EPA EPSCoR Progress Report

Title: Developmental Stability in Amphibians as a Biological Indicator of Chemical Contamination and Other Environmental Stressors
Investigators: Whiteman, Howard H., Loganathan, Bommanna G.
Institution: Murray State University
EPA Project Officer: ??? David fill in here??
Project Period: October 1 , 2001 through September 30, 2004
Project Amount: $165,775 (this is the EPA total)
Research Category: EPA EPSCoR

Description:

Objective: We proposed to evaluate the potential of using developmental stability as a biological indicator of anthropogenic and natural stress in amphibians. Amphibians are ideal biological indicators, because their semi-permeable epidermis and complex life cycle expose them to multiple stressors in both aquatic and terrestrial environments. Because of this, amphibians should be among the first vertebrates affected by anthropogenic stressors in either of these environments. Furthermore, some of the same stressors affecting amphibians are known to have negative effects on other species, including humans. Although we proposed to evaluate a wide range of possible stressors, a major thrust of this project is to correlate amphibian developmental stability with contaminant levels accumulated in their tissues. We hypothesized that amphibian developmental stability would decrease with increased levels of anthropogenic (contaminants, land use practices) and natural (population size and density) stressors. Our specific goals are to: (1) correlate the effects of environmental stressors with amphibian developmental stability; (2) evaluate the effect of species, life history stage, trophic level, and habitat type on measures of developmental stability; and (3) develop methods for separating the effects of anthropogenic and natural stressors.

Progress Summary: In Year 3 of this grant, our research continued with the hard work and dedication of graduate, undergraduate, and postdoctoral students. Specifically, we continued to process two species of amphibians, bullfrogs and spotted salamanders, for developmental stability. Contaminant analysis is now completed on spotted salamanders, and is ongoing on bullfrog adults and larvae. We are currently completing statistical analyses on the spotted salamander samples, and also completing analysis on the landscape characteristics that might affect amphibian developmental stability.

Preliminary Results: Our most recent contaminant results can be seen in the tables below.

Table.1. PCB and pesticide concentrations in normal and deformed amphibians. Numbers in the parenthesis indicate number of specimens pooled for analysis.

Sampling Location	Species	Life Stage	Concentration (ng/g wet wt.) Total PCBs	Total DDTs	HCB	Chlordane
Shuman #2 (Def)	Bullfrog	Larva	22.43	3.36	0.11	2.20
Bishop #1	Bullfrog	Larva	10.36	1.98	0.75	2.21
M. Morgan #3	Bullfrog	Larva	8.70	5.05	0.77	2.28
Bishop #4	Bullfrog	Larva	9.99	4.02	1.40	2.53
Tower LBL (4)	Bullfrog	Larva	11.30	6.43	BDL	1.38
Elk & Bison (1M)	Spotted Salamander	Adult Male	24.56	6.88	3.98	*33.96*
Site 68/80	Spotted Salamander	Adult Male	13.61	9.70	3.47	1.13
Star Camp 2 (1M)	Spotted Salamander	Adult Male	18.72	BDL	1.80	1.21
LBL-142 (4M)	Eastern Newt	Adult Male	20.73	6.07	0.49	1.20
LBL-220 (6M)	Eastern Newt	Adult Male	33.40	6.80	0.78	3.14
LBL-142 (2M)	Eastern Newt	Adult Male	41.89	6.10	BDL	5.47

Future Activities: We are currently collecting more bullfrog adults in an effort to increase our sample size and complete sampling of three disparate habitats (industrial, agricultural, and forested). We are also currently completing the contaminant analysis on these bullfrog populations.

Publications:

Manuscript in preparation:

1. Loganathan, B.G. and H. H. Whiteman. PCB congeners and chlorinated pesticide concentrations in amphibians collected from western Kentucky. In preparation for Int. J. Anal. Chem.

2. Benson, A. R., Whiteman, H. H., J. B. Boynton, M. Dotson, and R. Cates. Developmental stability as an indicator of amphibian population health. In preparation for Conservation Biology.

3. Meredith, C. S. and H. H. Whiteman. Lethal and sublethal effects of nitrate on amphibian embryos and larvae. In preparation for Ecological Applications.

Presentations:

1. Whiteman, H. and Loganathan, B.G. 2004. EPA-EPSCoR Project Status. Presented at 9th Annual Kentucky EPSCoR Conference.

2. Whiteman, H. H. 2004. Developmental Stability in Amphibians as a Biological Indicator of Chemical Contamination and Other Environmental Stressors. EPA Environmental Research Seminar, Atlanta, GA, Sept 28-29.

Students Supported:

Graduate theses:

2003- I-Lun Chien: "Contaminant analysis of amphibians from Western Kentucky". M.S.
2002- Jessica Boynton: "Utilization of remote sensing to model current and future threats to amphibian populations". M.S.
2002- Beth Kobylarz: "Effects of age on stress bioindicators and chemical contamination in bullfrogs". M.S.

Other graduate RAs:

Chris Eden

Undergraduate RAs:

Catherine Aubee
Trace Hardin
Joshua Kitchens
Michael O'Brien
Justin Kane
Rachael Brown

Supplemental Keywords: amphibians, bioindicators, contaminants

Scientific Discipline: conservation biology, toxicology