A simplified AQUATOX ecosystem model for endocrine disruption

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Endocrine disruption is widely studied at the individual level but the effects on population and ecosystem dynamics remain unclear. Mechanistic models can help understand the impact of endocrine dirsupters on aquatic environments and assess their ecological risk. However, the issue with modeling endocrine disruption is to find the appropriate endpoints that represent the reproductive disturbances observed in fish. This study takes the challenge to develop an ecosystem model that considers endocrine disruption in fish and the consequences on the whole ecosystem through ecotoxicological interactions, i.e feeding and competition relationships. The experimental data used to develop this model come from a multi-year whole-ecosystem study performed at the Experimental Lake Area (Ontario, Canada). The synthetic hormone 17α-ethinylestradiol (EE2), one of the most potent endocrine disrupters, was added during three years in an experimental lake at environmentally relevant concentrations. Experimental data were collected before, during and after EE2 addition. Endocrine disruption was observed in the fish species with a collapse of *fathead minnow* after the second year of EE2 addition. The ecoystem model that is being developed is an object-oriented model based on simplified AQUATOX equations for the species naturally present in the experimental lake (benthic invertebrates, phyto- and zooplankton, fish). The novelty of the study is to add appropriate equations for endocrine disruption. In AQUATOX, reproductive endpoints exist for fish with different age- or size-classes. With regards to endocrine disruption, males have to be differentiated from females. Therefore, three sex-classes were first added in the model: juveniles, males and females. Intersex fish are not considered because they can still reproduce and the important endpoint for modeling endocrine disruption is the reproductive ability of fish. Instead, a reproductive factor is associated with adults. For example, a non contaminated fish has a 100% reproductive factor while an intersex fish has a lower value, depending on the contamination level. Further model development will allow predicting the percentage of intersex fish, juveniles, males, and females. In addition to modeling the direct effects of EE2 on fish, the ecosystem model considers the lake dynamics (biomass, physico-chemical properties, hydraulics, etc.) and EE2 biomagnification in the aquatic food web.