Abstract:
A concern for environmental hazard assessments is that hazard predictions for population/ecosystems are derived solely from the evaluation of toxicity data at the organism level. We developed a structured population model that can be used to propagate the assessment of Daphnia magna organismal responses, i.e., to environmental change, to the population level, thereby enabling the causal association of organismal responses to ecosystems adversity. We developed a continuous structured population model based on the Sinko-Streifer equations and used multi-scale experimental data, i.e., individual- and population-level data, for model validation. Our model describes how fecundity and survival rates are affected by both time-varying density-independent factors, such as age, and density-dependent factors, such as competition. We performed uncertainty analysis and parameter subset selection analysis to test which density-dependent parameters can be estimated with a high degree of confidence. Further, we performed a sensitivity analysis to understand how changes in fecundity and survival rates affect population size and age-structure. This work is performed in collaboration with environmental toxicologists at North Carolina State University.