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Unravelling phylogenetic relationships among regionally co-existing species: *Hydropsyche* species (Trichoptera: Hydropsychidae) in the Loire River

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Abstract

Taxonomy is undoubtedly complementary to other fields in biology such as ecology, and both ecologists and taxonomists increasingly acknowledge that they can profit from phylogenetic ecology or ecological phylogeny, respectively. However, such mutual relations between these disciplines are constrained by traditional focuses on different operational scales: taxonomists are more familiar with large scales (e.g., global, continental, many species of a given clade), whereas ecologists are more familiar with small scales (regional, ecosystems, habitats, few species of a given clade). To foster mutually fruitful, 2-way exchanges between taxonomy and ecology at such smaller scales requires assessments of the small-scale performance of taxonomic practices so far used at larger scales. Such assessments are the objective of this study. To combine quantified ecology and phylogeny at the smaller scale, we designed a research project using 9 species of *Hydropsyche* (Trichoptera) from the Loire River (i.e., we focus on the regional scale). Here, we tried to unravel the phylogenetic relationships of this regional set of species using (1) many different characters (molecular and morphological characters of larvae and adults), (2) taxonomic congruence instead of total evidence (as the former provides more opportunities for future research on links between different data sets), and (3) an explicit data matrix and analysis methods that are commonly recommended for phylogenetic studies (e.g., maximum parsimony, maximum likelihood, bootstrapping), and we also included traditional, parsimonious, phylogenetic reasoning. Combining these elements, we obtained the following information for the regional *Hydropsyche* representatives from the Loire: (1) phylogenetic clusters of the species, (2) phylogenetic distances among the species, and (3) phylogenetic polarities of characters (plesio- to apomorphies) in the species tree. For our future ecological studies, this will enable (1) establishment of priorities in species selections for experimental approaches, (2) establishment of relationships between ecological and phylogenetic distances, and (3) interpretation of ecological response gradients across the species in the context of evolutionary processes such as adaptation, niche conservatism, or fitness. These future ecological studies will provide elements that in turn should be useful for taxonomists wishing to include small-scale ecological data into their analyses.

Key words: cladistics, molecular data, morphological data, phylogenetic distance, phylogenetic polarity

Introduction

Particularly in its larger sense (including phylogenetic systematics), taxonomy is undoubtedly complementary to other fields in biology such as ecology or developmental biology (Wheeler 2007), and proponents of these other fields acknowledge fruitful 2-way exchanges with taxonomy (Minelli 2007). For example, ecologists are increasingly aware that evolutionary processes and thus phylogenetic relationships underlie many ecological patterns (e.g., Ackerly & Donoghue 1995, Poff *et al.* 2006, Webb *et al.* 2002, 2006, Agrawal *et al.* 2009, Cavender-Bares *et al.* 2009). Likewise, taxonomists make increasingly use of ecological data to complement phylogenetic analyses (e.g., Freeman 2000, Nylin *et al.* 2001, Kaila & Stahls 2006, Sharkey 2007, Pauls *et al.*

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