

A Habitat Model for Virginia Northern Flying Squirrel (*Glaucomys Sabrinus Fuscus*) in West Virginia



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POSTER SIDE 1:

Introduction

For common wildlife species, data are gathered through both detailed macro- and microhabitat research on habitat use, home ranges, food habits, etc. (Shriner et al. 2002). However, for many endangered species, the consequence of uncertainty is that management plans frequently are not developed. Because of low population density, patchy distribution, and cryptic nature, habitat models are especially useful for rare, threatened, or endangered species, such as the Virginia northern flying squirrel (*Glaucomys Sabrinus Fuscus*) that inhabit forested landscapes, yet are difficult to physically survey. The Virginia northern flying squirrel is one of two federally endangered subspecies of the northern flying squirrel restricted to relict, montane boreal and northern hardwood forests in West Virginia. The Virginia subspecies occurs or could possibly occur in many counties located in the high elevations of the Allegheny Mountains in eastern West Virginia and extreme northwestern Virginia (Well-Gosling and Heaney 1984, U.S. Fish and Wildlife Service 1985, Odom et al. 2001).

In 1985 the West Virginia northern flying squirrel was protected as an endangered subspecies under the Endangered Species Act because it was determined to be in danger of becoming extinct. At that time only 10 squirrels were captured in four separate areas of its range. Today federal and state biologists have captured more than 1,100 squirrels at over 100 sites, and believe that this subspecies no longer faces the threat of extinction (Jennifer).

Small nocturnal animals, West Virginia northern flying squirrels are covered with soft, dense, silky fur that is brownish above and grayish beneath. Individuals are about a foot long, half of which is the broad, flat tail, and weigh less than five ounces. These squirrels seem to live in small groups and commonly share nests. They communicate with high-pitched chirps. Unlike other squirrels, West Virginia northern flying squirrels remain active in the winter. Their large, dark eyes enable these squirrels to see in low light. During the night, the squirrels are very active moving among trees and on the ground. Again, unlike other squirrels, West Virginia northern flying squirrels usually forage on lichen and fungi growing above and below ground instead of eating nuts. The single most important factor in the squirrels' population resurgence has been the regeneration of its forested habitat.

Materials and Methods Study Area

Common Name

Northern Flying Squirrel

Scientific Name

Glaucomys Sabrinus Fuscus

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Status

Although northern flying squirrel populations are stable throughout much of the species' range, the U.S. Fish and Wildlife Service officially listed the two southern Appalachian subspecies as Endangered in 1985 (U.S. Fish). One subspecies is found in West Virginia and an adjacent county of Virginia; the other subspecies occurs in North Carolina, Tennessee, and extreme southwestern Virginia.

West Virginia Status

The subspecies which occurs in West Virginia was first described in 1936 based on a specimen captured near Cranberry Glades, Pocahontas County. In West Virginia, the northern flying squirrel is now known from 90 sites in higher elevations (Natural Resource). Description The northern flying squirrel is a small, nocturnal mammal weighing 90-148 grams (3.2-5.2 ounces) and measuring 260-305 millimeters (10.25 to 12.0 inches) in total length (tip of nose to tip of the last tail bone) (Natural Resource). It has a long, broad, flattened tail, very large, dark eyes, and thick, silky fur. These squirrels glide in the air on the parachute created when they stretch all four legs and pull the loose folds of skin (patagia) between their fore and hind legs taut. Females are thought to have one litter of up to four young each year while biologists do not know for sure. The expected life span is thought to be about four years.

West Virginia northern flying squirrels live in high-elevation, spruce-northern hardwood forests of the Allegheny Highlands consisting of red spruce, fir, beech, yellow birch, sugar or red maple, hemlock and black cherry. The fur is light brown to reddish brown in color while the belly fur is mostly white. The distinctive patagia (folds of skin between the ankles and wrists) and the broad tail allow the squirrel to glide from tree to tree; bats are the only mammals that can truly fly.

There are two species of flying squirrels found in West Virginia, the northern flying squirrel (*Glaucomys Sabrinus Fuscus*) and the southern flying squirrel (*Glaucomys Volans*). The endangered northern flying squirrel can be distinguished from the common southern flying squirrel by its larger size and greater adult weight (90-148 grams (northern) vs. 50-90 grams (southern), the dark tip of its tail, and belly hairs which are gray at the base and white at the tip as opposed to the entirely white hairs of the southern flying squirrel. The coloration of the northern flying squirrel is "richer" than the relatively dull and paler southern flying squirrel.

Habitat

As its name implies, the northern flying squirrel is typically found in boreal habitats, especially spruce/fir/hemlock and northern hardwood forests. In West Virginia, this squirrel is usually associated with red spruce and northern hardwoods such as sugar maple, black cherry, American beech, black birch, and yellow birch.

These habitat types are most common in areas over 909 meters (3,000 feet) in elevation. Most known occurrences of the northern flying squirrel are in moist forests with at least some mature trees, standing snags, and downed logs; lichens and mosses are often abundant. In the southern

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Appalachians, northern flying squirrels tend to occupy small and potentially vulnerable islands of high elevation habitat. Land cover within 830 m of a northern flying squirrel capture site is protected (Natural Resource). We downloaded county boundary data for West Virginia from West Virginia GIS Technical Center; We also standardize, weigh, and use Map Algebra to manipulate the data by using reclassify tool in Geographic information systems (GIS) (Natural Resource).

Tools

Geographic information systems (GIS) can be used to construct spatially explicit habitat models for both common and rare wildlife species (McCombs 1997, Gibson et al. 2004, Posillico et al. 2004). With adequate data collection, such models often can analytically identify specific habitat characteristics across wider landscapes with high predictive power and therefore provide considerable utility.

Threats and Prospects

Most of the known locations of this squirrel are within the Monongahela National Forest and are protected. Under the present Forest Management Plan, all habitat within 0.83 kilometers (0.5 mile) of a northern flying squirrel capture site is protected (Natural Resource).

Because of its forested habitat, many agencies have fostered large spruce restoration projects that restore the historic red spruce ecosystem of the Allegheny Highlands in West Virginia. By growing acres of maturing forest and the interest in protecting the red spruce ecosystem can create a favorable forecast for the future of West Virginia northern flying squirrels for living.

Study area

To obtain habitat-use data to incorporate into our habitat modeling, we radio-tracked Virginia northern flying squirrels in the Allegheny Mountains on the MeadWestvaco Ecosystem Research Forest (MWERF) near Adolph, WV (38.74°N, 80.05°W; Randolph County) and on the Monongahela National Forest (MNF) near Parsons, WV (38.55° N, 79.83° W; Randolph and Tucker counties). Specific sites on the MNF included Stuart Knob, Canaan Heights, and McGowan Mountain areas.

Under the aegis of the United States Endangered Species Act of 1973, the presence of Virginia northern flying squirrels severely restricts active management for most purposes of remaining montane boreal stands in the Allegheny Mountains. Trepidation to undertake management activities, such as red spruce restoration that could benefit the Virginia northern flying squirrel, is due in part to the poorly defined distribution of the species in the region. Nonetheless, the restricted distribution of this subspecies makes it an excellent candidate for a habitat model because the range is large enough to encompass a landscape-level analysis, but small enough to be geographically definable and logistically manageable.

Elevation ranged from 64 to 1482 m in West Virginia. The climate is generally cool and moist with annual precipitation ranging from 120 to 150 cm, much of which occurs as snow during the

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winter months (Stephenson 1993). The forest community at the higher elevations (>909 m) was comprised of red spruce, eastern hemlock, sugar maple (*Acer saccharum*), red maple (*A. rubrum*), yellow birch (*Betula alleghaniensis*), American beech (*Fagus grandifolia*) and black cherry (*Prunus serotina*).

Habitat Model Construction

For the habitat model, we used West Virginia northern flying squirrel data from US Fish and Wild Life Service, West Virginia Northern Flying Squirrel (*Glaucomys Subrinus Fuscus*) data from Natural Resource Conservation Service to build a predictive model of occupancy. We determined land-cover types from a variety of sources, including Land Cover (WV) data in West Virginia Gap Analysis (GAP) from West Virginia GIS Technical Center in 1992, Digital Elevation Dataset (30-meter NED) from West Virginia GIS Technical Center in 1999 and Minor Civil Divisions/County Subdivisions (2000 and 2010 Census) data from West Virginia GIS Technical Center in 2011.

Geographic information systems (GIS) can be used to construct spatially explicit habitat models. Project Coordinate System was a resolution with a Universal Transverse Mercator (UTM) projection using the North American Datum 1983 (NAD 1983) Zone 17 North datum.

Additionally, the elevations where flying squirrels locate greater than 909 m were used more than would be expected based on landscape availability. Therefore, we incorporated these parameters into the construction of our habitat model. Only forested elevation types were used in the analysis and were given binary values for analysis (no data or elevation is under 909 m = 0, elevation is above 909m = 1). We created 2 classes for value 1 and 0; value 1 meets criteria or habitat, value 0 don't meet criteria or not habitat.

We created geographic surfaces, such as elevation and aspect, for the GIS using ArcView Spatial Analyst® from a digital elevation model (DEM) for elevation raster image from West Virginia GIS Technical Center in 1999. To manipulate data, we use reclassify function in spatial analyst tools to get the area meets criteria, which the flying squirrels live above 909 m elevation.

We standardized forest types where flying squirrel is located. Only forest types were used in the analysis and were given binary values for analysis (Mountain conifer forest, mountain hardwood/conifer forest, mountain hardwood forest, cove hardwood forest, northern hardwood forest of Allegheny highlands, Monongahela National Forest, Appalachian Mountains, northern hardwood/ evergreen forest of northern US = 1, everything else = 0). We created 2 classes for value 1 and value 0; value 1 meets criteria or habitat, value 0 don't meet criteria or not habitat.

We classified the raster imagery into land-cover types and elevation requirements which met the criteria (figure 1 and 2). We again reclassified the data to get only the area meets all criteria by

using raster calculator; we got the result as a following image (figure 3). We added the county boundary data and got the final result in West Virginia (figure 4).

POSTER SIDE 2:

Results

This model had a reasonably high predictive capability in identifying location of predicted Virginia northern flying squirrel habitat cover in West Virginia is calculated by using the number count of value 1 (habitat) (**3,985,570**) multiply to width (**30m**) and height (**30m**) and divide to conversion factor (**4048**) = $3,985,570 * 30 * 30 / 4048 = 886,119.81$ square meters. The area is covered for Northern Virginia flying squirrel (*Glaucomys Sabrinus Fuscus*) is **886,119.81** square meters or 9,538,114.2533118 square feet.

Discussion

Our Virginia northern flying squirrel habitat model is not only a definitive attempt to predict presence or absence but only an attempt to identify areas where conservation and/or forest-habitat enhancement could be prioritized. From a regulatory management standpoint, this model could contribute to protection and mitigation efforts on private lands in the region where mining, recreational development, resident construction, growing busy road, and wind energy development. Genetic isolation combined with unsuitable habitat greatly increases the chances of localized displacement or complete extinction of these subspecies. Also, there are many other natural and modified landscape features that could function as physical barriers to movement by flying squirrels.

Our predictive maps could be used to identify marginal habitat where active forest management or restoration activities could improve vegetative or structural conditions in the future as a first step (Schuler et al. 2002). Moreover, our model may help reduce the time and efforts for future Virginia northern flying squirrel surveys and/or research activities. Finally, our model provides a spatial map that shows how all of the optimal habitat patches are spatially related to each other. Conservation planning and/or long-term habitat restoration efforts can be benefit such as the release of understory spruce or the connecting of optimal patches with habitat corridors that would allow inter-patch movement.

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Maps

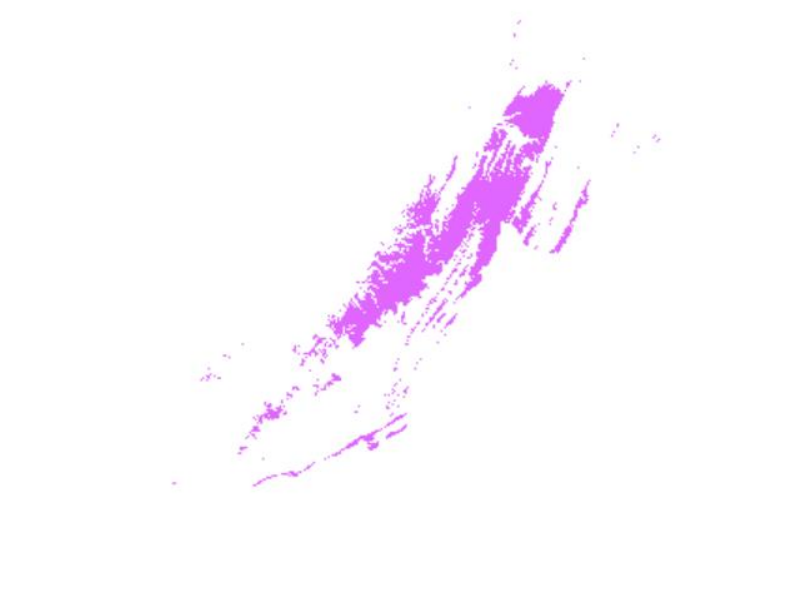


Figure 1.-Predicted Virginia northern flying squirrel habitat on elevation above 909m in West Virginia.

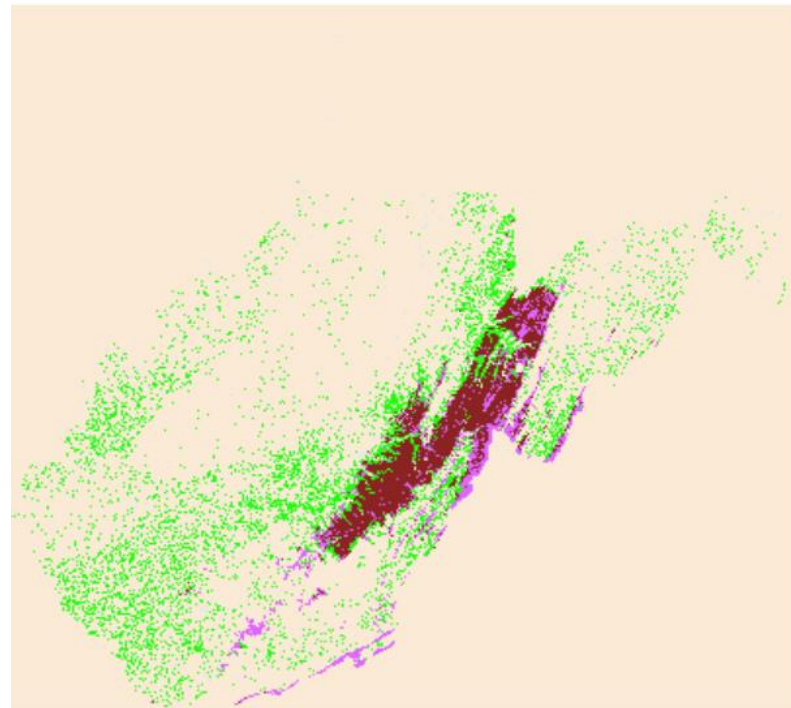


Figure 2.-Location of predicted Virginia northern flying squirrel habitat in several forests, where flying squirrels are located in eastern West Virginia. The green denotes the forests, where flying squirrel locates in West Virginia. The dark red denotes the elevation meet the criteria in eastern West Virginia.

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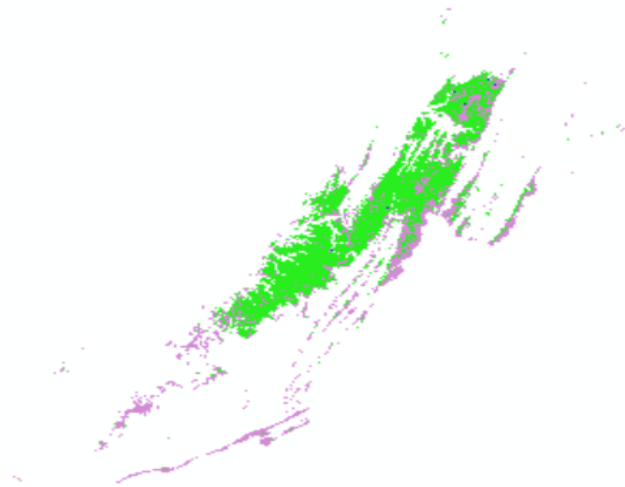


Figure 3.-Location of predicted Virginia northern flying squirrel habitat in eastern West Virginia. The purple denotes the forests, where flying squirrel locates in West Virginia. The green denotes the elevation meets the criteria (elevation above 909m) in eastern West Virginia.

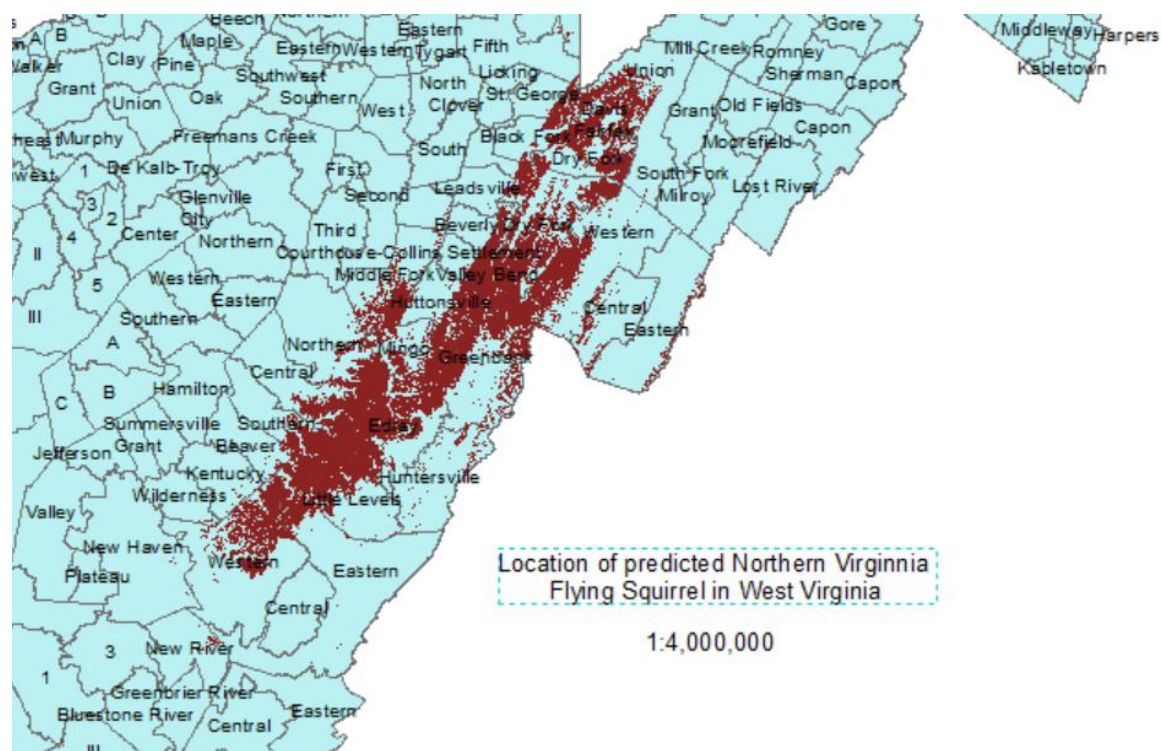


Figure 4.-Location of predicted Virginia northern flying squirrel habitat in several counties of eastern West Virginia. The dark red denotes