R³ – Responses to biotic and abiotic changes, Resilience and Reversibility of lake ecosystems

Universität Konstanz

E1: Resilience of littoral food webs to oligotrophication and neozoa invasion

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Background

The most important and recent environmental changes in Lake Constance are re-oligotrophication, increase of water temperature and invasion of new species (e.g. neozoa). Whereas many studies focused on the impacts of increasing temperature and re-oligotrophication in the pelagic system, it is unknown how the littoral ecosystem reacts to these changes. The effects of invasive species in the littoral are much more pronounced than in the pelagial; therefore, it is expected that the reaction of the littoral community to re-oligotrophication and climate change is influenced by neozoa species. Since 1958, 14 alien species of the macrozoobenthos have invaded the littoral in Lake Constance[1] with *Dreissena polymorpha* and *Dikerogammarus villosus* being two of the most abundant and successful species. Likewise the neozoans *Gasterosteus aculeatus* (three-spined stickleback) and *Gymnocephalus cernuus*[2] (ruffe) became important members of the fish community.

Project idea

Investigate changes in the fish & macrozoobenthos community of the littoral in Lake Constance due to re-oligotrophication & neozoa invasion

Research Questions:

- Are there any patterns in the dynamics of neozoa invasion?
- How do communities/dominant species react to re-oligotrophication and is this reaction influenced by invasive species?
- Do re-oligotrophication & invasive species have any influence on the size spectra of the macrozoobenthos & fish species?
- Are there changes in species traits (size, SIA)?
- Are there correlations between macrozoobenthos & fish species suggesting predator-prey relationships?

Figure 1: Numbers of fishes per catch from 1997 to 2014 at the three sites Birnau, Fels, and Langenargen (circles: day samples, triangles: night samples).

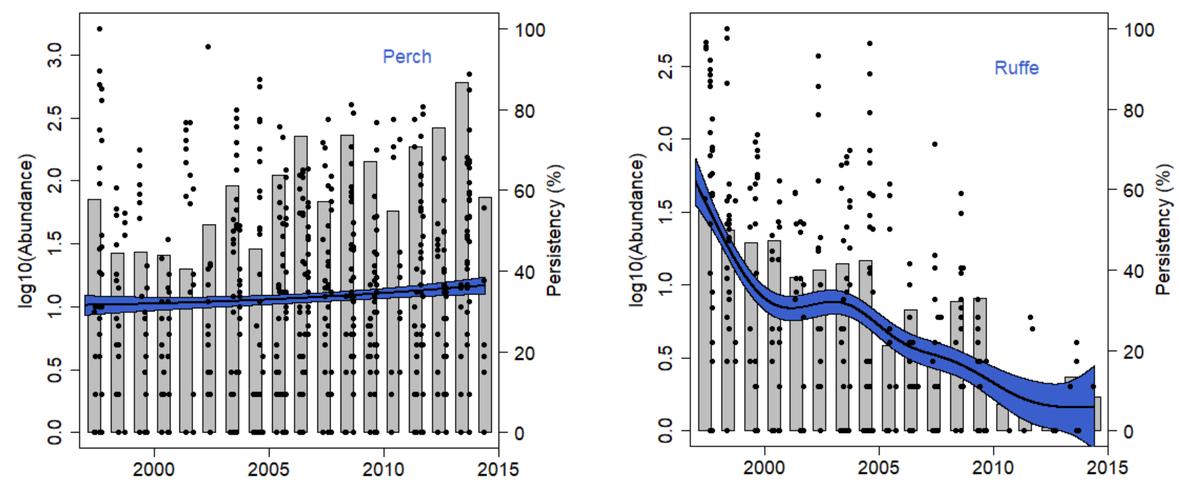

Figure 2: Abundance (log10-transformed) per catch of native perch, and of the neozoans ruffe and three-spined stickleback from 1997 to 2014 (dots and GAM fit ± SE), and persistency in catches in a specific year (grey bars, right y-axis).

Data Sets

Benthos Data I (K.-O. Rothhaupt; 1999 – 2017):

- No. of individuals per species
- Sampling date, site & depth

Benthos Data II (IGKB; 2000 – 2017):

- No. & biomass of individuals per species
- Sampling date, site & depth

Fish Data (R. Eckmann; 1997 – 2014):

- No. of individuals per species
- Sampling date, site & day/night samples

References

[1]Hanselmann, A. (2011). Räumliche und zeitliche Muster der Besiedlung des Bodensees mit Neozoen des Makrozoobenthos–eine Übersicht. *Lauterbornia*, *72*, 131-148.

[2]Rösch, R., and Schmid, W. 1996. Ruffe (*Gymnocephalus cernuus L.*), newly introduced into Lake Constance: preliminary data on population biology and possible effects on whitefish (*Coregonus lavaretus L.*). Ann. Zool. Fenn. 33: 467–471.

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