PREDICTING WILDLIFE POPULATION RISKS FROM CHEMICALS AND OTHER STRESSORS:

A DEMONSTRATION PROJECT FOCUSING ON EFFECTS OF METHYLMERCURY EXPOSURE AND HABITAT ALTERATION TO PISCIVOROUS BIRD POPULATIONS

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LTG 1 Poster 02

Science Questions

Long Term Goal 1: What are the best approaches and methods to develop and apply criteria for habitat alteration, nutrients, suspended and bedded sediments, pathogens and toxic chemicals that will support designated uses for aquatic systems?

How Research Addresses the Water Quality MYP Goals

Research demonstrates a generic approach based on EPA's ecological risk assessment paradigm to identify, predict, and/or diagnose ecological risks, and provides methods to develop criteria to support designated uses (Long Term Goal 1). Procedures are used to:

- Incorporate biological effects from single or multiple stressors;
- Integrate predictive models and empirical information, often acquired through strategic environmental and conservation partnerships;
- Quantitatively assess risks to wildlife populations, and analyze critical information to minimize uncertainty.

Critical issues addressed include:

- Selection of appropriate species
  - Availability of toxicological and demographic data
  - Useful population-level endpoints

Research Objectives

Develop, test, and integrate methods to:

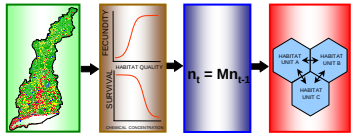
- Improve characterization of risks to individuals (including those from species of special concern);
- Extrapolate population-level effects from individual data;
- Evaluate risks at varying spatial scales to wildlife populations from toxic chemicals in the context of other stressors.

Assess risks from a toxic chemical occurring in the context of other non-chemical stressors using a data-rich and important example.

Research Approach and Methods

This research project demonstrates and tests an approach and framework for ecological risk assessment in support of population risk-based criteria development.

The conceptual model (below) describes a stepwise process to predict how the distribution and magnitude of anthropogenic stressors will affect wildlife populations:



Habitat & Stressor Distributions | Multi-Stressor Relationships | Non-Spatial & Spatially-Explicit Population Models

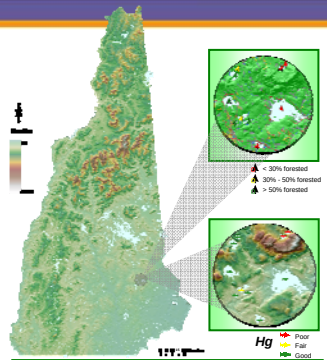
OUTCOME: Scientific support for Population risk-based criteria

To apply this conceptual approach to predict risks of dietary methylmercury (CH3Hg) and habitat alteration to populations of aquatic-dependent species, *i.e.*, fish-eating Common Loon (*Gavia immer*), these predictive methods are being developed through a network of scientific collaborators:

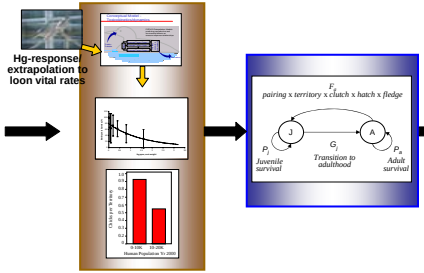
- Species extrapolation of stressor effects: from tested to untested species
- Ecological extrapolation: from individuals to populations
- Population dynamic projections onto landscapes affected by multiple stressors

Collaborations

Data, Methods, Results and Conclusions: Risks to Loon Populations from Mercury and Habitat Alteration

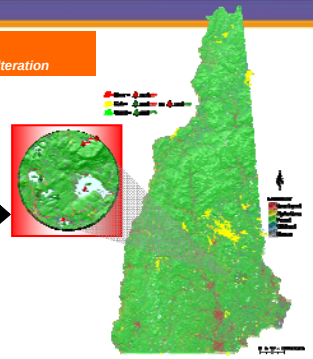


Spatial characterization of fish/loon Hg, loon habitat quality

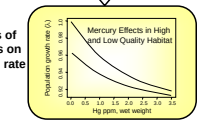


Hg, habitat responses relationships to loon vital rates

Loon population models integrating multiple stressor effects



Spatially-explicit population models accounting for spatial variation



Predicted effects of multiple stressors on population growth rate

Research Results

A scientific approach to integrate data and model results to assess risks to wildlife populations from multiple stressors is being applied prospectively to estimate risks to the Common Loon (a threatened species) from mercury and habitat degradation in New Hampshire. Information from field observations, controlled studies, and environmental data were used to estimate demographic parameters, and to develop biological response models for mercury and habitat suitability, respectively. Results to date include:

- Controlled studies (in cooperation with USGS) using the kestrel (a model carnivorous bird) were conducted to provide stressor-response models for CH_3Hg effects on avian reproduction;
- Field data (in cooperation with the NH Loon Preservation Committee and NH Department Environmental Services) were used to develop habitat models linking human of activities (human population density as indicator) and chick fitness.
- CH3Hg- and habitat-response models are being used to develop population model projections reflecting estimated levels of stressors in the field.
- Lower population growth rates are projected for equivalent CH_3Hg exposures in low versus high quality habitat;
- Observations of field populations are generally coherent with projections representing stressed populations: multiple stressors act additively or synergistically.

Research Conclusions & Future Directions

These methods quantitatively link increasing levels of specific single or multiple stressors to adverse outcomes at the population level, and respond to the need for greater realism and ecological significance in the estimation of stressor effects.

- Data and models from ongoing studies are being used to reduce uncertainties in specific areas such as the extrapolation of mercury effects across life stages and avian species.
- Ongoing refinements of these methods include spatially-explicit population modeling that can be used to account for variation in the distribution of stressors and wildlife across the landscape.
- Habitat modeling is also being applied to assess temporal changes by using satellite imagery to compare recent and historical landscapes.
- Future applications to geographic areas of increasing size (watershed to state to regional levels) and collaborations with US EPA STAR cooperators will permit comparisons between large regions of the US (*i.e.*, New England and the Mid-West), contributing to a better understanding of broad scale risks and providing scientific support for regional and national environmental regulations.

Interactions with Customers

Customers/collaborators currently involved in the application of this approach to regional issues include:

- NH Loon Preservation Committee (a division of Audubon);
- NH Department of Environmental Services and Fish & Wildlife Services;
- WI Department of Natural Resources

Ongoing interactions with the U.S. EPA's Office of Water, including participation in the Aquatic Life Guidelines Committee:

- Use this project as an example of a population risk-based approach for the development of national regulatory criteria.

How Research Contributes to Outcomes

This research demonstrates a collaborative and integrative approach to quantify risks to wildlife populations from toxic compounds, habitat alterations, and other stressors.

- Species-specific toxicological, habitat, and demographic models are being developed;
- Results are being extended into large scale spatially-explicit population projections;
- Provides a scientific foundation for regulatory criteria at the state, regional or national levels.