Macrophytes in boreal streams: Characterizing and predicting native occurrence and abundance to assess human impact (Rääpysjärvi et al. 2016) [1]

Macrophytes are a structurally and functionally essential element of stream ecosystems and therefore indispensable in assessment, protection and restoration of streams. Modelling based on continuous environmental gradients offers a potential approach to predict natural variability of communities and thereby improve detection of anthropogenic community change. Using data from minimally disturbed streams, we described natural macrophyte assemblages in pool and riffle habitats separately and in combination, and explored their variation across large scale environmental gradients.

Specifically, we developed RIVPACS-type models to predict the presence and abundance of macrophyte taxa at stream sites in the absence of human influence and, used data from impacted streams to explore the responses of three biotic indices to anthropogenic stress. The indices used, taxonomic completeness (O/E-taxa), a measure of compositional dissimilarity (BC-index) and an index taking into account the abundance of species (AB-index), are based on predicted and observed macrophyte communities. We found that size of the catchment area, altitude, latitude and percentage of lakes in the catchment were the large scale environmental variables that best predicted the natural variation of assemblages. The RIVPACS approach substantially improved both the precision and accuracy to predict the natural communities and the sensitivity to human disturbance. O/E-taxa performed best in relation to the null model decreasing the variation by 20% in pools, 29% in riffles and 32% in combined data. In general, models based on the riffle assemblages performed better than models based on pool assemblages, but including both habitats and predicting abundances instead of only presence/absence yielded the greatest accuracy and sensitivity. Our results support the use of multivariate modelling techniques in predicting reference condition to assess status of stream macrophyte communities.

Keywords

Agricultural pressure; Bioassessment; Predictive models; Reference condition; RIVPACS; Water Framework Directive

Highlights

Natural stream macrophyte variation was controllable with large scale environmental variables.

Community composition was predicted with reasonable accuracy and precision.

Predictive models including riffle habitat and abundances performed best.

The observed/expected indices showed clear responses to agricultural pressure.

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