Golf Course Maintenance and Amphibian Conservation

Frostburg State University

Dr. James Howard

Start Date: 1997
Number of Years: 3
Total Funding: $105,036

Objectives:

Laboratory Studies:

1. *To test the relative toxicity of the most commonly used pesticides (insecticides, fungicides and herbicides) with three diverse taxa of amphibians.*
2. *To develop a more complete and biologically realistic testing protocol including: a) multiple species; b) short term acute and long term chronic tests; c) multiple life history stages; d) multiple indicators of biological impact; and e) an environment that provides the opportunity to detoxify or potentiate chemicals with more biological realism.*

Field Studies:

3. *To access the feasibility of "stocking" wetlands in order to establish breeding populations of desired amphibian species.*
4. *To evaluate the relative success of small temporary wetlands versus a larger permanent body of water stocked with the same amphibians.*

Laboratory study. The toxicity of three fungicides (Chipco, Daconil and Fore) was investigated using wood frog tadpoles (Rana sylvatica) and grey treefrog tadpoles (Hyla chrysoscelis). Prior to beginning the chronic exposures, range finding 48 hr LC_{50}s (concentration of pesticide needed to kill 50% of test organisms) were determined using wood frog tadpoles. Chipco was the least toxic with LC_{50} values of 283,000 ppb. Daconil and Fore were thousands of times more toxic with LC50s of 170 ppb and 55,000 ppb, respectively. Chronic trials on wood frogs were completed in June and gray treefrog trials in October. Tadpoles were exposed to 0.5 x LC_{50} (high), 0.1 x LC_{50} (medium), 0.0 1 xLC50 (low) of each pesticide for periods of at least four weeks. Effects on survival, growth, and time to metamorphosis analysis were analyzed with analysis of variance. All concentrations of Fore significantly reduced survival in wood frog tadpoles (down 37% in high concentrations compared to controls). Only the high concentrations of Chipco and Fore had a significant effect on survival of treefrog tadpoles. Fore (high concentration) reduced in gray treefrog survival by 5%. Fore also produced significant declines in growth rates for both species and dramatically increased time to metamorphosis. High concentrations of Fore increased time to metamorphosis by three days in wood frogs and by 19 days in the gray treefrogs. Since these amphibians frequently breed in temporary pools of water, sublethal effects on time to metamorphosis can be expected to have dramatic impacts on population persistence. Tadpoles may not complete metamorphosis prior to pond drying or may emerge late in the season with lower energy reserves reducing chances of survival through winter.

Chipco and Daconil did not significantly increase the time to metamorphosis or growth rates at any exposure concentration in either species. Preliminary analysis of developmental abnormalities suggest exposure to medium and high concentrations of Fore also resulted in a higher than expected number of hind limb deformities for both species. Because the sample sizes are low for these treatments, detailed analysis will be completed when the third larval trial on fungicides is completed.

Water and sediment samples will be collected during the third larval trial to determine the persistence of these fungicides. Because many frog tadpoles feed in the substrate and are detritivores, the sediment concentrations may be more important contributors than pesticide residues in the water column.

Summary. Experiments of chronic exposures of three fungicides were conducted on two species of amphibians and data indicates that concentrations of Fore had significant effects on survival, growth, and time to metamorphosis of tadpoles. LC_{50} determinations indicate dramatic differences in toxicity among the three compounds evaluated with Chipco being the least toxic to amphibians.

Field Studies

In March of 1999, 632 eggs of *Ambystoma jeffersonianum* (Jefferson salamander) and 680 *Pseudacris triseriata feriarum* (upland chorus frog) eggs were translocated into each of the six experimental ponds at Rocky Gap State Park. As egg masses developed, the number of larvae that successfully hatched was recorded. After larvae metamorphosed, individuals were captured by pitfall traps, funnel traps, or time constrained searches. Captured individuals were marked via toe clipping and/or freeze branding. In addition, as a measure of relative health, snout to vent lengths (SVLs) were recorded for metamorphosed P. triseriata, while mass and SVLs were recorded for metamorphosed *A. jeffersonianum*. Only 10 metamorphosed *A. jeffersonianum* were captured from all experimental ponds and only four *P. triseriata* were captured. This number is much smaller than in previous years and may reflect the colonization of experimental ponds by predators. Returning adult chorus frogs from prior translocation efforts successfully reproduced in the wetland and were identified from patterns of toe clips.

In addition, we monitored the experimental wetlands as well as ponds located on the Rocky Gap Golf Course for natural colonization by local amphibian species. Egg masses found were identified to species, total number of eggs estimated, and location of deposition within experimental ponds was mapped. The species mapped included amphibians: *Rana clamitans* (green frog), *Rana sylvatica* (wood frog), *Bufo americanus* (American toad), *Pseudacris crucifer* (spring peeper), and *Hyla veriscolor* (gray tree frog). Only larvae of the American toad were found in ponds associated with the golf course at Rocky Gap. The design of our experimental ponds appears to have promoted colonization success for some species.

Summary. Egg masses of two species of amphibians were translocated into experimental ponds at Rocky Gap State Park. Hatching success was monitored in the egg masses and metamorphosed individuals of both species were captured and marked for future identification. One of the species (upland chorus frogs) from the 1998 translocations returned to breed in our experimental wetlands. The second species has a longer maturation period and is not expected to return to breed even if translocations are successful until spring 2000. Experimental ponds, as well as golf course ponds, were monitored for natural colonization of amphibian species. We detected six amphibian

species using our experimental wetlands for breeding. We only found evidence of one species using golf course ponds for breeding in 1999. That breeding effort was lost because of the stocking of the pond with fish.