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Assessing the effectiveness of surrogates for species over time: Evidence from decadal monitoring of a Mediterranean transitional water ecosystem

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ABSTRACT

The use of higher taxa or alternative approach to species surrogacy, such as the BestAgg procedure, could represent cost-effective solutions to avoid expensive species-level identifications in monitoring activities, especially on the long term. However, whether a set of surrogates would be effective in subsequent reiteration of the same assessment remains largely unsolved. We used a long-term dataset on macro-benthic assemblages to test the hypothesis that family-level and BestAgg surrogates which are effective for a limited period of monitoring could be successfully applied to quantify community patterns also in subsequent monitoring programmes. The effectiveness of surrogates in detecting temporal variations in assemblage structure as at species level remained basically unaffected over a decade. Recognizing once and for all if species surrogacy may have a practical value for monitoring will strongly depend on future assessments of the potential of surrogates to reflect community changes and to retain this prerogative over time.

1. Introduction

Environmental and biological monitoring is at the core of applied ecological research, providing invaluable insights on patterns and processes underlying the dynamics of ecosystems, and producing sets of data that are instrumental for progresses in theoretical ecology (Lovett et al., 2007; Lindenmayer et al., 2012). Monitoring is also essential for environmental policy, since systematic collections of data are necessary to inform the adaptive management of environmental issues (Lindenmayer and Likens, 2009), whether concerning the assessment and mitigation of human impacts (Bustamante et al., 2012; Ellingsen et al., 2017), the effectiveness of conservation strategies (Fraschetti et al., 2012), the success of restoration actions (Block et al., 2001), or the surveillance of the ecological quality status of ecosystems (Borja and Dauer, 2008).

The concept of monitoring intrinsically implies performing replicated observations through time, since single assessments cannot provide a comprehensive characterization of systems being investigated. This because communities and ecosystems are not static entities, which are subject to a complex interplay of processes acting at a range of spatial, but also, temporal scales, and historical data are often a prerequisite for a deeper understanding of mechanisms driving ecological changes (Lovett et al., 2007; Lindenmayer et al., 2012; Mieszkowska et al., 2014). However, sustaining data collection on the long term is expensive, requiring the availability of adequate and continuous funding, which often represents a critical aspect for the maintenance of effective monitoring programmes (Hewitt and Thrush, 2007) and stimulates advances in optimization strategies (Mueller and Geist, 2016; Ellingsen et al., 2017). Major cost components in monitoring activities, particularly when focusing on invertebrate taxa, concern species-level identifications of organisms (Mandelik et al., 2010). Reducing expense related to the achievement of fine taxonomic resolution, therefore, may allow allocating additional budget to extend the spatial coverage and/or the time span of routine monitoring programmes (Mueller et al., 2013).

Although several approaches have been proposed to save efforts during sample processing both reducing the number of operational units and simplifying their identification, including the use of species subsets, cross-taxon congruence, or morphological groups, the analysis of communities at taxonomic levels higher than species (e.g., genus, family) has been the mainstream procedure so far, especially in aquatic environments (Dauvin et al., 2003; Jones, 2008; Sánchez-Moyano et al., 2017). This last approach relies on the concept of taxonomic sufficiency (Ellis, 1985), which assumes that, to some extent, ecological patterns

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