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An expert-based approach to invertebrate conservation: Identification of priority areas in central-eastern Alps

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ABSTRACT

The private and public agencies for nature protection often ask land managers to implement biodiversity conservation plans. Invertebrates constitute a substantial proportion of terrestrial and freshwater biodiversity and are critical to ecosystem functions. However, their inclusion in conservation planning and management is under represented, particularly in the Alps.

In this paper we propose a new methodological solution and challenge for the identification of priority areas based on the integration of three approaches: invertebrate multi-taxa based; expert-based; and, GIS-based. The Trentino Province (eastern Italian Alps), was investigated as a case study.

The first methodological step was to select a panel of nineteen experts which played a strategic role in the suggestion of 229 species, endangered or of mandatory conservation interest. The second step was to find objective criteria for species prioritisation. These criteria, crossed with the experts taxonomical and ecological knowledge resulted in a list of 70 focal invertebrate species. The third step was to integrate with the GIS-based approach data layers from the habitat requirements of each of the 70 focal species to generate potential spatial-distributional maps. Potential distribution maps gave information about the sites (priority areas) in which the highest number of focal species could concentrate, thus suggesting where to focus future monitoring efforts. Several priority areas resulted outside the protected ones. Alluvial forest and hop-hornbeam woods were the habitats with the highest number of focal species, and thus they represent the habitats of major conservation interest and concern, because they are usually small, fragmented, and near urbanised areas located in the bottom of the valleys. The relatively simple processes involved in species and potential habitat distribution proposed in this paper can be conducted with a minimal amount of data, making it an attractive tool when time and funds are in short supply.

Introduction

Species richness and environmental quality are often positively correlated, thus one of the main challenges in conservation biology is to maximise species richness and biodiversity persistence (Cabeza & Moilanen 2001; May 1988). Human activities can create a mosaic of modified land cover and induce habitat fragmentation and landscape homogenisation, with consequent erosion of natural habitats and species richness (Krauss et al. 2010). Therefore, one of the main goals of landscape ecology is to identify which areas should be protected and how to manage simultaneously the species and their habitats (Schmeller, Gruber, & Budrys 2008). On the other hand the main goal for landscape ecologists is to maximise the cost/benefit in conservation planning. With respect to insects, Leather, Basset, and Hawkins (2008) recommend to follow five steps when creating a biodiversity conservation protocol, which can be summarised as: (1) knowing biodiversity; (2) understanding the past and present distribution of biodiversity; (3) implementing suitable monitoring systems to disentangle stochastic and natural variation from that resulting from anthropogenic actions; (4) identifying harmful factors influencing arthropod populations and their cascading effects on ecosystem services; and (5) seeking strategies to alleviate the action of harmful factors and restoring ecosystem services.

Several conservation status assessments have been proposed for vertebrate fauna (e.g.Battisti & Luiselli 2011; Brambilla, Gustin, & Celada 2011; Keller & Bollmann 2004; Primack 2006). On the other hand this kind of knowledge for invertebrate fauna is still at the beginning (Cabeza et al. 2010). Recently, some Red Lists have been published at the European level (Kalkman, Clausnitzer, & Dijkstra (2008); Nieto & Alexander 2010; van Swaay et al. 2010), pointing out the lack of data at the regional scale. Clark and May (2002) confirm the presence of a deep taxonomic bias in conservation

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research, with predominant vertebrate studies (69% of papers versus 3% of described species), while invertebrates are often overlooked (11% of papers versus 79% of species).

In general, there is no consensus about the criteria that should be used to prioritise biotopes. One of the most commonly used criterion is the occurrence of priority species (Koomen & van Helsdingen 1996). As reported by Fattorini (2010), biotope prioritisation could be achieved only after species prioritisation, which implies assessments of the conservation status of each species. The main difficulty is to find the best way to develop the species prioritisation. Amici and Battisti (2009) proposed a conceptual framework for objective selection of fragmentation-sensitive focal species for ecological network planning by an expert-based approach. This approach has been applied to mammals. For invertebrates, there is very limited knowledge on how many and which species are endangered and, often, the museum collections are not sufficient to give a complete estimate of local biodiversity. Fattorini (2010) proposed a two-step protocol to prioritise biotopes applied to invertebrates: the first step is the estimation of the vulnerability of each species from rarity measures, and the second step is to use the values of vulnerability of each species to rank the biotopes. This approach can be used when the distribution and autoecology of the considered taxa is well-known. The distribution can be deduced from museum collections and the ecological information from published literature. Unfortunately, in many cases the museum collections give spatially-biased information (Boakes et al. 2010) and for many invertebrate taxa the ecological knowledge is insufficient.

Two approaches have been applied in Italy for nature conservation: the protection of single species and the protection of habitats. Such approaches, that also include invertebrates, are applied through the implementation of the Bern Convention, the Flora, Fauna and Habitat Directive (FFH) (43/92/CEE) and of the Red Lists of the International Union for Conservation of Nature (IUCN) (Ballerio 2008). Some regions (for example Tuscany and South Tyrol) have produced local Red Lists that unfortunately have been compiled without using objective criteria to identify the level of risk, and thus cannot be used to propose action plans (Ballerio 2008).

Taking in consideration this gap of knowledge, the goal of our paper was to propose a new methodological solution for the identification of priority areas based on invertebrates-, experts- and GIS-based approach applied to the Alps.

We focused on the invertebrates of the central-eastern Italian Alps (Trentino Province), where no previous studies were conducted to identify the priority areas for invertebrate conservation of this area located in the core of the Alps.

Our aims were: (1) to create a list of focal species (*sensu* Lambeck, 1997); (2) to create maps for the areas rich in focal species; and, (3) to recommend a relatively simple approach for stakeholders (e.g. environmental protection agencies, parks) to support land-use decisions and to identify priority areas.

Methods

Study area

This research has been developed in the Trentino Province (6212 km^2) which is located in the Trentino-Alto Adige Region and represent a perfect case study being in the core of the Alps, having low human density (82.5 inhabitants/km^2) and representing the main mountain region of Italy (encompassing 12.8% of the whole Italian mountain territory) (Fig. 1). Furthermore, this region includes a mosaic of ecosystems characterised by natural habitats and montane agroecosystems of cultural and historical importance.

Key taxa

We selected 10 different orders of invertebrates: Arhynchobdellida; Coleoptera; Decapoda; Dictyoptera; Lepidoptera; Odonata; Orthoptera; Plecoptera; Pulmonata; and, Unionida. These taxa, living both in terrestrial and freshwater habitats, have been demonstrated to be useful tools for evaluating the habitats' natural value, and for monitoring and detecting environmental changes (Hodkinson & Jackson 2005; Rodrigues & Brooks 2007). Moreover, a partial knowledge of their local spatial distribution was already available before the beginning of the research (Ruffo & Stoch 2005).

The experts-based approach

Several examples of biodiversity conservation plans provided lists of species of conservation interest, but these species had been selected with difference accuracy and objectivity (Boitani, Falcucci, Maiorano, & Rondinini 2007). When the amount of knowledge on species distribution and conservation status is impossible to detect just by datasets or literature, it is useful to apply the Delphi method, also known as *expert based approach* (Amici & Battisti 2009; Hess & King 2002; McMillan & Marshall 2006). This method uses an examining board comprising people with different knowledge on the considered topics. Based on the aim of our research, we chose local people with different scientific and entomological expertise.

A total of 19 experts (see Acknowledgements) were involved on the project. Each expert collaborated to the species assessment. We asked to each panellist to propose a draft list of invertebrate species occurring in the study area and belonging to the 10 chosen higher taxa, which they considered endangered or of mandatory conservation interest.

Assessment criteria and ranking process

In order to follow a standardised approach to the evaluation of the drafted list of invertebrates proposed by the panellists, the IUCN criteria (IUCN 2009) were taken into account with the exception of the extent of occurrence (EOO) and area of occupancy (AOO). These criteria may be applied if a good level of data on spatial distribution is available (IUCN 2009), mostly lacking in Trentino. For this reason new criteria were added. A total of ten criteria were selected (Table 1).

Each species was evaluated by linking one or more of the selected criteria.

Subsequently, the list was ranked following a numerical gradient:

- rank 1: species matching only the Endangered criterion (criterion "c", Table 1),
- from rank 2 to 5: species that matched two or more criteria among the criteria "a, e, f, g, h, i, and j" (Table 1) (the number of criteria associated to each species determined the rank),
- rank 6: Endangered and Rare species (criterion "b + c", Table 1),
- rank 7: Protected species (criterion "d", Table 1).

Dataset creation, species-habitat attributions and distributional maps

After the evaluation process and the list of focal species were completed, we conducted an extensive literature research, examining collections and field surveys with the purpose of collating data on the species distribution within the Province. The examined collections belong to three Italian natural history museums: the Museo delle Scienze (Trento); the Museo Civico di Rovereto (Rovereto); and, the Museo Civico di Storia Naturale di Verona, and private collections (see Acknowledgements). During