

Salamander Diversity and Abundance Along Buck Run in The Laurel Fork Area of Highland County, Virginia

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Salamanders are distributed mainly in the temperate regions of the world with most species occurring in North America. Individuals usually are less than fifteen cm long and, although some are entirely aquatic, many species live under rocks and logs in damp woods. North American species are primarily woodland and belong to the family Plethodontidae. The southern Appalachians contain the

Highest levels of salamander species diversity and endemism (Dunn, 1926; and Highton, 1971 In Pague and Mitchell, 1987). In Virginia there are forty-five species, with highest salamander species diversities being found in the southern Blue Ridge (including the Mount Rogers highlands) and the New River Valley (Pague and Mitchell, 1987).

Governor's School participants (1994) found that both diversity and density of salamanders were greater at lower elevations on Whitetop Mountain in southwest Virginia. They collected a total of 37 salamanders distributed among seven species at 1402 m, but only three species and thirteen individuals at 1646 m. The 1995 Governor's School students conducted a similar study of salamanders occurred at the highest elevation (1082 m). However, this "highest" elevation near the ridge of Peters Mountain was well below the lowest altitude on Whitetop. The dominant species at the highest and middle (945 m) elevations was the slimy salamander (*Plethodon glutinosus*.) Slimy and redback (*P. cinereus*) salamanders were found mainly under rock, whereas the only Jefferson salamander (*Ambystoma jeffersonianum*) a species not previously reported from Alleghany County, was discovered beneath a log. At the lowest elevation (457 m along a stream), the mountain dusky salamander (*Desmognathus ochrophaeus*) was the only species found.

Methods and Materials

In 1996 the Governor's School surveyed the Laurel Fork area of Highland Co., in the extreme western portion of the Commonwealth. The Laurel Fork area in Highland County is located within the George Washington and Jefferson National Forests. This area has vegetation resembling that of southern Canada because of the high elevations (914-1280 m) which provide a year-round cool, moist environment. Temperatures often are 5-10° C cooler than in nearby Monterey and commonly dip to 4-10°C on some nights in July. Red spruce (*Picea nibe*), a species more characteristic of New England or Canada than Virginia, is abundant in the forests. It is found with other northern hardwood species, including beech (*Fagus grandifolia*), black cherry (*Prunus serotina*), and yellow birch (*Betula peltata*). Such an aggregation of northern species is rare elsewhere in Virginia where oak forests typically predominate. This region may represent the largest expanse of uninhabited "wilderness" found in Virginia.

The Laurel Fork area in the northwest corner of Highland County is one of thirteen "local sites of special concern in Virginia" designated by Richard Hoffman (1987). The spruce forests represent a habitat type found at no more than fifteen other localities in the state (Adams and Stephenson, 1991), and the northern hardwood forests are among the most extensive examples of this forest type in Virginia. The uniqueness of the area has attracted herpetologists from Virginia and neighboring states for years. Pague and Mitchell (1987) reported nineteen species of salamanders from the Laurel Fork area alone (Young, 1993). One species which has sparked a great deal of interest since its discovery at nearby high elevation sites in West Virginia, is the Cheat Mountain salamander (*Plethodon nettingi*). Some (Brock Tucker, pers. comm.) have suggested this species may well occur at Laurel Fork. In fact, Hoffman (1987)

claims that the Laurel Fork area is the most likely place for the occurrence of this species, if its range includes any part of Virginia.

The purpose of this study was to investigate the relationship of density and diversity of salamanders to elevation in the Laurel Fork area of Highland County. We hypothesized: (1) density and diversity of salamanders would decrease as elevation increased and (2) salamanders would be distributed in equal abundance under rocks and logs.

The first collection site at 884 m, along the elevational transect extending up the Buck Run Trail from Laurel Fork to the Locust Springs picnic area, was established near its junction with the Laurel Fork Trail. Each of four groups (six to seven persons each) spread out over an area of approximately 50 X 50 m (0.25 ha) for a period of fifteen minutes to look for salamanders. All cover objects (*i.e.*, logs and rocks) were turned over and the bases of stumps and trees, as well as leaf litter, were thoroughly searched. All moved objects were carefully replaced. The search included Buck Run and its banks. Salamanders collected were tallied as to habitat and identified to species. This process was repeated at other elevations of 914, 945, 975, 1006, 1036, 1067 and 1116 m. Northern hardwood trees tended to dominate at all sites except for the highest elevation which was dominated by red spruce (*Picea rubens*). Collections at elevations 884-1,006 m were made in Buck Run, along its immediate banks, and on the slopes rising from either side. Slopes on the sides of Buck Run at the 1,006 m collection site were not as steep as those at sites located from 884 to 975m. The two collection sites at 1,036 and 1,067 m were on the northeasterly facing slope well above Buck Run. The collection site at the highest elevation (1,116 m) was in the very wet flat, dominated by red spruce and hemlock

(*Tauga canadensis*), located immediately above the beaver ponds near the Locust Spring picnic area. Collection sites at 914 and 1,006 m included seep areas.

Results

Overall, 225 salamanders were found representing nine different species (Table 1). Over fifty percent of the individuals were mountain dusky salamanders (*Desmognathus ochrophaeus*). The least abundant, the northern dusky salamander (*D. fuscus*), accounted for less than one percent of all salamanders collected.

Nearly ninety percent of all salamanders were collected from under rocks and logs, with few (3.1%) found in the water. Eight of the nine species were found under rocks and seven under logs. Only two species were actually collected from within streams.

The species and number of salamanders varied noticeably through the elevation gradient (Table 1). As elevation increased both the number and species of salamanders generally increased. The greatest numbers were found at 1,006 m, 1,036 m, and 1,167 m, whereas the fewest were collected at the lowest elevations (884 and 914 m).

Elevation	Species	No.
Site 1 884	<i>Desmognathus ochrophaeus</i>	9
	<i>Notophtalmus viridescens</i>	1
	<i>Plethodon cinereus</i>	6
	<i>Plethodon glutinosus</i>	2
	Total	18
Site 2 914	<i>Desmognathus monticola</i>	2

	<i>Desmognathus ochrophaeus</i>	9
	<i>Gyrinophilus prophyriticus</i>	2
	<i>Notophthalmus viridescens</i>	1
	<i>Plethodon wehrlei</i>	2
	Total	16
Site 3 945	<i>Desmognathus monticola</i>	1
	<i>Desmognathus ochrophaeus</i>	19
	<i>Plethodon cinereus</i>	3
	<i>Plethodon glutinosus</i>	3
	<i>Plethodon wehrlei</i>	1
	Total	27
Site 4 975	<i>Desmognathus monticola</i>	3
	<i>Desmognathus ochrophaeus</i>	21
	<i>Gyrinophilus</i>	1
	<i>Notophthalmus viridescens</i>	1
	<i>Plethodon glutinosus</i>	5
	Total	31
Site 5 1,006	<i>Desmognathus monticola</i>	4
	<i>Desmognathus ochrophaeus</i>	17
	<i>Notophthalmus viridescens</i>	1
	<i>Plethodon cinereus</i>	4
	<i>Plethodon glutinosus</i>	9
	Total	35

Site 6 1,036	<i>Desmognathus ochrophaeus</i>	16
	<i>Eurycea bislineata</i>	1
	<i>Gyrinophilus porphyriticus</i>	1
	<i>Plethodon cinereus</i>	9
	<i>Plethodon glutinosus</i>	5
	<i>Plethodon wehrlei</i>	4
	Total	36
Site 7 1,067	<i>Desmognathus ochrophaeus</i>	4
	<i>Eurycea bislineata</i>	2
	<i>Notophthalmus viridescens</i>	2
	<i>Plethodon cinereus</i>	12
	<i>Plethodon glutinosus</i>	6
	<i>Plethodon wehrlei</i>	1
	Total	27
Site 8 1,116	<i>Desmognathus fuscus</i>	2
	<i>Desmognathus ochrophaeus</i>	21
	<i>Eurycea bislineata</i>	2
	<i>Gyrinophilus porphyriticus</i>	7
	<i>Notophthalmus viridescens</i>	1
	<i>Plethodon cinereus</i>	1
	<i>Plethodon glutinosus</i>	1
	Total	35

With the exception of the site at 1,067 m, where the redback salamander (*Plethodon cinereus*) was the dominant species, the mountain dusky was dominant. The northern dusky (*Desmognathus fuscus*) was found only at the highest elevation site, a seep habitat. The mountain dusky and slimy (*P. glutinosus*) salamanders tended to be more abundant in the mid-elevational segments, although the mountain dusky also was numerous at the highest elevation. By contrast, the Plethodontids (redback, slimy, and Wehrle's (*P. wehrlei*) tended to be more abundant at the higher elevations (with the exception of the highest elevation where their numbers decreased). The spring salamander (*Gyrinophilus porphyriticus*) clearly attained its greatest abundance in the red spruce-hemlock stand at the highest elevation. The two-lined salamander (*Eurycea bislineata*) was found only at the three highest elevations, whereas the red eft (*Notophthalmus viridescens*) was found in generally low numbers long the entire elevational gradient. Surprisingly, the two-lined salamander was away from its normal habitat, water, by as far as 50 meters. A Bray-Curtis ordination conducted on the eight salamander communities placed sites 1, 3, and 4 together near the middle of the two dimensional array (Figure 1). These sites were low in diversity and similar not only in composition of salamanders, but also in vegetation, aspect, and inclination. Note that Site 7 (1,067 m) at one end of the X-axis of the ordination, was dominated by the redback and had the highest diversity of any site. At the opposite end of the same axis, site 2 represents a unique assemblage of the seal, spring, Wehrle's and mountain dusky salamanders. The Y-axis constitutes a gradient from maximal importance by the slimy salamander (site 5) to the only site where the northern dusky was present (site 8).

Figure 1. Bray-Curtis ordination based on assemblages of salamanders collected at each site along the elevational gradient.

Discussion

Weather conditions during our study were very favorable for collecting salamanders. It was humid due to thunderstorms that occurred the previous day and night, and the temperature was moderate throughout the day. The salamanders were active and easily found, even at a distance away from the stream.

Where diversity of trees was greater, the humidity seemed higher and moisture was present. This may explain why more salamanders were found in areas with a greater diversity of trees. In general, the salamanders preferred sites that were more moist. An area with level terrain and a high diversity of trees was associated with the largest number and species of salamanders collected.

The low number of salamanders found under logs could have been due to the fact that some salamanders live inside logs, or due to the abundance of rocks. It was impossible for us to look inside logs without destroying vital ecosystems. The low number of salamanders collected from the stream itself could have been due to the greater difficulty of capturing them in the water than on terrestrial habitats. This made it more difficult to document some of the salamanders in and around the stream. Salamanders seen but not caught and definitely identified were not included in our results. Outside the survey area (e.g., the Laurel Fork Trail), we found an abundance of red efts. The low number of these found along our transect was surprising, especially given the distinctively bright color of the red eft.

The fact that fewer salamanders were collected at the lower elevations may reflect our lack of experience at catching them. On the other hand, since the number of salamanders we found gradually increased until we reached 1,067 m (presumably the driest site), the true effect of the complex-elevational gradient on their distribution seems a more likely explanation. Although the mountain dusky was by far the most abundant salamander, it did drop substantially at 1,067 m to only 14.8 percent of the total collection at that site. The redback on the other hand, rose to its highest number making up 44.4 percent of the catch at this same site. This might reflect the fact, "that the *D. ochrophaeus* is normally found. . . not actually in the water, but where the ground is saturated." The redback is a terrestrial salamander confined more or less to wooded or forested areas (Conant and Collins 1991).

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