Evaluation of CASM's Applicability for site-specific Ecological Risk Assessment using Field Data from Lake Suwa

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Abstract

The Comprehensive Aquatic System Model for Lake Suwa (CASM_SUWA) was developed using field data from Lake Suwa and evaluated to examine its applicability for ecological risk assessment of chemicals. CASM is an ecosystem effects model that simulates the daily production dynamics of populations, including predator-prey interactions, through time in relation to daily change of light intensity, water temperature, and nutrients availability. The CASM_SUWA model consists of five phytoplankton populations, three zooplankton populations, two benthic insect populations, a single benthic invertebrate population, three omnivorous fish populations, and a single piscivorous fish population. By calibrating the model parameters, a reasonable model simulation that represents the characteristics of the Lake Suwa ecosystem under no chemical stress was established. The results of sensitivity analyses showed that model parameter values of the all trophic levels were important in determining the biomass of each trophic level in the model. With several exposure scenarios, the risks posed by linear alkylbenzene sulfonates (LAS) and pentachlorophenol (PCP) on the model species were estimated. At LAS exposure concentration of 0.1 mg/l, which is in the range of background LAS concentration levels in Japanese river and lake, the probability of 50% decrease in annual omnivorous fish production was approximately 0.9. The results of the risk estimation demonstrated that CASM_SUWA estimated the risks of direct toxic effects on each population and the indirect ecological effects that propagate the food web in the model ecosystem. The analyses of the results imply that CASM_SUWA could be used to provide an explicit basis in determining ecological regulatory levels of chemicals for aquatic ecosystems.