Investigation of the control mechanisms of the food web in Lake Kinneret using multi-target regression trees

Atanasova Nataša [1], Gideon Gal[2], Mateja Škerjanec[1], Dragi Kocev[3], Sašo Džeroski[3], Boris Kompare[1]

Abstract

The Lake Kinneret ecosystem underwent a major disruption in the mid-1990's in part due to large and rapid changes in lake level rendering it currently as unstable ecosystem. The impact of the instability on the phytoplankton population have been documented, however, the affects of the changes on the zooplankton population dynamics remain unknown. In particular it is important to know the basic control mechanism for the zooplankton population, since it can guide the policy measures for improved lake management (e.g. control of fish catch). We explore this issue by applying machine learning techniques to an extensive database consisting of 25 years of biological, chemical and physical data collected in, and around, the lake. We use the machine learning toolbox CLUS for building multi-target regression trees, in order to investigate the basic control mechanisms of the food web in Lake Kinneret. The most popular modelling approaches build a model that is able to predict a single dependant variable (e.g. M5P algorithm). On the other hand, multi-target regression trees search for relationships between multiple dependant variables and a set of independent variables. Hence, when there are multiple dependant variables, the single-target approaches will yield a separate model for each dependant variable, while the multi-target approach yields a single model for all dependant variables. We performed a series of experiments, where three zooplankton groups, i.e. micro-zooplankton, herbivorous zooplankton, and predatory zooplankton were set as dependant variables to be modeled from a set of independent ecosystem and environmental variables. Preliminary results support the following hypotheses: 1. Under normal conditions the zooplankton herbivore population is driven by top-down pressure asserted by predatory zooplankton, 2. The changes to the lake ecosystem (i.e. phytoplankton succession) did not affect these dynamics, and, 3. Years of extreme changes to lake level lead to top-down pressure being asserted by planktivore fish on the zooplankton population.

[1] Institute of Sanitary Engineering, Faculty of Civil and Geodetic Engineering, University of Ljubljana, Hajdrihova 28, SI-1000 Ljubljana, Slovenia, natanaso@fgg.uni-lj.si, bkompare@fgg.uni-lj.si, mateja.skerjanes@fgg.uni-lj.si
[2] Kinneret Limnological Laboratory, Israel Oceanographic & Limnological Research, P.O. Box, 447, Migdal 14950, ISRAEL, gal@ocean.org.il
[3] Department of Knowledge Technologies, Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia, Dragi.Kocev@ijs.si, Saso.Dzeroski@ijs.si