USGS NSF Internship Opportunity

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USGS Center:	National Wildlife Health Center
Project Title:	Amphibian Population Dynamic Models for Decision Making
Summary:	Amphibians are among the most threatened vertebrate taxa worldwide, and are facing a suite of potential stressors. In a recent synthesis, researchers identified four major threats - land use change, disease risk, climate change, and pesticide use - contributed to the local extinction of amphibian populations, but the strength and direction of these effects varied geographically, suggesting that responses to declines were dependent on local context. The small-scale variation in the effects of these factors makes the development of a broad-scale conservation strategy difficult. Instead, strategies that are responsive to locally-varying threats are needed to effectively conserve amphibian populations. Developing these strategies given limited field data, and predicting the benefits of combinations of conservation actions, are two salient challenges. Generally the fields of mathematical ecology, focused on the development of parsimonious models that reflect ecological theory, and statistical ecology, focused on the estimation of parameters from empirical data, have developed separately - limiting advancement in our ability to understand and forecast population changes. This limitation impedes the selection of beneficial management strategies, and makes proactive management difficult. We propose to integrate statistical estimation procedures with theoretical mathematical ecology, building an age-structured amphibian population model and parameterizing this model with multiple sources of information including previous research results and expert opinion. Our mechanistic mathematical model of amphibian population dynamics can assist with estimating the effectiveness of management strategies, elucidating the relationships between stressors and amphibian declines, provide guidance on listing decisions for USFWS, and identify proactive management strategies to prepare for future threats. Specifically, the project will consist of three lines of work occurring in tandem; 1) gathering and summarizing previous information on the

	effects of stressors on amphibian demographics, and conducting an expert elicitation process to fill in the gaps in information, 2) the development of a theoretical model of amphibian population dynamics, and 3) the parameterization of the theoretical model with empirical data. This model will allow us to achieve our objectives of investigating which life stages or life history strategies are most sensitive to stressors, which mitigation tactics would be most useful in what situations, and potentially whether populations are at risk of extirpation.
Project Hypothesis or Objectives:	Amphibian populations have been subject to worldwide declines. The factors responsible for these declines include habitat loss, climate change, contamination of environments, and disease. However, these factors vary geographically in terms of their influence on amphibian population dynamics. We propose to bring together distributed field data on multiple amphibian metapopulations, and extend population dynamics models for spatially explicit meta-populations that incorporate these factors to examine the mechanisms behind these declines. This approach will (1) confront predictions of causes of population declines with real data, (2) provide a framework for improving predictive modeling of population outcomes, and (3) evaluate mitigation strategies for local populations. These models will assist with the development of mitigation strategies and can provide information for those species scheduled to be considered by USFWS for listing under the Endangered Species Act.
Duration:	Up to 12 months
Internship Location:	Madison, WI
Field(s) of Study:	Life Science
Applicable NSF Division:	IOS Integrative Organismal Systems, DEB Environmental Biology
Intern Type Preference:	NSF Graduate Research Fellow (GRF) via the Graduate Research Intern Program (GRIP)
Keywords:	Amphibians, population modeling, disease, climate change, environmental contaminants, quantitative ecology, mathematical ecology, decision making
Expected Outcome:	annoted computer code that will allow users to explore various scenarios. At least one manuscript, led by the student on the development of the amphibian population model.
Special skills/training Required:	Familiarity with amphibian ecology and/or structured decision making is a bonus but not essential, knowledge of statistical techniques commonly used in wildlife such as mark-recapture and/or knowledge population modeling is required, familiarity with the R statistical program is required.

- **Duties/Responsibilities:** Candidate will work with USGS statisticians, wildlife disease specialists, and amphibian biologists to developing a modelling framework for answering questions regarding amphibian population dynamics. This will entail computer programming, statistical estimation, and effective communication in written and oral forms with project personnel and stakeholders. The results of this development will be computer code that will allow managers the ability to explore a variety of scenarios regarding amphibian population dynamics. Candidate will interact with scientists from USGS, and potentially USFWS, state management agencies, and non-profit organizations with an interest in amphibian management. This opportunity will provide the student with the opportunity to work on an applied management issue.