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THE FOOD INDUSTRY AND THE ENVIRONMENT

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Density-dependent effects as key drivers of intraspecific size structure of six abundant fish species in lakes across Europe

Ignasi Arranz (ignasi.arranz@uvic.cat)
Thomas Mehner
Lluís Benejam
Christine Argillier
Kerstin Holmgren
Erik Jeppesen
Torben L. Lauridsen
Pietro Volta
Ian J. Winfield
Sandra Brucet

I. Arranz *and* ***L. Benejam****, Aquatic Ecology Group, BETA Technology Centre, University of Vic - Central University of Catalonia.*
T. Mehner*, Leibniz-Institute of Freshwater Ecology and Inland Fisheries.*
C. Argillier*, Irstea UR HYAX, Centre d'Aix-en-Provence.*
K. Holmgren*, Institute of Freshwater Research, Department of Aquatic Resources, Swedish University of Agricultural Sciences.*
E. Jeppesen *and* ***T. L. Lauridsen****, Lake Ecology Section and Arctic Research Centre, Department of Bioscience, Aarhus University; Sino-Danish Center for Education and Research (SDC).*
P. Volta*, CNR Institute of Ecosystem Study, L.go Tonolli.*
J. Winfield*, Lake Ecosystems Group, Centre for Ecology & Hydrology, Lancaster Environment Centre.*
S. Brucet*, Lake Ecology Section, Department of Bioscience, Aarhus University, Vejløovej 25, 8600 Silkeborg, Denmark; Aquatic Ecology Group, BETA Technology Centre, University of Vic Central University of Catalonia.*

Abstract

- Fish size structure has traditionally been used for elucidating trophic interactions and patterns of energy transfer through trophic levels (Trebilco et al. 2013).
- We analysed the size structure of six common freshwater fish species in several hundred European lakes.
- We found little effect on the strength of the environmental gradients of size structure.
- The intraspecific density-dependent effect was the strongest and most consistent predictor.

Objectives

We studied fish size structure of six common European fish species and compared whether these variables responded to:

(1) Environmental gradients (e.g. temperature).

(2) Relative estimates of abundance (catch per unit effort, CPUE): CPUE intra- (CPUE of the focal species, hereafter, CPUEintra) and interspecific competition (CPUE of the other five competing species, hereafter, CPUEinter).

Methodology

- We used **356 lakes** from the dataset of the EU project WISER (Fig. 1).
- **Six species** were chosen: perch *(Perca fluaviatilis),* ruffe (*Gymnocephalus cernuus),* zander (*Sander lucioperca*),roach *(Rutilus rutilus),* common bream (*Abramis brama*) and white bream (*Blicca bjoerkna*).
- **Three size metrics** were calculated for each fish population: mean body size, size diversity and the slope of the linear size spectrum (Fig. 2).
- **Four environmental** (temperature, productivity, area and depth) and **two biotic predictors** (CPUEintra and CPUEinter) to identify which predictors were related to the size metrics.

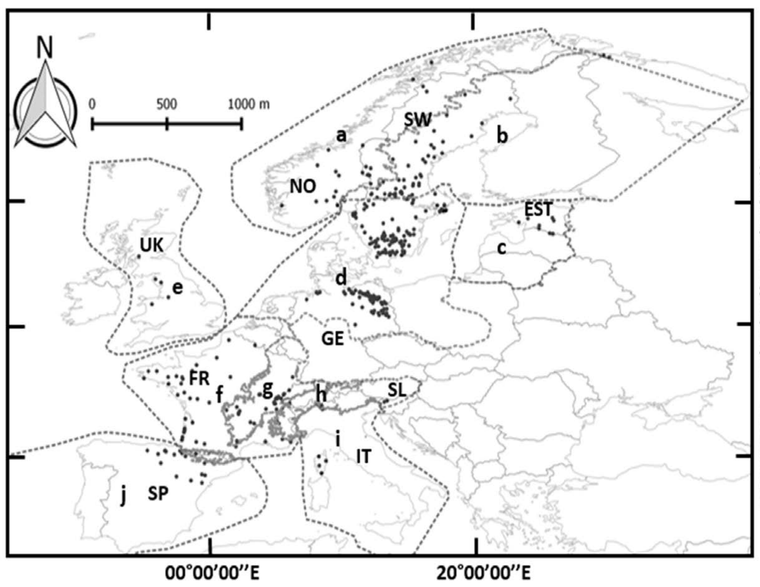

Figure 1: Geographical distribution of study lakes across European continent.

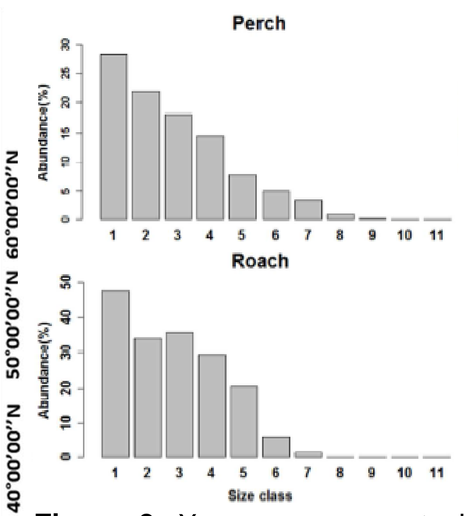

Figure 2: X axes represented fresh mass by a $\log_2$ scale and y axes represent the relative frequencies (%) for each size class.

Findings

- Our results showed some difference to environmental gradients.
- Temperature variations across Europe induced the same response for five of the six species, with fish size declining at higher temperatures.
- Density-dependent effect was the strongest predictor of the

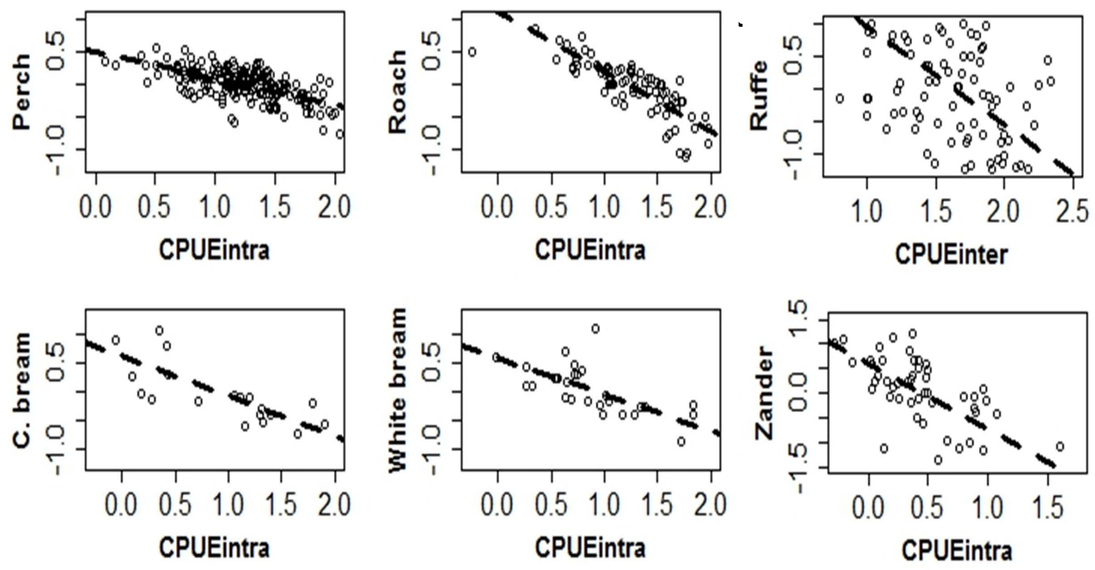

Figure 2: Y axis represents size metrics and x axis the CPUEintra and CPUEinter predictors

Conclusions

- **Density-dependent effects are key drivers of the variation of the size structure at species level.**
- **The response of the environmental variables was weak but there were similar responses.**
- **The weak influence of the temperature at species level contrast with the high effect at community level (Emmrich et al. 2014).**
- **Finding approaches which approximate life history from size variables may be a major step to improve the programmes for managing inland water.**

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