The spruce-fir forest

icon of the southern Blue Ridge Mountains

"The closer I get to the Blue Ridge Parkway, the better I feel. As soon as I pass through Balsam Grove, NC on Hwy 215 and begin the last climb to the Parkway, the landscape begins to change and my spirits soar. Every time. Even if I make the trip several times in one week, it's always the same. It's something like leaving the plains states and beginning the climb to the Rocky Mountains except the Parkway is just 30-40 minutes from home. I know what it is. It's the spruce and the fir, most of the time shrouded in clouds and fog. There's just something about those coniferous spires rising out of a swirling white mist, whether just off the side of the road or across a valley of low clouds on a distant peak." ..... John Turner, Director, Southern Highlands Reserve.

It's tempting to think of this scene as having been here forever and that it will always be here, but that is not the case.

At one time, the spruce-fir forest was much larger. It reached almost to Atlanta. The southern Appalachian spruce-fir forest, which grows only in the highest elevations of the southern Appalachians, is the highest and coldest forest ecosystem in the southern mountains. It thrives in elevations above 4,500 feet where the climate is too harsh to support the hardwood forest that dominates below. A relic of the last ice age, spruce-fir occurs in an archipelago of island-like forest patches scattered across the highest peaks.

Only in the last 10,000 years have the Appalachian spruce-fir forests become isolated from the much larger

northern boreal forests of Canada and the extreme northeastern US. While southern spruce-fir forests are related to the boreal forests of the north, and are home to a number of plant and animal species that are more common at northern latitudes, the southern spruce-fir is a disjunct and unique ecosystem.

Roughly 95% of the southern spruce-fir forest is owned by federal and state entities like the Great Smoky Mountains National Park and the Blue Ridge Parkway, or state-owned lands, such as Mount Mitchell State Park.

> The red spruce-Fraser fir forests of the southern Blue Ridge are ranked as the second most endangered ecosystem in the United States (Noss et al. 1995).

They are globally unique, especially when associated with highly vulnerable communities, such as grass and heath balds and rock/cliff outcrops (White et al. 1993).

The changes this unique ecosystem has endured across the ages show no signs of abating. Born of an ice age, the spruce-fir forest must now face the challenges of a warming planet, the exotic Balsam Wooly Adelgid that has decimated the Fraser fir population and the threats of air pollution and nitrogen deposition. This forest is in peril.

Although spruce-fir forests have been declining naturally for 10,000 years, recent declines in the health and composition of these forests have been accelerated by early 1900's timber management, large scale wildfires, exotic pests, and air pollution during the past century. Continued decline of this habitat may result in the complete loss of some species from the region.

In addition to long-term documented worries about the viability of the spruce-fir ecosystem, the Hemlock Wooly Adelgid presents a serious threat to the neighboring hemlock forest which grows in elevations immediately below the spruce-fir and sometimes grades in ecotones adjacent to the spruce-fir forest. Although state, federal and private landowners have constituted measures to combat the ravages of the HWA, many fear the complete loss of the hemlock forest. If this scenario comes true, we would be facing a high peaks southern Blue Ridge region devoid of conifers and the species and communities they nourish.

Spruce-fir and the northern hardwood forests provide habitat for a group of birds more commonly associated with the boreal forests of northeast North America. For many of these birds, the southern Blue Ridge represents the extreme southern limit of their distributions. In addition, several species appear to represent long-isolated endemic populations which may be genetically distinct from populations elsewhere (Lee and Browning in press, Milling et al.1997)

Over 155 bird species nest in the southern Blue Ridge. The highest priority species most directly sensitive to further losses of the spruce-fir forest is the Red Crossbill. This Crossbill, possibly endemic to the southern Blue Ridge, is dependent upon spruce cone and conifer crops at high elevations for food.

The Southern Appalachian population of Red Crossbill is a federal "Species of Concern" designated by the US Fish and Wildlife Service. In North Carolina the Southern Appalachian population is on the NC Natural Heritage Program List of Rare Animals as "Significantly Rare" and is on the Tennessee Natural Heritage Program's "Tracked" list.

The Northern Saw-whet Owl, Black-capped Chickadee, Red-breasted Nuthatch, Brown Creeper, Winter Wren, Golden-crowned Kinglet, and other species are of particular conservation concern and may be affected by future changes in the high peaks forest. All the birds mentioned above, with the exception of the Red Crossbill and Northern Saw-whet Owl, have declined measurably on mountains where adelgid infestations caused dramatic changes in the forest's structure (Rabenold et al. 1998).

The southern Appalachians in general, including the spruce-fir forest, are one of the most diverse temperate forests world-wide. This area contains an estimated 80 species of amphibians and reptiles, 175 species of land birds, 65 species of mammals, 2,250 species of vascular plants, and possibly as many as 25,000 species of invertebrates (Boone and Aplet 1994, USDA FS 1993b, Hamel 1992). Climate change represents a significant challenge to this diversity region-wide. But the sensitive nature of the spruce-fir forests make it especially vunerable.

Four federally endangered/threatened species call the spruce-fir forest home: the Carolina Northern Flying Squirrel, Spruce-Fir Moss Spider, Rock Gnome Lichen, and Spreading Avens - Geum radiatum.

The spruce fir moss spider, is known only from the high elevation spruce-fir communities in western North Carolina. Federally endangered, the spruce fir moss spider is one of the smallest members of the primitive suborder of spiders that are often popularly referred to as "tarantulas" (Harp 1991, 1992). Adults of this species measure only 0.10 to 0.15 inch (about the size of a BB) The typical habitat of this spider is found in damp, but well drained, moss mats growing on rock outcrops and boulders in well shaded situations within these forests (Coyle 1981, 1997, 1999; Harp 1992).

Another species affected by declines in the spruce-fir forest is the **Northern Saw-Whet Owl**. The Saw-whet Owl is primarily a creature of the great boreal forests of

Canada. However, like many other components of the spruce-fir ecosystem, disjunct populations of this nocturnal predator also inhabit spruce-fir forests.

Fewer than 500 pair of saw-whets are left in the high peaks forest. Global warming, air pollution, outbreaks of new pests, and burgeoning recreational demands may further degrade these forests, leading to the possible extirpation of saw whets from the southern Appalachians.(USFS)

At Milepost 423.7, the Blue Ridge Parkway passes near the southern limit of the Saw-whet's eastern breeding range at Tanasee Bald.

The call of the Saw-whet Owl may be heard on calm evenings between March and June along those stretches of the Parkway which pass near upper elevation spruce-fir forests. Calling is heaviest during April and May. The Mt. Mitchell area and the portion of the Parkway between Mt. Pisgah and Richland Balsam are known to contain breeding populations of Saw-whet Owls.

Although it is probably the most common owl of the spruce-fir zone along the Parkway, the Saw-whet has rarely been observed. During daylight hours it roosts in thick evergreen cover, usually on interior branches of vigorous young Red Spruce or Fraser Fir trees. Saw-whets nest in cavities, frequently those excavated by Flickers or other woodpeckers, although a naturally occurring Saw-whet Owl nest has never been observed in the Southern Appalachians. You are much more likely to hear than see our smallest and rarest owl. The unmistakable call, a continuous series of single notes, may be maintained for an hour or more at a time. (WNC Nature Center website).

The ancient Rock Gnome Lichen is another member of the spruce-fir ecosystem that faces challenges. A member of the reindeer moss family, the rock gnome is the only species in its genus to grow in North America. Its

closest relatives live in the Himalayas and the highest mountains of eastern Asia, including Japan. Like other lichens, the rock gnome is thought to be among Earth's first colonizers, clinging to rock surfaces and dissolving nutrients in the soil, allowing other plants like mosses to move in.

Scattered along high, rocky peaks and moist, deep river gorges throughout the Southeast, including the Blue Ridge Parkway and Great Smoky Mountains National Park, the rock gnome lichen was federally listed as endangered in January 1995. At the time, 32 populations were known to exist in the country-only seven covering areas larger than two square meters. Most covered about a yard or less. Since then, the total number of populations has risen to 49.

Evidence shows that certain human activities continue to affect the species' status. Hikers, rock climbers, and sightseers flock to Appalachian summits for grand scenic views and athletic thrills, unaware of the rare and delicate plant life under foot.

"There are places in the Blue Ridge Parkway where you can see footsteps where people have walked [on the lichen]," says Chris Ulrey, a plant ecologist for the park.

"No matter how well we 'sign' a place-whether we use interpretive signs or more law enforcement types-people continue to go into these closed areas. If people really want to help, they should stay on trails and help us police these areas."

Invasive species and dangerously high acidity from air pollution may play a role in population decline as well. The balsam and hemlock wooly adelgids destroy Frasier firs and hemlocks that play vital roles in balancing ecosystems where the rock gnome exists. Streambeds with dwindling hemlock populations lose shade, causing a change in air moisture. Because of the lichen's demand for a precise amount of light and moisture, it cannot adapt quickly enough to such abrupt habitat changes.

A majority of rock gnome populations exist at high altitudes, relying on the moisture from clouds. These clouds may contain large amounts of contaminants produced by nearby coal-burning power plants and vehicular traffic. According to the Park Service, local rainfall in the Great Smoky Mountains is five to ten times more acidic than normal rain, and clouds covering the mountaintops are often 100 times more acidic, resulting in increased damage to vegetation at higher elevations. "It would probably be foolish to assume that air quality does not have an effect on the lichen, but it's a hard thing to prove," Ulrey says, mostly because such monitoring is costly and not an option with current park budgets.

Former U.S. Fish and Wildlife Service (FWS) biologist Nora Murdock, now a National Park Service (NPS) ecologist, expressed her concern for the rock gnome lichen in a statement that applies equally to all threatened and endangered species:

"For the majority of people in this country, their day-to-day lives certainly wouldn't be impacted if the rock gnome lichen disappeared," Murdock says. "But it's one more brick out of the foundation of the building, and we don't know enough about what it's connected to and what it's holding up. Maybe you can get away with pulling one brick out-but then you take another, and another, and at some point you take the final one. The more you look into the connections, the more you realize how complex everything is, how little we know, and how desperately dangerous it is to let these species slip away from us."

The Carolina Northern Flying Squirrel,

another endangered member of the high peaks forest, also depends on the continued success of the spruce fir ecosystem. The squirrels use conifers not only as a food source and den site but also as a source of conifer oils when they ingest fungi from conifer roots and staminate cones. Conifer oils help alleviate the effect of a nematode, Strongyloides robustus, which can

cause the squirrels to become emaciated and unable to reproduce.

The highest quality habitat for the northern flying squirrel is the transition zone between spruce fir forest and the northern hardwood forest, a mix of red spruce, Fraser fir, yellow birch, buckeye, sugar maple and even some beech at elevations above 4000 feet.

The spreading avens, Geum radiatum, is a species of relatively ancient origin. It has existed in the southern Appalachians since before the last Ice Age, but it's future may be limited. This geum exists in small, isolated populations in high-elevation cliffs, outcrops, grassy balds, and steep slopes in full sun. There are only 11 of 16 original sites left. Seven of these support less than 50 plants each, and 3 of those sites support less than 10 individuals.

Geum radiatum

Geum radiatum

Being confined to small areas on a few rocky mountain summits, this species is extremely vulnerable to such seemingly minor threats as trampling by hikers, climbers, and sightseers, as well as to more pervasive threats such as acid precipitation, and other forms of air pollution. An exotic insect, the balsam woolly adelgid, contributes to the decline of the fir forests adjacent to the cliffs where spreading avens grows. Although spreading avens does not grow beneath the dense spruce fir forest, the death of the adjacent forests results in drier and hotter conditions, as well as increased soil erosion. All of these factors threaten the last remaining spreading avens populations.

In closing, Nora Murdock's comments about the rock gnome lichen bear repeating:

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