AED Contribution # AED-05-028

Review of Simulation Methods for Spatially Explicit Population-Level Risk Assessment.

Steven Walters[a], Anne Kuhn[a], Matthew C. Nicholson[a], Jason S. Grear[a], Nathan H. Schumaker[b] and Diane E. Nacci[a]. [a] US Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Atlantic Ecology Division, Narragansett, RI. [b] US Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Western Ecology Division, Corvallis, OR.

Factors that significantly impact population dynamics, such as resource availability and exposure to stressors, frequently vary over space and thereby determine the heterogeneous spatial distributions of organisms. Considering this fact, the US Environmental Protection Agency's National Health and Environmental Effects Research Laboratory (NHEERL) is evaluating modeling tools for predicting population response to multiple stressors in a spatially explicit framework. The goal of the present study is to assess the strengths and applicability of a suite of spatially explicit population models (SEPM's) ranging from relatively simple metapopulation modeling approaches to more complex and detailed individual-based SEPM's. Such models vary in their characteristic data requirements and measurement endpoints, their level of specificity in describing population dynamics, and their inclusion of landscape-level detail. This spectrum of model complexity thus parallels the hierarchical ordering of objectives within a tiered risk assessment framework, from screening level to definitive, site-specific assessments. In addition to projecting the spatial distribution of populations, SEPM's provide a means of assessing local to regional source-sink dynamics and the relative spatial distribution of populations under alternate exposure scenarios. Furthermore, SEPM's are ideally suited for identifying emergent interactive effects of multiple stressors, as well as the relative strengths of impact of each stressor, and for revealing scale-dependent variations in population response. Our efforts are focused on modeling population-level risks of decline from mercury exposure and land use change to common loons (*Gavia immer*) in New England. This project, part of a larger NHEERL demonstration study, integrates research from several other components examining effects of multiple stressors on loon populations. The described research will help to illustrate the efficacy of modeling techniques for assessing risks to wildlife when the complex interactions arising from spatially heterogeneous processes are explicitly considered.

KEYWORDS: Spatially explicit population models; Ecological risk assessment; Scale-dependent effects and response; Common loons (*Gavia immer*); New England; Mercury; Land use change.