North Carolina (in red).**



Data source: NC GAP, 1992.

### **Problems Affecting Species And Habitats**

Spruce-fir habitats in North Carolina are now found within a narrow range of suitable conditions, isolated from each other and the rest of their range. This condition alone makes them more susceptible to perturbation and catastrophic events that could significantly affect their availability into the future. In addition, much of the spruce-fir habitat in North Carolina and throughout the southern Appalachians has been significantly altered due to a number of factors including historic logging, fire, exotic insects, historic grazing, and recreational development. Much of the spruce was logged in the early 20<sup>th</sup> century and in some areas (notably the Great Balsams) slash fires burned not only the coarse woody debris, but also the organic soil, which has subsequently inhibited the re-development of spruce and fir forests over large areas (Schafale and Weakley 1990).

In the latter part of the 20<sup>th</sup> century, the balsam wooly adelgid (*Adelges piceae*) began to have severe negative impacts upon Fraser firs throughout the region, resulting in the death of most of the mature fir of the high elevation forests. While some Fraser fir remains in certain

locations, the majority of late successional fir has been killed and often replaced by young fir, mixed northern hardwoods, and open, herbaceous habitats. The removal of mature Fraser fir from the canopy has profound implications for the spruce-fir ecosystem and the continued existence of several unique plants and animals (Nicholas *et al.* 1999).

In addition, during the latter part of the 20<sup>th</sup> century, the Blue Ridge Parkway was completed through western North Carolina. The Parkway traverses most of the high elevation islands of spruce-fir habitat. The Parkway and its associated development (the motor road, vistas, and visitor facilities) have had a significant impact on the amount of spruce-fir habitats available. More recent negative impacts upon spruce fir forests include insect outbreaks in several areas including Roan Mountain, the Black Mountains, and the Great Balsam mountains. Some research has shown that recent increases in acid precipitation in the mountains of western North Carolina may have impacts on forest health and productivity, particularly in the high mountains (Schafale and Weakley 1990, Hunter *et al.* 1999).

The wildlife species associated with spruce-fir forest have certainly suffered losses due the impacts of all of these activities and events. Certainly the local relative abundance of many birds and mammals has decreased as the availability of spruce-fir habitats has declined (e.g., red crossbill, brown creeper, pine siskin, black-capped chickadee, northern saw-whet owl, northern flying squirrel). The fact that these habitats are so small and isolated from each other could have a negative impact upon genetic health of individual populations, as well as demographic effects upon populations.

### **Species And Habitat Conservation Actions and Priorities For Implementation**

While the vast majority of spruce-fir habitat in North Carolina is currently under conservation ownership by either state and federal government agencies or conservation groups (e.g., The Nature Conservancy), there remain areas of private ownership (particularly in the Plott Balsams and Black/Craggy Mountains), which, if developed in the future, could hasten the decline of the habitat as well as the species which depend upon it. In addition, the state and federal agencies which own/manage these habitats have goals and objectives which can conflict with conservation objectives for the habitat. For example state and federal parks have objectives to provide visitor services and developed recreational facilities that have, and could continue to decrease the availability or suitability of spruce-fir habitats under their jurisdiction. It is important to understand the influence of specific land uses within the landscape on ecological communities to avoid or mitigate associated impacts on wildlife species of concern (Rodewald 2003).

Many of the state and federal agencies take a passive role towards management of forest communities on their lands, particularly communities or habitats which support rare or endangered species, like spruce-fir forests do. While this management scenario may be beneficial in some instances for some habitats, it may not be appropriate to sustain habitats and associated species that are in decline and/or have very limited distribution to begin with.

There are opportunities for active management of spruce-fir forests that could increase its distribution, health, and longevity that are not currently being pursued. Conservation actions that are appropriate and necessary to sustain spruce-fir forests and their inhabitants include both protection measures (acquisition/easement etc.) and management.

#### *Protection Actions*

- Assess, monitor, and mitigate impacts of existing management of state and federal holdings.
- Eliminate or minimize negative affects of future development of state and federal government holdings (state and federal parks, US Forest Service recreation developments).
- Acquire additional acreage of spruce-fir habitat through purchase, conservation easement, or other perpetual management agreements.

#### *Habitat Management and Restoration Actions*

- Continue efforts to study and develop management tools to ensure Fraser fir survival.
- Consider, implement, and evaluate effectiveness of spruce restoration in non-forested areas.
- Develop and/or implement techniques for managing pure spruce stands to include habitats components of the entire spruce-fir/northern hardwood community (i.e., thinning).
- Test silvicultural techniques to re-introduce spruce into formerly disturbed areas that have regenerated in northern hardwood or northern red oak communities (i.e., thinning and underplanting).

### **Priority Research, Survey, And Monitoring**

Surveys are needed to determine the distribution, relative abundance, and status of all wildlife species associated with spruce-fir forests. Monitoring systems need to be expanded and/or targeted to be able to assess current population status and trend information for all wildlife species associated with spruce-fir forests. Priority research needed for spruce-fir habitats and their associated species includes not only studies on the population biology of wildlife species, but also ecological relationships between the species, their habitats, and the biological, physical, and chemical habitat components.

#### **• Surveys**

- Focus survey priorities on species believed to be declining, at risk, or exclusively dependent on the rare spruce-fir forest communities (e.g. red crossbill, brown creeper, black-capped chickadee, rock vole, rock shrew, northern flying squirrel, Weller's salamander, pigmy salamander).

- Give secondary priority to surveys for species for which current distribution information is more available (e.g. northern saw-whet owl), or for species associated with additional, more extensive habitats (e.g. masked shrew, smoky shrew, hairy woodpecker, Canada warbler, sharp-shinned hawk, northern slimy salamander).
- **Monitoring**
  - Establish MAPS Stations, migration banding stations, or other means to monitor population status and trends for bird species not adequately sampled under existing monitoring protocols (i.e., BBS).
  - Establish monitoring systems and protocols for small mammal population status and trends including northern flying squirrel, rock shrew, and rock vole.
  - Establish monitoring systems and protocols for spruce-fir associated amphibians such as Weller's and pigmy salamanders.
  - Establish mechanisms for monitoring the distribution and condition of spruce-fir habitats through time.
- **Research**
  - Genetics*
    - Studies to explore the degree of endemism of Southern Appalachian populations (e.g. pine siskin, red crossbill, northern saw-whet owl, black-capped chickadee).
    - Studies to explore the degree of genetic isolation of species restricted to high elevations (e.g. northern flying squirrel, rock vole, rock shrew, Weller's salamander, northern saw-whet owl).
  - Habitat*
    - Studies to document ecological relationships between habitat use and availability for all taxonomic groups.
    - Studies to effectively map and/or model spruce-fir habitats both within and between habitat islands.
    - Studies on the impact of air pollution and climate change on the future availability of spruce-fir forests in North Carolina.
    - Studies to document forest management and restoration techniques that will benefit the habitat and associated species.
  - Population demographics*
    - Research on population demographics including trends, population structure, survivorship, reproduction, and population viability for all spruce-fir associated species/groups.

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