Adverse Outcome Pathways Linked to Population Models as an Applied Framework for Investigating Effects of Chemical Stressors

David H. Miller, U.S. EPA, Mid-Continent Ecology Division, Grosse Ile, MI 48138 USA
Joseph E. Tietge, U.S. EPA, Mid-Continent Ecology Division, Duluth, MN 55804 USA
Mark E. McMaster, Environment Canada, Ecosystem Health Assessment, Burlington, ON L7R 4A6 Canada
Kelly R. Munkittrick, COSIA, Saint John, NB, E2G 1A5 Canada
Gerald T. Ankley, U.S. EPA, Mid-Continent Ecology Division, Duluth, MN 55804 USA

In addressing Beneficial Use Impairments (BUIs) at a Great Lakes Area of Concern (AOC), recovery from loss of fish and wildlife populations exposed to stressors is targeted for use in decision making. We describe a framework that can be applied in conjunction with field monitoring efforts (e.g., through effects based monitoring programs) to link chemically induced alterations in molecular and biochemical endpoints to adverse outcomes in whole organisms and populations. Our approach employs a simple density dependent logistic matrix model linked to adverse outcome pathways (AOPs) for reproductive effects in fish caused by contaminants that impact different points within the hypothalamic-pituitary-gonadal axis. Application of this framework requires only a life table for the organism of interest, a measure of carrying capacity for the given population, and estimation of the effect of stressors on vital rates of organisms within the study population. We demonstrate our applied framework using linked AOP and population models parameterized with long-term monitoring data for white sucker (*Catostomus commersoni*) collected from a study site at Jackfish Bay, Lake Superior. Individual-level responses of fish exposed to pulp mill effluent were used to demonstrate the framework's capability to project alterations in population status, both in terms of ongoing impact and subsequent recovery after stressor mitigation associated with process changes at the mill. Extrapolation of the applied framework demonstrated at the Jackfish Bay site can be made to characterize population status of other species at other Great Lakes AOCs, including accounting for effects of multiple stressors (both chemical and non-chemical) and complex landscapes (i.e., meta-populations including emigration and immigration processes). This abstract does not necessarily reflect U.S. EPA Policy.