Sprucing Up the Forest for Fairy Diddles

CLIFTON AVERY

Commission biologists lead habitat restoration projects to benefit the Endangered Carolina Northern flying squirrel

Written by Christine A. Kelly / Photographed by Melissa McGaw

"Stand still! Stand still!" I command. The flailing student comes to a halt but hasn't shaken the long-tailed furry brown hitchhiker clinging to his pant leg: a flying squirrel.





"It won't bite. It just needs a launch point," I say. The flying squirrel scurries up the front of the kid's sweatshirt to his shoulder, pauses to gather itself, then launches into the air. In its panic, it lands short of the nearest tree trunk but scrambles the last few feet, bolting behind it, then dashes up the trunk. From a branch it peers down, its big black eyes blinking at us.

The rest of the students, giggling a few seconds ago, are now hushed with mouths agape, staring back at it. Someone steps closer with a camera and the flying squirrel jumps, floating off in a slow glide down the mountainside. Demonstrating remarkable maneuverability, it banks a hard left to sail past a tree branch and out of sight. The whole course of its glide, which lasts seconds, is accompanied by a chorus of "whoa!" and "that was awesome" and awed laughter.

It is like that every time. There's something magical about a flying squirrel. No wonder its folk name is "Fairy Diddle." I prefer to call them "flyers."

I turn back to the class of aspiring wildlife biologists who attend Haywood Community College. They are helping me check squirrel boxes in the Great Balsams, just up the road from their campus in Clyde. I had just finished measuring and tagging this flying squirrel and put it back in its nest box. I can't make a scurrying sciurid stay put though. This one busted out and dropped to the forest floor right smack in the middle of 20 students, cueing a teachable moment.

"Flying squirrels aren't capable of powered flight," I say. "They glide by pushing off with powerful hindquarters, extending their fore and hind legs, and spreading out their patagium." I demonstrate the patagium (or "wing" membrane) with my arms wide. "To do this, they need a tree for launching." I turn to the student who served as a human launch beam. His expression lies halfway between amused and embarrassed. "Or something tall that serves the same function. An Endangered species just used you as a launch tree. Consider yourself lucky."

Actually, each student was fortunate that day. Sometimes we check boxes without finding any squirrels. Just 10 percent of the roughly 350 boxes checked each winter are occupied. This is no ordinary flying squirrel. It's the Carolina Northern flying squirrel, a critter you are only likely to see if you're really looking for it.

Flyer 101

North Carolina is home to two species of flying squirrels. Both species of these gliding tree squirrels are nocturnal cavity-dwellers. The smaller, grayish-brown Southern flying squirrel is found throughout North Carolina at mid to low elevations, where it subsists on nuts and seeds. The rarer Carolina Northern flying squirrel dons a cinnamon-brown coat and is found only on 13 massifs in North Carolina, Tennessee and Virginia's highest mountains.

In 1985, the U.S. Fish and Wildlife Service listed the Carolina Northern flying squirrel as Endangered, due to its limited and discontinuous range making it vulnerable to habitat destruction, fragmentation or alteration. Biologists noted particular concerns about past and future clearing of forests, introduced insect pests such as the Balsam woolly adelgid, recreation and other development, pollution (heavy metals, pesticides and acid rain) and the potential for global warming further limiting its range.

Despite their similar appearance and ability to glide, North Carolina's two flying squirrels differ in key aspects of their ecology. The Carolina Northern flying squirrel lives in North Carolina's so called boreal forest zone, selecting cool, moist, north-facing slopes. Its haunts are the dark spruce, fir and birch forests above 4,500 feet elevation. There, it consumes truffles, buds, fruits, lichens and anything from bird eggs to nestlings to crayfish.

NATURE'S WAYS

How Do Flying Squirrels 'Fly?'
See Nature's Ways, page 43.

Our acoustic surveys and radio-telemetry tracking data have made it clear that Northern flying squirrels prefer mature conifers. In fact, according to research by Dr. Cordie Diggins and Dr. Mark Ford of Virginia Tech, Carolina Northern flying squirrels have smaller home ranges in high-quality habitat of taller conifers, foraging nightly in the spruce and fir. Why so? The answer may have something to do with the truffles they eat.

As if its gliding ability was not captivating enough, this flying squirrel's role in forest dynamics is also fascinating. At night, they parachute down from the trees to dig for truffles, the fruiting bodies of mycorrhizal fungi associated with the roots of spruce trees. The mycorrhizae form a fibrous net around the roots of the tree, helping the tree capture water and nutrients. The fungus in turn obtains sugar from the tree.

To a flying squirrel, the tasty, nutritious part of the truffle is the tough outer skin. However, they inadvertently ingest some of the spores at the center of a truffle. The undigested spores are dispersed across the forest floor in the flying squirrel's droppings. Other small mammals, such as red-backed voles, do much of the same. However, the flying squirrel's unique gliding locomotion enables it to cover larger areas, dispersing spores broadly. Thus, Dr. Peter Weigl, the preeminent authority on the Carolina Northern flying squirrel, noted that it effectively perpetuates its own habitat. But in some parts of their range, where past land use has drastically altered the forest, the flying squirrels can't do it alone. They need our help.

Changing Times and Trees

On a chilly mountain morning in June, my crew is parked at Black Balsam, donning winter coats and hats. Joining us is volunteer Julie Wade, a wildlife student at Haywood. I fit Julie with an external frame backpack to which I have strapped three ammo cans housing devices that will record the vocalizations of flying squirrels. We're collecting baseline data on flying squirrels in an area slated for habitat restoration. In a few months, we'll be planting nearly 1,000 red spruce seedlings with the help of Julie and her classmates.

First, we want to see if Northern flying squirrels persist here. I have my doubts because the habitat is degraded. Between 1905 and 1920, spruce was logged from every corner of Haywood County's high mountains reachable by railroad. The extraction did not employ the sustainable practices used today. In several areas, including the forest we're about to survey, the slash caught fire. Raging fires in 1925 and 1942 incinerated soil and led to erosion during storms and freeze-thaw cycles. Thus, the loss of habitat that led to the Carolina Northern being listed as Endangered happened over a discrete window of a mere few decades. Mind you, no one even knew about the Carolina Northern flying squirrel back then. It wasn't discovered in North Carolina until 1953.

Across this moonscape of eroded soils, a forest began to recover, only it was not the same forest as before. The spruce-fir forest is not a fire-adapted community. The normal forest dynamics here occur at the scale of individual tree fall gaps. In this newly cleared, soil-depleted setting, acres of blackberry and pioneer hardwoods like fire cherry replaced the spruce and fir that had once grown alongside yellow birch and sugar maple. The forest we now survey

Opposite, left to right: Chris Kelly, a wildlife diversity biologist for the Commission, holds a female Northern flying squirrel caught in Haywood County. Next, Kelly weighs the flying squirrel as part of her research. Middle: Flying squirrels chew raw birch bark down to fine strips to create nesting material. Kelly checks a nesting box for flying squirrels at the Buckeye Creek site in Haywood County. Kelly takes a flying squirrel's measurements.

Biologist Chris Kelly records data in a notebook. Bottom: Both species of flying squirrels that live in North Carolina are nocturnal cavity dwellers that den in trees. The Northern flying squirrel lives in forests of yellow birch and red spruce like this one being planted with spruce seedlings.

features a canopy of 70-year-old yellow birch, with mid-story birch, sugar maple and buckeye. Spruce occurs in small clumps, with some individuals reaching the canopy, but the majority in the mid-story shaded by hardwoods.

That spruce and Carolina Northern flying squirrels persist here seems unlikely. But they have, thanks to flexibility in their life histories. For example, the Northern flying squirrel is not restricted to conifer forests or a diet of truffles; they will use Northern hardwood stands in the absence of conifers and eat a varied diet. Likewise, while red spruce grows faster in the sun, it is not restricted to open areas. Spruce is remarkably shade tolerant. Individuals sometimes sit in the shade of hardwoods for 50 to 100 years ready to grow into the next tree fall gap. And so both remain, but over a much shrunken range and in a heavily altered forest.

But their plasticity has its limits. One threat the Northern flying squirrel faces is upslope encroachment by the Southern flying squirrel. Unlike the Northern flying squirrel, which can subsist on the nutritious oils of Usnea lichens when the snow piles up, the Southern flying squirrel's small body size demands a constant, cacheable supply of nuts and seeds to survive winter's cold. The lack of such a source of hard mast in the spruce zone seems to limit Southerns from becoming established there as a year-round resident. Warmer winters may increase contact between the two species, as the Southern flying squirrel ventures upslope, bringing with it the parasitic intestinal worm *Strongyloides robustus*. The Southern flying squirrel fares well when infested by this parasite, but the Northern flying squirrel does not.

Planting for the Future

A healthy, robust Northern flying squirrel population needs high-quality, well-connected forest habitat. Restoration of this forest community is the mission of the Southern Appalachian Spruce Restoration Initiative (SASRI), which formed in 2012 and is a partnership among agency biologists, non-governmental organizations, university researchers and nonprofits. SASRI partners guide restoration objectives and propagation, planting and monitoring efforts. One of SASRI's objectives is to restore conifers to hardwood-dominated stands, creating a mixed forest. Another goal is to restore connectivity between patches of high-quality habitat to enable dispersal of the squirrels.

In some areas, large swaths of blackberries separating forest patches exceed the flyer's glide distance (and tall students are unlikely to be standing at the ready as squirrel launch pads). Squirrel-sponsored spore spreading may achieve these objectives, but at a snail's pace and only in those areas having a spruce seed source. Biologists and foresters can speed up the process by planting spruce seedlings where they are scarce and releasing existing seedlings to sunlight to accelerate growth. Release is accomplished by selectively cutting hardwood trees shading vigorous spruce trees in the understory.

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First though, we need seedlings—preferably locally-sourced seedlings. The nearest are in West Virginia, so we grow our own. Each autumn, I find myself crouched beneath towering spruce trees, picking fresh red cones off the forest floor and dropping them into brown paper bags. Fingers sticky with sap, I leave the cool mountain top to deliver my cone haul to The Southern Highlands Reserve, a native plant arboretum and research facility on Toxaway Mountain in Transylvania County. Their small staff have grown spruce for 10 years and are experts at extracting seed from cones, cataloging the germinating plants and growing such vigorous seedlings that they prefer to call them small trees.

Since 2013, spruce has veritably taken over the Reserve's nursery space. The four restoration efforts implemented thus far clear out the nursery in a matter of hours as partners load trucks and trailers with trees bound for the woods. The experience leaves Southern Highlands Reserve Director Kelly Holdbrooks reeling with a mix of excitement for contributing to conservation and sadness to see the trees go. Her sadness is short-lived as she turns around to start the next batch of seedlings that will be needed.

In September, we're back at the Black Balsam parking lot having just cleared out the Reserve's seedling stock. The restoration site is 1 mile from the parking lot. Volunteers from hiking clubs and trail maintenance crews spend two days hauling seedlings down the trail. Haywood instructor Shannon Rabby distributes hard hats and shovels to his forestry students. Everybody leaves the parking lot with a sack of red spruce seedlings. The seedlings are freshly watered, weighing that much more.

The students bring enthusiasm to the planting days, despite having never seen a Carolina Northern flying squirrel. They plant the trees quickly (hoping to exceed the number planted by Warren Wilson College's forestry crew which will plant later that week) but they plant with care. Throughout, they pepper me with questions and ideas about release work and monitoring. Their forestry education comes to life with each seedling they bury in the ground. A few muse that they want to see these trees in 30 years. And of course, they all want to see a Carolina Northern flying squirrel. So, I invite them back to help me check squirrel boxes in the winter. I can't promise we'll catch any Northern flying squirrels, but if we do, maybe someone will be lucky enough to serve as a launch pad.

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