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Quantile regression approach for the assessment of environmental variables as constraints in the macroinvertebrate distribution

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Macroinvertebrate distribution-environment relationships have been extensively investigated in literature, but the wide scatter of data usually results in poorly fitting models that can not have a wide use for the definition of restoration strategies and interventions.

The theory of constraints in the analysis of the relationships between the distribution of organisms and the environmental variables is not usually applied in freshwater ecology, even if it would be reasonable. Traditional methods are focused on determining a direct relationship (e.g. central response models) among distribution and environmental gradients. This approach does not allow dealing with multiple stressors that can influence simultaneously macroinvertebrate communities, increasing their overall variability in distribution and abundance.

The role of environmental factors as constraints can be tested using a statistical tool called quantile regression. Quantile regression permits estimates for all parts of the distribution and, especially, allows to test hypotheses about factors setting maximum or minimum limits to values such as organism density. This kind of test specifically allows for other factors to affect the dependent variable without compromising the fit of the analytical model, thus dealing with scatter distributions which are common in survey data.

We studied the macroinvertebrate assemblages of the upper sector of the Serio river (Lombardy) and we identified the main natural environmental variables that can act as constraint at microhabitat level. We analyzed data using quantile regression and defined habitat suitability for target taxa across hydraulic and morphological gradients, evaluating their limiting action.