Abstract

The concept of integrated environmental monitoring includes the gathering of all the information necessary to obtain a comprehensive view of ecosystem status, processes and functionality, through a classical ecological approach. The present research falls in this context by combining passive and active biomonitoring, sediment mineralogy, element total content analysis and partitioning among sediment fractions, water chemical analyses and biodiversity analysis. The approach was applied to two of the main river systems of the "Cilento, Vallo di Diano e Alburni" National Park (PNCVDA), the Bussento and the Calore Salernitano, in order to obtain clear scenarios of river quality and of the subtended processes, in an area hosting exceptional biodiversity. Specifically, 19 elements among macronutrients (Ca, K, Mg, P, S), micronutrients (Co, Cr, Cu, Fe, Mn, Na, Ni, Si, V, Zn) and non-essential elements (Al, As, Cd, Pb), collectively referred to as Potentially Toxic Elements (PTEs), were analysed in 49 sites along the Bussento and Calore Salernitano rivers for two consecutive years. In order to obtain clear scenarios of stable concentration gradients, an ensemble of two passive biomonitors, *Helosciadium nodiflorum* (L.) W.D.J. Koch and *Mentha aquatica* L., and two active biomonitors, *Fontinalis antipyretica* Hedw. and *Chara gymnophylla* A. Braun, were employed. Whereas *H. nodiflorum* and *F. antipyretica* were already recognized as fine biomonitors of PTEs in freshwater ecosystems, *M. aquatica* and *Ch. gymnophylla* were novel, and were preliminary validated using the former biomonitors as references. Since no information on the charophyte flora of the PNCVDA was available, the biodiversity of this group of algae in the area was also investigated, in order to avoid the introduction of allochthonous biomonitors possibly interfering with local communities. Finally, in order to shed light on the possible causes of PTE concentration gradients and to highlight other criticalities, sediment mineralogy, sediment PTE fractionation, the concentrations in water of PTEs, photosynthetic pigments, anions, and several chemical-physical parameters like pH, dissolved oxygen, conductivity and redox potential were also investigated. State-of the art spatial and multivariate statistical techniques, involving methods specifically developed for the project, were employed throughout in the analysis of the complex datasets derived from the experimental activities.

Overall, three main criticalities were highlighted in the Bussento and Calore Salernitano rivers: i) the presence of springs occasionally emitting water with high PTE concentrations, ii) the presence of wastewater discharges and iii) the presence of nutrient leaching from agricultural soils. With the exception of the latter, the criticalities appear to be localized to few sites on both the river systems, an occurrence involving also the presence of high Al, As, Co, Fe, and Mn concentrations in a few sites, which are likely related to the presence of metallic structures or wastes in the riverbed.

The approach embraced for the research, joining chemical, physical, botanical, zoological, geological, cartographical and statistical skills, represents a true ecological strategy to the study of complex ecosystems, and an example of how multiple activities can be coupled to obtain a comprehensive view of freshwater ecosystem integrity. Despite the enormous efforts required, it is the unique approach capable of dealing with the complexity of ecological systems, and what it is advocated for to cope with the current local and global scale crises of the Anthropocene.