



ORIGINAL INVESTIGATION

**Eurasian badger habitat selection in Mediterranean environments:
Does scale really matter?**

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Abstract

It is widely believed that spatial scale affects habitat selection, and should influence management options, especially for species with wide geographic distribution or large territories. Eurasian badger habitat selection has been well studied throughout most of its European distribution range, but never at multiple spatial scales. We used compositional analysis to assess habitat selection of Eurasian badgers in southern Portugal at four spatial scales (1, 4, 25, and 100 km²). We assessed habitat use from setts, latrines and footprints presence, and road kills. Oak woodlands with understorey were selected at all scales, being the most preferred habitat at 3 scales (1, 4, and 100 km²). Pastures were most selected at the scale of the 25 km² cell, but their use was not significantly different from oak woodland with understorey. Shrubs and pastures were also secondly important at the majority of scales. Contrary to findings at northern latitudes, deciduous forests decreased in importance as cell size increased. In the highly humanized and fragmented landscape of southern Portugal, Eurasian badgers are selecting the matrix of oak woodlands interspersed with patches of pastures, shrubs and riparian vegetation. In these oak woodlands, scale does not have a marked effect. Management for badgers should provide, for at least, 30% of oak woodland cover at all scales. Our study illustrates the across-scale importance of maintaining the historically human altered, sustainable and unique landscape and land use system – the *montado*.

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Keywords: *Meles meles*; Landscape ecology; *Montado*; Portugal

Introduction

Species rarity, rates of decline, habitat fragmentation, and species–area relationships are all sensitive to the

scale at which they are measured, and therefore conservation decision-makers must explicitly consider scale in interpreting them (Hartley and Kunin 2003; Turner and Tjørve 2005). For instance, Schaefer et al. (2000) found that studies conducted at different spatial scales produced markedly different conservation recommendations for caribou (*Rangifer tarandus*). Similarly, in field experiments to understand the role of predation

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in natural communities, Englund (1997) concluded that the results of small-scale experiments reflected prey movements, while the results of large-scale experiments were due mainly to predator-related mortality. Moreover, data analysed at different scales could also have divergent interpretation. There is no single natural scale at which ecological phenomena should be studied (Levin 1992); to the extent that biological processes are controlled by dominant physical processes, the scale of these abiotic processes may suggest an appropriate scale for some systems (Turner et al. 1989). The perceptual of human observation can create a biased filter for understanding biological systems (Levin 1992). Many authors advocate a multiscale approach in studies of habitat selection (Powell 1994; Morrison et al. 1998; Aued et al. 2003) but there are few examples in land management and conservation strategies.

Eurasian badgers (*Meles meles* L., 1758) are potentially important species in conservation plans (Schonewald-Cox et al. 1991) because it is one of the largest mustelids in much of its range, is highly area-sensitive (variable home range sizes, e.g. 0.14 km² in UK – Cheeseman et al. 1981; 4.46 km² in Portugal – Rosalino et al. 2004; 25 km² in Poland – Kowalczyk et al. 2003), and has high cultural and esthetic value (e.g. Neal and Cheeseman 1996 state that badger seem to typify the very essence of the countryside). Moreover, Virgós (2001) showed that badgers are sensitive to forest loss or fragmentation in Iberian landscapes.

This medium-sized carnivore, often described as a generalist in terms of food and habitat (Neal and Cheeseman 1996; Revilla and Palomares 2002; Virgós 2002), occurs throughout almost all Eurasia, including the island of Crete and Rhodes, ranging from the British islands to Japan (Neal and Cheeseman 1996; Mitchell-Jones et al. 1999). Habitat selection studies have been conducted in some areas of its European distribution range (e.g. Brøseth et al. 1997; Revilla et al. 2000; Good et al. 2001; Rosalino et al. 2004; Rosalino et al. 2005b), especially in the UK (e.g. Kruuk et al. 1979; da Silva et al. 1993; Feore and Montgomery 1999). However, to our knowledge, no previous studies on Eurasian badgers consider effects of spatial scale. Although, Jepsen et al. (2005) did not investigate scale effect on badgers, they suggest that local terrain and habitat features were more important for the choice of sett sites (burrow systems, which provide shelter during the day and can be used for breeding) than larger-scale environmental characteristics.

In this study, we investigate if habitat selection patterns by badgers in Mediterranean landscapes vary with the scale of analysis (e.g. 1, 4, 25, and 100 km² grids), and how such variation might affect conservation strategies and land management policies.

Because the proportions of landscape units vary with scale, and because the animal unit of analysis also

changes (e.g., individual, social group, population) with scale, we hypothesised that habitat use patterns should differ across scales.

Material and methods

Scale is a measure of two factors: grain and extent. While the finest level of resolution (or smallest interval in an observation set) determines grain, the total area sampled (or range over which observations at a particular grain are made) establishes extent (Gergel and Turner 2002; Hay et al. 2001). Our study focused on the effect of grain. We divided our analysis into four overlapping levels of resolution or grain (1, 4, 25, and 100 km²).

Study area

We studied habitat use by badgers in the regions of Alentejo and Algarve (centroid = 38°03'N, 08°07'W; ca. 35,000 km²), Southern Portugal (Fig. 1). The landscape reflects the Mediterranean climate, with variations determined by proximity to the Atlantic coast, altitude, aspect and geological features. The dominant plant communities derive from the progressive degradation of the pristine forests dominated by oaks, and are characterized by the existence of sclerophyllous and evergreen trees, cork oak (*Quercus suber*) and holm oak (*Quercus ilex*) (Rivas-Martínez 1975). These Mediterranean woodlands, known in Portugal as *montados* and in Spain as *dehesas*, form the major remaining wood-pasture system of Europe (Díaz et al. 1997; Makhzoumi 1997; Grove and Rackham 2003) and the dominant landscape in south Iberia. The study area comprised several different habitats which, for analytical purposes, were clustered into more or less homogeneous groups: oak woodlands with understorey (35%), oak woodlands without understorey (3%), shrubland (rockroses, *Cistus* spp.; kermes oak, *Quercus coccifera*; brooms *Genista* spp.; heaths, *Erica* spp., without trees) (10%), other deciduous trees (1%), eucalyptus plantations, *Eucalyptus* sp. (4%), conifers plantations (2%), orchards and olive yards (13%), pastures (30%), water systems (1%), and others (1%).

In the *montados*, four main rural activities (cork extraction, wood gathering, livestock husbandry, and agriculture) are pursued simultaneously in a single space where, nevertheless, high biodiversity levels are maintained (Blondel and Aronson 1999; Plieninger et al. 2003). These systems are characterised by the combination of an open tree cover of cork and/or holm oaks in variable densities, with a rotation of cultures, grazing and fallow (Pinto-Correia 1993). Cork and holm *montados* have an almost allopatric distribution, with cork oak being better adapted to higher humidity, flourishing either under strong oceanic influence or where local factors contribute to a more humid climate, and holm oak to dry conditions (Pinto-Correia 2000). The different landscape structure across *montado* range, results from the variation in tree and understorey (e.g. *Cistus* spp., *Genista* spp., *Lavandula* spp., *Erica* spp.) composition and density, agriculture and forestry practices (e.g. wheat production, cork extraction), grazing species (e.g. pig, sheep, goat, cattle) and intensity.

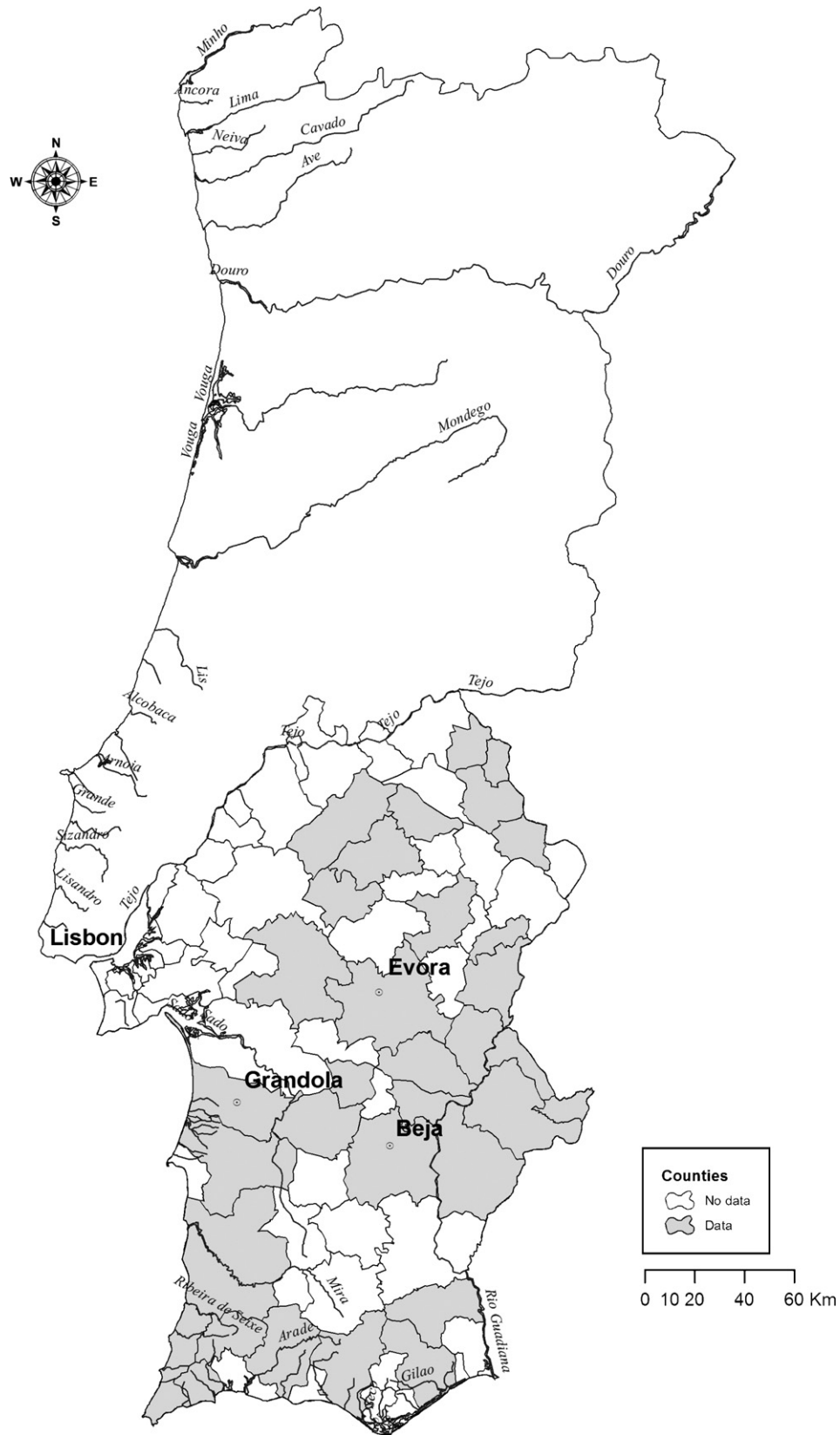


Fig. 1. Study area location for multiscale habitat analysis (Alentejo and Algarve regions) in southern Portugal.

Topography includes coastal plains (0 m a.s.l.) and mountains (1025 m a.s.l. – Serra S. Mamede), and the climate is typically Mediterranean with cold to mild winters and hot and dry summers (with temperatures ranging from -8 to 45.2 °C; Instituto de Meteorologia: <http://www.meteo.pt/Informacao-Climatica/Anos/Ano2001/Temperatura.htm>). Human settlements are sparse and activities are generally restricted to cork extraction in summer, cattle rearing, hunting and traditional agriculture.

Badger data compilation

To examine badger habitat selection at 4 scales, badger presence was derived from about 1900 km of transect surveys conducted during 1990–2002 by a total of 15 observers from the CBA, the Department of Biology of the University of Évora, the Institute for Nature Conservation (ICN) and the center of Studies for Iberian Avifauna (CEAI). Each transect was established in a dirt road walked at about 1.8 km/h by two observers, and were representative of the sampling areas' landscape. Observers looked for signs in the roadway and within 2 m of the road, for a total width of 10 m, and each had at least 2 years of previous experience using this method to detect carnivore presence. This efficient survey method is frequently used to detect carnivore presence at large scales (Sadlier et al. 2004). Although some transects were visited more than once, we used data from only the most recent survey (ca. 90% of the data corresponds to the last 6 years). We recorded badger presence or pseudo-absence (non-detections, which could reflect true absence or a failure to detect presence) in each $1 \text{ km} \times 1 \text{ km}$ grid cell (in a presence/absence format) with transect lengths within cells varying from 250 to 1000 m/cell, and covering habitats in the same proportion as available in each cell.

Badger presence was assigned if a badger footprint, scat, latrine, or sett was recorded in the $1 \text{ km} \times 1 \text{ km}$ cell. Each of these signs can be a result of different activities (e.g. foot prints and latrines – patrolling and feeding activities; setts – refuges and reproduction), and thus animals may be selecting different landcovers for every of those activities. Collectively these signs should reflect habitat selection across various activities (e.g. feeding, scent-marking, breeding). Because badgers' home range sizes are stable across seasons (Rosalino et al. 2004) we ignored seasonal effects.

The larger cells ($2 \text{ km} \times 2 \text{ km}$, $5 \text{ km} \times 5 \text{ km}$ and $10 \text{ km} \times 10 \text{ km}$) were included in the analysis only if at least 20% of the constituent $1 \text{ km} \times 1 \text{ km}$ cells had been surveyed for badgers. Badgers were considered present in large cells if, at least one badger sign was detected within its limits. Because badgers signs cannot be confused with signs of other species, we assumed a negligible number of false presences. Data were analyzed in a Geographic Information System built for the study area in ArcView (ArcView version 3.1, ESRI, California, USA) (For details see Santos 2003).

We cannot assert that badgers were absent in areas where no sign was detected. For this reason, we compared used habitats to available habitats rather than to “unused” habitats. In this scheme, failure to detect badgers reduces statistical power, but does not produce bias as long as badger signs were equally detectable in each habitat type. Differences in detectability

were minimised because dirt roads provided a uniform substrate for signs.

Spatially correlated data may bias habitat selection inferences (Betts et al. 2006). Thus, measuring spatial autocorrelation, i.e., the extent to which detecting badger presence at one location affects the probability of detecting presence in a nearby new location, is crucial in spatially explicit analysis. We used Moran's I index (Moran 1950) to evaluate spatial autocorrelation between badgers presence data:

$$I(h) = N(h) \frac{\sum_{h=1}^N \sum_{i=1}^N W_{ij} z_i z_h}{\sum_{i=1}^N z_i^2},$$

where $I(h)$ is the value of the index for interval class h , $N(h)$ the number of observations in interval class h , z_i the measured value at point i , and z_h is the measured value at point h and W_i the weight function being 1 when points are in close proximity and 0 when points are farther apart (Moran 1950). The index value was then used to calculate the Moran's I statistic

$$I_k = (I(h) - u_1) / \sqrt{u_2},$$

where u_1 and u_2 are the expected value and the variance under the null hypothesis that there is no spatial autocorrelation and compared to a normal distribution (Cheng and Stephens 1986; Epperson and Li 1996). This cross-autocorrelation coefficient measures the communality in the spatial patterns of the variables (Fortin et al. 1989) and varies from -1 (perfect negative spatial autocorrelation) to $+1$ (perfect positive spatial autocorrelation), with values close to 0 representing no spatial autocorrelation. To estimate the threshold distance at which spatial autocorrelation is negligible, we progressively increased the neighborhood distance from a radius of 1000 m (corresponding to smaller grid cells) to 5000 m (larger than the 3390 m maximum home range diameter defined for a circular 9.02 km^2 badger territory area in Portugal – Rosalino et al. 2004), and measured Morans I index for each radius distances. Spatial autocorrelation was calculated using ROOKCASE Microsoft Excel Add-in (Sawada 1999).

Habitat data

Habitat composition for the four scales of analysis was calculated as the proportion of each cell occupied by each habitat type, based on a land cover map produced by the National Center for Geographic Information (CNIG) from 1990 aerial photography, photo interpreted and field verified in 1991. CNIG recognized 668 vegetation categories reflecting dominant overstorey vegetation, variation in tree canopy cover, and understorey conditions. Because multivariate procedures demand a parsimonious set of explanatory variables, we merged similar categories into 10 broad habitat categories as described above: oak woodlands with understorey, oak woodlands without understorey, shrubland, other deciduous trees, eucalyptus plantations, conifer plantations, orchards and olive yards, pastures, water systems, and “other.”

Habitat selection analysis

At each scale, we compared habitat use by badgers to habitats available using compositional analysis (Aebischer

et al. 1993b). This method has four main assumptions: (1) each animal (or cell) provides an independent measure of habitat use; (2) habitat compositions of the different monitored animals (or positive cells) are equally accurate; (3) residuals after model fitting show multivariate normality (assessed through Kolmogorov–Smirnov test; Zar, 1999); and (4) each habitat type in the analysis is used (at least to a trivial extent) by the species (Aebischer et al. 1993a). Leban et al. (2001) recommended compositional analysis as a better method for analysing resource selection due to its modest requirements for sample sizes, ability to evaluate resource selection among identifiable animal groups, and utility in conducting multiple comparisons among resource types and animal groups.

For the analysis we compared habitat composition within cells (1, 4, 25, and 100 km²) containing badger signs with the availability of habitats in all the study area, again based on the CNIG map. Habitat use (and availability) is given by a set of proportions that describe habitat composition and sum to 1. Compositional analysis (Aebischer et al. 1993b) involves MANOVA of the log-transformed ratios $y_i = \ln(x_i/x_j)$ ($i = 1, \dots, D, i \neq j$), where x_1, x_2, \dots, x_D are individual's proportional habitat use (Aebischer et al. 1993b). To address the fourth assumption we replaced any zero values with 0.001 under the assumption that a zero reflected failure of the sampling regime to detect very low usage (Aebischer et al. 1993a). All analyses were performed using Resource Selection for Windows (Fred Leban, University of Idaho, Moscow, USA). To avoid distributional assumptions, we used randomization tests to estimate significance levels (Aebischer et al. 1993b).

Results

Badger signs were detected in 38 of the 100 km² cells, 92 of 25 km² cells, 260 of the 4 km² cells, and 372 of the 1 km² cells. Due to compositional analysis software limitations, we could use only 150 of the 4 km² and 150 of the 1 km² cells in our analyses; these were randomly selected in an automated random selection procedure in

Microsoft Excel. Moran's I statistic values failed to reject the null hypothesis of no spatial autocorrelation at all analysed distances (> 1000 m) (see Fig. 2).

Habitat use was not random at any of the scales considered ($-N \ln \lambda_{1 \text{ km}^2} = 115.3$, $P < 0.0001$, $n = 150$; $-N \ln \lambda_{4 \text{ km}^2} = 81.6$, $P < 0.0001$, $n = 150$; $-N \ln \lambda_{25 \text{ km}^2} = 155.9$, $P < 0.0001$, $n = 92$; $-N \ln \lambda_{100 \text{ km}^2} = 95.0$, $P < 0.0001$, $n = 38$). The distribution of residuals was not multivariate normal ($K - S_{1 \text{ km}^2} = 7.528$; $K - S_{4 \text{ km}^2} = 7.794$; $K - S_{25 \text{ km}^2} = 3.859$; $K - S_{100 \text{ km}^2} = 3.307$; all $P < 0.0001$). However, the failure of this single assumption does not influence the significance level (computed by randomization) or the fitting of models to log-ratio data (Aebischer et al. 1993b).

Oak woodland with understorey was ranked as the most used habitat at three scales: pastures where most highly ranked at the 25 km² grid, but their use was not significantly different from oak woodland with understorey (Table 1).

Shrublands and pastures ranked in the top four habitat types at each scale. Deciduous forests were the only habitat type whose rank followed a clear trend with scale, decreasing in importance as cell size increased.

Discussion

Most authors who analysed animal-habitat use at multiple scales found that habitat selection varied with spatial scale (e.g. Schaefer et al. 2000; Schooley and Wiens 2001; Thompson and McGarigal 2002). However, our results suggest that habitat selection by Eurasian badgers in Southern Portugal is scale independent, with oak woodland with understorey being the most used habitat in three of the four scales of analysis.

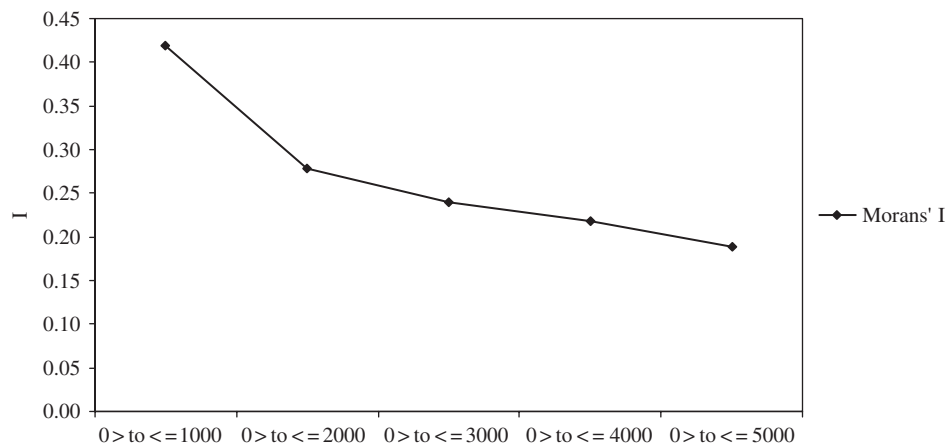


Fig. 2. Moran's I statistic results for lag distance's of 1 km and 5 increments, for badger's presence/absence data in the study area. Spatial autocorrelation is significant only for distances > 1000 m .

Table 1. Habitat ranking matrix based on comparing proportions of habitat use within each square with the proportion of total available habitat types in Alentejo and Algarve

1 km ²	OWU	SHR	P	FRT	WAT	EP	OTH	DEC	CON	OWWU	Rank
OWU		+	+++	+++	+++	+++	+++	+++	+++	+++	9
SHR	-		+	+	+++	+++	+++	+++	+++	+++	8
P	----	-		+	+++	+++	+++	+++	+++	+++	7
FRT	----	-	-		+	+	+++	+++	+++	+++	6
WAT	----	----	----	-		+	++	+	+	+++	5
EP	----	----	----	-	-		+	+	+	+++	4
OTH	----	----	----	----	-	-		+	+	+++	3
DEC	----	----	----	----	-	-	-		+	+++	2
CON	----	----	----	----	-	-	-	-		+++	1
OWWU	----	----	----	----	----	----	----	----	----		0
4 km ²											
OWU		+	+++	+++	+++	+++	+++	+++	+++	+++	9
SHR	-		+	+	+++	+++	+++	+++	+++	+++	8
P	----	-		+	+++	+++	+++	+++	+++	+++	7
FRT	----	-	-		+	+	+++	+++	+++	+++	6
WAT	----	----	----	-		+	+	+	+	+++	5
EP	----	----	----	-	-		+	+	+	+	4
OTH	----	----	----	----	-	-		+	+	+	3
DEC	----	----	----	----	-	-	-		+	+	2
CON	----	----	----	----	-	-	-	-		+	1
OWWU	----	----	----	----	----	-	-	-	-		0
25 km ²											
P		+	+	+++	+++	+++	+++	+++	+++	+++	9
FRT	-		+	+++	+++	+++	+++	+++	+++	+++	8
OWU	-	-		+	+++	+++	+++	+++	+++	+++	7
SHR	----	----	-		+++	+++	+++	+++	+++	+++	6
OTH	----	----	----	----		+	+	+++	+++	+++	5
WAT	----	----	----	----	-		+	+	+	+++	4
CON	----	----	----	----	-	-		+	+++	+++	3
EP	----	----	----	----	-	-	-		+	+++	2
DEC	----	----	----	----	----	----	----	-		+	1
OWWU	----	----	----	----	----	----	----	----	-		0
100 km ²											
OWU		+	+	+	+++	+++	+++	+++	+++	+++	9
P	+		+	+	+++	+++	+++	+++	+++	+++	8
FRT	+	+		+	+	+++	+++	+++	+++	+++	7
SHR	+	+	+		+	+++	+++	+++	+++	+++	6
WAT	----	----	+	+		+	+	+++	+++	+++	5
EP	----	----	----	----	+		+	+++	+++	+++	4
OTH	----	----	----	----	+	+		+	+++	+++	3
CON	----	----	----	----	----	----	+		+	+++	2
OWWU	----	----	----	----	----	----	----	+		+	1
DEC	----	----	----	----	----	----	----	----	+		0

Oak woodlands with understorey (OWU); oak woodlands without understorey (OWWU); shrubs (SHR); deciduous trees (DEC); eucalyptus plantations (EP); conifers plantations (CON); fruit trees orchards (FRT); pastures (P); water (WAT); and others (OTH). +++ and ---- denotes, respectively, a positive and negative significant difference between two habitats ($P < 0.05$); + and - denotes, respectively, a positive and negative non-significant difference between two habitats ($P < 0.05$); Rank: 9 – most used; 0 – less used.

Badger habitat selection

Badgers have an extensive geographical range (Neal and Cheeseman 1996) across which one might expect adaptations to highly different habitat characteristics. They have been characterised as habitat generalists (Virgós 2002) with habitat selection driven by key resources that differ among regions. In Doñana (SW Spain) and in Iberia highlands, food and vegetation cover (which influences shelter) are considered most important (Revilla et al. 2000; Virgós et al. 2005), while in Alentejo and Algarve (Southern Portugal) only shelter provided by vegetation seems to drive selection (see also Rosalino 2004), shown by the selection of cork oak woodland with understorey across all scales.

Rosalino et al. (2004) have described the role of shelter characteristics of the landscape for badgers, in a sub-region of Alentejo (Grândola Mountain). The understorey cover provides a cooler microclimate during the high temperatures of the summer, and provides a secure pathway for movements between food patches. Eurasian badgers select cork oak woodland for setts construction (Rosalino et al. 2004), and often select shrubs as resting sites during the summer (Loureiro et al., unpublished data). These findings probably underlie our observation that badgers select oak woodlands with understorey, and shrub cover. Badgers did not seem to select for deciduous trees at any scale in our study. In contrast, deciduous trees are important habitats for badgers in northern Europe (e.g., Van Apeldoorn et al. 1998; Wright et al. 2000). These areas provide for high moisture content, arable soil for sett construction, and staple food availability (earthworms) (e.g., Kruuk and Parish 1981). However, in southern Europe's Mediterranean habitats, badgers do not select deciduous forests perhaps because they are found only in small patches scattered throughout the landscape or because badger diet shifts toward insects and fruits in this region (Rosalino et al. 2005a).

Scale effect

In the southern Portuguese Mediterranean landscape, badger habitat selection did not markedly depend on the scale of analysis. Oak woodlands were the most selected habitat at all scales, and therefore are of concern for the maintenance of viable Eurasian badger populations. This scale-independent selection of habitats by badgers in southern Portugal seems to be related with the fact that the landscape matrix (oak woodlands) provide two of the most important resources for badgers survival, namely food (e.g. fruits such as acorns, strawberry tree fruits and pears, whose trees are spread throughout the matrix) and shelter (from high temperatures and disturbance, including persecution). Since the diverse

individual life history adaptations (e.g. life experience such as dispersal movements) have the effect of modifying the animal scales of observation (i.e. how animals perceive their habitat in different scales, such as for daily movement or for home-range configuration) (Levin 1992), the scale-independent selection of oak woodland systems enhance the importance of this landscape for badgers.

Contrary to findings that, at northern latitudes, deciduous forests are of great importance to badgers (e.g., Van Apeldoorn et al. 1998; Wright et al. 2000), we detected a decrease in importance as cell size increased.

Management perspective

A multiscale view of a species distribution, ecological preferences, and threats can improve the understanding of the functional links among these factors (Hartley and Kunin 2003). Eurasian badgers in southern Portugal select oak woodlands at all spatial scales. Although generally described as generalists with respect to habitat (e.g. Virgós 2002) and food (e.g. Rosalino et al. 2004; Goszczynski et al. 2000 for a review), badgers may depend upon habitats that provide relatively stable resources in areas where resources are scarce and unpredictably available, such as in western European Mediterranean regions. Insects, one of the most important foods for badgers, are most abundant in cork oak woodlands (see Rosalino et al. 2004). These results suggest that oak woodland with understorey is a key landscape unit for the Eurasian badger in the Mediterranean habitats of the south-western Iberian Peninsula. The *montado* is a cultural landscape, reflecting a long-term interaction between people and their natural environments (Moreira et al. 2001). These landscape units are involved in a dynamic process of cycles of disturbance (e.g. shrub clear-cutting to allow cork removal every 7–8 years) and stability (in between years). Thus, sustainable management is a key issue to the maintenance of high levels of biodiversity, and therefore to the long-term viability of the badger population.

Because the *pre-montado* vegetation no longer exists, we cannot know if badgers may have fared better in more ancient landscapes. Our results suggest that badger conservation is promoted by maintaining at least 30% of oak woodland cover at all scales. This is especially important at the landscape scale, where we recommend the maintenance of connected oak woodland patches across southern Portugal to maintain viable badger populations and to mitigate the predicted negative effect of fragmentation and loss of these woodlands (see Virgós 2002). Although national legislation in Portugal and Spain, protects cork oak woodlands, roads are fragmenting them. More intense types of agriculture and

dams are degrading and in some cases destroying them. To overcome these fragmentation problems we recommended: (1) management actions that promote the maintenance of large and connected patches of cork oak woodlands (> 100 ha-Virgós 2002), (2) plantation and restoration of degraded cork oak woodlands, (3) prevention and protection of these fire-prone vegetation types, (4) design of corridors to connect isolated patches of cork oak woodlands, (5) maintenance of traditional management practices to promote cork natural regeneration and low human modification, and (6) creation of laws and regulations to favour extensification (crop cultivation abandoned with diversity of cultures and stocking rate reduced; larger areas used as natural pastures; Pinto-Correia and Mascarenhas 1999; see also Santos 2003).

In conservation planning one must define management objectives for landscape features and associated biodiversity. Using the European badger as a focal species, we found the across-scale importance of maintaining the historically human altered, sustainable and unique landscape and land use system – the *montado*.

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Zusammenfassung

Habitatauswahl des eurasischen Dachses in mediterranen Gebieten: Ist die Wahl der untersuchten Biotopgröße von Bedeutung?

Es wird weithin angenommen, daß die Biotopgröße die Wahl des Lebensraums beeinträchtigt, und daß dies

die Landschaftsplanung beeinflussen sollte, besonders bei Tierarten mit ausgedehnten Lebensräumen und weiter geographischer Verbreitung.

Die Auswahl des Lebensraumes durch den eurasischen Dachse ist im Grossteil des europäischen Verbreitungsraumes weitgehend bekannt, jedoch wurden bei Untersuchungen niemals mehrfache Flächenmaße angewandt. Wir haben Kompositionsanalysen verwandt, um die Wahl des Lebensraumes von eurasischen Dachsen in Südportugal mittels fünf Rastergrößen (1, 4, 25, and 100 km²) unter Verwendung von Anwesenheitsanzeichen (Dachsbau, Dachabtritte, Spuren, Strassenkadaver) abzuschätzen. Bei keiner Rastergröße wurde die Wahl des Lebensraumes zufällig getroffen. Bei allen verwendeten Rastergrößen wurden Eichenwälder mit Unterwuchs ausgewählt, der bevorzugteste Lebensraum bei 4 Rastergrößen (1 m², 4, 25, and 100 km²). Bei einer Rastergröße von 25 km² wurden Weiden bevorzugt. Ferner waren bei der Mehrzahl der Rastergrößen Sträucher und Weiden von zweithäufigster Bedeutung. Im Gegensatz zu Ergebnissen aus nördlichen Breiten verloren Laubwälder mit zunehmender Rastergröße in Portugal an Bedeutung. In der stark bevölkerten und fragmentierten Landschaft Südportugals bevorzugten eurasische Dachse die Matrix von Eichenwäldern mit dazwischenliegenden Weiden, Sträuchern und Ufervegetation. In diesen offenen Eichenwäldern hat die Wahl der Rastergröße keinen merklichen Effekt.

Die Landschafts- und Naturschutzplanung sollte deshalb mindestens 30% Eichenwaldanteil im Landschaftsbild sicherstellen, um den Dachsebestand langfristig zu sichern. Unsere Fallstudie zeigt die Bedeutung historischer Kulturlandschaften wie des Montados für den Artenreichtum, Naturschutz und für die Sicherstellung einer zukunftsfähigen und ausgewogenen Landnutzung.

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