Ecol Res (2010) 25: 1019–1031
DOI 10.1007/s11284-010-0728-9

ORIGINAL ARTICLE

Sara M. Santos · Maria da Luz Mathias
António P. Mira

Local coexistence and niche differences between the Lusitanian and Mediterranean pine voles (*Microtus lusitanicus* and *M. duodecimcostatus*)

Received: 25 November 2009 / Accepted: 7 April 2010 / Published online: 22 May 2010

Abstract In the present study, we analyzed the coexistence pattern of the Lusitanian pine vole (*Microtus lusitanicus*) and the Mediterranean pine vole (*Microtus duodecimcostatus*) in a potential area of sympatry in a Mediterranean landscape (Portugal). We also determined the relative contribution of local, landscape, and spatial factors explaining the differences in the distribution patterns of the two species in the region. Using a kriging interpolation method, we obtained a map of sympatric and allopatric areas of species occurrence. The estimated sympatry area corresponded to a northwest–southeast belt representing 11.3% of the study area. Habitat niche differences were assessed with binomial GLMs followed by a variance partitioning. At a local scale, higher altitude, higher cover of shrubs, lower clay content in the soil, and lower cover of tree canopy were the most important factors distinguishing *M. lusitanicus* presence sites from those with *M. duodecimcostatus*. At a larger scale, the presence of forest landscape units and the low abundance of "montado" units were the most influencing landscape factors in the identification of *M. lusitanicus* occurrence sites when compared to *M. duodecimcostatus*. Our results suggested that local coexistence of *M. lusitanicus* and *M. duodecimcostatus* in the field is a rare event. The differences in distribution patterns of the two pine vole species were mostly explained by fine-scale environmental factors and by shared spatial effects.

Keywords *Microtus lusitanicus* · *Microtus duodecimcostatus* · Kriging · Sympatry · Niche differences

S. M. Santos (✉) · M. Mathias
Department of Animal Biology,
Centre for Environmental and Marine Studies,
Faculty of Sciences, University of Lisbon,
Campo Grande, 1749-016 Lisbon, Portugal
E-mail: saramlsantos@yahoo.com
Tel.: +351-21-7500000
Fax: +351-21-7500028
E-mail: mmathias@fc.ul.pt

A. P. Mira
Conservation Biology Unit,
Institute of Mediterranean Agricultural
and Environmental Sciences, University of Évora,
Pólo da Mitra, 7002-554 Évora, Portugal
E-mail: amira@uevora.pt

Introduction

Mechanisms and limits to species coexistence can often be best revealed in zones of sympatry between closely related species (Grant 1972; Nicholls and Racey 2006; Spaeth 2009). Coexistence may be allowed, for instance, by character displacement, or some form of resource partitioning (Rosenzweig 1991; Morris 1996; Case and Taper 2000; Schluter 2000; Jones et al. 2001; Kronfeld-Schor and Dayan 2003; Spaeth 2009). A central focus of the theory of density-dependent habitat selection is to explain patterns of species distribution and abundance by understanding how coexisting species share and divide resources. Most studies contributing to this issue involved tests of species interactions, and produced interesting theoretical models, including isodars (i.e., a line in the state-space of habitat densities where fitness is equal in each habitat, but along which fitness varies; Morris 2003), isolegs (i.e., a line in the state-space of species densities along which the choice of habitat is equal; Rosenzweig 1991), or a combination of both (Rosenzweig 1981, 1991; Abramsky et al. 1990; Morris 1996, 1999, 2000; Schmidt et al. 2000). The majority of these studies showed that habitat partitioning was the main mechanism of species coexistence, as a consequence of competition differences among habitats (e.g., Abramsky et al. 1990; Rosenzweig 1991; Morris 1996). These theories, based on density-dependent habitat use and analysis of competitor isoclines (whose slopes estimate the average magnitude of competition), led to major advances in the understanding of species