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Journal of Environmental Management 74 (2005) 79–87

Journal of Environmental Management

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Cross-taxonomic potential and spatial transferability of an umbrella species index

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Received 13 February 2004; revised 29 July 2004; accepted 26 August 2004

Abstract

Validation that conservation of certain species effectively protects a high proportion of co-occurring species is rare. Our previous work has suggested that an umbrella index based on geographic distribution and life history characteristics would maximize the proportion of conspecifics protected per unit area conserved. Using bird and butterfly data from three mountain ranges in the Great Basin, we examined whether umbrella species also would confer protection to species in different taxonomic groups. Further, we addressed the spatial transferability of umbrella species by considering whether species identified as umbrellas in one mountain range would be effective umbrellas in other mountain ranges. Overall, equal proportions of species would be protected using either cross-taxonomic umbrella species or same-taxon umbrella species. Our data suggested that in a given mountain range, umbrella species identified using data from the same mountain range versus a different mountain range would be equally effective. The ability of one set of umbrella species to confer protection to co-occurring species, however, may vary among taxonomic groups and geographic regions.

Keywords: Conservation; Great basin; Spatial transferability; Umbrella species

1. Introduction

Ecologists and resource managers are forced to make land-use decisions using limited time, money, and information (Stohlgren et al., 1995; Oliver and Beattie, 1996; Niemi et al., 1997; Simberloff, 1998). Umbrella species, species whose conservation confers a protective umbrella to co-occurring species, are an attractive short-cut under these circumstances. A key advantage of using umbrella species is that it often is easier to survey and monitor a few species in an assemblage than to survey all species. If effective umbrella species can be identified for target ecosystems, then land-use decisions potentially could be made more quickly and efficiently. However, only a few studies have demonstrated that conservation of one or a few species is likely to confer protection to many other species in either the same taxonomic group or different taxonomic groups (Martikainen et al., 1998; Fleishman et al., 2000, 2001b; Suter et al., 2002). The lack of supporting evidence has made the umbrella species concept controversial, and many doubt it is operational (Kerr, 1997; Oliver et al., 1998; Caro and O'Doherty, 1999; Andelman and Fagan, 2000; Rubinoff, 2001). Nonetheless, strong pressure to develop conservation tools for managed landscapes has maintained the conceptual popularity of umbrella species, highlighting the need for further empirical examination.

In theory, selection of umbrella species is prospective, based on the assumption that if the resource requirements of an umbrella species are met, the requirements of many other species also will be satisfied (Fleishman et al., 2001b). In practice, the species usually touted as umbrellas are charismatic vertebrates with legal protection. Instead of using ecological criteria to select umbrella species, biologists usually have been restricted to determining,

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0301-4797/$ - see front matter © 2004 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jenvman.2004.08.010

post hoc, whether other species will benefit from the conservation of listed species.

In an effort to develop a prospective, more quantitative, and objective method for identifying umbrella species, Fleishman et al. (2000) proposed the 'umbrella index'. The umbrella index calculates the potential of each species in a regional biota to serve as a conservation umbrella for other species in that assemblage using three criteria—mean proportion of co-occurring species, occurrence rate, and sensitivity to human land use (Fleishman et al., 2000). Previous work suggested the umbrella index may be useful for prioritizing locations for conservation because it tended to maximize species protection per unit of conserved area (Fleishman et al., 2001b). Here, we use data for birds and butterflies in montane canyons in the Great Basin of western North America to examine whether the index successfully can identify species that might serve as a conservation umbrella for different taxonomic groups. We also assess whether umbrella species identified using the index method are spatially transferable.

2. Methods

2.1. Field methods

We collected data for our analyses in three adjacent mountain ranges in the central Great Basin, the Shoshone

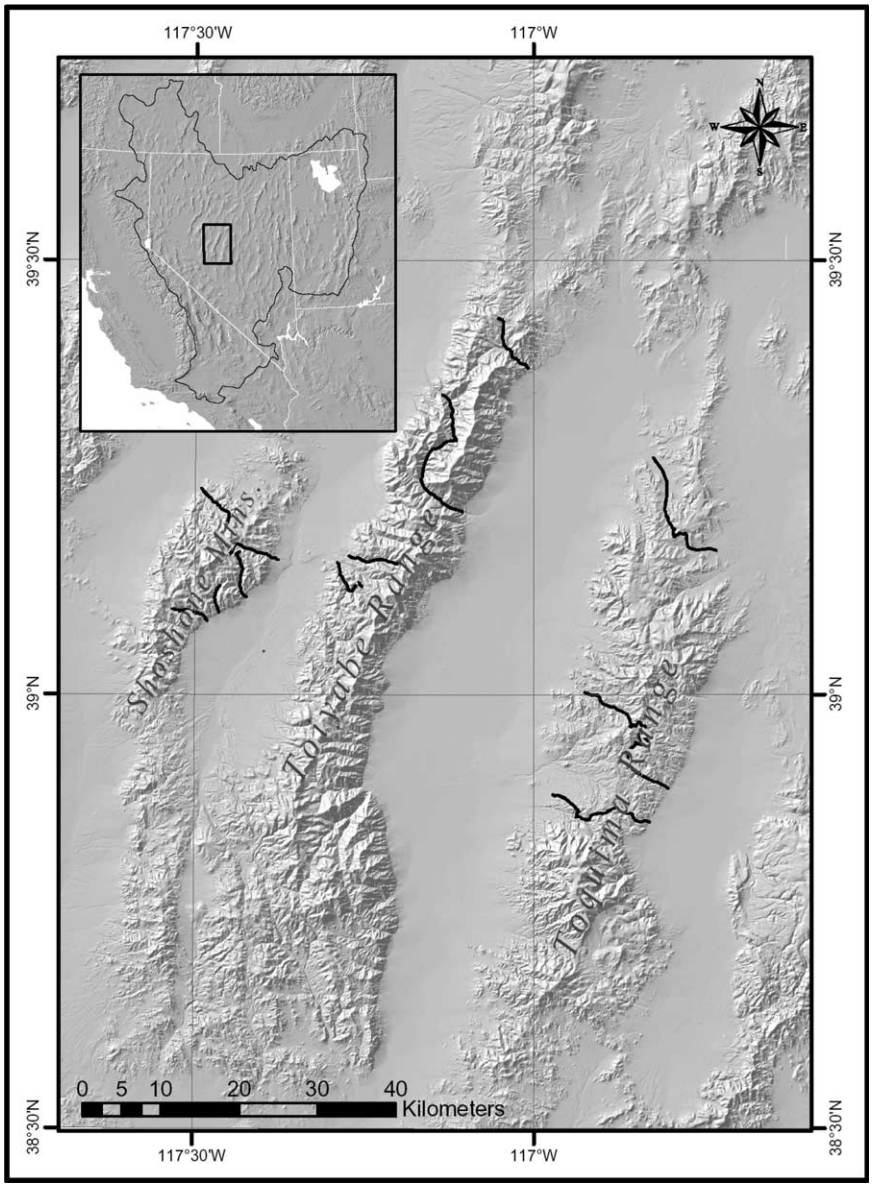

Fig. 1. Location of the Shoshone Mountains and Toiyabe and Toquima ranges (black rectangle, see inset) in the Great Basin (irregular shape with black border, see inset) and of the canyons surveyed in the three mountain ranges. Three pairs of canyons in the Toquima Range and one pair of canyons in the Toiyabe Range connect at the crest of the range.