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SESSION
01
REALISING EUROPEAN POLICY AMBITIONS

River restoration management in the face of climate change: in-stream habitat or catchment restoration?

Teppo Vehanen (Finnish Game and Fisheries Research Institute, Finland, teppo.vehanen@rktl.fi), Tapio Sutela (Finnish Game and Fisheries Research Institute, Finland)

Introduction

Diversity-rich freshwater ecosystems are currently declining rapidly. An important question for the future is where should we focus on in our management efforts to effectively improve the ecological status of rivers?

In-stream physical habitat restoration

The main focus in Finnish rivers has been in physical in-stream habitat restoration. A long term study in six Finnish streams revealed four important results (Fig. 1.)

- ❖ Instream habitat restoration increased juvenile brown trout, *Salmo trutta,* densities
- ❖In northern conditions, however, the effect of habitat restoration on juvenile salmonid densities took a long time. This may be due to slow recovery of the ecosystem from mechanical restoration work.
- ❖Large woody debris was an important restoration material
- ❖ Large scale regional effects, like droughts, overwhelm local restoration effects by declining fish densities in large area.

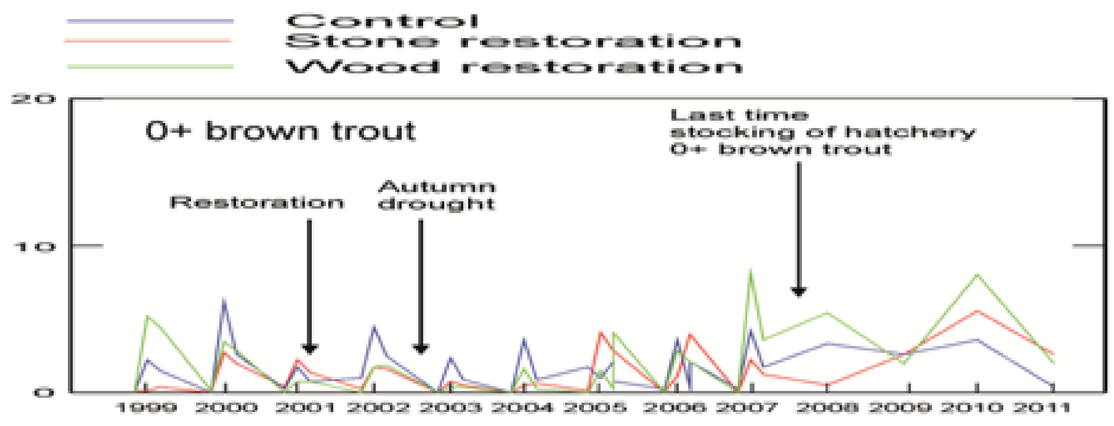

Fig. 1. Densities of age-0+ brown trout (ind. 100 m^2) in six streams in Finland. Each of the six rivers had three riffles: one was restored using boulders and rocks, second one using also large woody debris, and third was left as untouched control.

The role of catchment

The intensity of land use largely determines the variability in water quality values in a limited geographical area. Loading of solids and nutrients from agriculture land can have a large impact on riverine fish populations (Fig. 2).

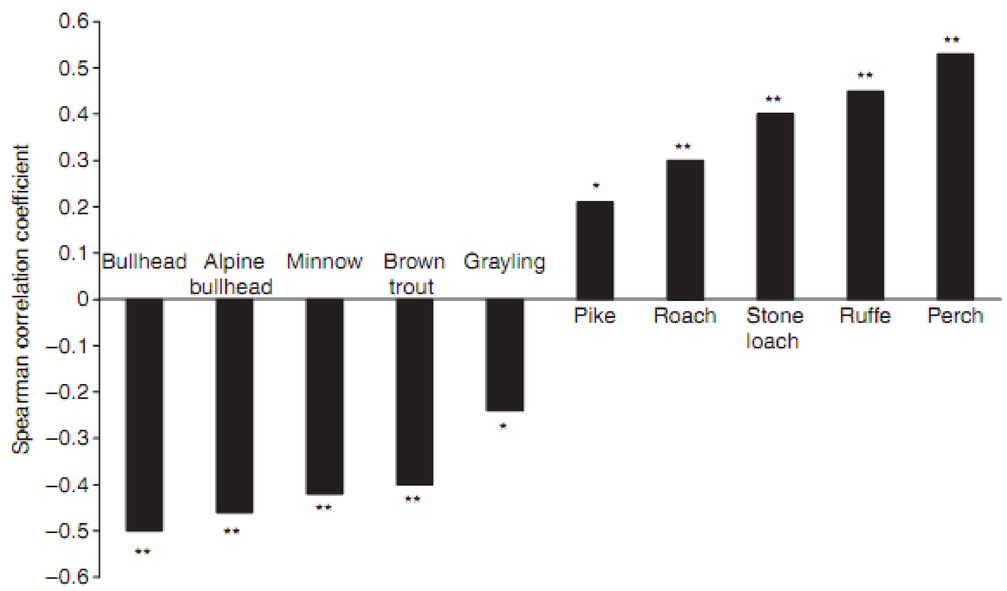

Fig. 2. Correlation between the intensity of land use (% of agricultural land in the catchment) and density of ten fish species in mid-sized rivers in Mid-Western-Finland.

In the West Coast of Finland productive agricultural land exists in areas where Acid Sulfate Soils (ASS, former seawater bottoms) exist near the surface. Acid releases from ASS, usually connected to heavy precipitation events, have lead to severe degradation of the fish biota in the rivers of the area (Fig. 3).

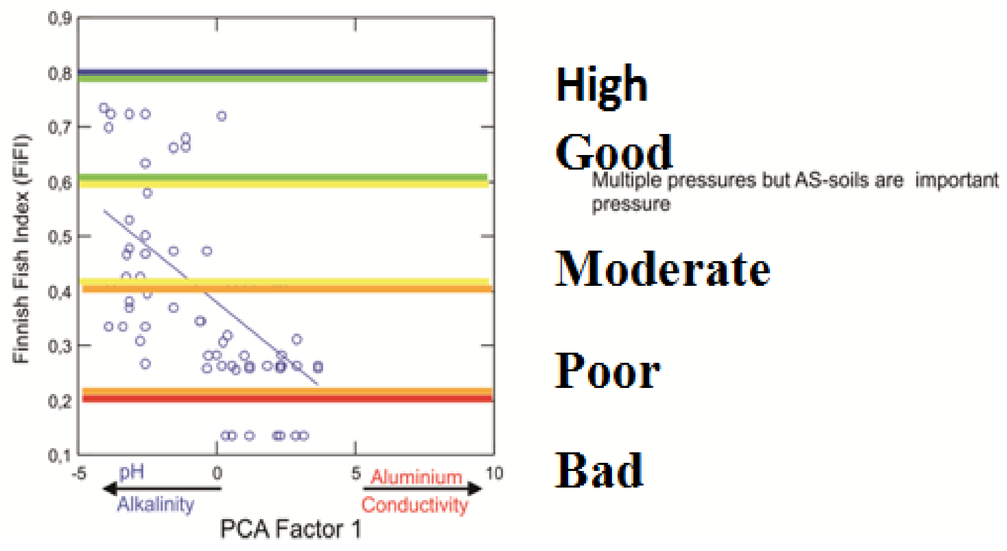

Fig. 3. Fish based ecological classification of rivers in the West Coast of Finland in the area of Acid Sulfate Soils. FiFI index (y-axis) constitutes of five variables: proportion of tolerant and intolerant fish species, density of 0+-salmonids, density of cyprinids and number of fish species. Water quality (x-axis): pH and alkalinity increases to left, aluminium content and conductivity to the right.

Climate change

Based on climate scenarios temperatures will increase in Finland especially in winter with increasing winter precipitation and frequency of heavy precipitation and drought events. This is likely to change the timing and increase the magnitude of loading of sediments and nutrients from agriculture, peat mining and forestry. Heavy precipitation events will increase the possibility of acid releases from Acid Sulphate Soils.

Conclusions

Our results show in the future a wider perspective should be adopted in restoration efforts; from in-stream restoration to the management of the entire catchment. Specifically, innovative methods to protect the waters from nutrient and acidic leaks, and information how these methods work in a changing climate, are sorely needed.