Assessment of water temperature effects and aquatic habitat on fish and benthic invertebrates

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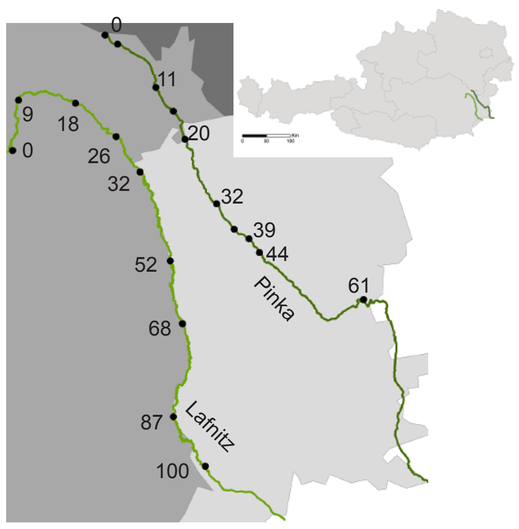


Fig. 1: Rivers Lafnitz and Pinka with sampling sites and corresponding distance from source in km.

ABOUT THE PROJECT

Climate scenarios of the IPCC for the Central European area expect that the climate will warm up in all seasons. Global warming has already shown impacts on European freshwater ecosystems and the services they provide to humans. Main goal of the project is to understand and define the mitigation effect of riparian vegetation against adverse effects to benthic invertebrate and fish communities . Our aim is to assess the habitat characterization for key fish and invertebrate species which is closely linked to temperature characteristics. This should contribute to support river managers in sustainable river restoration towards climate change adaptation, ecological services and socio-economic consequences.

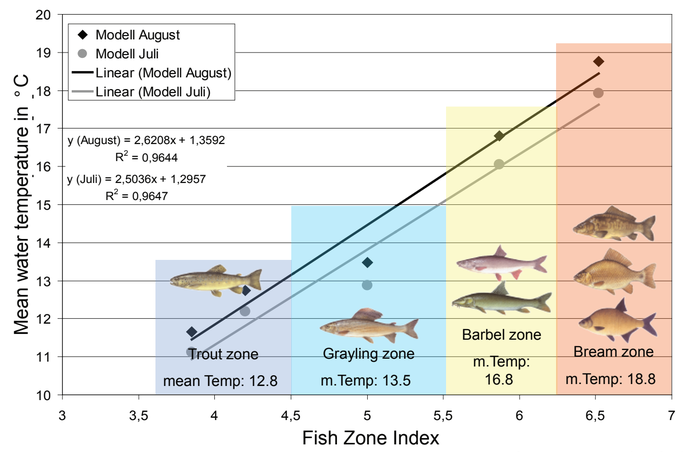


Fig. 2: Mean summer water temperatures for Austria's fish zones with corresponding fish zone index. Data from 200 unimpacted sites in an average year (2000)

STUDY SITE & METHODOLOGY

The study is conducted at two rivers in the south-east of Austria, the Lafnitz and Pinka (Fig.1). Both are located in the Hungarian Plains ecoregion. This lowland region is subject to the highest future temperature increase in Austria (2 - 2.5°C until 2040).

At different sections along the river course samples were taken:

- point measurements of depth, flow velocity, substrate type, temperature, shading, etc. (Fig. 3)
- fish samples using the electrofishing method
- sampling of benthic invertebrates on the riverbottom and deadwood structures

The aim is to identify important variables for key species and their response to temperature effects.

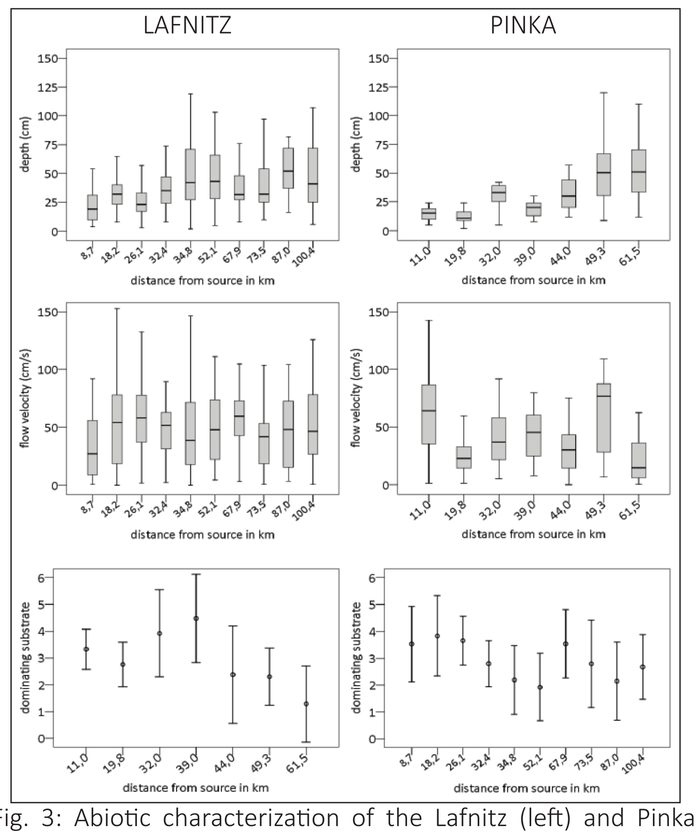


Fig. 3: Abiotic characterization of the Lafnitz (left) and Pinka (right) and longitudinal changes. Variables depth, flow velocity and substrate (0=mud, 6=large rocks) are the most important microhabitat features for fishes and benthic invertebrates.

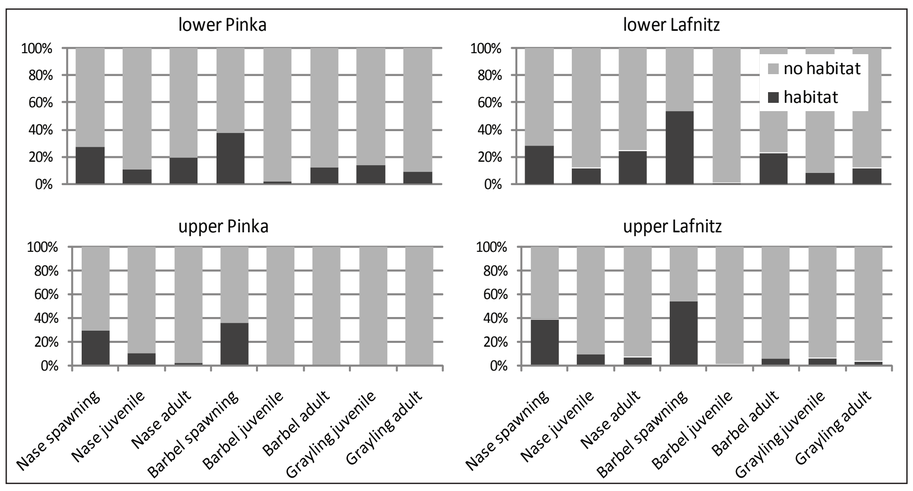
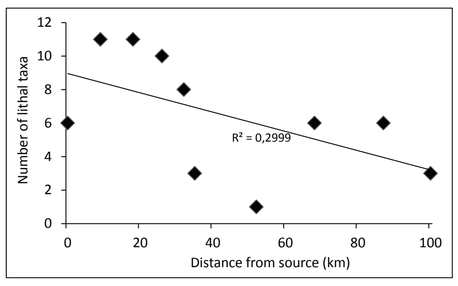


Fig. 4: Potential habitat for key fish species nase (*Chondrostoma nasus*), barbel (*Barbus barbus*) and grayling (*Thymallus thymallus*) expressed as share of total available habitat in upper and lower reach of the Lafnitz and Pinka (cut values at 40 km at the Lafnitz and 29 km at the Pinka).

RESULTS

- Modelling fish habitat preferences with logistic regression allowed to calculate the potential habitat (Fig.4). Both Lafnitz and Pinka serve only very limited habitat for grayling. Both rivers provide habitats for spawning of barbel and nase but juvenile habitats are limited (Fig. 4).
- While the number of exclusive lithal invertebrate taxa is decreasing with river length, the number of xylal taxa found exclusively on deadwood structures is increasing with river length (Fig. 5).
- Biocenotic indices for both fish and invertebrates show a strong correlation with water temperature in the longitudinal gradient (R^2=0.975) at the Lafnitz. Notably, temperature and index values are increasing strongly throughout the first 50 km (trout and grayling zones) and remain high and relatively stable throughout the rest of the river course (barbel zone).



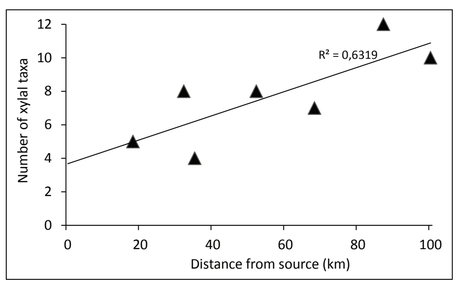


Fig. 5: Exclusive xylal (on submerged wood) and lithal (on rock) species in longitudinal gradient. Data from river Lafnitz.

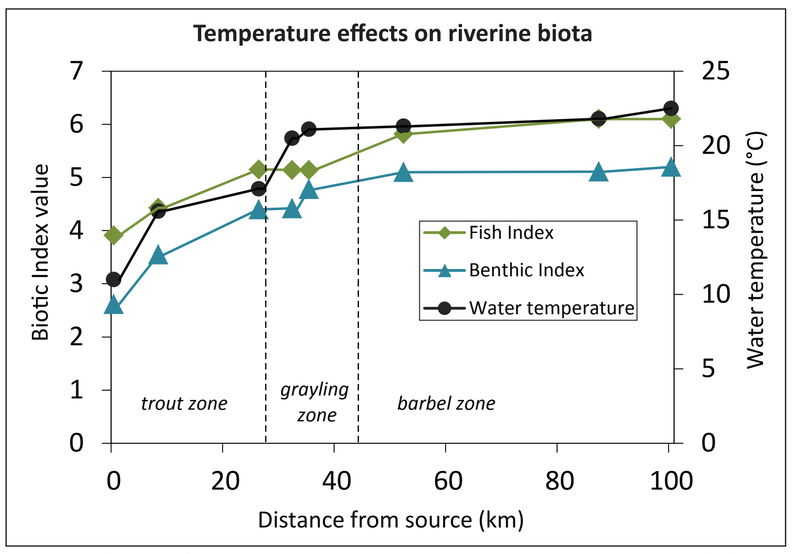


Fig. 6: Relation of water temperature (7 a.m. summer maxima) with biotic indices for fish (Fish zonation index) and benthic invertebrates (River zonation index). Both indices are based on species inventory at sampling sites.

DISCUSSION

- Temperature is a crucial factor for biotic assemblages in riverine ecosystems.
- Increasing temperature induced by climatic changes may cause shifts of fish or invertebrate communities leading to reduced habitat availability and even extinction of cold-adapted species.
- Different types of habitats are needed for different species or life stages.
- Riparian vegetation has an important role for the ecological integrity by buffering climate change effects and providing direct and indirect habitats for fishes and benthic invertebrates

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