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Diatom assemblages distribution in catalan rivers, NE Spain, in relation to chemical and physiographical factors

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Abstract

Distribution patterns of epilithic diatom assemblages in streams in northeastern Spain and their relation to different environmental gradients are presented. Thirty-five sites were sampled covering a wide range of fluvial typologies. Gradient analysis was used to analyze the community structure and the major ecological gradients underlying variation in species composition. Two major gradients were evident; the first was a complex gradient from oligotrophic, pristine, fast-flowing highland rivers to mainly eutrophic rivers of low elevation; and the second related to altitudinal and seasonal variation of temperature. Two sets of factors were evident; one was associated with water chemistry, and the other to seasonal and physiographical variation. Variance partitioning allowed the separation of the effects of the different sets of environmental parameters. The contribution of physiography and water chemistry to diatom distribution was more unclear when the level of disturbance was intermediate. Considering the relatively high proportion of variation explained by physiographical variables alone, we suggest that when using diatoms to evaluate water quality, ecoregional characteristics of river stretches should also be considered.

Keywords: Diatoms; Epilithon; Water quality; Multivariate methods; Community analyses

1. Introduction

Chemical analyses of water provide a good indication of the chemical quality of the aquatic systems, but do not integrate ecological factors such as altered riparian vegetation or altered flow regime and therefore, do not necessarily reflect the ecological state of the system (Karr et al., 2000). Biological assessment is a useful alternative for assessing the ecological quality of aquatic ecosystems since biological communities integrate the environmental effects of water chemistry, in addition to the physical and geomorphological characteristics of rivers and lakes (Stevenson and Pan, 1999).

Diatoms are a siliceous class of algae reputed for being very sensitive to chemical conditions. They usually account for the highest number of species among the primary producers in aquatic systems (Pan et al., 1999). Consequently, they are frequently used as biological indicators of water quality and a number of methods for monitoring European rivers based on diatoms have been already proposed (Kelly et al., 1998, Prygiel et al., 2002). Diatom analysis have therefore been considered an important contribution to the European Water Framework Directive (European Commission, 2000), which aims to achieve a "good status" for all waters in the EU before 2015.

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Despite their potential, the use of diatoms as biological indicators of water quality of fluvial systems may be hampered because their distributional patterns respond to a multitude of different factors, ranging from biogeographical to biogeochemical and human influenced (Potapova and Charles, 2002). The challenge of determining which portion of the distribution of a given community is associated with human influences and which is related to the defining characteristics of a given ecoregion needs to be resolved (e.g. Hall et al., 1999). This knowledge may be essential in the assessment of biological quality, which is based on the degree of deviation from a reference biological population. Biological integrity (Karr, 1991) is measured by comparing a given site with reference ecosystems that lie in similar geomorphological and climatic settings but are not exposed to human impact. The search for reference sites is often difficult in particular in regions of extensive human activities, and this may hamper the application of this concept. Knowing in depth the autoecological characteristics of species may be extremely helpful to make an objective search for reference conditions.

Multivariate techniques (ter Braak and Verdonschot, 1995) allow the elucidation of ecological factors, which explain most of the variation in diatom distribution. In particular, variance partitioning (Borcard et al., 1992) may help to separate regional and general factors influencing diatom distribution. In this paper we use multivariate techniques to elucidate the physiographical, chemical and physical factors associated with diatom community structure in NE Spain.

2. Methods

2.1. Diatom sampling, preparation and analysis

This study was carried out in a number of rivers located in Catalonia (NE Spain) (Fig. 1). These sites were selected to cover a wide range of fluvial typologies with different levels of human disturbance. Fifty-seven

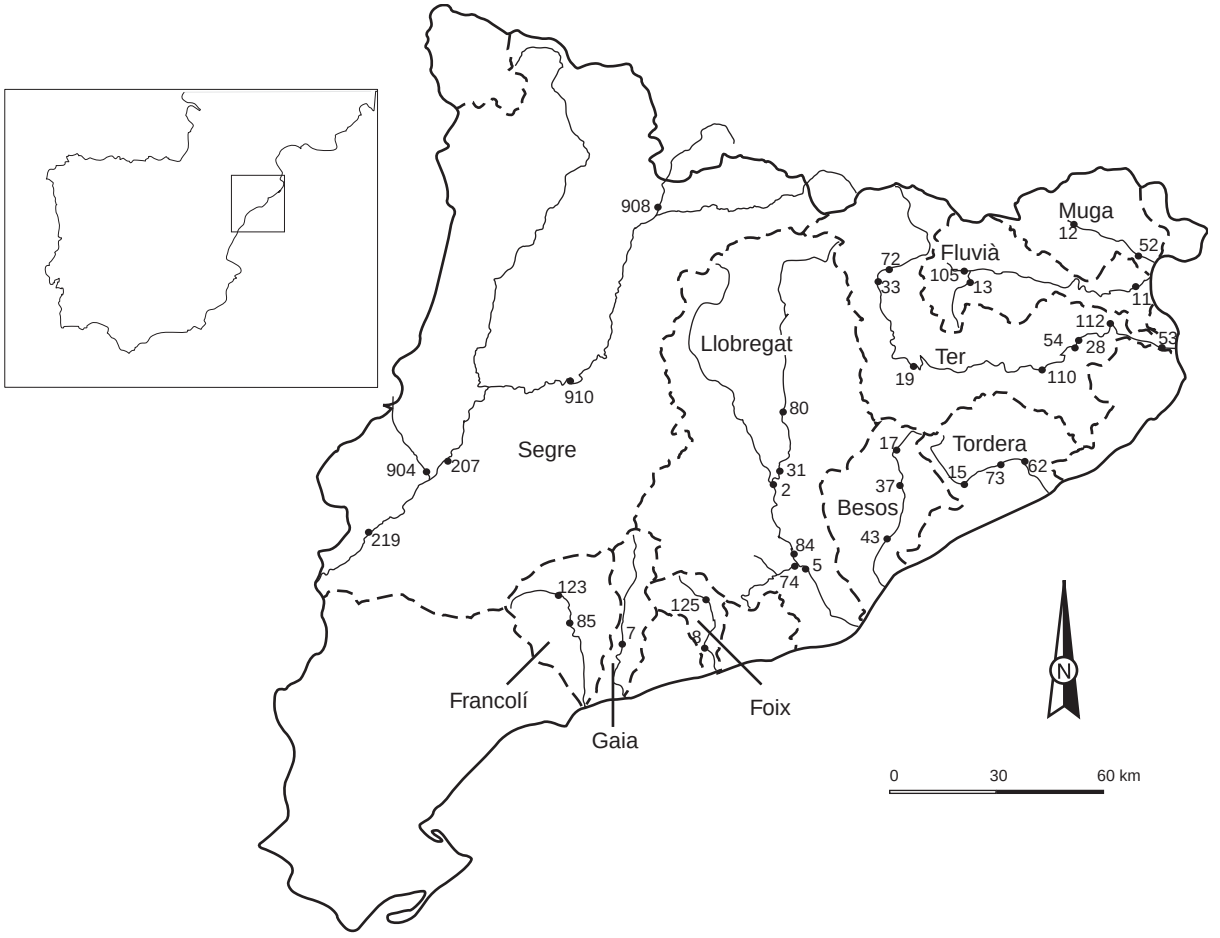

Fig. 1. Map of the study area and location of the sampling sites. The boundaries among different catchment basins are also pictured.