Macrophytes response to environmental stressors: changing scale from habitat characteristics to catchment-wide pressures

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Macrophytes response to environmental stressors : changing scale from habitat features to catchment-wide pressures

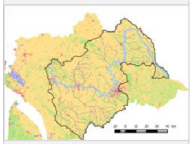
Sandrine LORIOT[1], Thibaut FERET[1], Bertrand VILLENEUVE[2], Christian CHAUVIN[1]

[1] Irstea Bordeaux, CARMA, Aquatic Ecosystems and Global Changes, 50 avenue de Verdun - 33612 Cestas, France.
(contact: sandrine.loriot@irstea.fr)

[2] Irstea Lyon, LHQ Aquatic Habitats, Ecology and Pollutions, 5 rue de la Doua - 69626 Villeurbanne, France.

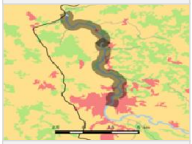
Multi-scale approach : from catchment structure to site habitat

Catchment



Land-cover

Reach

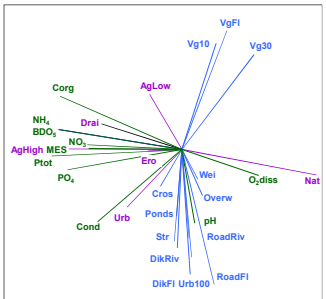


Reach corridor use

Site

Hydromorphology
Physico-chemistry

Assessing the pressures effects on the biological metrics regarding the scale of analysis



Correlations between PLS predictors are shown by PCA

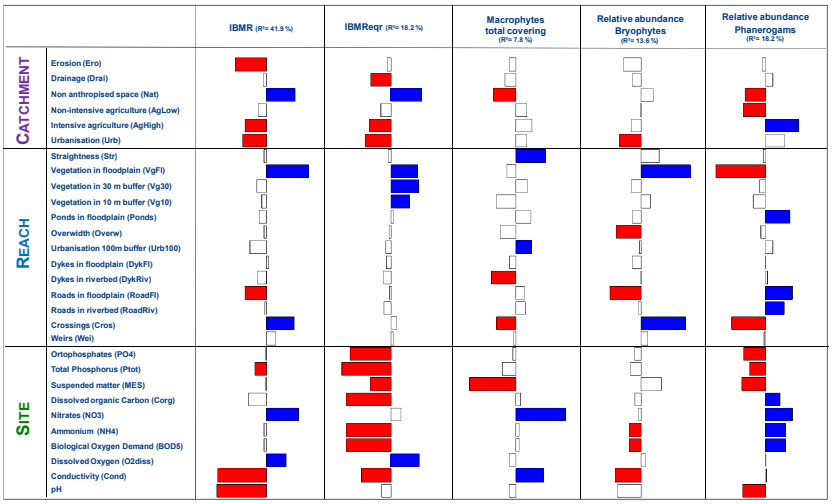
Developing macrophytes-based methods for assessing and managing the ecological status in rivers needs to deal with different analysis scales: floristic data are recorded at the site scale while the anthropic pressures are defined at the large scale of catchment area. Focusing on hydromorphology highlights the needs of multi-scales approach. Indeed these environmental parameters cover functioning (hydrology) and features (substrate, river shape) at nested scales. To be able to understand the relationship between global descriptors (anthropic pressures) and precise population composition and structuration (bioindicators), focusing the right scale for each approach is essential.

METHODOLOGY

The search for sensitive macrophytes metrics for assessing the impact of environmental parameters were tackled by a PLS modeling distinguishing pressures at catchment, reach and site scales so as to respect the hierarchical spatial organization. This multi-scalar method was developed to identify and quantify the biotic response through these different scales.

Focusing on hydromorphological pressures and the local scale, a PCA analysis was realised on a biological metric in order to refine the PLS model reading. This study was undertaken using the French river monitoring databases (chemical, hydromorphological and biological parameters). The habitat description (local scale) was derived from the macrophyte survey protocol.

MULTI-SCALE ANALYSIS

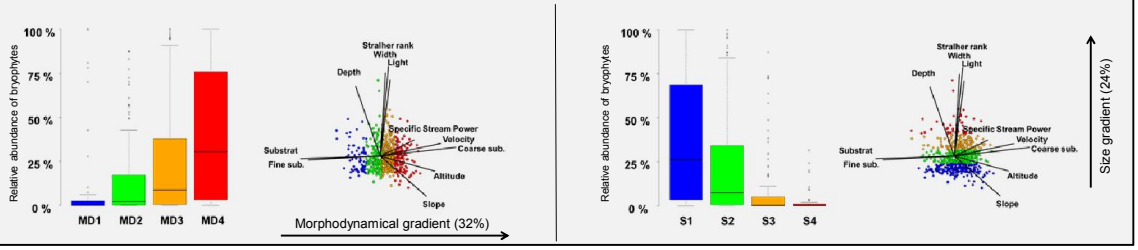


At the global scale the PLS shows that nutrients load and organic matter had a predominant effect on the biological compartment, and that land use features played an integrating role for the pressures expression.
Oppositely, the analysis shows the difficulty to characterise the role of hydromorphological descriptors assessed at the medium scale.
That is clearly shown using a global metric as IBMR* (Index value and Ecological Quality Ratio).

LOCAL SCALE

If at a large scale, the descriptors of pressures cannot directly explain the response of the biological metrics, the link is more clearly evidenced by analysing the local hydromorphological parameters. The habitat descriptors are recorded in the same time and at the same site where the floristic data is surveyed (100 m stretch).

At this consistent scale, data describing both population and habitat are closely related. The exemple of the bryophytes relative abundance shows a clear gradient of response of the biological metrics regarding the morphodynamical (MD) and size (S) gradient of the stream.



CONCLUSIONS

The Water Framework Directive required to fit the biological assessment methods as sensitive indicators of catchment-wide scale pressures. The whole results of the study shows that the direct relationship is basically poor at the site scale, as it can be expected from the ecological nested concepts. To be able to fit efficient and relevant assessment methods in the one hand and diagnosis methods in the other, developing methodologies must be undertaken at the consistent and right scale, both for biological and environmental parameters. If necessary, relationships between catchment-wide pressure descriptors and local habitats features (morphology, substrate, chemicals) must be defined in an other approach for establish proper links on the global population response model (e.g. DPSIR models).

* *Biological macrophytes index for rivers (Haury et al., 2006): French macrophytes index for ecological status assessment of streams*

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