Incorporating Demography Into Ecological Risk Assessments

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demography and toxicology = risk

The Office of Water’s action is demography to be risk projections. However, there is increasing recognition that currently estimated exposure effects on adults do not capture the full range of risk from adult exposure to young or other population components. Moreover, a general understanding is that exposure effects on adults should be more strongly related to population-level risk than the more commonly assessed exposure effects on other population components. Therefore, a general understanding of exposure effects on adults should be more strongly related to population-level risk than the more commonly assessed exposure effects on other population components.


AGENCY PROBLEM

Baseline Models

VITAL RATES

- breeding propensity
- b
- hatchling survival
- sh
- total juvenile survival
- su
- conditional recruitment
- ur
- adult survival

Matrix models provide a formal and exact mathematical representation of the life cycle diagram, with each matrix parameter representing a vital rate in specific ways to represent pathways in the life cycle.

Figure 1. Conceptual approach to additively express endpoints represented in the life cycle.

Matrix models provide a formal and exact mathematical representation of the life cycle diagram, with each matrix parameter representing a vital rate. Population models combine the vital rates in specific ways to represent pathways in the life cycle.

Changes in population fitness with increasing levels of single (solid lines) and additively combined (dotted lines) vital rates.

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Future Directions

- Incorporate demographic models both with and without normalizing
- Incorporate various components into stochastic models to test the uncertainty component risk estimation (see H. Miller et al., 2005)
- Evaluate potential effects of changing density-dependent stressors in strongly territorial species (see H. Miller et al., 2005)

Risk projections can be expressed in terms of effects of stress-induced vital rate impairments on population fitness (i.e., population growth rate). The poster by Kuhn et al. describes research allowing these projections to incorporate spatial variation across the landscape.

The prediction that although adult survival of many species tends to be less chemically sensitive than reproduction, very small--perhaps even undetectable--changes in adult survival could significantly affect population fitness in the common loon. This expectation is well-founded in the theoretical literature and is critical for risk assessment specific to common loons and other wildlife species with similar life histories. We demonstrate how the predicted population impact of seemingly small stressor effects can be assessed through integration of toxicology and demography. Application of this approach will allow development of criteria by the Office of Water to minimize potential impacts on wildlife populations. State partners report that the demographic models described here have affected regulatory policy.