Managing for Invasive Species and Pesticide and Fertilizer Exposure: How Golf Courses Can Bolster Amphibian Communities

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Objectives:

1. To test the interaction of three stresses (i.e. invasive species, insecticide exposure, and fertilizer exposure) that can affect amphibian population diversity on golf courses.

Start Date: 2003
Project Duration: two years
Total Funding: $59,000

During this year of funding we have completed our proposed study for year two on the interactive effects of an invasive species (overwintered bullfrog tadpoles) on amphibians reared in enclosures in golf course and reference ponds. Additionally, we examined the effect of water from golf course ponds on tadpoles reared in the presence or absence of predators in the laboratory. We also conducted two other studies that relate the how golf course ponds may impact amphibian communities: a cattle tank study examining the effects of overwintered bullfrog tadpoles and a pathogenic fungus on a larval amphibian community, and a cattle tank study on the interactive effect of three contaminants on an amphibian population.

Bullfrogs are a common invasive species in golf course water features.

We will begin analyzing the results and preparing to write manuscripts this fall and winter; additionally, portions of this data will be presented at the annual meeting for the Society of Environmental Toxicology and Chemistry meeting on November 15th in Portland, OR, and at the Fifth World Congress in Herpetology in Stellenbosch, South Africa in June 2005.

The objective of our proposed study was to determine how amphibians reared in golf course ponds differed from those reared in reference ponds by comparing size, time, and survival to metamorphosis of spotted salamanders (*Ambystoma maculatum*), American toads (*Bufo americanus*), and southern leopard frogs (*Rana sphenocephala*).

We reared these amphibians together in field enclosures that measured approximately 0.7 m X 1.5 m X 1 m. Half of the enclosures included the presence of overwintered bullfrogs, which may be a strong competitive stress in these habitats. We used a total of 40 enclosures, with ten enclosures located at two reference ponds and two golf course ponds. Amphibians were added after hatching and reared through metamorphosis.

Preliminary analyses suggest that toads and frogs reared in golf course ponds did well relative to anurans reared in golf course ponds. Salamanders, however, appear to have done less well on golf course ponds than in control ponds. This may be a result of what appears to low abundance of invertebrates in golf course ponds relative to control ponds (i.e., it looks like a high abundance of insect predators in reference ponds resulted in the elimination of toads and frogs, toads and frogs in golf course ponds did not experience this stress).

Spotted salamanders appear to have done less well on golf course ponds than in control ponds probably due to limited zooplankton and invertebrates in golf course ponds.

Salamanders may be more negatively impacted by golf courses since their food resource base is invertebrates/zooplankton, and these resources appeared to be scarce from our water samples. We'll be able to determine if amphibians can complete the aquatic phase of their life cycle in habitats located on golf courses, and whether the presence of bullfrogs influences amphibian abundance and diversity.

Summary Points

- The objective this study is to determine how amphibians reared in golf course ponds differed from those reared in reference ponds by comparing size, time, and survival to metamorphosis of spotted salamanders, American toads, and southern leopard frogs.
- Preliminary analyses suggest that toads and frogs reared in golf course ponds did well relative to anurans reared in golf course ponds.
- Salamanders may be more negatively impacted by golf courses since their food resource base is invertebrates/zooplankton, and these resources appeared to be scarce from our water samples.