

Abundance and Diversity of Stream Salamanders on Golf Courses

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Objectives:

1. Measure stream salamander abundance and diversity on 10 golf courses in western North Carolina to make biologically relevant management suggestions to improve the quality of golf courses for amphibian biodiversity.

Start Date: 2008

Project Duration: two years

Total Funding: \$65,800

The southern Appalachian Mountain region harbors an exceptional amphibian diversity that is dominated by salamanders. These salamanders are integral ecological components of the headwater ecosystems they inhabit where they often account for the majority of vertebrate biomass. They are found in close association with headwater stream habitats, forming communities that are comprised of five to nine species from the genera *Desmognathus*, *Eurycea*, *Gyrinophilus*, and *Pseudotriton*. These salamanders all have biphasic life cycles consisting of an aquatic larval stage that is followed by a terrestrial adult stage.

Stream salamanders are dependent upon both the stream and the surrounding riparian habitat for foraging, breeding, and dispersal. Though less conspicuous and least studied, the larval stage is essential to the persistence of or the reestablishment of adult salamanders in the surrounding riparian habitat. Managing landscapes with an eye for both human use and preservation of biodiversity can create a win-win situation for stakeholders and wildlife. Considering that the average golf course consist of more than 150 acres of green space (70% is rough, non-play areas) and there are more than 17,000 golf courses in the U.S. that total over 2.2 million acres, we suggest there is great potential for golf courses to serve as sanctuaries for many



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wildlife species if the habitat needs of species are present.

Our project measured stream salamander abundance and diversity in order to make biologically relevant management suggestions to improve the quality of golf courses for stream salamanders. We sampled 10 golf courses in the montane region of the southern Appalachians within a 25-mile radius of Highlands, NC to compare upstream, through-course, and downstream areas. We also conducted chemical analyses of leaf litter in streams to test for the presence of insecticides, herbicides, and fungicides that may affect the survival of aquatic larvae.

During the 2009 summer field season, Mark Mackey (PhD student) and two field technicians were able to catch

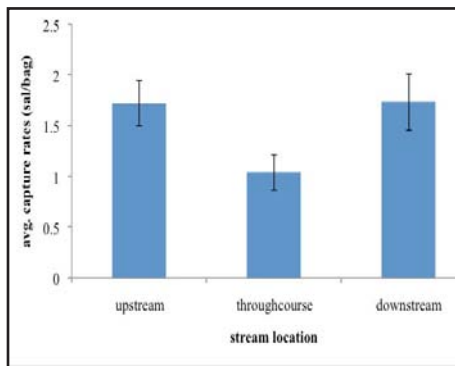


Figure 1. Average larval salamander capture rates per leaf litter bag for stream segments located upstream, through, and downstream of actively managed golf course areas.

over 2,300 salamanders of seven species on the 10 golf courses involved in this study. They sampled salamander larvae using leaf litter bags that were placed in streams to act as aquatic refugia. Each course contained 30 leaf bags, with a total of 300 leaf bags in the study. Each of the 300 leaf bags was checked three times throughout the field season producing a total of 1,015 salamanders (Figure 1).

Adult salamanders were sampled by visiting the golf course streams at night. Two researchers would systematically search each bank of the stream, catching or noting all salamanders that were encountered. There were six stream transects per course with a total of 60 in the study. Each

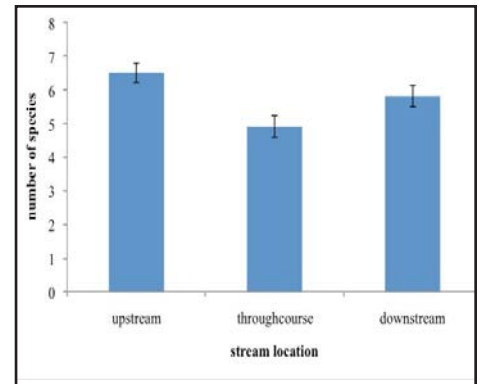


Figure 2. Average number of stream salamander species detected in stream segments located upstream, through, and downstream of actively managed golf course areas.

of these transects was surveyed three times throughout the field season, producing a total of 1,200 adult salamanders.

A total of seven species of larvae and adults were captured on the 10 golf courses (Figure 2). Twelve different habitat measurements were recorded and quantified at the 60 stream transects at the beginning, middle, and end of the summer field season. Aquatic habitat characteristics measured include pH, dissolved oxygen, water temperature, percent sedimentation, percent substrate cover (sand, pebbles, conglomerates), amount of coarse woody debris, amount of cover rocks, water surface velocity, stream width, and stream depth.

Summary Points

- A total of 2,215 salamanders of seven species were caught on the 10 golf courses during the 2009 field season.
- The 300 total leaf bags were checked three times throughout the field season, producing 1,015 larval salamanders.
- The 60 total stream transects in the study were surveyed on three different nights, resulting on 1,200 adult salamanders.
- Data on 12 important aquatic and terrestrial habitat characteristics, including chemical contaminants, were quantified in order to better understand the influence of golf course management techniques on the stream salamander communities.