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

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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.

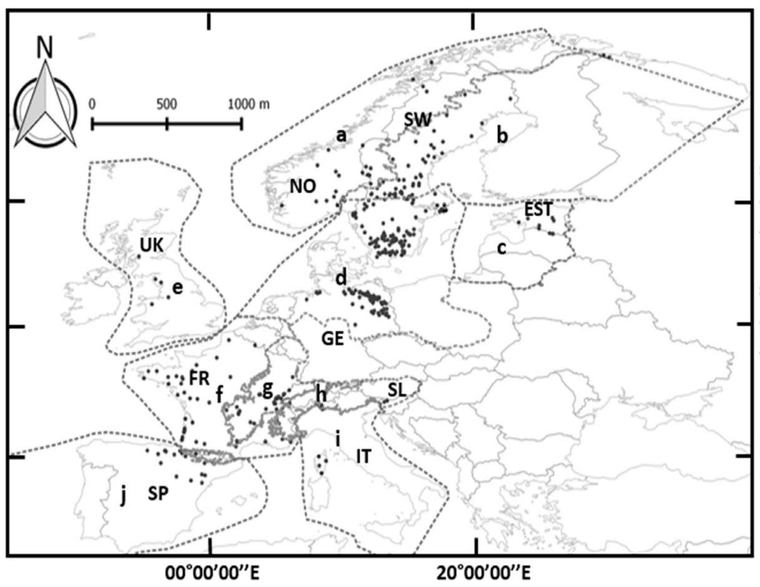

Figure 1: Geographical distribution of study lakes across European continent.

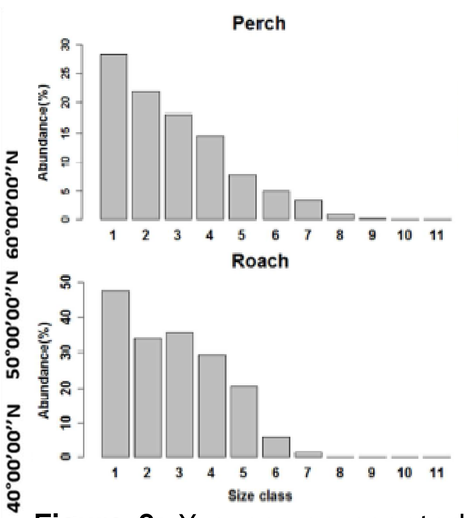

Figure 2: X axes represented fresh mass by a $\log_2$ scale and y axes represent the relative frequencies (%) for each size class.

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

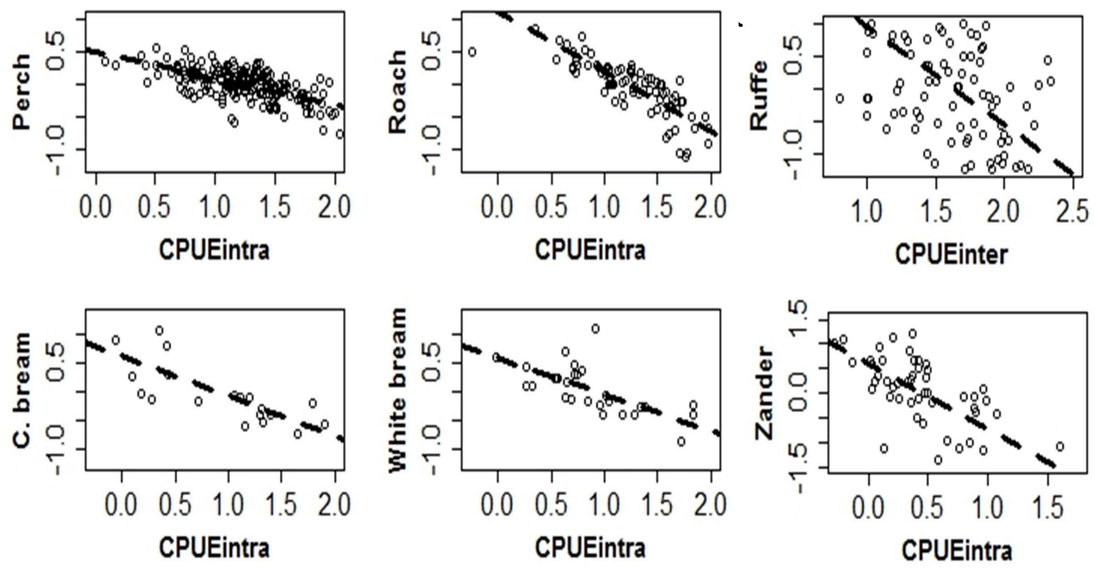

Figure 2: Y axis represents size metrics and x axis the CPUEintra and CPUEinter predictors

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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