Universidade de Évora - Escola de Ciências e Tecnologia

Mestrado em Biologia da Conservação

Dissertação

A importância de espécies-presa cinegéticas e da heterogeneidade da paisagem nos padrões de ocupação de mamíferos carnívoros em zonas de caça de Portugal continental

Francisco Maria de Sousa Ferreira Martelo Fradinho

Orientador(es) | Ricardo Pita
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Importance of prey game species and landscape heterogeneity on mammalian carnivore occupancy patterns in hunting areas across mainland Portugal

ABSTRACT

The Mediterranean basin, including the Iberian Peninsula, is warming faster than the global average, leading to increased aridity and posing new challenges for wildlife facing concurrent impacts of human activities (*e.g.* agriculture, forestry, hunting). Mesocarnivores are particularly sensitive to these pressures, making it crucial to assess their vulnerability to ongoing environmental changes. However, most studies in Mediterranean environments focus on specific landscape or regions, highlighting the need for research considering different geographic areas. In this study, we used detection-occupancy modelling to evaluate mesocarnivore responses to natural and human-induced changes across various hunting areas in mainland Portugal. Our results indicated that landscape composition and structure at different spatial scales significantly influenced mesocarnivore occupancy, with season, human footprint, and hunting regulations mainly affecting species detectability. Overall, this study highlights the need to consider human disturbance and land use gradients at multiple scales to properly understand mesocarnivore-environment relationships in Mediterranean ecosystems.

Key words: Conservation; Camera-trapping; Hunting management; Mesocarnivores; Ecological modelling

A importância de espécies-presa cinegéticas e da heterogeneidade da paisagem nos padrões de ocupação de mamíferos carnívoros em zonas de caça de Portugal continental

RESUMO

A bacia do Mediterrâneo, incluindo a Península Ibérica, está a aquecer mais rapidamente que a média global, resultando em maior aridez e novos desafios para a vida selvagem, já afetada pelas atividades humanas (e.g. agricultura, caça). Os mesocarnívoros são particularmente vulneráveis a estas pressões, sendo crucial avaliar sua resposta às mudanças ambientais. Contudo, a maioria dos estudos nesta região foca-se em paisagens específicas, sendo necessária investigação que abranja diferentes regiões. Neste estudo, utilizámos modelos de deteção-ocupação para avaliar as respostas dos mesocarnívoros a mudanças naturais e antropogénicas em diferentes áreas de Portugal. Os resultados indicam que a composição e estrutura da paisagem a várias escalas espaciais influenciam a ocupação dos mesocarnívoros, enquanto a sazonalidade, pegada humana e os regulamentos de caça afetam sobretudo a sua detetabilidade. Este estudo reforça a importância de considerar a perturbação humana e gradientes de uso do solo para compreender as relações mesocarnívoros-ambiente em ecossistemas mediterrânicos.

Palavras-chave: Conservação; Foto-armadilhagem; Gestão de caça; Mesocarnívoros; Modelação ecológica

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LIST OF ABBREVIATIONS

% - Percentage of landscape cover

AGR – Agricultural

AGRFOR – Agro-forestry

Al – Alcoutim study area

ALT - Altitude

AR - Parque Natural da Serra da Arrábida study area

ART - Artificial zones

AV - Aveiro study area

CB – Cubeira study area

CJ - Castreja study area

CM – Castelo Melhor study area

CTL - camera trap locations

ED – Edge density

FOR – Forestry

HFP – Human footprint

HL – Hortas das Laranjeiras study area

HMT – Hunting management type

L- Linear

LB - Lombada study area

MSDI – Modified Simpson diversity index

NL - Non-linear

NP - Number of patches

OPEN – Open areas

PAST – Pastures

PD – Pedrógão study area

PL – Penela study area

PM – Porcas de Murça study area

PR – Patch richness

SA – Sudoeste Alentejano study area

SB - São Brás study area

SEAS – Season

SHR - Shrubs

TL – Tolosa study area

TP – Tapada Nacional de Mafra study area

VNP – Vila Nova de Paiva study area

WN – Water bodies

ZCA - Associative hunting zone

ZCM - Municipal hunting zone

ZCN - National hunting zone

ZCT - Touristic hunting zone

1. Introduction

One of the prevalent challenges frequently addressed in conservation biology is to uncover the effects of human-mediated environmental change on biodiversity (Pecl *et al.,* 2017; Newbold *et al.,* 2015). Human-mediated environmental change results mostly from the continuous growth and expansion of human populations in the last decades, leading to various disturbances including the urban sprawl and the intensification of activities such as agriculture, industry, livestock production and hunting (United Nations, Department of Economic and Social Affairs, Population Division, 2015; Tscharntke *et al.,* 2012; de Mello Beisiegel, 2017). To better understand the magnitude of these effects on wildlife, large scale studies are essential, as they have the potential to encompass a broad range of environmental scenarios, and therefore to elucidate on how such variation impacts animal populations (Pearson & Dawson, 2003). Moreover, as population responses to environmental change influence interspecific relations within and across trophic levels, assessing responses of multiple species to environmental variation over large spatial scales, particularly for common and widely distributed species, becomes critical to infer changes in the overall functioning of ecosystems (Díaz *et al.,* 2021; Pereira *et al.,* 2012). Assessing population-level responses of multiple common species to both natural and human-mediated environmental change over large geographical extents is important to better understand and predict biodiversity trends and improve national and international sustainable development goals (Newbold *et al.,* 2015).

Among terrestrial vertebrates, mammals are considered ideal models for assessing the effects of environmental changes on wildlife populations and communities given their sensitivity to these changes, despite their widespread distribution (Levinsky *et al.,* 2007). In particular, due to their position in trophic networks, carnivores can be used as references for landscape management programs (Barea-Azcón *et al.,* 2007; Amici *et al.,* 2009). While some mesocarnivores may adapt well to urban and highly humanized rural environments (Hipólito *et al.,* 2016), responses to land use change are often species- or community-specific and can vary according to the intensity and spatial scale of changes, with many species and populations currently facing increasing extinction risk (Gálvez *et al.,* 2021; Fischer

& Lindenmayer, 2007). In addition, the direct interaction between humans and carnivores often reflects an underlying conflict due to frequent negative outcomes for humans or their resources (*e.g.* livestock farming, small game species), which reduces tolerance for coexistence (Prugh *et al.,* 2009). Therefore, terrestrial mammals, and specially mesocarnivore species, that are common in human-dominated landscapes, are good ecological indicators to evaluate how wildlife populations respond to natural and human-induced disturbances related to broad patterns of land use and resource exploitation across large geographical extents (Carroll *et al.,* 2001; Amici *et al.,* 2009; Shamoon *et al.,* 2017). In the European context, this is notably relevant in the multifunctional, biodiversity-rich cultural landscapes such as the Mediterranean basin (Pinto-Correia & Vos, 2005), where besides the threats related to the increase of human activities (*e.g.* agriculture, forestry, hunting), species must cope with seasonal extremes, which impose a diversity of environmental constraints differing greatly from region to region (Shamoon *et al.,* 2017). While studies investigating land use change effects on mesomammals in Mediterranean environments are relatively common, inferences have mostly relied on data from single specific landscapes or regions (Santos *et al.*, 2016; Torre *et al.*, 2022). To our knowledge, however, no study has considered multiple areas from different geographic regions to uncover broad patterns, while considering eventual area-specific variations related to local geographic and historic land use diversity.

In this study, we assessed mesomammal responses to seasonal and human-induced environmental variation and disturbance (*e.g.* land use variation, hunting management regime) across different areas from mainland Portugal, aiming to draw nationwide inferences on the impacts of environmental change on species occurrence patterns. Portugal comprises a diverse community of mesomammals (Mathias *et al.,* 2023) and a range of geographical, cultural, and ecological contexts (Gonçalves *et al.,* 2012), thus providing a suitable research arena for the purposes of the study. Along this diverse and multifunctional set of landscape types, the hunting activity in Portugal plays a key socio-economic role across the country (Pinto-Correia & Vos, 2005; Martínez *et al.,* 2002), potentially affecting mesomammal communities (Beja *et al.,* 2009). More specifically, carnivores and their prey, including keystone small-game populations such as the European rabbit (*Oryctolagus* *cuniculus*), may be particularly affected by hunting activity in addition to variations in landscape composition and structure (Curveira-Santos *et al.*, 2019).

Because mesomammals are challenging to survey due to their elusive behaviors and predominant nocturnal habits among most species (Nichols *et al.*, 2011), we used camera-trapping data obtained in the context of a larger monitoring program targeting wild boar populations (Torres *et al.*, 2022). Based on this data we employed detection-occupancy modelling across selected areas (Mackenzie *et al.*, 2002), to test the general prediction that mesomammals species are affected by season, human disturbance, hunting management approach, topography and land use gradients measured at different spatial scales. For this, we considered the following specific hypothesis and predictions: **(H1)** Distinct hunting administrative regimes affect mesomammals' detection and occupancy probabilities differently, due to differences, for instance, in local management scenarios, such as supplemental feeding of small game species, or eventual culling of some predator species (Beja *et al.*, 2009; Curveira-Santos *et al.*, 2019); **(H2)** Seasonality also affects species detection and occupancy given that most animals should alter their movements and space-use to minimize risk, mediate physiological costs, and maintain access to resources (Linck, 2021; Barrull *et al.*, 2014; Finnegan *et al.*, 2021); **(H3)** Human presence and disturbance may have contrasting effects on mesomammal detection and occupancy, depending on the species ecology, possibly favouring more generalist and opportunistic species, while hindering more specialized and elusive species (Cruz *et al.*, 2018; Sévêque *et al.*, 2020; Linck, 2021; Rodriguez *et al.*, 2021); **(H4)** Topography, namely altitude, also drives the detection and occupancy probability of mesomammals, due to its effects on prey availability, animals' movement and habitat use (Petrov *et al.*, 2016); **(H5)** Land use variation and landscape heterogeneity at different spatial scales provide another relevant environmental factor driving mesomammal occupancy probability (Gompper *et al.*, 2016; Jetz *et al.*, 2004), according to species-specific general ecological requirements reported in several studies carried out or specifically focused on specific landscape or region (*e.g.* Santos-Reis *et al.*, 2005); and **(H6)** Despite the broad trophic niche of most common mesocarnivores in Portugal, which includes small mammals, invertebrates and fruits (Barrull *et al.*, 2014), the presence of mesomammal prey species (e.g.

rabbits and hares) positively influences their likelihood of occupancy, given their expected close association to prey availability (Rosalino *et al.*, 2010).

2. Methodology

2.1. Study Area

The study was conducted in 16 distinct areas distributed across mainland Portugal (Figure 1 A). These areas encompass 21 hunting grounds (2 National hunting areas, 9 Associative hunting areas, 3 Touristic hunting areas and 7 Municipal hunting areas). These study areas were selected to represent different landscapes, habitats, and management features of mainland Portugal (see Table 1).

Selected hunting areas varied in their type of management according to legislation and management entity. National hunting areas are constituted in regions were the physical and biological attributes allow the establishment of hunting centers that, for safety reasons, are created and managed by the Portuguese state. Municipal hunting areas are created for a limited number of hunters in only especially accessible conditions. Both types of hunting areas are accessible to all types of hunters, but the priority of access to each hunter follows a descending hierarchy. Owners and tenants of the terrain in which these areas are created have priority access, followed by hunters residing in the area's municipality and not registered in other hunting areas, then nonresident hunters of the municipality not associated with another hunting area, and finally all remaining hunters. Touristic hunting areas use game resources in an economic way to provide adequate touristic services for all hunters including foreign ones. Associative hunting areas are managed through joint groups of hunters who are in charge of maintaining those areas and therefore enjoy more privileged access to them, allowing only associates and guests to enter as well (De Ministros, P. D. C., 1999). For practical reasons, we included the Parque Natural da Serra da Arrábida in the group of National hunting areas, given this area spans several municipalities and is management by state entities (De Ministros, P. D. C., 1976), contrary to Associative and Touristic areas, which are privately managed.

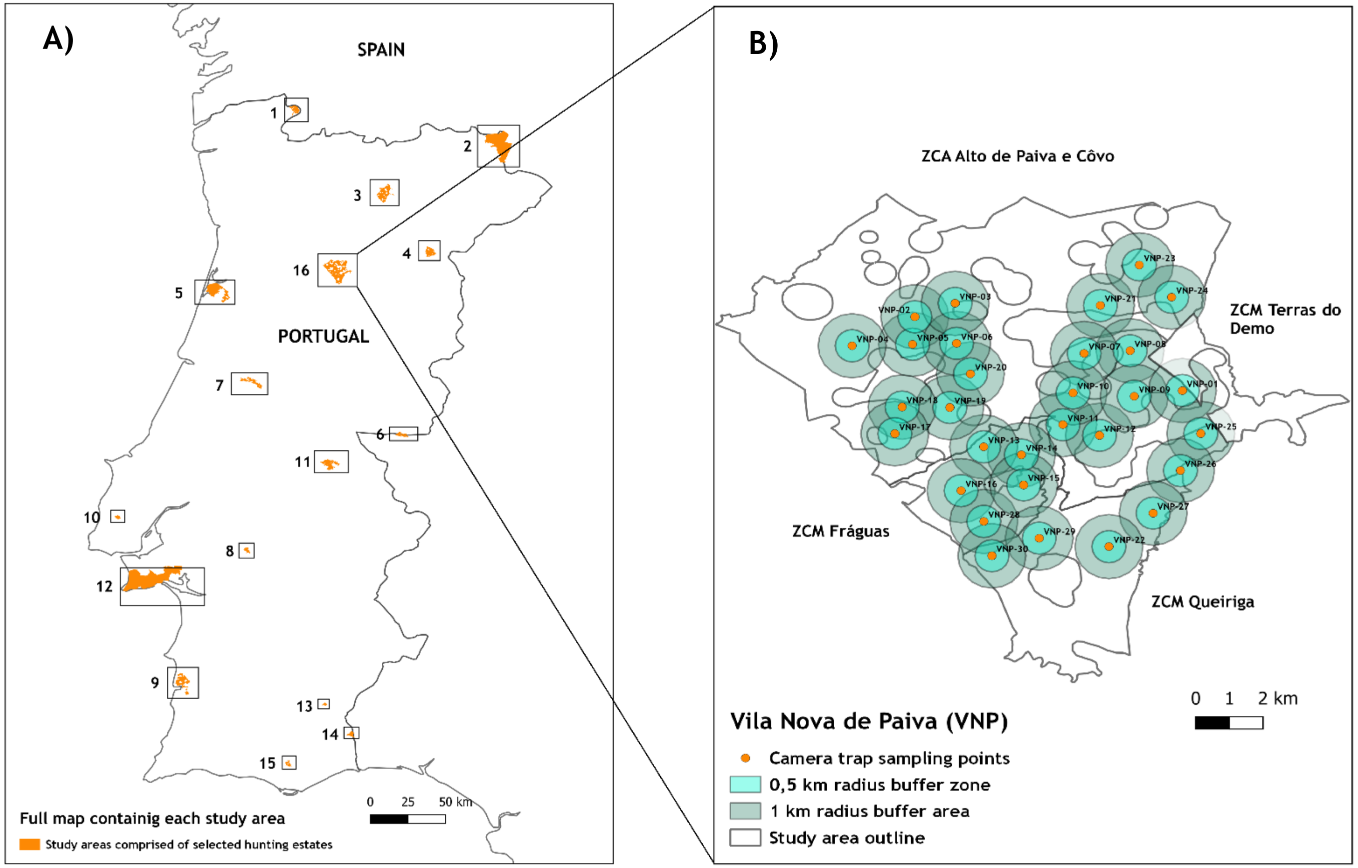

FIGURE 1 – **A)** Location of the 16 study areas selected to determine the factors driving mammalian carnivores and prey game occupancy across Mainland Portugal:1-Castreja (CJ), 2-Lombada (LB), 3-Porcas de Murça (PM), 4-Castelo Melhor (CM), 5-Aveiro (AV), 6-Cubeira (CB), 7-Penela (PL), 8-Pedrógão (PD), 9-Sudoeste Alentejano (SA), 10-Tapada Nacional de Mafra (TM), 11-Tolosa (TL), 12-Parque Natural da Serra da Arrábida (AR), 13-Hortas das Laranjeiras (HL), 14-Alcoutim (AL), 15-São Brás (SB), 16-Vila Nova de Paiva (VNP). **B)** Example showing the locations of camera traps sampling points of the Vila Nova de Paiva study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted. (The full maps of all the study areas are included in Appendix 1 (Figures A1 –A16))

TABLE 1 – Study area/Hunting zone descriptors (*This area was considered together with National Hunting grounds, see text for details)

Study Areas	Hunting Zones	Area(ha)	Hunting administrative type	Hunting modality	Sampling period	Nº cameras	Nº of photos
Castreja (CJ)	ZCA de Castreja	2470	Associative hunting ground	Montaria and individual hunting	Winter/Spring (Fev-Mai) 2021	25	145.588
Lombada (LB)	ZCN da Lombada	21184	National hunting ground	Montaria and individual hunting	Winter/Spring (Jan-Abr) 2021	30	105.891
Porcas de Murça (PM)	ZCM Porca de Murça	6404	Municipal hunting ground	Montaria and individual hunting	Winter/Spring (Fev-Mai) 2021	25	121.363
Castelo Melhor (CM)	ZCA de Castelo Melhor	3329	Associative hunting ground	Montaria and individual hunting	Winter/Spring (Jan-Abr) 2021	25	207.246
Aveiro (AV)	ZCM Aveiro	9350	Municipal hunting ground	Montaria and individual hunting	Spring (Mar-Mai) 2021	25	26.509
Cubeira (CB)	ZCT da Herdade da Cubeira	1812	Touristic hunting ground	Montaria and individual hunting	Spring (Mar-Mai) 2021	25	246.298
Penela (PL)	ZCM de Penela	3502	Municipal hunting ground	Montaria and individual hunting	Spring (Mar-Mai) 2021	25	135.809
Pedrógão (PD)	ZCT da Herdade de Pedrógão	1018	Touristic hunting ground	Montaria and individual hunting	Summer/Fall (Jul-Out) 2021	25	225.838
Sudoeste Alentejano (SA)	ZCM do Sudoeste Alentejano + ZCA do Vidigal + ZCA da Herdade de Casas Novas	6142	Associative hunting ground	Montaria and individual hunting	Summer (Jul-Set) 2021	25	201.089
Tapada Nacional de Mafra (TM)	ZCN da Tapada de Mafra	805	National hunting ground	Montaria and individual hunting	Summer/Fall (Jul-Nov) 2021	25	245.376
Tolosa (TL)	ZCA da Lage da Prata + ZCA da Herdade de Perlim + ZCA de Tolosa	4695	Associative hunting ground	Montaria and individual hunting	Summer/Fall (Ago-Out) 2021	25	177.986
Parque Natural da Serra da Arrábida (AR)	Parque Natural. da Arrábida	36283	National hunting ground (*)	None	Summer (Jul-Set) 2021	25	91.911
Hortas das Laranjeiras (HL)	ZCT da Herdade das Hortas	496	Touristic hunting ground	Montaria/individual hunting	Summer/Fall (Ago-Dez) 2021	25	160.573
Alcoutim (AL)	ZCM da Oliveirinha	1295	Municipal hunting ground	Montaria/individual hunting	Fall (Nov-Dez) 2021	25	68.530
São Brás (SB)	ZCA Bicas da Serra	1129	Associative hunting ground	Montaria/individual hunting	Fall (Nov-Dez) 2021	25	20.981
Vila Nova de Paiva (VNP)	ZCA Alto Paiva e Côvo + ZCM Fráguas + ZCM Queiriga + ZCM Terras de Demo	14073	Associative and municipal hunting grounds	Montaria	Fall (Out-Nov) 2022	30	16.651

2.2. Mesocarnivore and small game species surveys

Camera trapping was used to sample the focal species. This methodology allows for the collection of extensive observation data for a wide range of species, and when implemented over large spatial extents, it can provide useful insights into the population status of multiple species simultaneously. Camera trapping has been widely used to survey mammalian species that are difficult to observe, including those occurring at low densities (Wilson & Delahay, 2001), such as the Iberian-lynx (Guil *et al.,* 2010) and the Iberian-wolf (Mattioli *et al.,* 2018). This technique is often preferred over many others due to the ability to detect the species without causing stress to the animals, significantly decreasing the difficulty of obtaining presence and absence data (Wemmer *et al.,* 1996). These devices also spare researchers from the strenuous labor of continuous sampling, since they can remain active in the field for 24 hours a day, over several weeks.

A total of 410 cameras (Browning Strike Force HD PRO) were used, with 25 to 30 cameras per study area (see Table 1), separated 500m to 1000m from each other (see Figure 1 B). Cameras were placed considering the main habitats of each study area and were settled in locations with good visibility and without obstruction from vegetation. Each camera was placed 30-40 cm above the ground and oriented northward, to guarantee that there would not be photos due to the sunlight hitting the sensors of the cameras. Cameras were set to take three consecutive photos, followed by a 30 second delay period before the next set of shots, thereby maintaining a balance between increasing species detectability and the storage capacity of the memory cards (32 GB each). No bait was used to avoid interfering with the behavior of the animals.

In each area, cameras were left in the field for a minimum of 30 days before being removed. The study period spanned from January to December 2021, except for one of the study areas which was sampled in October-November 2022 (see Table 1). Photographic data was then processed through the digiKam software (DigiKam, 2022), which allowed the organization and tagging of each picture by species, as well as Fast Picture Viewer program (Axel Rietschin Software Developments, 2017), which accelerated viewing of the bulk of photographic data.

Finally, the species evaluated in this study were separated in two groups one for prey species and the other for carnivore species. The two small game species considered were the European rabbit (*Oryctolagus cuniculus*) and the Iberian hare (*Lepus granatensis*). While the mesocarnivore group was composed of the red fox (*Vulpes vulpes*), the European badger (*Meles meles*), the beech marten (*Martes foina*), the Egyptian mongoose (*Herpestes ichneumon*) and the common genet (*Genetta genetta*).

2.3. Survey and site variables

A set of survey and site covariables was chosen, taking into account their influence on the detection-occupancy of our focal species. In this case, related to game management, season, human disturbance, topography and land uses.

Human disturbance was assessed based on the human footprint index (HFP, Wildlife Conservation Society, 2005), which is a proxy of human population density, land transformation, human infrastructures and accessibility (Sanderson *et al.*, 2002). HFP values were extracted for each camera trap coordinates from the global dataset available at the NASA Socioeconomic Data and Application Center website (Venter *et al.*, 2018). This involved converting the raster to numerical values in a scale of 0-50, with 0 being no human presence/disturbance and 50 being the maximum value of human presence/disturbance. We also considered the altitude of each camera-trap, extracted from the EU-DEM dataset, available at 25m resolution (European Environmental Agency, 2016).

Land use data was extracted from the Carta de Uso e Ocupação do Solo (Carta de Uso e Ocupação do Solo, 2024) using the QGIS software (QGIS Geographic Information System, 2022). More specifically, a set of landscape metrics were estimated in circular buffers, with 500m and 1000m radius, around each camera-trap to consider scale-dependent responses by each species. These spatial extents were considered given the home-range and core-area sizes of some of the species considered in this study, such as the red fox (474 m radius - Cavallini & Lovari, 1994), the common genet (512 m radius- Santos-Reis *et al.*, 2005), and the beech marten (455 m radius- Santos-Reis *et al.*, 2005). Landscape covariables were extracted for each camera trap and spatial extent included the cover, number, and density of patches from eight main land use classes (agriculture, forest, bodies of water, shrub, pasture, agroforestry surfaces, artificial territory, and open areas) (see Table 2), as well as the total edge density, total number of patches, number (richness) of land uses, and the modified Simpson diversity index. For this, we used the 'landscapemetrics' package (Hesselbarth *et al.*, 2019) implemented in the Rstudio software (Posit team, 2023). This required converting the vector data into raster (assuming a pixel size of 10m). Then, we obtained a set of class-based metrics for each land use class through the 'samplelsm' function, namely the Number of patches (Np) and the Percentage cover (%) (McGarigal, 2023; see Table 2). We also extracted Landscape Based Metrics, including the overall Edge density (Ed), a metric that describes the configuration of the landscape; and several metrics describing the diversity and composition of the landscape, including the Modified Simpson diversity index (Msidi), the Number of patches (Np) and the Patch richness (Pr) (McGarigal, 2023; see Table 2).

Overall, when considering the measurements made within the 500 and 1000m buffers (for land use-related covariables), and the occupancy probabilities of prey species (used as a further covariable in carnivore occupancy modelling) as well, a total of 47 covariables were considered to test each of the six hypotheses previously defined.

TABLE 2 – Covariables considered for estimating detection probability (*p*) and occupancy probability (*Ψ*) of mesomammalian species in hunting areas across Portugal. * Indicates variables considered only in carnivore species detection-occupancy modelling.

Variable	Code	Type	Description	Mean ± SD at trap location	Mean ± SD 500m buffer	Mean ± SD 1000m buffer	Parameter	Underlying hypothesis
Hunting administrative type	HAT	Categorical	The four types of hunting zone administrative types: Associative/Municipal/Nacional/Touristic	–	–	–	*p, Ψ*	H1
Season	SEAS	Categorical	Winter/Spring/Summer/Fall	–	–	–	*p, Ψ*	H2
Human footprint	HFP	Continuous	Used as measure of human disturbance, values range from 0 to 50, being 0 an indication of no human presence and 50 an indication of continual human presence	11,823±9,410	–	–	*p, Ψ*	H3
Altitude	ALT	Continuous	Altitude at which each camera trapping sampling point was located	373.997±317.634	–	–	*Ψ*	H4
Land use class-based metrics								
Number of Patches								
Agriculture	Np_AGR	Continuous	Number of patches of Agriculture, including Agriculture fields subsistence and intense crop production (ex:maize)	–	1,920±0,102	5,188±0,231	*Ψ*	H5
Forest	Np_FOR	Continuous	Number of patches of Forest, including Pine forests, Montado (open canopy woodlands of Quercus sp.), Mixed forests, Chestnut	–	2.301±0,090	4,898±0,194	*Ψ*	H5
Water bodies	Np_WB	Continuous	Number of patches of Bodies of water, including Ponds, streams, bodies of water for agricultural use	–	0,199±0,025	0,558±0,051	*Ψ*	H5
Shrub	Np_SHR	Continuous	Number of patches of Shrub, including Shrub formations, rocky outcrops	–	1.693±0,098	3.740±0,180	*Ψ*	H5
Pastures	Np_PAST	Continuous	Number of patches of Pastures, including Semi-natural pastures	–	0,751±0,065	2,036±0,135	*Ψ*	H5
Agro Forestry	Np_AGRFOR	Continuous	Number of patches of Agro Forestry, including Eucalyptus plantations, Strawberry plantations, exotic plantations, Vineyards, olive and almond trees	–	0,392±0,049	0,983±0,100	*Ψ*	H5
Artificial Zones	Np_ART	Continuous	Number of patches of Artificial Zones, including Urban and rural settlements, roads	–	0,491±0,065	1,768±0,165	*Ψ*	H5
Open areas	Np_OPEN	Continuous	Number of patches of Open areas including Meadows, Planes, Sand dunes	–	0,143±0,035	0,320±0,056	*Ψ*	H5
% Cover								
Agriculture	%_AGR	Continuous	Percentage of landscape coverage of Agriculture, including Agriculture fields subsistence and intense crop production (ex:maize)	–	12,177±0,916	14,285±0,871	*Ψ*	H5
Forests	%_FOR	Continuous	Percentage of landscape coverage of Forests, including Pine forests, Montado (open canopy woodlands of Quercus sp.), Mixed forests, Chestnut	–	53,739±1,750	49,759±1,607	*Ψ*	H5
Water bodies	%_WB	Continuous	Percentage of landscape coverage of Bodies of water, including Ponds, streams, Bodies of water for agricultural use	–	1,263±0,196	1,590±0,226	*Ψ*	H5
Shrub	%_SHR	Continuous	Percentage of landscape coverage of Shrub, including Shrub formations, rocky outcrops	–	22,235±1,517	21,740±1,359	*Ψ*	H5
Pastures	%_PAST	Continuous	Percentage of landscape coverage of Pastures, including Semi-natural pastures	–	4,386±0,529	5,160±0,466	*Ψ*	H5
Agro Forestry	%_AFRFOR	Continuous	Percentage of landscape coverage of Agro Forestry, including Eucalyptus plantations, Strawberry plantations, exotic plantations, Vineyards, olive and almond trees	–	4,073±0,682	4,649±0,653	*Ψ*	H5

Artificial Zones	%_ART	Continuous	Percentage of landscape coverage of Artificial Zones, including Urban and rural settlements, roads	–	1,393±0,221	2.080±0,246	Ψ	H5
Open areas	%_OPEN	Continuous	Percentage of landscape coverage of Open areas	–	0,734±0,200	0,737±0,179	Ψ	H5
Landscape-based metrics								
Edge density	ED	Continuous	Total Edge density	–	60,657±1,889	62,907±1,583	Ψ	H5
Modified Simpson diversity index	MSDI	Continuous	Modified Simpson diversity index	–	0,554±0,019	0,687±0,019	Ψ	H5
Number of patches	NP	Continuous	Total number of patches from the different land uses	–	7,881±0,236	19,483±0,541	Ψ	H5
Patch richness	PR	Continuous	Land use richness	–	3,398±0,064	4,619±0,071	Ψ	H5
Predicted prey occupancy								
European rabbit occupancy probability *	RAB	Continuous	Predicted occupancy probability of the European rabbit for each camera trap based on multi-model selection	0,290±0,276	–	–	Ψ	H6
Iberian hare occupancy probability *	HAR	Continuous	Predicted occupancy probability of the Iberian hare for each camera trap based on multi-model selection	0,152±0,206	–	–	Ψ	H6

2.4. Detection-occupancy modelling

We implemented single-season occupancy models for each species using the package ‘unmarked’ (Fiske & Chandler, 2011), assuming population closure during the 30-days sampling period within each area and including the sampling area as a random effect to account for biogeographic differences among the 16 study areas. Occupancy models are hierarchical logistic regressions that account for imperfect detection by modelling detection (p) and occupancy probabilities (Ψ) at the same time (Mackenzie *et al.,* 2002). For this, we built detection histories for each species by splitting the sampling period into 6 occasions, each comprising 5 days. If a species was detected at least once in any of the 5 days, then detection was recorded as 1 for that occasion (and as 0 if the species was not detected). A matrix of 1’s and 0’s, for detection/non-detection, respectively, in each of the 6 occasions was created for each camera-trap and species in the 16 study areas. As in other studies using camera trapping, some losses of data are expected due to malfunction, vandalism or even theft (see Apendix1, B1) (Meek, 2019). These losses were excluded and for every camera that did not yield photos of the intended species, their detection history was counted as null (Mackenzie *et al.,* 2002).

To determine the best models for both detection and occupancy for each specific species, we first identified the best detection sub-model while keeping the occupancy sub-model constant (Ψ ~1). We then used the best detection sub-model to find the best occupancy sub-model. For determining the most supported detection-occupancy model at each of these steps, we used the Akaike information criterion corrected for small sample sizes (AICc) (Akaike, 1974). In each step, each predictor variable was first tested alone by running single-covariate models, considering for sub-model building and selecting the ones yielding AICc scores lower than that of the sub-model without covariates. All candidate variables that were not highly correlated to each other (Pearson correlation < 0.5; e.g. Dormann *et al.,* 2013) were then considered in multi-model building and selection based on AICc (Fiske & Chandler, 2011).

The covariates considered for the detection (p) sub-models included the type of hunting administration (HAT, i.e. either Associative, Municipal, National or

Touristic Hunting areas), the season (SEAS, i.e. either spring, summer, fall, winter) and the human footprint index (HFP) (see Table 2)

For occupancy sub-model selection (Ψ), besides the HAT, SEAS and HFP, we considered the number of patches and % cover of every land use class, *i.e.* agriculture (AGR), forest (FOR), water bodies (WB), shrub (SHR), pasture (PAST), agroforestry surfaces (AGRFOR), artificial territory (ART), and open areas (OPEN). We also considered several landscape-based metrics, namely total edge density (ED), the modified Simpson diversity index (MSDI), the number of patches (NP), the patch richness (PR), all measured at different spatial extents (500m and 1000m buffers). Additionally, the altitude (ALT) of each camera was also considered (see Table 2). As an additional step, after obtaining the final model for each prey species, their predicted occupancy probabilities of rabbits (RAB) and Iberian hares (HAR) at each camera trap were also used as covariables in the occupancy models of carnivore species (see Table 2). Excluding SEAS, HAT, and predicted prey occupancy (RAB and HAR), all other variables were modelled considering either linear or both linear and quadratic terms to test potential nonlinear responses by carnivores to environmental gradients.

When no single model provided the single best solution and other alternative models were equally supported (ΔAICc<2), the model average function ('model.avg') the 'MuMIn' package (Burnham & Anderson, 2002), was applied to assess main effects of covariables on species detection and occupancy probabilities.

3. Results

The total number of images caught through camera trapping across the 16 study areas considered was 2,197,639 (see Table 1). Of all study areas, the *ZCT da Herdade de Pedrógão* and the *ZCM de Penela* were the areas with the highest number of cameras with non-usable data (N=6 cameras for both), while the *ZCM do Sudoeste Alentejano + ZCA do Vidigal ZCA da Herdade de Casas Novas* was the area with the highest number of lost cameras (8 were lost). The study area *Tapada de Mafra* had the lowest number of active/recovered cameras (N=10 in total).

The European rabbit (23,036 records) and the fox (11,329 records) were the most represented species in the photographic data, followed by the Iberian hare (3,152 records) and the European badger (2,215 records), the common genet (1,239 records), the beech marten (1,129 records), and the Egyptian mongoose (495 records) (see Figure 2 and Table 3). The red fox was the most prevalent species, being present in all the study areas, while beech marten and the Iberian hare were the least represented species, both remaining undetected in five study areas. The study areas of *Castelo Melhor (CM)*, *Cubeira (CB)*, *Tolosa (TL)* and *Vila Nova de Paiva (VNP)*, were the only ones in which all seven species were detected. The *Castreja (CJ)* study area was the one with the lowest number of species detected, in this case only three. The study areas with the lowest number of photos coincided with those in which fewer cameras were recovered or had less suitable data, in this case *Penela (PL)*, *Sudoeste Alentejano (SA)* and *Tapada Nacional de Mafra (TM)* (see Table 3).

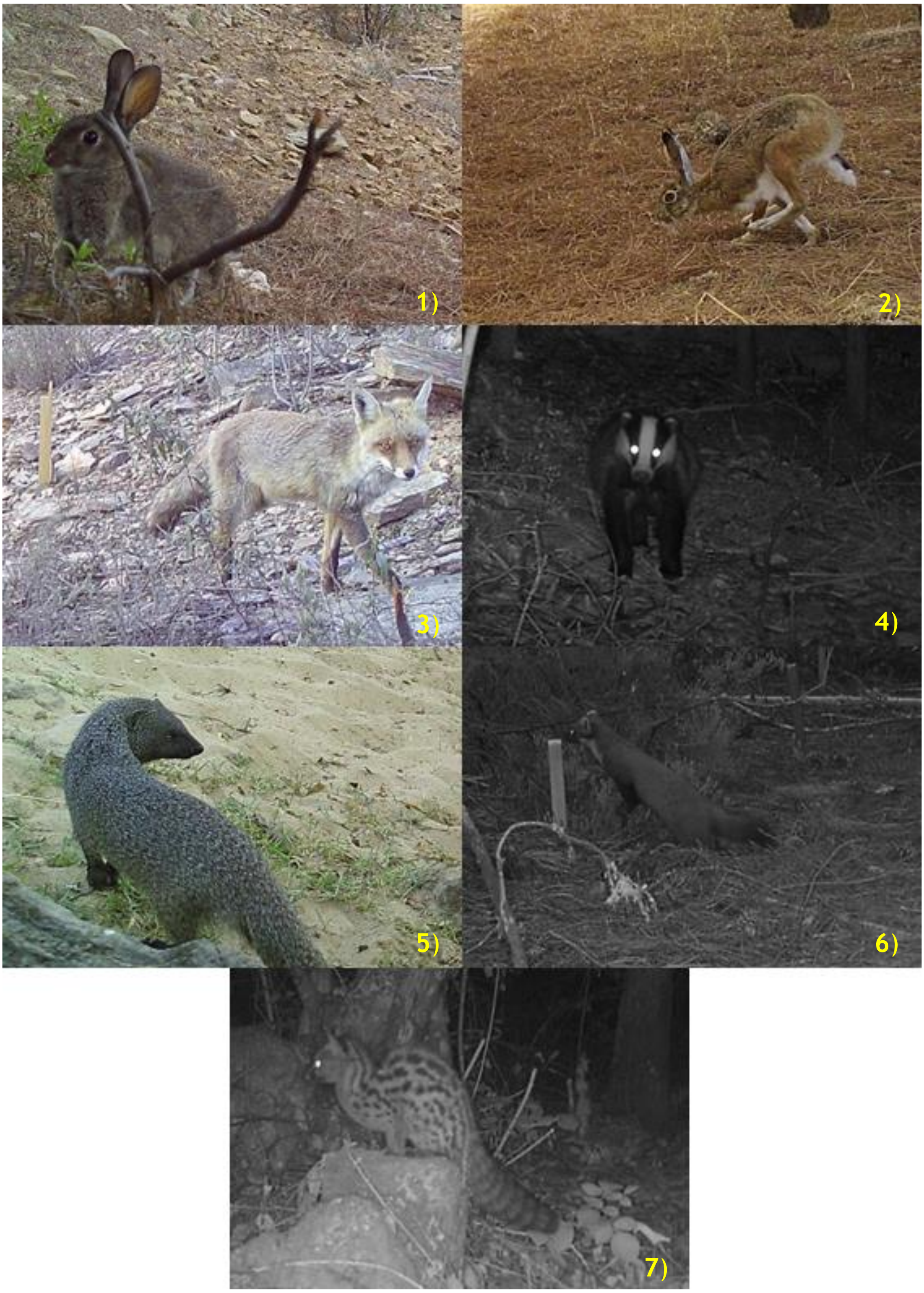

FIGURE 2 - Examples of photographs obtained in this study, showing the different species considered: 1) European rabbit (*Oryctolagus cuniculus*); 2) Iberian hare (*Lepus granatensis*); 3) red fox (*Vulpes vulpes*); 4) European badger (*Meles meles*); 5) beech marten (*Martes foina*); 6) Egyptian mongoose (*Herpestes ichneumon*); 7) common genet (*Genetta genetta*).

TABLE 3 – Total number of individual records by species and study area, throughout the first month of the camera trap sampling.

	European rabbit (*Oryctolagus cuniculus*)	Iberian hare (*Lepus granatensis*)	Red fox (*Vulpes vulpes*)	European badger (*Meles meles*)	Egyptian mongoose (*Herpestes ichneumon*)	Common genet (*Genneta genneta*)	Beech marten (*Martes foina*)	Total by study area
Castreja (CJ)	448	21	957	0	0	0	0	1426
Lombada (LB)	524	92	1281	60	0	94	438	2489
Porcas de Murça (PM)	236	208	627	76	0	69	232	1448
Castelo Melhor (CM)	267	28	896	77	46	49	14	1377
Aveiro (AV)	1220	0	788	1162	101	163	0	3434
Cubeira (CB)	118	928	1088	222	3	75	28	2462
Penela (PL)	260	0	138	0	10	204	51	663
Pedrógão (PD)	0	321	1124	121	155	90	28	1839
Sudoeste Alentejano (SA)	0	92	45	21	12	0	16	186
Tapada Nacional de Mafra (TM)	13	0	151	22	3	36	0	225
Tolosa (TL)	965	989	820	106	75	33	54	3042
Parque Natural da Serra da Arrábida (AR)	1713	0	895	6	27	185	0	2826
Hortas das Laranjeiras (HL)	12076	21	280	263	18	0	0	12658
Alcoutim (AL)	3067	433	605	54	2	4	70	4235
São Brás (SB)	311	0	433	13	3	34	104	898
Vila Nova de Paiva (VNP)	1818	19	1201	12	40	203	94	3387
Total by species	23036	3152	11329	2215	495	1239	1129	42595

For each species, the number of candidate covariables of occupancy varied between three (red fox, European badger and Egyptian mongoose) and five (beech marten and Iberian hare), with evidence for both linear and nonlinear responses relative to land use class-based metrics and, to a lesser extent, to landscape-based metrics, considering both spatial extents evaluated (see Table 4 and Appendix 2, A1-A14 for full results). Regarding detectability, the Egyptian mongoose, was the only case in which no covariables were considered in multi-model building and selection (see Table 4 and Appendix 2, A6 for full results).

TABLE 4 - Covariables and type of response (linear L/non-linear NL) measured at camera trap locations (CTL) within 500m and 1000m buffers, that when included in the detection-occupancy models resulted in lower AICc than the models without covariates. HMT-Hunting management type; SEAS-Season; HFP-Human footprint; ALT-Altitude; AGR-Agricultural; FOR-Forestry; WN-Water bodies; SHR-Shrubs; PAST-Pastures; AGRFOR-Agro-forestry; ART-Artificial zones; OPEN-Open areas; ED-Edge density; MSDI-Modified Simpson diversity index; NP-Number of patches; PR-Patch richness. Models with lowest AICc compared to the models without covariates. For each species, among those covariables that were highly correlated (see Appendix 2, A15), only the lowest model AICc was considered in the final set of candidate covariables for multi-model building and AICc-based selection (final candidate covariables in red; discarded correlated covariables in light grey). (see Appendix 2 A1-A14 in Appendix 2 for full results)

Covariable	European rabbit			Iberian hare			Red fox			European badger			Beech marten			Egyptian mongoose			Common genet		
	CTL	500m	1000m	CTL	500m	1000m	CTL	500m	1000m	CTL	500m	1000m	CTL	500m	1000m	CTL	500m	1000m	CTL	500m	1000m
DETECTION submodel																					
HAT	L			L			L														
SEAS	L						L			L			L						L		
HFP				L						L			L						L		
OCCUPANCY submodel																					
HAT																			L		
SEAS																					
HFP																					
ALT										L											
Land use class-based metrics																					
Number of patches (Np)																					
AGR						NL															
FOR																					
WB			L																		
SHR					NL			L							L						
PAST			NL			L												L			
ARGFOR																	L	L			NL
ART								L													
OPEN					NL	NL								L	L						
Percentage Cover (%)																					
AGR		NL	NL														NL				
FOR														L	L						
WB														NL							
SHR		L			L	L					L	L			NL						
PAST															L						
ARGFOR											L	L									
ART																					
OPEN			NL		L	NL			NL					L	L						

Landscape-based metrics																					
ED																					
MSDI																				NL	
NP																					
PR																					L
Predicted prey occupancy																					
RAB																			L		
HAR																					

Overall, with the exception of the Iberian hare, our multi-model building, and selection approach applied to each species revealed that no single model provided the best fit for observed data (see Table 5), and so effects were mostly inferred through model averaging (see Table 5 and 6).

3.1. Small game species

Model ranking of detection submodels for each small game species (see Table 5 and Appendix 2, A1 and A2) revealed that hunting administrative types, affected the detectability of both European rabbits and Iberian hares. More specifically, the detection probability of European rabbits was higher in the touristic hunting areas (see Table 6). Conversely, the detectability of the Iberian hare was greater in the associative hunting areas then in the touristic, municipal and national hunting areas (see Table 6). The Season also affected European rabbit detectability, being greatest during the summer, followed by fall, winter, and spring. Lastly human presence (human footprint index) affected negatively the detectability of the Iberian hare (see Table 6).

The Iberian hare's probability of occupancy showed a unimodal response to the number of patches of agriculture, within the 1000m buffer, meaning this model's linear term was positive while the quadratic term was negative, leading to an (∩-shaped curve (see Table 6). In the case of the European rabbit occupancy, there was a similar unimodal response to the percentage of patches of agriculture within the 500m buffer (see Table 6). The European rabbit´s occupancy showed a negative correlation to the number of water bodies. The occupancy of Iberian hare showed unimodal response to the number of shrub patches within the 500m buffer (see Table 6). Both species' occupancy was influenced by the percentage of patches of shrub in the 500m buffer, positively for the European rabbit and negatively for the Iberian hare. In the same way, both species' occupancy was also influenced by the number of patches of pastures within the 1000m buffer area. In the case of the Iberian hare, the species responded positively to this covariate, while the European rabbit showed a unimodal response (see Table 6). The Iberian hare's occupancy showed a U-shape response relative to the number of patches of open areas in the 500m buffer (see Table 6). At the 1000m buffer scale, the occupancy probability of European rabbits showed a unimodal response to percentage of cover by Open area patches (see Table 6). For the small game species univariate occupancy model list see Appendix 2, A8 and A9.

3.2. Mesocarnivore species

The mesocarnivore species' detection submodel ranking (see Appendix 2, A3-A7), revealed that, among carnivores, the red fox was the only species whose detection varied with the hunting administrative type, with higher detectability in touristic hunting zones than in national, associative and municipal hunting zones. Carnivore species detection was influenced by the season, except in the case of the Egyptian mongoose. Red fox detectability was higher in winter, followed by fall, spring and summer (see Table 6). In the case of the beech marten, detection was also higher during the winter, followed by fall, summer, and spring. In the case of the European badger, its detection was greater in the spring, summer, winter and much lower in the fall. The common genet's detection was also greater in the spring, fall and winter, being lower in the summer. The detectability of the European badger, beech marten and common genet were further influenced by the human footprint index, with positive influence in the case of the European badger and common genet' detection, and negative influence in the case of the beech marten.

As regards to occupancy, the red fox showed a positive response to the number of patches of shrubs and artificial territories in the 500m buffer, and a unimodal non-linear (∩-shaped) response to the cover of open areas in the 1000m buffer (see Table 6). The European badger occupancy was negatively affected by the cover of shrubs, and positively affected by agro-forestry cover within the 500m buffer. In addition, it was the only species affected by altitude, with lower occupancy probability at higher elevations (see Table 6). The beech marten showed a positive response to the number of shrub patches and to the cover of forest land uses within the 500m and 1000m buffers, respectively, and a negative response to the cover by pastures within the 1000m buffers. In addition, this species also exhibited a unimodal non-linear (∩-shaped) response to the cover by bodies of water within the 500m buffer. On the other hand, the cover of open areas negatively affected the species' occupancy probability also at this spatial extent (see Table 6). The Egyptian mongoose showed a unimodal non-linear (∩-shaped) response to the percentage of agricultural coverage within the 500m buffer (see Table 6), and a positive response to the number of pasture patches within 1000m buffers. The occupancy probability of Egyptian mongooses and the common genets were also affected by the number of agroforestry patches within the 1000 buffer area, with positive response and U-shaped response, respectively (see Table 6). The occupancy probability of common genets varied according to the different types of hunting administration, being higher in national hunting zones, followed by the municipal and touristic hunting zones, with lowest values in associative hunting zones. The species' occupancy also showed a negative response to patch richness in the 1000m buffer, and a U-shape response to the modified Simpson diversity index (msidi) (see Table 6). Lastly, the common genet was the only species that included the predicted occupancy probability of one of the prey species (the European rabbit), in this case suggesting that the common genet's occupancy had a negative response to the European rabbits' occupancy (see Table 6). For the mesocarnivore species' univariate occupancy model list see Appendix 2, A10 and A14.

TABLE 5 - List of best supported models (deltaAICc<2) for each species, with indication of models AICc, delta AICc, AICc-weights (considering all candidate models, see Appendix 1 to 14) and the adjusted R^2. All models included the sampled hunting area ID as random effect to account for the biogeographic differences among sites. In model denotation, *p* is the detection probability, *Psi* is the occupancy probability, and $(covariable)^2$ indicates the inclusion of both linear and quadratic terms (see Table 4). HMT – Hunting management type; SEAS – Season; HFP – Human footprint; ALT – Altitude; AGR – Agricultural; FOR – Forestry; WN – Water bodies; SHR – Shrubs; PAST – Pastures; AGRFOR – Agro-forestry; ART –Artificial zones; OPEN – Open areas; MSDI – Modified Simpson diversity index; NP – Number of patches; PR – Patch richness. For a full list of candidate model ranking for each species, see Appendix 2, A16 to A22.

Species	Model	AICc	Delta AICc	AICc-weights	Adj-*R2*
Prey					
European rabbit	***p*** [HAT + SEAS], ***Psi*** [(%_AGR_500)^2 + %_SHR_500 + Np_WB_1000 + (Np_PAST_1000)^2 + (%_OPEN_1000)^2]	1105.03	0.00	0.20	0.407
	p [HAT + SEAS], ***Psi*** [(%_AGR_500)^2 + %_SHR_500 + Np_WB_1000 + (%_OPEN_1000)^2]	1105.22	0.19	0.18	0.399
	p [HAT + SEAS], ***Psi*** [%_SHR_500 + Np_WB_1000 + (Np_PAST_1000)^2 + (%_OPEN_1000)^2]	1105.62	0.59	0.15	0.398
Iberian hare	***p*** [HAT + HFP], ***Psi*** [(Np_SHR_500)^2 + (Np_OPEN_500)^2 + %_SHR_500 + (Np_AGR_1000)^2 + Np_PAST_1000]	648.74	0.00	0.474	0.265
Carnivores					
Red fox	***p*** [HAT + SEAS], ***Psi*** [Np_SHR_500 + Np_ART_500+ (%_OPEN_1000)^2]	2481.32	0.00	0.532	0.176
	p [HAT + SEAS], ***Psi*** [Np_SHR_500 + Np_ART_500]	2483.01	0.23	0.228	0.163
European badger	***p*** [HFP + SEAS], ***Psi*** [ALT + %_SHR_500 + %_AGRFOR_500]	869.00	0.00	0.341	0.186
	p [HFP + SEAS], ***Psi*** [ALT + %_AGRFOR_500]	869.58	0.59	0.254	0.179
	p [HFP + SEAS], ***Psi*** [ALT + %Shrub_500]	870.27	1.27	0.181	0.178
Beech marten	***p*** [HFP + SEAS], ***Psi*** [(%_WB_500)^2 + %_OPEN_500 + Np_SHR_1000 + %_FOR_1000 + %_PAST_1000]	899.47	0.00	0.262	0.284
	p [HFP + SEAS], ***Psi*** [(%_WB_500)^2 + %_OPEN_500 + Np_SHR_1000 + %_FOR_1000]	899.75	0.27	0.228	0.278
Egyptian mongoose	***p*** [1], ***Psi*** [(%_AGR_500)^2 + Np_AGRFOR_1000]	560.61	0.00	0.337	0.145
	p [1], ***Psi*** [(%_AGR_500)^2 + Np_PAST_1000 + Np_AGRFOR_1000]	560.61	0.00	0.336	0.151
	p [1], ***Psi*** [(%_AGR_500)^2 + Np_PAST_1000]	562.25	1.64	0.148	0.140
Common genet	***p*** [HFP + SEAS], ***Psi*** [HAT + (MSDI_500)^2 + PR_1000]	885.17	0.00	0.275	0.193
	p [HFP + SEAS], ***Psi*** [HAT + (MSDI_500)^2 + PR_1000 + RAB]	885.73	0.55	0.209	0.197
	p [HFP + SEAS], ***Psi*** [HAT + (Np_AGRFOR_1000)^2 + (MSDI_500)^2 + PR_1000]	886.20	1.03	0.165	0.201
	p [HFP + SEAS], ***Psi*** [HAT + (Np_AGRFOR_1000)^2 + (MSDI_500)^2]	887.04	1.86	0.108	0.194

TABLE 6 - Effect size (coefficients) estimates (mean ± se) of covariables based on model averaging of best supported models (except in the case of Iberian hares, for which a single model was best supported, (see Appendix 2, A16 to A22 and for the full results). *p* is the detection probability; *Psi* is the occupancy probability. Predicted effects for continuous covariables are also depicted. HMT – Hunting management type; SEAS – Season; HFP – Human footprint; ALT – Altitude; AGR – Agricultural; FOR – Forestry; WN – Water bodies; SHR – Shrubs; PAST – Pastures; AGRFOR – Agro-forestry; ART – Artificial zones; OPEN – Open areas; ED - Edge density; MSDI – Modified Simpson diversity index; NP – Number of patches; PR – Patch richness. For categorical variables considered in the submodels of detectability, the baseline category for estimating effect sizes was 'Turistic Hunting' in the case of Hunting regime type, and 'winter" in the case of the Season.

Species	Model Parameter	Covariable	Predicted Effect	Linear term		Quadratic term	
				Coefficient (mean ± se)	*p*-value	Coefficient (mean ± se)	*p*-value
Prey							
European rabbit	*p*	HAT - Associative		-0.760 ± 0.340	0.026		
		HAT - Municipal		-0.918 ± 0.307	0.003		
		HAT - National		-0.837 ± 0.297	0.005		
		SEAS - Fall		0.879 ± 0.282	0.002		
		SEAS - Spring		-0.132 ± 0.322	0.681		
		SEAS - Summer		0.944 ± 0.325	0.004		
	Psi	%_AGR_500	∩	0.440 ± 0.684	0.520	-1.269 ± 1.338	0.343
		%_SHR_500	+	0.509 ± 0.222	0.022		
		Np_WB_1000	-	-0.526 ± 0.261	0.044		
		Np_PAST_1000	∩	0.818 ± 0.750	0.275	-0.815 ± 0.814	0.317
		%_OPEN_1000	∩	2.220 ± 1.157	0.055	-6.917 ± 3.657	0.059
Iberian hare	*p*	HAT - Associative		0.630 ± 0.304	0.781		
		HAT - Municipal		-0.042 ± 0.339	0.903		
		HAT - National		-1.233 ± 0.604	0.041		
		HFP	-	-0.034 ± 0.023	0.137		
	Psi	Np_SHR_500	∩	1.718 ± 0.985	8.13e-02	-3.275 ± 1.621	4.33e-02
		Np_OPEN_500	∪	-3.066 ± 1.433	3.24e-02	9.972 ± 4.527	2.76e-02
		%_SHR_500	-	-1.175 ± 0.447	8.59e-03		
		Np_AGR_1000	∩	1.695 ± 1.018	9.59e-02	-2.991 ± 1.452	3.94e-02
		Np_PAST_1000	+	0.643 ± 0.209	2.08e-03		
Carnivores							
Red fox	*p*	HAT - Associative		-0.375 ± 0.194	0.052		
		HAT - Municipal		-0.665 ± 0.183	2.73e-04		
		HAT - National		-0.264 ± 0.203	0.193		
		SEAS - Fall		-0.195 ± 0.159	0.221		
		SEAS - Spring		-0.511 ± 0.199	0.010		
		SEAS - Summer		-0.540 ± 0.159	0.001		
	Psi	Np_SHR_500	+	0.496 ± 0.226	0.028		
		Np_ART_500	+	0.524 ± 0.272	0.054		
		%_OPEN_1000	∩	0.587 ± 0.633	0.354	-0.789 ± 0.810	0.330
European badger	*p*	SEAS - Fall		-0.869 ± 0.586	0.138		
		SEAS - Spring		0.467 ± 0.400	0.244		
		SEAS - Summer		0.004 ± 0.352	0.990		
		HFP	+	0.030 ± 0.013	0.020		
	Psi	ALT	-	-0.823 ± 0.357	0.021		
		%_SHR_500	-	-0.299 ± 0.306	0.329		
		%_AGRFOR_500	+	0.264 ± 0.231	0.253		
Beech marten	*p*	SEAS - Fall		-0.799 ± 0.309	0.009		
		SEAS - Spring		-1.637 ± 0.369	8.6e-06		
		SEAS - Summer		-1.272 ± 0.450	0.005		
		HFP	-	-0.061 ± 0.020	0.002		
	Psi	%_WB_500	∩	2.249 ± 1.084	0.038	-3.669 ± 1.833	0.045
		%_OPEN_500	-	-6.906 ± 7.672	0.368		
		Np_SHR_1000	+	0.526 ± 0.234	0.024		
		%_FOR_1000	+	0.765 ± 0.245	0.002		
		%_PAST_1000	-	-0.234 ± 0.305	0.442		
Egyptian mongoose	*p*	1					
	Psi	%_AGR_500	∩	1.311 ± 0.567	0.021	-1.450 ± 0.583	0.013
		Np_PAST_1000	+	0.235 ± 0.276	0.394		
		Np_AGRFOR_1000	+	0.466 ± 0.328	0.156		

Common genet	*p*	SEAS – Fall		0.694 ± 0.360	0.054		
		SEAS – Spring		0.806 ± 0.354	0.023		
		SEAS - Summer		-0.376 ± 0.382	0.323		
		HFP	+	0.043 ± 0.013	0.001		
	Psi	HAT – Associative		-1.249 ± 1.037	0.228		
		HAT – Municipal		0.536 ± 1.011	0.596		
		HAT – National		3.369 ± 1.458	0.021		
		Np_AGRFOR_1000	∪	-0.677 ± 1.247	0.587	1.211 ± 2.223	0.586
		MSDI_500	∪	-1.847 ± 0.876	0.035	2.662 ± 0.993	0.007
		PR_1000	-	-0.514 ± 0.336	0.126		
		RAB	-	-0.131 ± 0.283	0.643		

4. Discussion

There is compelling evidence indicating global biodiversity declines in response to human-induced environmental changes driven by urban expansion and the intensification of activities such as agriculture, livestock production, and hunting (Pecl, *et al.,* 2017; Newbold *et al.,* 2015; Primack *et al.,* 2018). The assessment of population status and responses to these changes over large spatial scales has been largely built from observations obtained in separate local studies (Gonzalez *et al.,* 2016). Although it is possible to analyse results from each study area separately, such approaches may have limited value for making inferences beyond those study areas. The advances in hierarchical population models accounting for nested structures and allowing the inclusion of random effects to apportion variance components of hierarchical sampling designs, present an opportunity to overcome such limitations, however, such approaches remain poorly explored to infer species responses to environmental change over large spatial scales, most likely due to implementation challenges (Miller & Grant, 2015). Our study brings an important contribution in this regard, providing compelling evidence of how hierarchical sampling designs may be used to infer broad patterns of species responses to environmental change. By simultaneously assessing the detection-occupancy of keystone mesocarnivores and small game prey species in hunting areas from different geographical and ecological contexts across Portugal, our hierarchical approach allowed for a synthetic alternative to infer broad patterns of species responses to human disturbance and land use gradients in seasonal Mediterranean environments.

As predicted, occupancy modelling of mesocarnivore and small game species in multiple study areas across Portugal indicated the importance of accounting for environmental variation affecting species detectability. In particular, the type of hunting administration appeared to significantly impact the detectability of both small game species and the most widespread and abundant mesocarnivore, the red fox, suggesting that hunting management regime should be routinely considered in mesomammal detection-occupancy modelling in hunting areas. According to our results, rabbit and red fox detectability were apparently higher in tourist hunting areas, while hares were more likely to be detected in associative hunting areas. This could partly be related to the restocking game species, like the rabbit and the hare, to further support the hunting practice, which should increase the availability of prey items, and hence attract more predators to those areas (Beja *et al.*, 2009, De Ministros, P. D. C., 1999). Also according to predictions, species detectability was affected by the season, being apparently greater during the wettest seasons for carnivores (winter for foxes and martens, and spring for badgers and genets), which is when food resources are more abundant (Barrull *et al.,* 2014; Mysłajek *et al.,* 2016; Torre *et al.,* 2003; Vilella *et al.,* 2020; Shamoon *et al.,* 2017), and when some species likely increase their reproductive behaviours (Kämmerle *et al.*, 2020). In the case of rabbits, our results point out to a greater detectability during the summer, which could reflect the higher abundance usually reported for this species following the peak of its reproduction season (Gonçalves *et al.,* 2002; Ferreira, 2003) together with reduced hunting pressure during this period (De Ministros, P. D. C., 1999). Also, in line with predictions, the human footprint index affected the detectability of a considerable number of species. In particular, the Iberian hare and the beech marten appeared generally more where human footprint is lower, while the opposite trend was apparent for badgers and genets, potentially reflecting different behavioral tolerance to human presence among species (Prenda *et al.,* 2022; Hipólito *et al.,* 2016).

Contrary to our predictions, large-scale mesomammal occupancy was apparently little affected by human footprint in hunting areas across mainland Portugal. Likewise, hunting administrative type was not a major driver of occupancy of the species considered in this study, except in the case of the genet, which was apparently more likely to occur in national hunting areas, possibly reflecting its avoidance of privately administered hunting zones, where illegal culling may become a threat (Beja *et al.*, 2009). Season also had negligible effects on species occupancy, suggesting that despite eventually affecting local activity or abundance, seasonality did not impact species occurrence over large spatial extents. Results also pointed out for little effects of altitude in species occupancy, except in the case of the badger, which was apparently less likely to occupy elevated sites, typically associated to colder and less vegetated areas, as well as harder rocks making it more difficult for badgers to dig their sets (Rosalino *et al.*, 2019).

Overall, in line with our predictions, landscape metrics describing the composition and structure of main land uses at different spatial scales, were in general the most influential variables for mesomammal occupancy probability in hunting areas across mainland Portugal. Agricultural and agroforestry habitats in particular, influenced the occupancy of most mesomammal species considered. Badgers and Egyptian mongooses were positively related to overall cover and number of patches of agroforestry habitats within the 500m and 1000m buffers, respectively, highlighting the affinity of these species to these systems (e.g. Palomares & Delibes, 1993; Pita *et al.,* 2009, 2020). In addition, similarly to the European rabbit, the Egyptian mongoose exhibited unimodal response to agricultural habitats within the 500m buffers, a pattern also observed in the relationship between Iberian hares and the number of agricultural patches within the 1000m buffers. Iberian hares and Egyptian mongooses also showed to be positively affected by the number of pastures within the 1000m buffers. These results suggest an association of these species to intermediate levels of agricultural land cover, thus agreeing with the idea that agricultural areas may provide a relevant resource for some mammal species (Farfán *et al.,* 2012; Duarte, 2000), as long as these types of habitats form interspersed mosaics including other land uses (Ales *et al.*, 1992). For instance, shrub cover within the 500m buffer showed a positive effect on rabbit occupancy, while the number of pastures and other open areas within the 1000m buffers resulted in unimodal responses by this species, indicating its preference for mosaics of agricultural, pastures and shrub habitats (Ferreira, 2003; Gea-Izquierdo *et al.*, 2005; Serronha, 2014). In the case of the Iberian hare, increased shrub cover within 500m buffers was associated to lower occupancy, while the number of pastures within 1000m buffer affected the species more positively, evidencing its association to open pasture areas able to provide food and shelter (Paupério, 2003; Farfán *et al.,* 2012). This pattern was also apparent for the Egyptian mongoose, which together with the badger, seems to thrive relatively well in agricultural landscapes (Pita *et al.,* 2009, 2020). Agroforestry areas within 1000m buffers were apparently also important for the common genet, even though the U-shaped response (also observed in relation to the modified Simpson diversity index), lacks a clear ecological explanation. A possible reason could be related to the spatial grain of habitat information which may be too coarse and focused on large patches, disregarding smaller but significant habitats. This may also explain the apparent negative relation between rabbits and the number of water bodies within 1000m buffers.

Also associated to human-dominated environments, the red fox was the most common and widespread carnivore species in mainland Portugal, showing a unimodal response to the coverage of open habitats within the 1000m buffer, and a positive relationship with the number of shrub patches and artificial areas within the 500m buffer. This reflects the adaptability of this species to altered landscapes comprising small remnant patches of more natural woodland habitats, and a preference for food resources that may be more abundant in these habitats (Recio *et al.*, 2015; Díaz-Ruiz *et al.*, 2013; Curveira-Santos *et al.*, 2019). Conversely, as expected, the cover by forested habitats was most influential for the beech marten, with the species showing higher occupancy where both forest and shrub cover within the 1000m buffers were greater and the cover by pastures was lower, with negative relation to open habitats within the 500m buffers. These results are in line with the general habitat preferences described for the species (Santos & Santos-Reis, 2010) and highlight its association to close woodlands providing shelter for resting and avoidance of predators (Mangas *et al.*, 2008). Clear patterns of species-environment relationships were less evident for the genet, which may suggest context-dependent responses, or the effect of interspecific interactions not explicitly assessed here. Notably, this species was also the only carnivore apparently affected by prey, being less likely to occur in areas where rabbit occupancy was higher. This result is difficult to explain but may be in part related to the fact that, like many of the carnivore species studied here, genets prefer to prey on smaller mammals such as rodents and shrews (Torre *et al.*, 2003, Zapata *et al.*, 2007, Vilella *et al.*, 2020). While camera trapping has been recently used to survey small mammals, this typically requires a more specific set-up of cameras in the field in order to allow the identification of the species (Nichols *et al.*, 2011), which was not possible to implement in this study, thus limiting a more thorough evaluation of how mesocarnivore occupancy patterns are affected by the availability of different prey items. A further limitation of our approach is that hunting activity was broadly characterized in terms of administrative types, lacking more detailed information on local hunting numbers and habitat management practices to properly assess potential effects on mesomammal species.

Despite these limitations, our study based on nationwide hierarchical sampling of multiple hunting areas in different geographical regions allows for stronger inferences to be drawn regarding the responses of relatively common and widespread mesomammals to broad environmental gradients related to human disturbance, hunting type, topography, seasonality and land uses measured at different spatial scales. Future studies should consider the evaluation of responses by other less common species such as the polecat (*Mustela putorius*), or the wild cat (*Felis silvestris*), together with a more detailed assessment of habitat and food resources, as well as hunting management practices across different areas.

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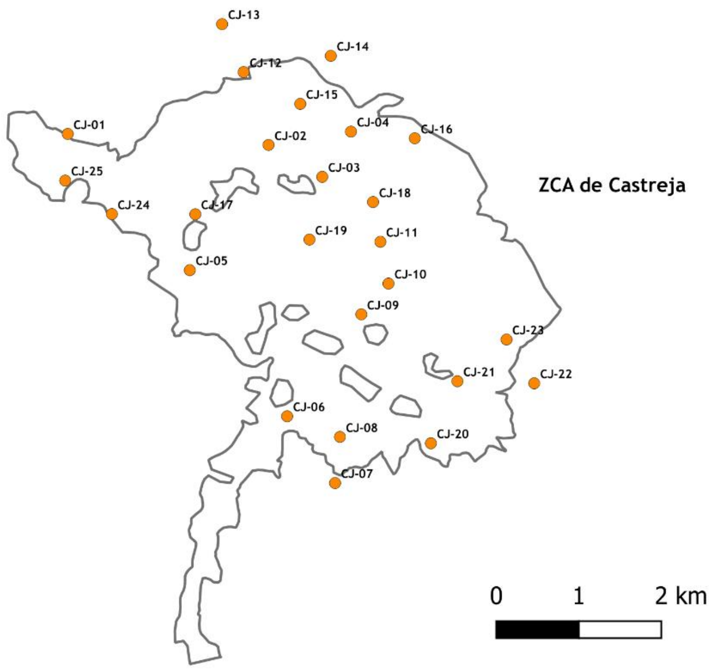
APPENDIX 1

Study areas and camera traps location/operationalization



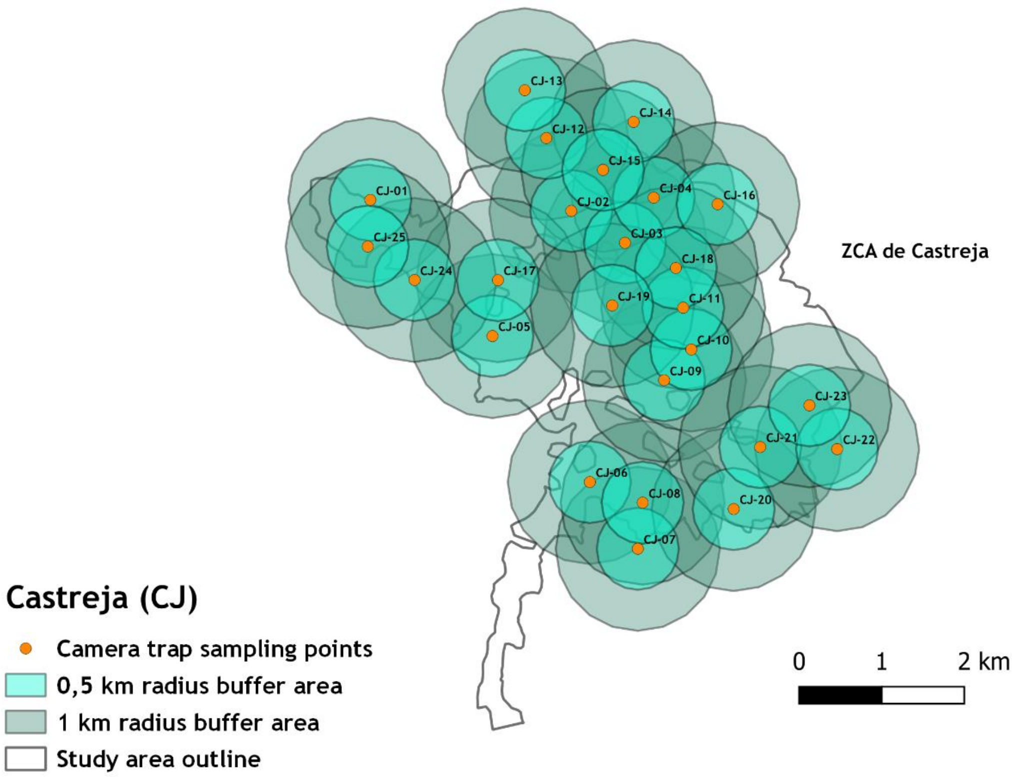


FIGURE A1 - Example showing the locations of camera traps sampling points of the Castreja study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted.

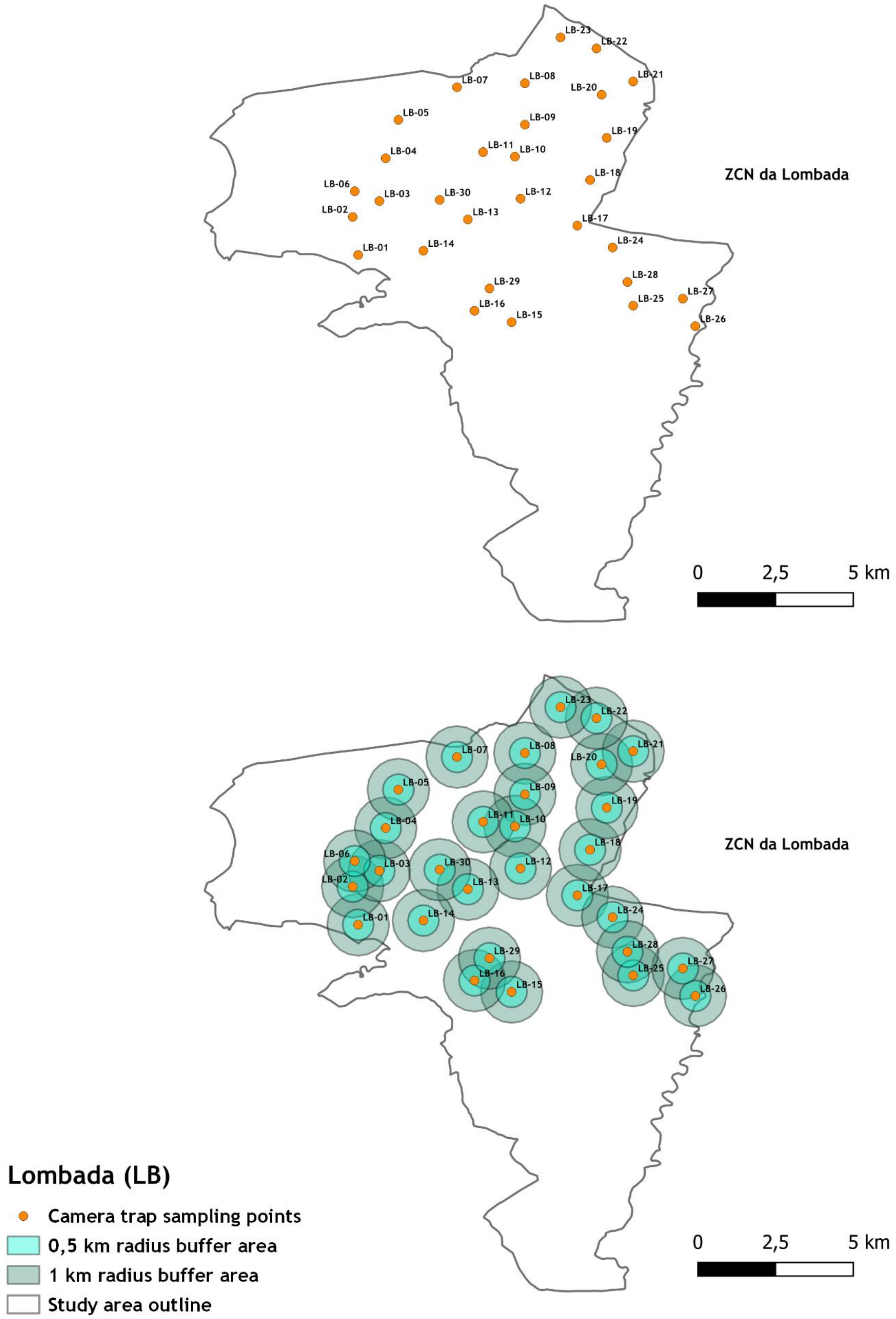


FIGURE A2 - Example showing the locations of camera traps sampling points of the Lombada study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted.

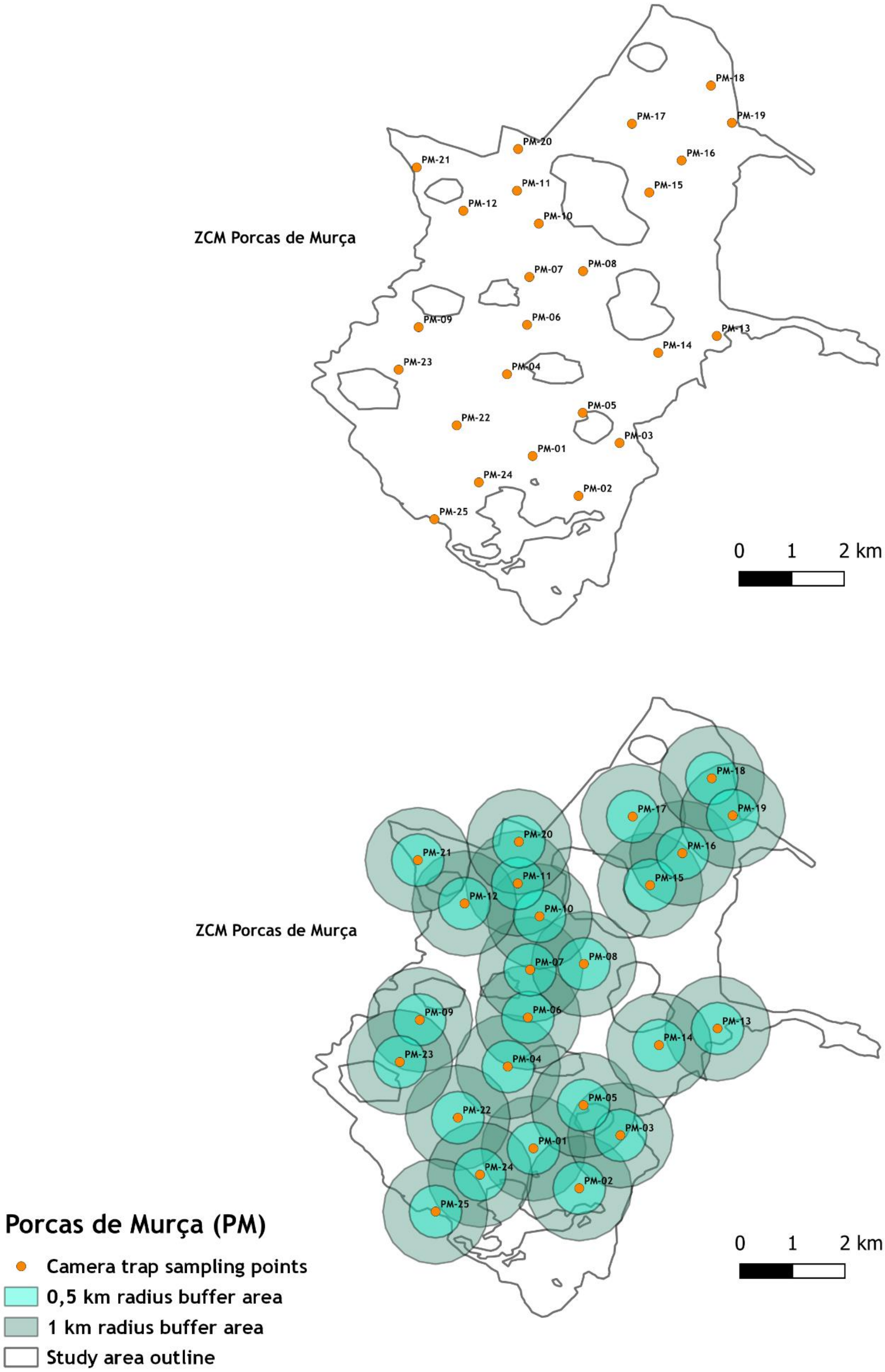


FIGURE A3 - Example showing the locations of camera traps sampling points of the Porcas de Murça study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted.

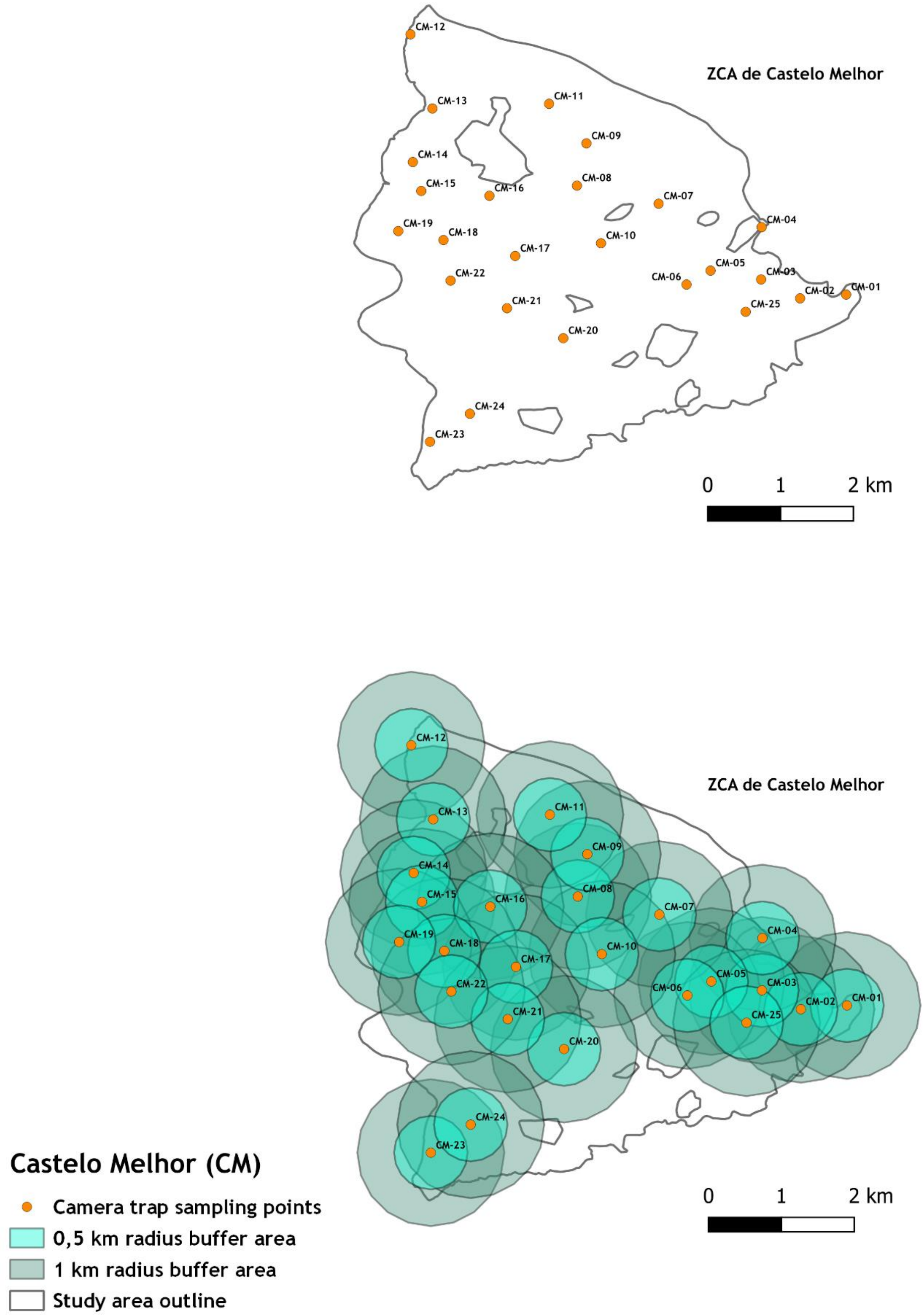


FIGURE A4 - Example showing the locations of camera traps sampling points of the Castelo Melhor study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted.

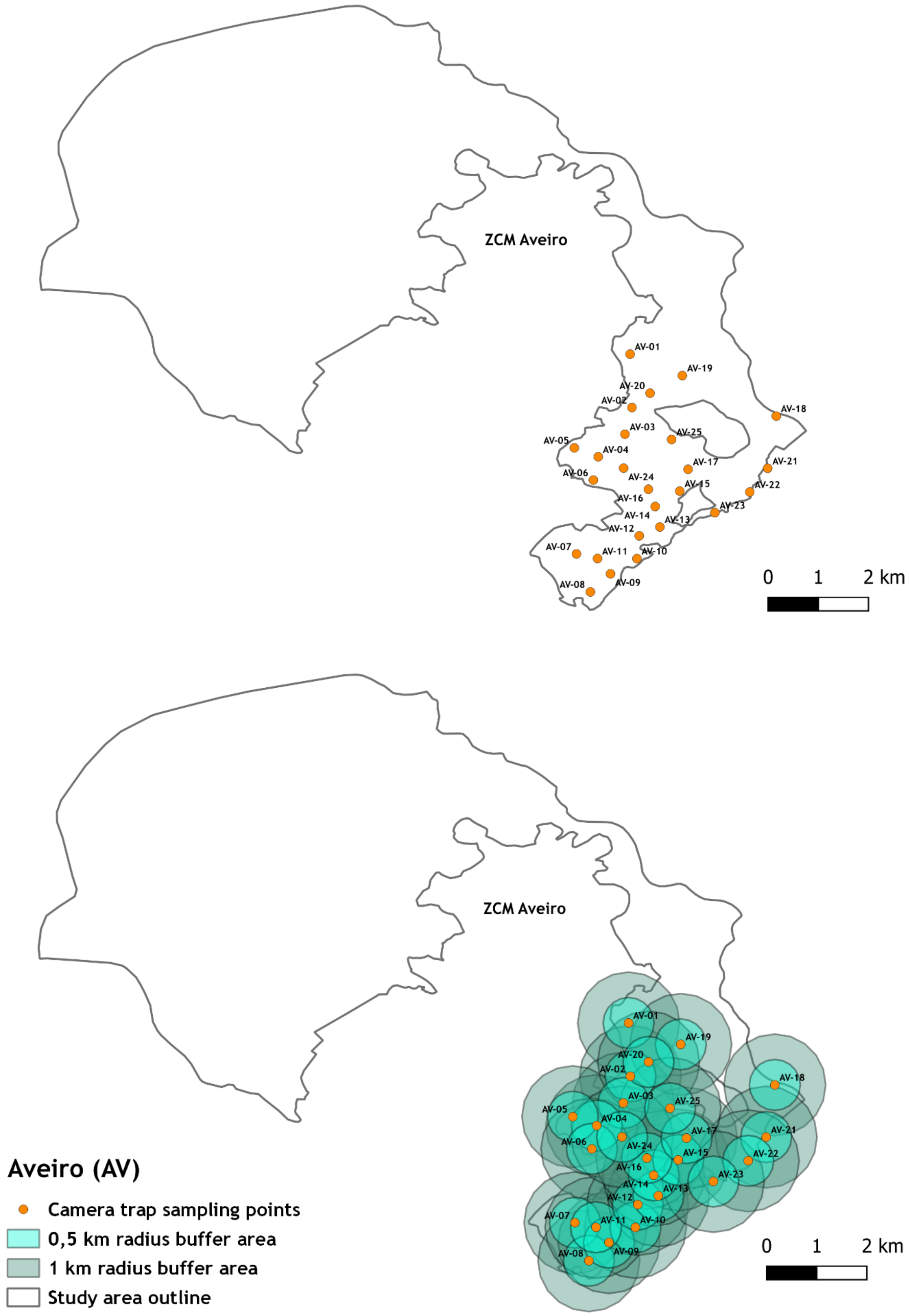


FIGURE A5 - Example showing the locations of camera traps sampling points of the Aveiro study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted.

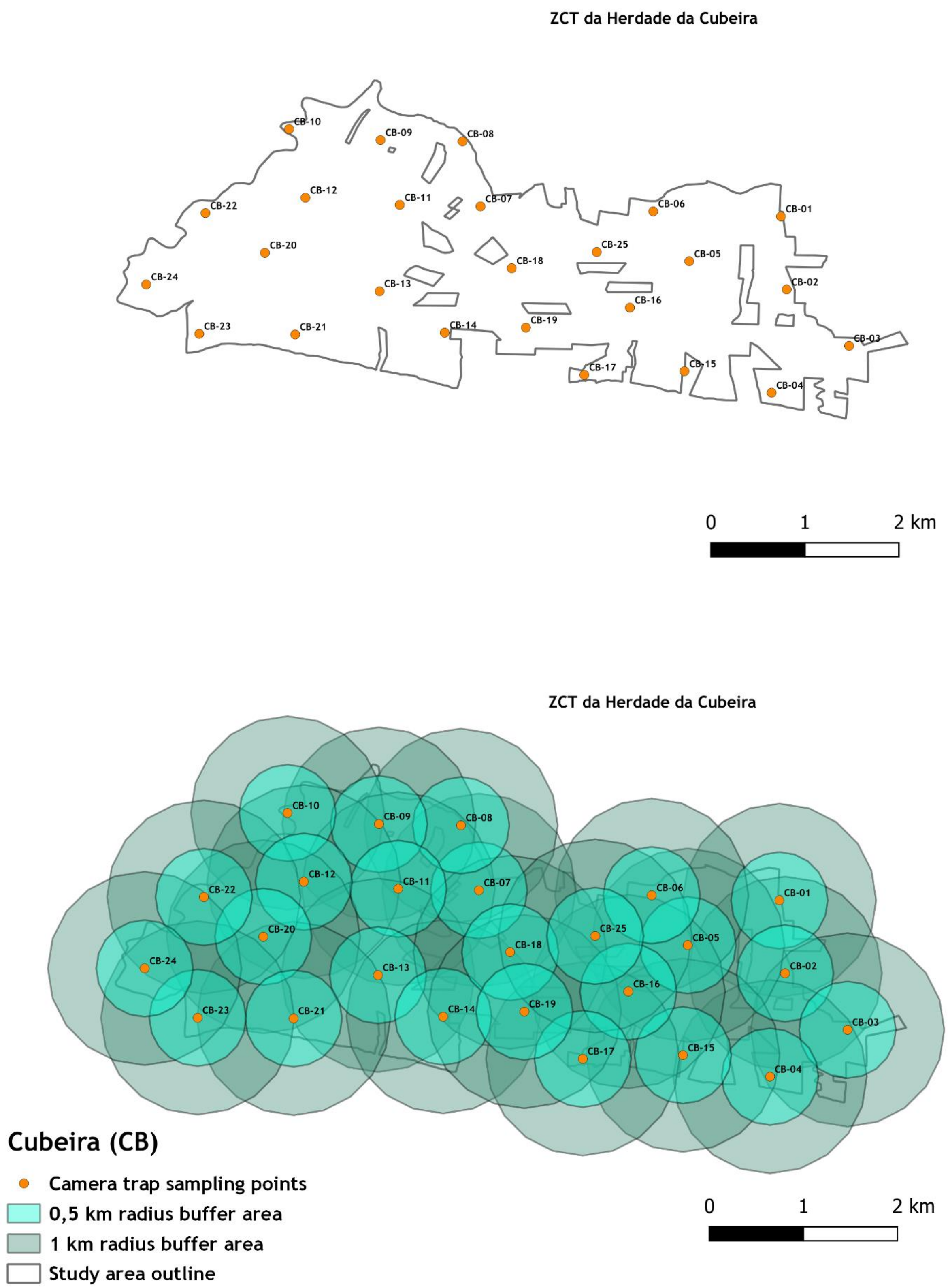
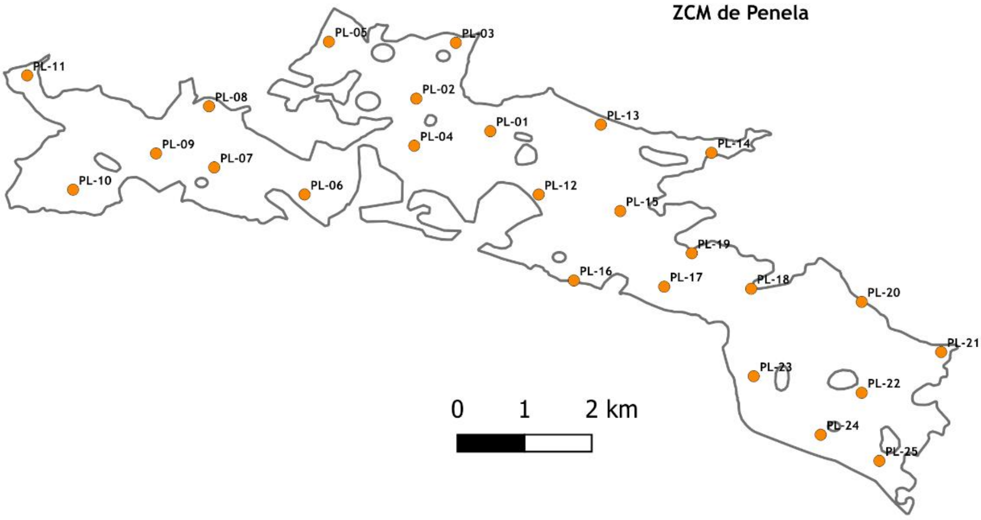


FIGURE A6 - Example showing the locations of camera traps sampling points of the Cubeira study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted.



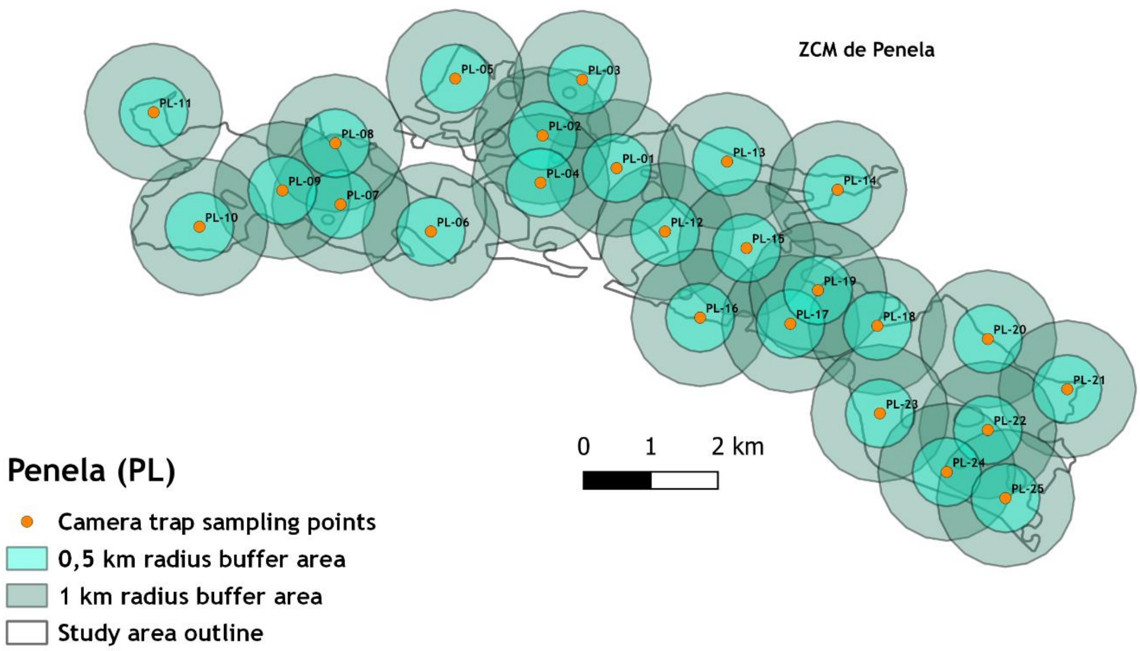


FIGURE A7 - Example showing the locations of camera traps sampling points of the Penela study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted.

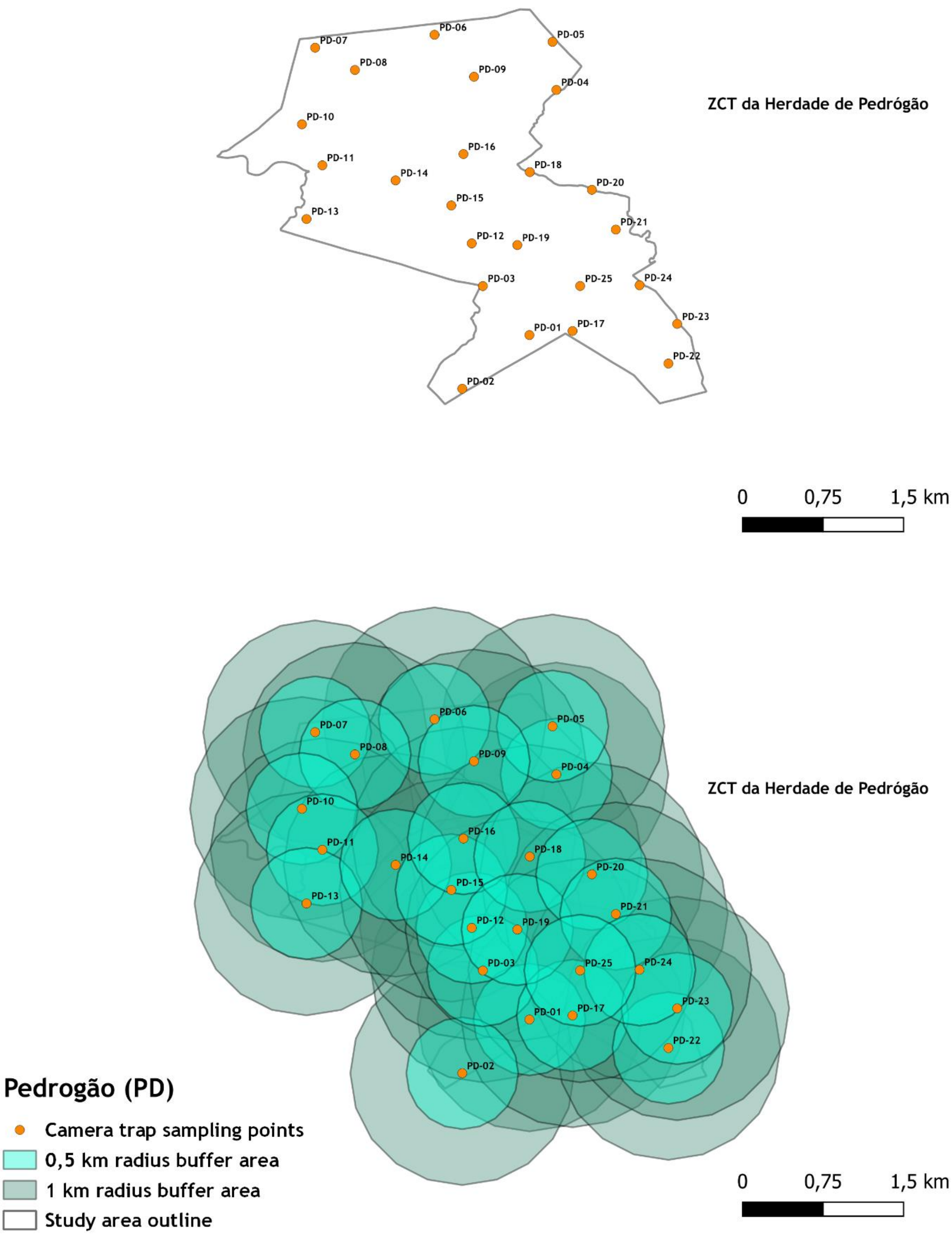


FIGURE A8 - Example showing the locations of camera traps sampling points of the Pedrógão study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted.

FIGURE A9 - Example showing the locations of camera traps sampling points of the Odemira study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted.

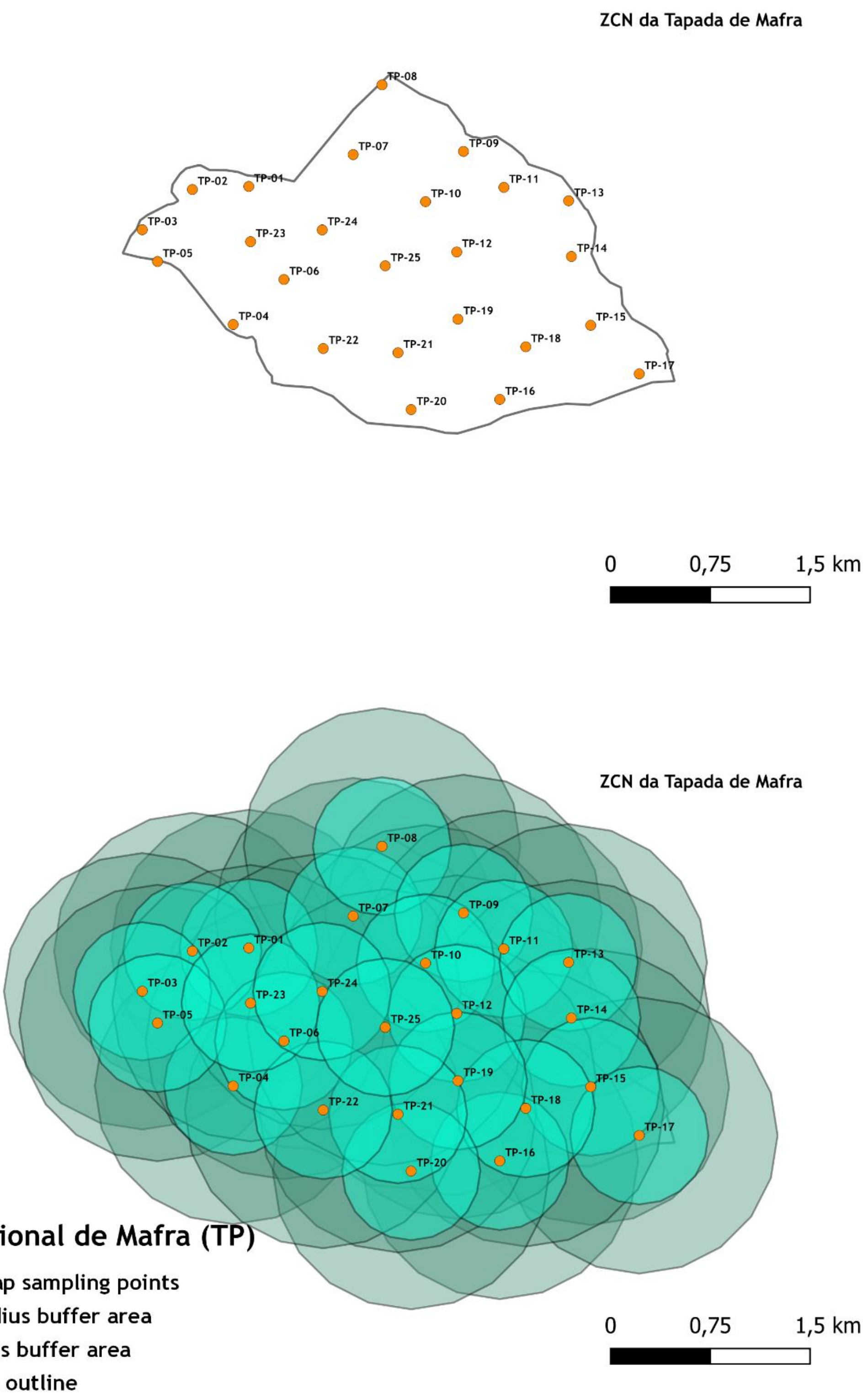
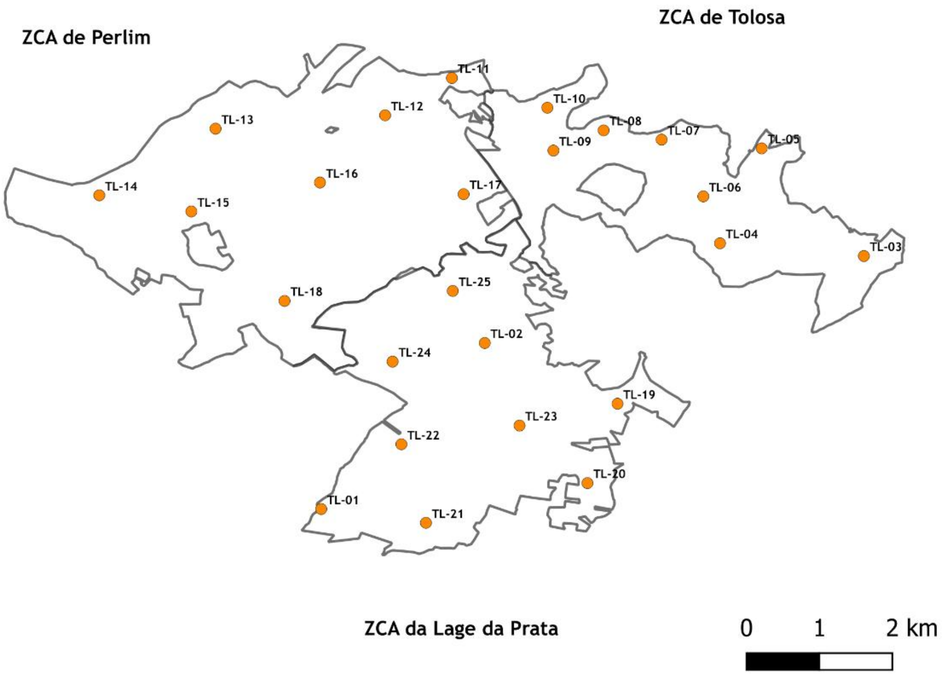


FIGURE A10 - Example showing the locations of camera traps sampling points of the Tapada de Mafra study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted.



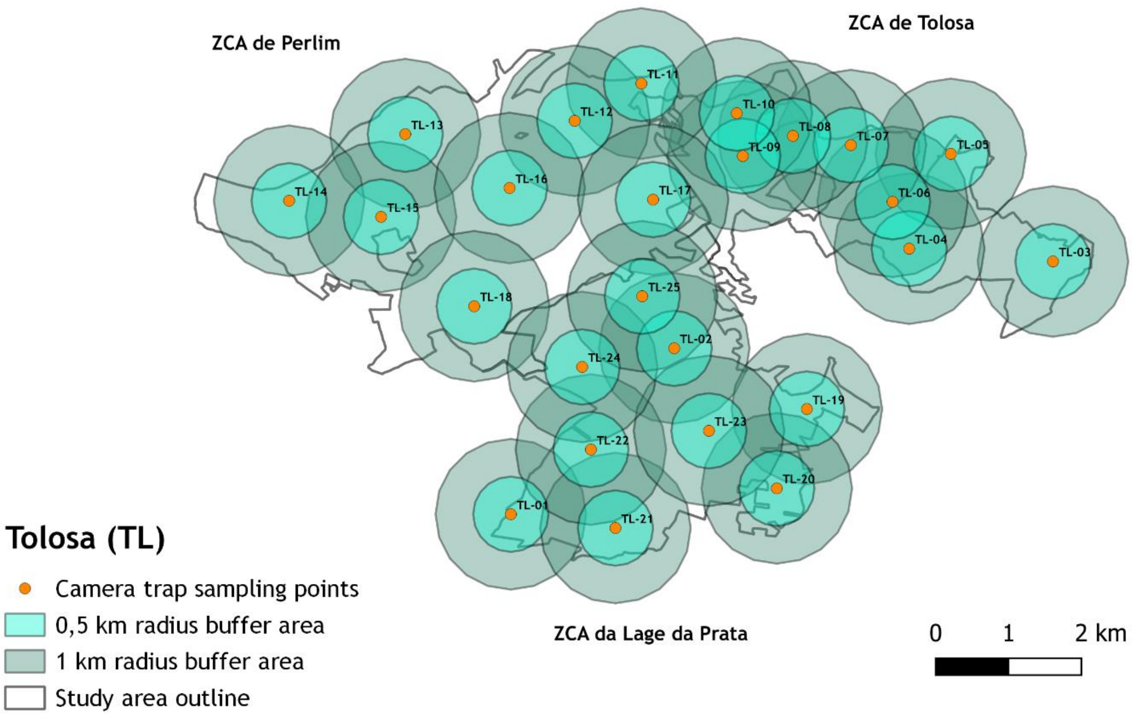


FIGURE A11 - Example showing the locations of camera traps sampling points of the Tolosa study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted.

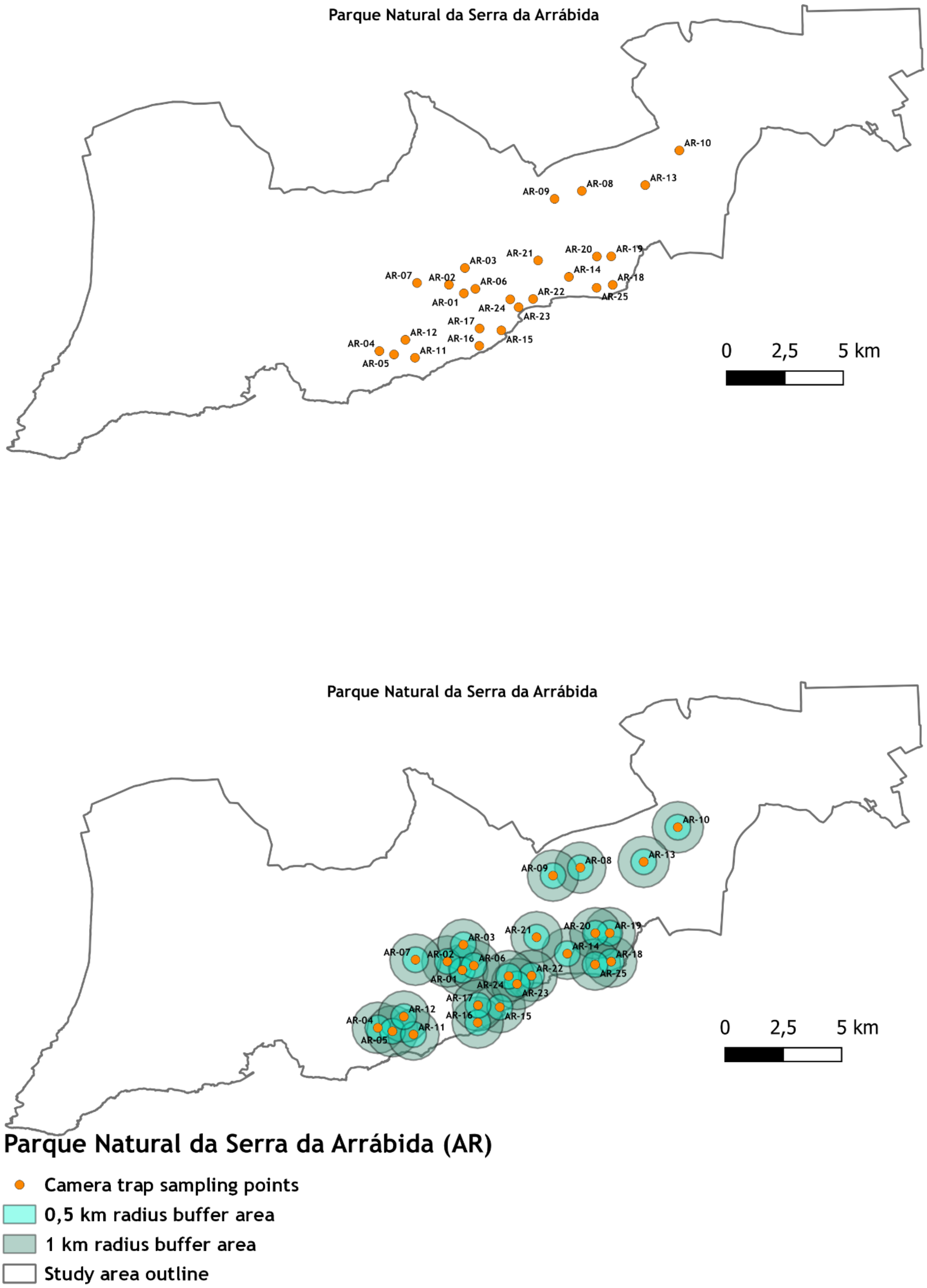


FIGURE A12 - Example showing the locations of camera traps sampling points of the Parque Natural da Serra da Arrábida study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted.

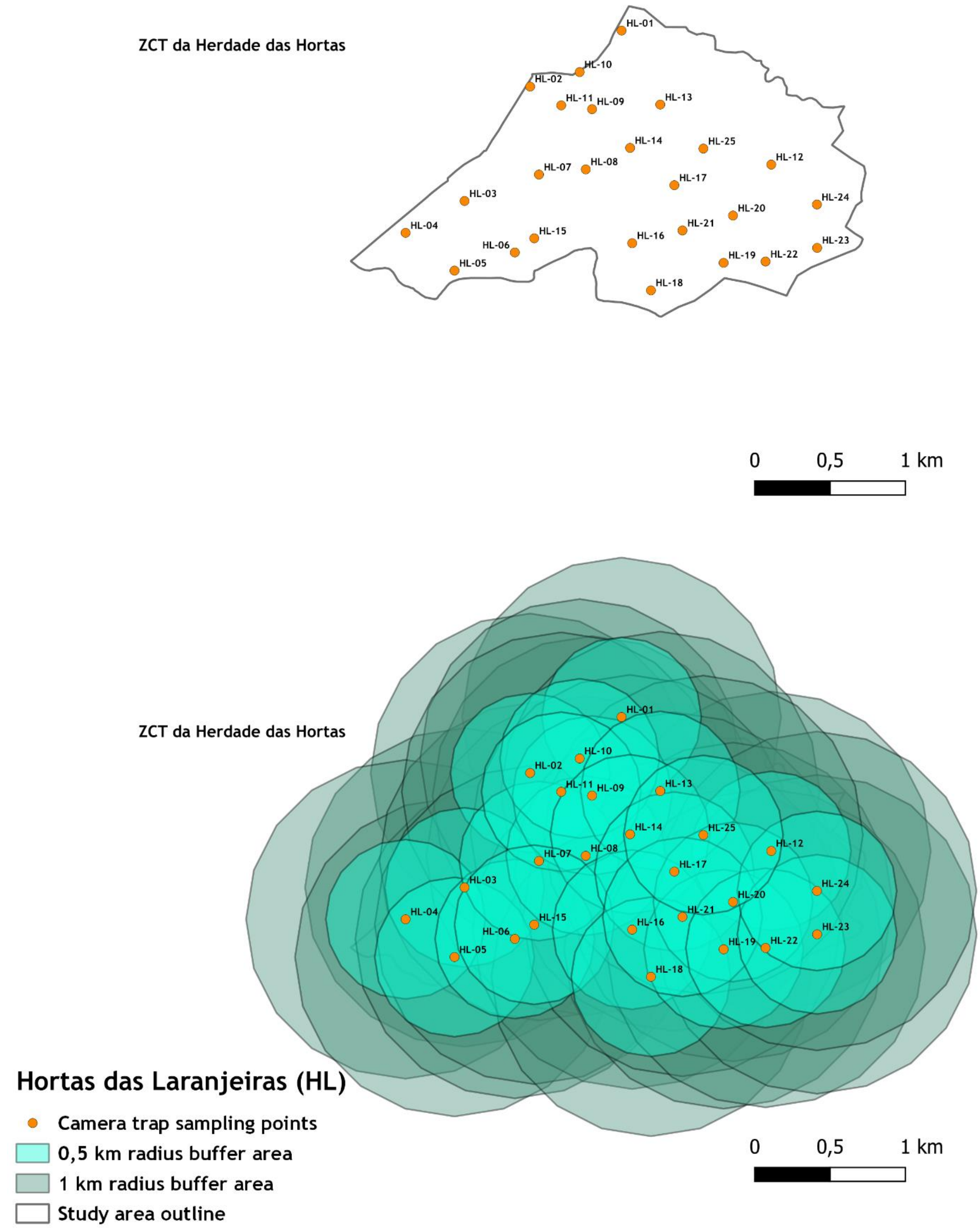


FIGURE A13 - Example showing the locations of camera traps sampling points of the Hortas das Laranjeiras study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted

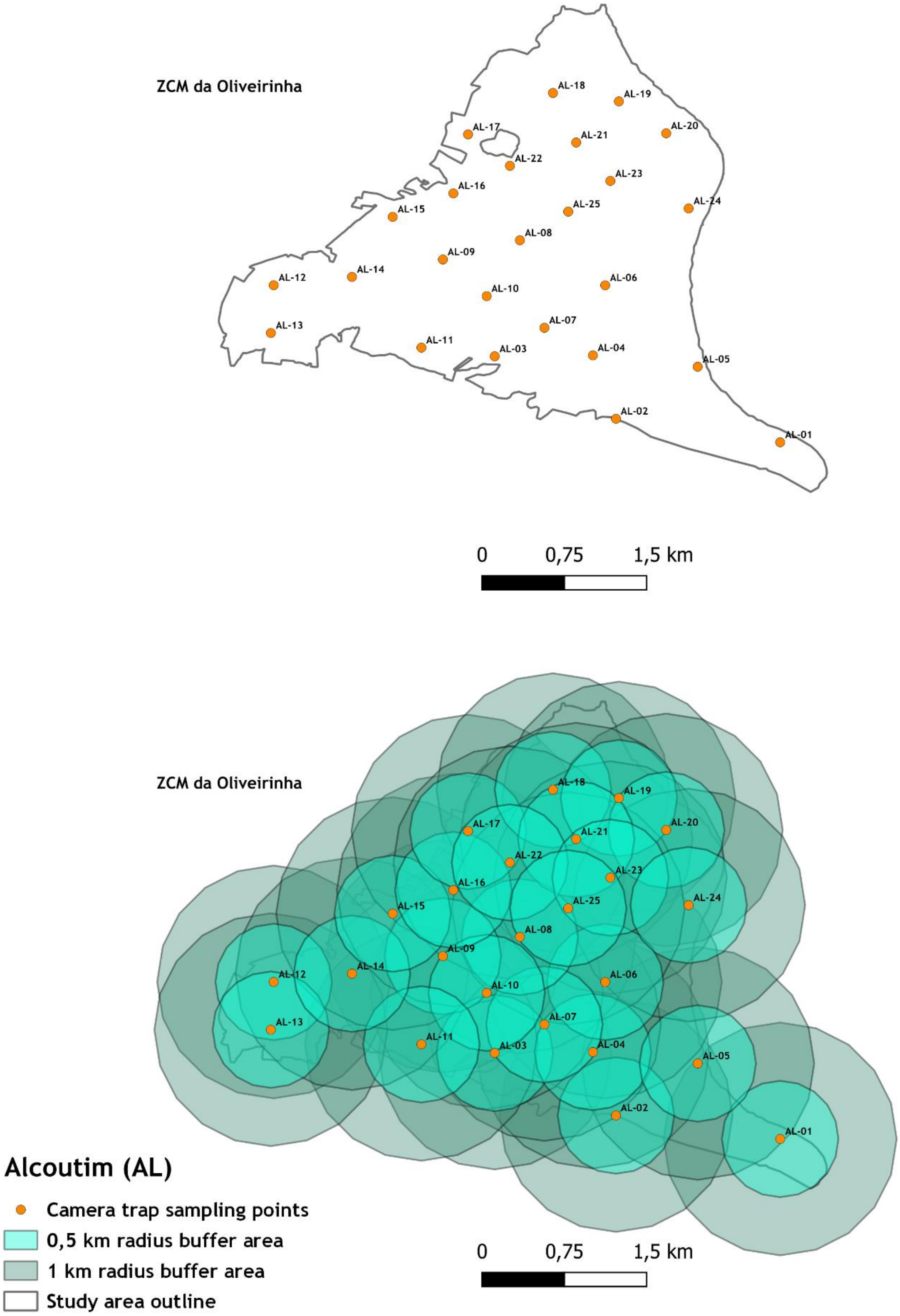
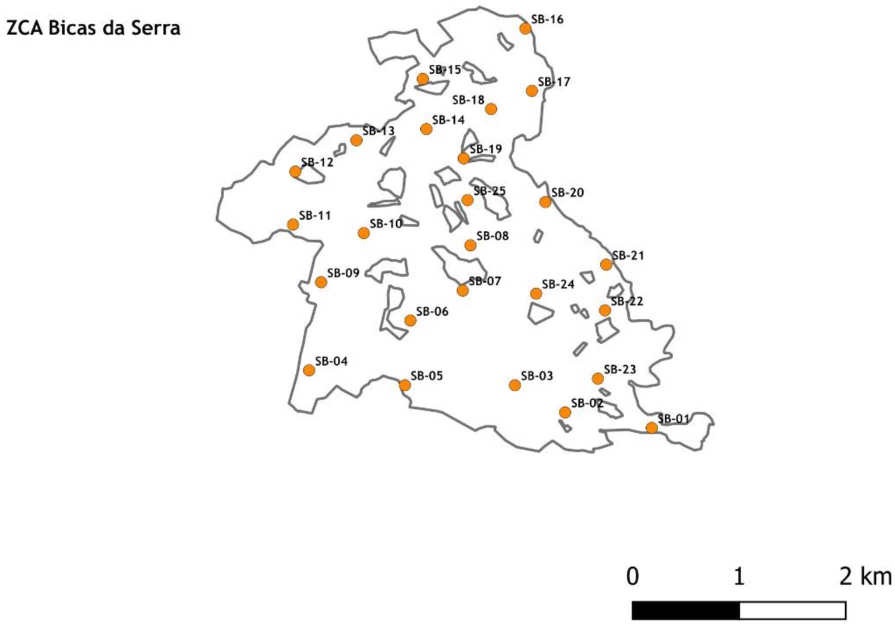


FIGURE A14 - Example showing the locations of camera traps sampling points of the Alcoutim study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted.



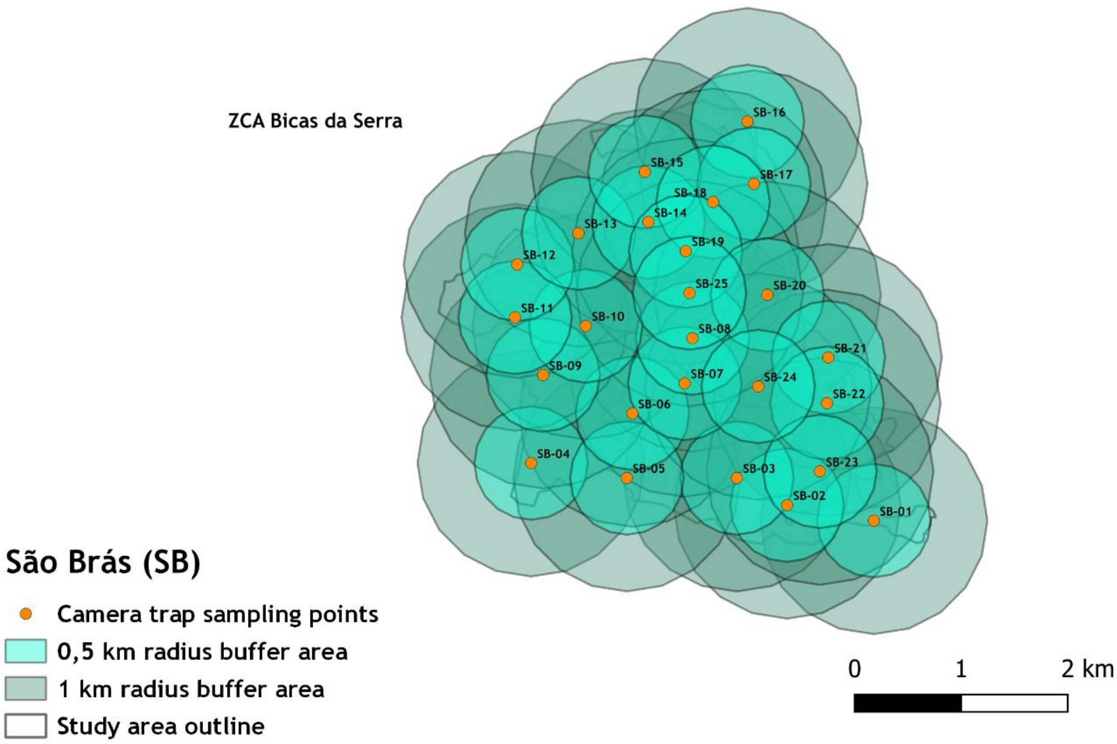


FIGURE A15 - Example showing the locations of camera traps sampling points of the São Brás study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted.

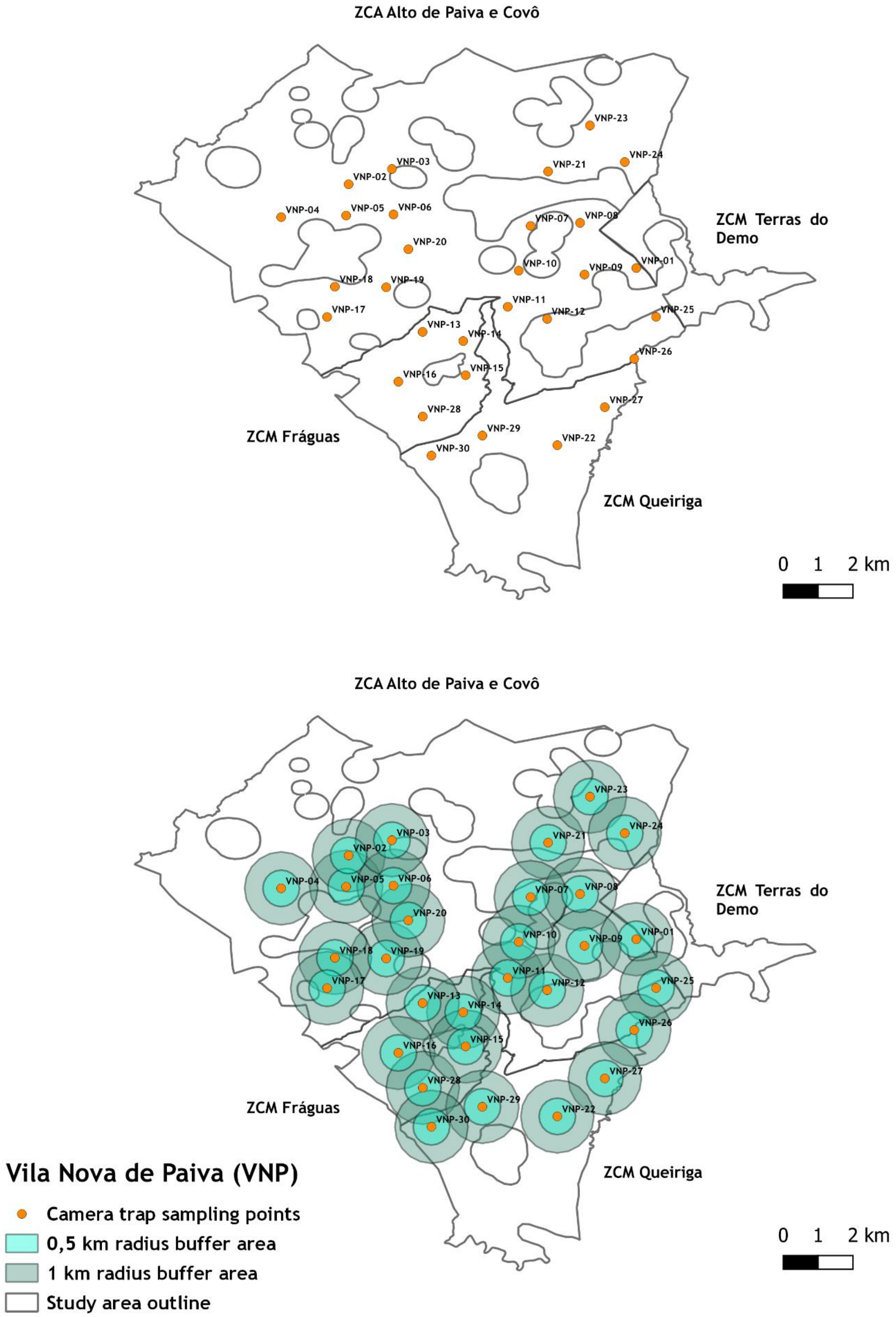


FIGURE A16 - Example showing the locations of camera traps sampling points of the Vila Nova de Paiva study area, and the 500 and 1000m buffers around each trap, from which landscape variables were extracted.

Table B1- Camera information by study area/hunting zones *(during the interval of time considered for observation collection of the yielded photographs

	Cameras without relevant data*	Cameras not found
Castreja (CJ)	2,5,11	1,24,25
Lombada (LB)	12	9,17
Porcas de Murça (PM)	1	8,21
Castelo Melhor (CM)	9,12	24
Aveiro (AV)	-	24
Cubeira (CB)	-	21
Penela (PL)	4,5,9,15,16,17	-
Pedrógão (PD)	2,4,6,8,9,17	18,24
Sudoeste Alentejano (SA)	18,21	1,2,3,10,13,15,17,20
Tapada Nacional de Mafra (TM)	3,7,8	9
Tolosa (TL)	17	3,7,11
Parque Natural da Serra da Arrábida (AR)	4	1
Hortas das Laranjeiras (HL)	-	-
Alcoutim (AL)	1,2,6	-
São Brás (SB)	7,8,19	-
Vila Nova de Paiva (VNP)	-	6,22,23

APPENDIX 2

Supporting Results

Table A1 - List of every univariate detection probability (p) covariable model specific to the European rabbit 's detection history, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. The sampled hunting area ID was included as random effect to account for the biogeographic differences among sites. Occupancy was assumed as constant (i.e. Psi ~1).

Full model formula	AICc	deltaAICc	AICc-weights	adj-R2
~ 1 ~ (1|Local)	1168.254	48.84	0.000	-
~ HFP ~ (1|Local)	1169.986	50.57	0.000	0.224
~ HAT ~ (1|Local)	1165.848	17.43	0.000	0.304
~ SEAS ~ (1|Local)	1126.323	6.91	0.021	0.325
~ HFP + HAT ~ (1|Local)	1138.374	18.96	0.000	0.305
~ HFP + SEAS ~ (1|Local)	1126.453	7.04	0.020	0.328
~ HAT + SEAS ~ (1|Local)	1119.415	0.00	0.666	0.350
~ HFP + HAT + SEAS ~ (1|Local)	1121.056	1.64	0.293	0.351

Table A2 - List of every univariate detection probability (p) covariable model specific to the Iberian hare 's detection history, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. The sampled hunting area ID was included as random effect to account for the biogeographic differences among sites. Occupancy was assumed as constant (i.e. Psi ~1).

Full model formula	AICc	deltaAICc	AICc-weights	adj-R2
~ 1 ~ (1|Local)	693.054	1.03	0.156	-
~ HFP ~ (1|Local)	694.823	2.80	0.065	0.080
~ HAT ~ (1|Local)	692.436	0.41	0.213	0.099
~ SEAS ~ (1|Local)	692.778	0.76	0.180	0.098
~ HFP + HAT ~ (1|Local)	692.022	0.00	0.262	0.107
~ HFP + SEAS ~ (1|Local)	694.649	2.63	0.070	0.099
~ HAT + SEAS ~ (1|Local)	696.010	3.99	0.036	0.107
~ HFP + HAT + SEAS ~ (1|Local)	697.351	5.33	0.018	0.109

Table A3 - List of every univariate detection probability (*p*) covariable model specific to the red fox 's detection history, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. The sampled hunting area ID was included as random effect to account for the biogeographic differences among sites. Occupancy was assumed as constant (i.e. Psi ~1).

Full model formula	AICc	deltaAICc	AICc-weights	adj-R2
~ 1 ~ (1|Local)	2503.706	12.02	0.002	-
~ HFP ~ (1|Local)	2501.705	10.02	0.004	0.082
~ HAT ~ (1|Local)	2498.147	6.46	0.025	0.101
~ SEAS ~ (1|Local)	2500.327	8.64	0.008	0.096
~ HFP + HAT ~ (1|Local)	2498.231	6.55	0.024	0.106
~ HFP + SEAS ~ (1|Local)	2501.888	10.20	0.004	0.097
~ HAT + SEAS ~ (1|Local)	2491.684	0.00	0.629	0.132
~ HFP + HAT + SEAS ~ (1|Local)	2493.131	1.45	0.305	0.134

Table A4 - List of every univariate detection probability (*p*) covariable model specific to the European badger's detection history, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. The sampled hunting area ID was included as random effect to account for the biogeographic differences among sites. Occupancy was assumed as constant (i.e. Psi ~1).

Full model formula	AICc	deltaAICc	AICc-weights	adj-R2
~ 1 ~ (1|Local)	890.499	12.04	0.001	-
~ HFP ~ (1|Local)	879.028	0.57	0.214	0.128
~ HAT ~ (1|Local)	885.721	7.26	0.008	0.121
~ SEAS ~ (1|Local)	882.522	4.07	0.037	0.130
~ HFP + HAT ~ (1|Local)	878.790	0.33	0.241	0.145
~ HFP + SEAS ~ (1|Local)	878.457	0.00	0.285	0.146
~ HAT + SEAS ~ (1|Local)	883.140	4.68	0.027	0.145
~ HFP + HAT + SEAS ~ (1|Local)	879.290	0.83	0.188	0.160

Table A5 - List of every univariate detection probability (*p*) covariable model specific to the beech marten's detection history, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. The sampled hunting area ID was included as random effect to account for the biogeographic differences among sites. Occupancy was assumed as constant (i.e. Psi ~1).

Full model formula	AICc	deltaAICc	AICc-weights	adj-R2
~ 1 ~ (1|Local)	955.524	34.09	0.000	-
~ HFP ~ (1|Local)	941.609	20.17	0.000	0.139
~ HAT ~ (1|Local)	941.179	19.74	0.000	0.151
~ SEAS ~ (1|Local)	926.091	4.65	0.083	0.188
~ HFP + HAT ~ (1|Local)	933.338	11.90	0.000	0.176
~ HFP + SEAS ~ (1|Local)	921.437	0.00	0.851	0.205
~ HAT + SEAS ~ (1|Local)	931.439	10.00	0.006	0.191
~ HFP + HAT + SEAS ~ (1|Local)	926.824	5.39	0.058	0.207

Table A6 – List of every univariate detection probability (*p*) covariable model specific to the Egyptian mongoose's detection history, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. The sampled hunting area ID was included as random effect to account for the biogeographic differences among sites. Occupancy was assumed as constant (i.e. Psi ~1).

Full model formula	AICc	deltaAICc	AICc-weights	adj-R2
~ 1 ~ (1|Local)	568.641	0.00	0.601	-
~ HFP ~ (1|Local)	570.512	1.87	0.236	0.101
~ HAT ~ (1|Local)	573.733	5.09	0.047	0.104
~ SEAS ~ (1|Local)	573.105	4.46	0.065	0.106
~ HFP + HAT ~ (1|Local)	575.663	7.02	0.018	0.105
~ HFP + SEAS ~ (1|Local)	575.132	6.49	0.023	0.106
~ HAT + SEAS ~ (1|Local)	577.601	8.96	0.007	0.112
~ HFP + HAT + SEAS ~ (1|Local)	579.583	10.94	0.003	0.112

Table A7 – List of every univariate detection probability (*p*) covariable model specific to the common genet's detection history, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. The sampled hunting area ID was included as random effect to account for the biogeographic differences among sites. Occupancy was assumed as constant (i.e. Psi ~1).

Full model formula	AICc	deltaAICc	AICc-weights	adj-R2
~ 1 ~ (1|Local)	909.406	2.04	0.113	-
~ HFP ~ (1|Local)	908.811	1.45	0.152	0.082
~ HAT ~ (1|Local)	909.765	2.40	0.094	0.091
~ SEAS ~ (1|Local)	910.804	3.44	0.056	0.088
~ HFP + HAT ~ (1|Local)	908.132	0.77	0.214	0.101
~ HFP + SEAS ~ (1|Local)	907.365	0.00	0.314	0.103
~ HAT + SEAS ~ (1|Local)	912.502	5.14	0.024	0.100
~ HFP + HAT + SEAS ~ (1|Local)	911.891	4.53	0.033	0.108

Table A8 - List of every univariate occupancy probability (*Psi*) covariable model, specific to the European rabbit's detection history while keeping the best previously determined detection model constant, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. The sampled hunting area ID was included as random effect to account for the biogeographic differences among sites.

Covariate	Occupancy submodel formula	AICc	AICc-weights	adj-R2
Hunting Administrative Type	~HAT+SEAS ~HAT + (1|Local)	1125.478	0.046	0.351
Season	~HAT+SEAS ~SEAS + (1|Local)	1125.307	0.05	0.351
Footprint	~HAT+SEAS ~HFP + (1|Local)	1121.459	0.242	0.350
Altitude	~HAT+SEAS ~scale (ALT) + (1|Local)	1120.539	0.263	0.352
	~HAT+SEAS ~scale (ALT) + I(scale(ALT^2)) ~HAT+SEAS ~ (1|Local)	1120.432	0.277	0.356
Number of patches Agriculture CBM 500	~HAT+SEAS ~scale (Np_AGR_500) + (1|Local)	1120.622	0.311	0.352
	~HAT+SEAS ~scale (Np_AGR_500) + I(scale(Np_AGR_500^2)) + (1|Local)	1122.508	0.121	0.352
Number of patches Forest CBM 500	~HAT+SEAS ~scale (Np_FOR_500) + (1|Local)	1121.170	0.267	0.351
	~HAT+SEAS ~scale (Np_FOR_500) + I(scale(Np_FOR_500^2)) + (1|Local)	1123.297	0.092	0.351
Number of patches Bodies of water CBM 500	~HAT+SEAS ~scale (Np_WB_500) + (1|Local)	1120.774	0.300	0.351
	~HAT+SEAS ~scale (Np_WB_500) + I(scale(Np_WB_500^2)) + (1|Local)	1122.803	0.109	0.352
Number of patches Shrub CBM 500	~HAT+SEAS ~scale (Np_SHR_500) + (1|Local)	1121.227	0.248	0.351
	~HAT+SEAS ~scale (Np_SHR_500) + I(scale(Np_SHR_500^2)) + (1|Local)	1122.424	0.137	0.352
Number of patches Pastures CBM 500	~HAT+SEAS ~scale (Np_PAST_500) + (1|Local)	1119.060	0.394	0.355
	~HAT+SEAS ~scale (Np_PAST_500) + I(scale(Np_PAST_500^2)) + (1|Local)	110.766	0.277	0.357
Number of patches Agroforestry CBM 500	~HAT+SEAS ~scale (Np_AGRFOR_500) + (1|Local)	1120.139	0.357	0.353
	~HAT+SEAS ~scale (Np_AGRFOR_500) + I(scale(Np_AGRFOR_500^2)) + (1|Local)	1122.175	0.129	0.353
Number of patches Artificial Zones CBM 500	~HAT+SEAS ~scale (Np_ART_500) + (1|Local)	1120.888	0.264	0.351
	~HAT+SEAS ~scale (Np_ART_500) + I(scale(Np_ART_500^2)) + (1|Local)	1121.607	0.184	0.354
Number of patches Open areas CBM 500	~HAT+SEAS ~scale (Np_OPEN_500) + (1|Local)	1121.176	0.176	0.351
	~HAT+SEAS ~scale (Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + (1|Local)	1119.542	0.399	0.358
Percentage of Cover Agriculture CBM 500	~HAT+SEAS ~scale (%_AGR_500) + (1|Local)	1116.551	0.251	0.359
	~HAT+SEAS ~scale (%_AGR_500) + I(scale(%_AGR_500^2)) + (1|Local)	1114.532	0.689	0.367
Percentage of Cover Forest CBM 500	~HAT+SEAS ~scale (%_FOR_500) + (1|Local)	1119.567	0.396	0.354
	~HAT+SEAS ~scale (%_FOR_500) + I(scale(%_FOR_500^2)) + (1|Local)	1121.172	0.177	0.355
Percentage of Cover Bodies of water CBM 500	~HAT+SEAS ~scale (%_WB_500) + (1|Local)	1121.448	0.243	0.350
	~HAT+SEAS ~scale (%_WB_500) + I(scale(%_WB_500^2)) + (1|Local)	1123.526	0.086	0.350
Percentage of Cover Shrub CBM 500	~HAT+SEAS ~scale (%_SHR_500) + (1|Local)	1115.331	0.585	0.362
	~HAT+SEAS ~scale (%_SHR_500) + I(scale(%_SHR_500^2)) + (1|Local)	1116.421	0.339	0.363
Percentage of Cover Pastures CBM 500	~HAT+SEAS ~scale (%_PAST_500) + (1|Local)	1119.436	0.385	0.354
	~HAT+SEAS ~scale (%_PAST_500) + I(scale(%_PAST_500^2)) + (1|Local)	1120.501	0.226	0.356
Percentage of Cover Agroforestry CBM 500	~HAT+SEAS ~scale (%_AFRFOR_500) + (1|Local)	1121.469	0.229	0.351
	~HAT+SEAS ~scale (%_AFRFOR_500) + I(scale(%_AFRFOR_500^2)) + (1|Local)	1122.555	0.133	0.341
Percentage of Cover Artificial Zones CBM 500	~HAT+SEAS ~scale (%_ART _500) + (1|Local)	1121.403	0.245	0.350
	~HAT+SEAS ~scale (%_ART _500) + I(scale(%_ART _500^2)) + (1|Local)	1123.375	0.092	0.351
Percentage of Cover Open areas CBM 500	~HAT+SEAS ~scale (%_OPEN_500) + (1|Local)	1121.231	0.258	0.351
	~HAT+SEAS ~scale (%_OPEN_500) + I(scale(%_OPEN_500^2)) + (1|Local)	1123.083	0.102	0.351

Number of patches Agriculture CBM 1000	~HAT+SEAS ~scale (Np_AGR_1000) + (1|Local)	1120.570	0.294	0.352
	~HAT+SEAS ~scale (Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + (1|Local)	1121.513	0.183	0.354
Number of patches Forest CBM 1000	~HAT+SEAS ~scale (Np_FOR_1000) + (1|Local)	1121.490	0.238	0.350
	~HAT+SEAS ~scale (Np_FOR_1000 + I(scale(Np_FOR_1000^2)) + (1|Local)	1123.391	0.092	0.350
Number of patches Bodies of water CBM 1000	~HAT+SEAS ~scale (Np_WB_1000) + (1|Local)	1117.063	0.589	0.358
	~HAT+SEAS ~scale (Np_WB_1000) + I(scale(Np_WB_1000^2)) + (1|Local)	1118.953	0.229	0.359
Number of patches Shrub CBM 1000	~HAT+SEAS ~scale (Np_SHR_1000) + (1|Local)	1121.434	0.244	0.350
	~HAT+SEAS ~scale (Np_SHR_1000) + I(scale(Np_SHR_1000^2)) + (1|Local)	1123.518	0.086	0.350
Number of patches Pastures CBM 1000	~HAT+SEAS ~scale (Np_PAST_1000) + (1|Local)	1120.125	0.091	0.353
	~HAT+SEAS ~scale (Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + (1|Local)	1115.833	0.779	0.365
Number of patches Agroforestry CBM 1000	~HAT+SEAS ~scale (Np_AGRFOR_1000) + (1|Local)	1121.521	0.232	0.350
	~HAT+SEAS ~scale (Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + (1|Local)	1123.129	0.104	0.351
Number of patches Artificial Zones CBM 1000	~HAT+SEAS ~scale (Np_ART_1000) + (1|Local)	1119.734	0.380	0.354
	~HAT+SEAS ~scale (Np_ART_1000) + I(scale(Np_ART_1000^2)) + (1|Local)	1121.283	0.175	0.354
Number of patches Open areas CBM 1000	~HAT+SEAS ~scale (Np_OPEN_1000) + (1|Local)	1120.402	0.323	0.352
	~HAT+SEAS ~scale (Np_OPEN_1000) + I(scale(Np_OPEN_1000^2)) + (1|Local)	1121.959	0.148	0.353
Percentage of Cover Agriculture CBM 1000	~HAT+SEAS ~scale (%_AGR_1000) + (1|Local)	1117.973	0.231	0.357
	~HAT+SEAS ~scale (%_AGR_1000) + I(scale(%_AGR_1000^2)) + (1|Local)	1115.888	0.656	0.364
Percentage of Cover Forest CBM 1000	~HAT+SEAS ~scale (%_FOR_1000) + (1|Local)	1120.295	0.334	0.352
	~HAT+SEAS ~scale (%_FOR_1000) + I(scale(%_FOR_1000^2)) + (1|Local)	1121.930	0.147	0.353
Percentage of Cover Bodies of water CBM 1000	~HAT+SEAS ~scale (%_WB_1000) + (1|Local)	1121.090	0.252	0.351
	~HAT+SEAS ~scale (%_WB_1000) + I(scale(%_WB_1000^2)) + (1|Local)	1121.945	0.165	0.353
Percentage of Cover Shrub CBM 1000	~HAT+SEAS ~scale (%_SHR_1000) + (1|Local)	1117.499	0.525	0.358
	~HAT+SEAS ~scale (%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	1118.797	0.274	0.359
Percentage of Cover Pastures CBM 1000	~HAT+SEAS ~scale (%_PAST_1000) + (1|Local)	1118.529	0.342	0.356
	~HAT+SEAS ~scale (%_PAST_1000) + I(scale(%_PAST_1000^2)) + (1|Local)	1118.033	0.438	0.361
Percentage of Cover Agroforetry CBM 1000	~HAT+SEAS ~scale (%_AFRFOR_1000) + (1|Local)	1121.464	0.238	0.350
	~HAT+SEAS ~scale (%_AFRFOR_1000) + I(scale(%_AFRFOR_1000^2)) + (1|Local)	1123.202	0.100	0.351
Percentage of Cover Artificial Zones CBM 1000	~HAT+SEAS ~scale (%_ART_1000) + (1|Local)	1121.370	0.248	0.350
	~HAT+SEAS ~scale (%_ART_1000) + I(scale(%_ART_1000^2)) + (1|Local)	1123.355	0.092	0.351
Percentage of Cover Open areas CBM 1000	~HAT+SEAS ~scale (%_OPEN_1000) + (1|Local)	1120.169	0.078	0.353
	~HAT+SEAS ~scale (%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1115.497	0.808	0.365
Edge Density LBM 500	~HAT+SEAS ~scale (ED_500) + (1|Local)	1121.440	0.216	0.350
	~HAT+SEAS ~scale (ED_500) + I(scale(ED_500^2)) + (1|Local)	1121.725	0.188	0.354
Modified Simpson Diversity Index LBM 500	~HAT+SEAS ~scale (MSDI_500) + (1|Local)	1121.512	0.152	0.350
	~HAT+SEAS ~scale (MSDI_500) + I(scale(MSDI_500^2)) + (1|Local)	1119.514	0.413	0.358
Number of Patches LBM 500	~HAT+SEAS ~scale (NP_500) + (1|Local)	1121.245	0.259	0.351
	~HAT+SEAS ~scale (NP_500) + I(scale(NP_500^2)) + (1|Local)	1123.275	0.094	0.351
Patch Richness LBM 500	~HAT+SEAS ~scale (PR_500) + (1|Local)	1121.301	0.253	0.350
	~HAT+SEAS ~scale (PR_500) + I(scale(PR_500^2)) + (1|Local)	1123.236	0.096	0.360
Edge density LBM 1000	~HAT+SEAS ~scale (ED_1000) + (1|Local)	1121.199	0.260	0.351
	~HAT+SEAS ~scale (ED_1000) + I(scale(ED_1000^2)) + (1|Local)	1122.989	0.106	0.351
Modified Simpson Diversity Index LBM 1000	~HAT+SEAS ~scale (MSDI_1000) + (1|Local)	1121.410	0.149	0.350
	~HAT+SEAS ~scale (MSDI_1000) + I(scale(MSDI_1000^2)) + (1|Local)	1119.228	0.445	0.358

Number of patches LBM 1000	**~HAT+SEAS ~scale (NP_1000) + (1|Local)**	1121.228	0.255	0.351
	~HAT+SEAS ~scale (NP_1000) + I(scale(NP_1000^2)) + (1|Local)	1122.840	0.114	0.352
Patch Richness LBM 1000	**~HAT+SEAS ~scale (PR_1000) + (1|Local)**	1121.37	0.239	0.350
	~HAT+SEAS ~scale (PR_1000) + I(scale(PR_1000^2)) + (1|Local)	1122.688	0.124	0.352

Table A9 - List of every univariate occupancy probability (*Psi*) covariable model, specific to the Iberian hare's detection history while keeping the best previously determined detection model constant, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. The sampled hunting area ID was included as random effect to account for the biogeographic differences among sites.

Covariate	Occupancy submodel formula	AICc	AICc-weights	adj-R2
Hunting Administrative Type	~HFP+HATS~HAT + (1|Local)	693.447	0.329	0.121
Season	~HFP+HATS~SEAS + (1|Local)	696.656	0.09	0.112
Footprint	~HFP+HATS~HFP + (1|Local)	693.670	0.600	0.108
Altitude	~HFP+HATS~scale (ALT) + (1|Local)	693.783	0.256	0.108
	~HFP+HATS~scale (ALT) + I(scale(ALT^2)) ~HFP+HATS~ (1|Local)	695.205	0.126	0.110
Number of patches Agriculture CBM 500	~HFP+HATS~scale (Np_AGR_500) + (1|Local)	693.989	0.237	0.107
	~HFP+HATS~scale (Np_AGR_500) + I(scale(Np_AGR_500^2)) + (1|Local)	695.188	0.130	0.110
Number of patches Forest CBM 500	~HFP+HATS~scale (Np_FOR_500) + (1|Local)	693.936	0.252	0.107
	~HFP+HATS~scale (Np_FOR_500) + I(scale(Np_FOR_500^2)) + (1|Local)	695.977	0.091	0.107
Number of patches Bodies of water CBM 500	~HFP+HATS~scale (Np_WB_500) + (1|Local)	694.032	0.215	0.107
	~HFP+HATS~scale (Np_WB_500) + I(scale(Np_WB_500^2)) + (1|Local)	694.216	0.196	0.112
Number of patches Shrub CBM 500	~HFP+HATS~scale (Np_SHR_500) + (1|Local)	691.651	0.225	0.114
	~HFP+HATS~scale (Np_SHR_500) + I(scale(Np_SHR_500^2)) + (1|Local)	689.729	0.588	0.125
Number of patches Pastures CBM 500	~HFP+HATS~scale (Np_PAST_500) + (1|Local)	691.598	0.461	0.114
	~HFP+HATS~scale (Np_PAST_500) + I(scale(Np_PAST_500^2)) + (1|Local)	693.630	0.167	0.114
Number of patches Agroforestry CBM 500	~HFP+HATS~scale (Np_AGRFOR_500) + (1|Local)	692.354	0.308	0.112
	~HFP+HATS~scale (Np_AGRFOR_500) + I(scale(Np_AGRFOR_500^2)) + (1|Local)	692.230	0.328	0.118
Number of patches Artificial Zones CBM 500	~HFP+HATS~scale (Np_ART_500) + (1|Local)	694.102	0.223	0.107
	~HFP+HATS~scale (Np_ART_500) + I(scale(Np_ART_500^2)) + (1|Local)	294.921	0.148	0.110
Number of patches Open areas CBM 500	~HFP+HATS~scale (Np_OPEN_500) + (1|Local)	685.872	0.007	0.130
	~HFP+HATS~scale (Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + (1|Local)	675.934	0.993	0.164
Percentage of Cover Agriculture CBM 500	~HFP+HATS~scale (%_AGR_500) + (1|Local)	694.114	0.238	0.107
	~HFP+HATS~scale (%_AGR_500) + I(scale(%_AGR_500^2)) + (1|Local)	696.216	0.083	0.107
Percentage of Cover Forest CBM 500	~HFP+HATS~scale (%_FOR_500) + (1|Local)	693.230	0.306	0.109
	~HFP+HATS~scale (%_FOR_500) + I(scale(%_FOR_500^2)) + (1|Local)	694.890	0.134	0.110
Percentage of Cover Bodies of water CBM 500	~HFP+HATS~scale (%_WB_500) + (1|Local)	693.213	0.316	0.109
	~HFP+HATS~scale (%_WB_500) + I(scale(%_WB_500^2)) + (1|Local)	695.297	0.111	0.109
Percentage of Cover Shrub CBM 500	~HFP+HATS~scale (%_SHR_500) + (1|Local)	687.271	0.678	0.126
	~HFP+HATS~scale (%_SHR_500) + I(scale(%_SHR_500^2)) + (1|Local)	689.194	0.259	0.127
Percentage of Cover Pastures CBM 500	~HFP+HATS~scale (%_PAST_500) + (1|Local)	693.959	0.249	0.107
	~HFP+HATS~scale (%_PAST_500) + I(scale(%_PAST_500^2)) + (1|Local)	695.880	0.095	0.108
Percentage of Cover Agroforestry CBM 500	~HFP+HATS~scale (%_AFRFOR_500) + (1|Local)	692.246	0.309	0.112
	~HFP+HATS~scale (%_AFRFOR_500) + I(scale(%_AFRFOR_500^2)) + (1|Local)	692.027	0.345	0.119
Percentage of Cover Artificial Zones CBM 500	~HFP+HATS~scale (%_ART _500) + (1|Local)	692.897	0.205	0.110
	~HFP+HATS~scale (%_ART _500) + I(scale(%_ART _500^2)) + (1|Local)	691.204	0.478	0.121
Percentage of Cover Open areas CBM 500	~HFP+HATS~scale (%_OPEN_500) + (1|Local)	687.693	0.650	0.125
	~HFP+HATS~scale (%_OPEN_500) + I(scale(%_OPEN_500^2)) + (1|Local)	689.411	0.275	0.126

Number of patches Agriculture CBM 1000	~HFP+HATS~scale (Np_AGR_1000) + (1|Local)	692.668	0.019	0.111
	~HFP+HATS~scale (Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + (1|Local)	684.831	0.955	0.139
Number of patches Forest CBM 1000	~HFP+HATS~scale (Np_FOR_1000) + (1|Local)	691.918	0.351	0.113
	~HFP+HATS~scale (Np_FOR_1000 + I(scale(Np_FOR_1000^2)) + (1|Local)	692.133	0.315	0.118
Number of patches Bodies of water CBM 1000	~HFP+HATS~scale (Np_WB_1000) + (1|Local)	693.504	0.133	0.108
	~HFP+HATS~scale (Np_WB_1000) + I(scale(Np_WB_1000^2)) + (1|Local)	690.542	0.587	0.123
Number of patches Shrub CBM 1000	~HFP+HATS~scale (Np_SHR_1000) + (1|Local)	693.176	0.295	0.109
	~HFP+HATS~scale (Np_SHR_1000) + I(scale(Np_SHR_1000^2)) + (1|Local)	694.165	0.180	0.113
Number of patches Pastures CBM 1000	~HFP+HATS~scale (Np_PAST_1000) + (1|Local)	678.630	0.608	0.151
	~HFP+HATS~scale (Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + (1|Local)	679.515	0.391	0.154
Number of patches Agroforestry CBM 1000	~HFP+HATS~scale (Np_AGRFOR_1000) + (1|Local)	692.436	0.361	0.112
	~HFP+HATS~scale (Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + (1|Local)	693.666	0.195	0.114
Number of patches Artificial Zones CBM 1000	~HFP+HATS~scale (Np_ART_1000) + (1|Local)	692.612	0.216	0.111
	~HFP+HATS~scale (Np_ART_1000) + I(scale(Np_ART_1000^2)) + (1|Local)	690.948	0.495	0.122
Number of patches Open areas CBM 1000	~HFP+HATS~scale (Np_OPEN_1000) + (1|Local)	689.810	0.172	0.119
	~HFP+HATS~scale (Np_OPEN_1000) + I(scale(Np_OPEN_1000^2)) + (1|Local)	686.806	0.771	0.134
Percentage of Cover Agriculture CBM 1000	~HFP+HATS~scale (%_AGR_1000) + (1|Local)	694.102	0.238	0.107
	~HFP+HATS~scale (%_AGR_1000) + I(scale(%_AGR_1000^2)) + (1|Local)	696.079	0.089	0.107
Percentage of Cover Forest CBM 1000	~HFP+HATS~scale (%_FOR_1000) + (1|Local)	693.810	0.263	0.108
	~HFP+HATS~scale (%_FOR_1000) + I(scale(%_FOR_1000^2)) + (1|Local)	695.872	0.094	0.108
Percentage of Cover Bodies of water CBM 1000	~HFP+HATS~scale (%_WB_1000) + (1|Local)	691.358	0.475	0.115
	~HFP+HATS~scale (%_WB_1000) + I(scale(%_WB_1000^2)) + (1|Local)	693.257	0.184	0.115
Percentage of Cover Shrub CBM 1000	~HFP+HATS~scale (%_SHR_1000) + (1|Local)	687.393	0.669	0.126
	~HFP+HATS~scale (%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	689.241	0.265	0.127
Percentage of Cover Pastures CBM 1000	~HFP+HATS~scale (%_PAST_1000) + (1|Local)	693.073	0.139	0.110
	~HFP+HATS~scale (%_PAST_1000) + I(scale(%_PAST_1000^2)) + (1|Local)	690.071	0.625	0.124
Percentage of Cover Agroforetry CBM 1000	~HFP+HATS~scale (%_AFRFOR_1000) + (1|Local)	691.831	0.401	0.113
	~HFP+HATS~scale (%_AFRFOR_1000) + I(scale(%_AFRFOR_1000^2)) + (1|Local)	692.884	0.236	0.116
Percentage of Cover Artificial Zones CBM 1000	~HFP+HATS~scale (%_ART_1000) + (1|Local)	692.738	0.267	0.111
	~HFP+HATS~scale (%_ART_1000) + I(scale(%_ART_1000^2)) + (1|Local)	692.188	0.351	0.118
Percentage of Cover Open areas CBM 1000	~HFP+HATS~scale (%_OPEN_1000) + (1|Local)	686.011	0.262	0.130
	~HFP+HATS~scale (%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	683.977	0.725	0.142
Edge Density LBM 500	~HFP+HATS~scale (ED_500) + (1|Local)	693.847	0.260	0.107
	~HFP+HATS~scale (ED_500) + I(scale(ED_500^2)) + (1|Local)	695.951	0.091	0.107
Modified Simpson Diversity Index LBM 500	~HFP+HATS~scale (MSDI_500) + (1|Local)	694.090	0.240	0.107
	~HFP+HATS~scale (MSDI_500) + I(scale(MSDI_500^2)) + (1|Local)	696.174	0.085	0.107
Number of Patches LBM 500	~HFP+HATS~scale (NP_500) + (1|Local)	693.963	0.246	0.107
	~HFP+HATS~scale (NP_500) + I(scale(NP_500^2)) + (1|Local)	695.680	0.104	0.108
Patch Richness LBM 500	~HFP+HATS~scale (PR_500) + (1|Local)	692.2544	0.404	0.112
	~HFP+HATS~scale (PR_500) + I(scale(PR_500^2)) + (1|Local)	694.352	0.142	0.112
Edge density LBM 1000	~HFP+HATS~scale (ED_1000) + (1|Local)	694.090	0.170	0.101
	~HFP+HATS~scale (ED_1000) + I(scale(ED_1000^2)) + (1|Local)	692.634	0.352	0.117
Modified Simpson Diversity Index LBM 1000	~HFP+HATS~scale (MSDI_1000) + (1|Local)	694.103	0.176	0.107
	~HFP+HATS~scale (MSDI_1000) + I(scale(MSDI_1000^2)) + (1|Local)	692.867	0.326	0.116

Number of patches LBM 1000	~HFP+HATS~scale (NP_1000) + (1|Local)	693.224	0.288	0.109
	~HFP+HATS~scale (NP_1000) + I(scale(NP_1000^2)) + (1|Local)	694.089	0.187	0.113
Patch Richness LBM 1000	~HFP+HATS~scale (PR_1000) + (1|Local)	685.460	0.689	0.132
	~HFP+HATS~scale (PR_1000) + I(scale(PR_1000^2)) + (1|Local)	687.221	0.286	0.133

Table A10 – List of every univariate occupancy probability (*Psi*) covariable model, specific to the red fox's detection history while keeping the best previously determined detection model constant, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. The sampled hunting area ID was included as random effect to account for the biogeographic differences among sites.

Covariate	Occupancy submodel formula	AICc	AICc-weights	adj-R2
Hunting Administrative Type	~HATS+SEAS ~HAT + (1|Local)	2495.501	0.129	0.138
Season	~HATS+SEAS ~SEAS + (1|Local)	2496.489	0.083	0.136
Footprint	~HATS+SEAS ~HFP + (1|Local)	2493.799	0.235	0.132
Altitude	~HATS+SEAS ~scale (ALT) + (1|Local)	2492.711	0.327	0.135
	~HATS+SEAS ~scale (ALT) + I(scale(ALT^2)) ~HATS+SEAS ~ (1|Local)	2494.608	0.127	0.135
Number of patches Agriculture CBM 500	~HATS+SEAS ~scale (Np_AGR_500) + (1|Local)	2493.142	0.193	0.134
	~HATS+SEAS ~scale (Np_AGR_500) + I(scale(Np_AGR_500^2)) + (1|Local)	2491.642	0.408	0.142
Number of patches Forest CBM 500	~HATS+SEAS ~scale (Np_FOR_500) + (1|Local)	2493.569	0.252	0.133
	~HATS+SEAS ~scale (Np_FOR_500) + I(scale(Np_FOR_500^2)) + (1|Local)	2495.390	0.101	0.133
Number of patches Bodies of water CBM 500	~HATS+SEAS ~scale (Np_WB_500) + (1|Local)	2493.141	0.289	0.134
	~HATS+SEAS ~scale (Np_WB_500) + I(scale(Np_WB_500^2)) + (1|Local)	2495.025	0.113	0.134
Number of patches Shrub CBM 500	~HATS+SEAS ~scale (Np_SHR_500) + (1|Local)	2487.231	0.642	0.148
	~HATS+SEAS ~scale (Np_SHR_500) + I(scale(Np_SHR_500^2)) + (1|Local)	2488.833	0.288	0.149
Number of patches Pastures CBM 500	~HATS+SEAS ~scale (Np_PAST_500) + (1|Local)	2493.367	0.257	0.133
	~HATS+SEAS ~scale (Np_PAST_500) + I(scale(Np_PAST_500^2)) + (1|Local)	2494.483	0.147	0.136
Number of patches Agroforestry CBM 500	~HATS+SEAS ~scale (Np_AGRFOR_500) + (1|Local)	2490.554	0.489	0.140
	~HATS+SEAS ~scale (Np_AGRFOR_500) + I(scale(Np_AGRFOR_500^2)) + (1|Local)	2492.045	0.232	0.141
Number of patches Artificial Zones CBM 500	~HATS+SEAS ~scale (Np_ART_500) + (1|Local)	2486.737	0.688	0.149
	~HATS+SEAS ~scale (Np_ART_500) + I(scale(Np_ART_500^2)) + (1|Local)	2488.734	0.254	0.149
Number of patches Open areas CBM 500	~HATS+SEAS ~scale (Np_OPEN_500) + (1|Local)	2493.197	0.287	0.134
	~HATS+SEAS ~scale (Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + (1|Local)	2495.260	0.102	0.134
Percentage of Cover Agriculture CBM 500	~HATS+SEAS ~scale (%_AGR_500) + (1|Local)	2493.795	0.237	0.132
	~HATS+SEAS ~scale (%_AGR_500) + I(scale(%_AGR_500^2)) + (1|Local)	2495.876	0.084	0.132
Percentage of Cover Forest CBM 500	~HATS+SEAS ~scale (%_FOR_500) + (1|Local)	2492.997	0.290	0.134
	~HATS+SEAS ~scale (%_FOR_500) + I(scale(%_FOR_500^2)) + (1|Local)	2494.296	0.151	0.136
Percentage of Cover Bodies of water CBM 500	~HATS+SEAS ~scale (%_WB_500) + (1|Local)	2493.773	0.236	0.132
	~HATS+SEAS ~scale (%_WB_500) + I(scale(%_WB_500^2)) + (1|Local)	2495.658	0.092	0.133
Percentage of Cover Shrub CBM 500	~HATS+SEAS ~scale (%_SHR_500) + (1|Local)	2492.599	0.317	0.135
	~HATS+SEAS ~scale (%_SHR_500) + I(scale(%_SHR_500^2)) + (1|Local)	2493.699	0.183	0.138

Percentage of Cover Pastures CBM 500	~HATS+SEAS ~scale (%_PAST_500) + (1|Local)	2493.526	0.176	0.133
	~HATS+SEAS ~scale (%_PAST_500) + I(scale(%_PAST_500^2)) + (1|Local)	2491.980	0.382	0.142
Percentage of Cover Agroforestry CBM 500	~HATS+SEAS ~scale (%_AFRFOR_500) + (1|Local)	2493.705	0.226	0.132
	~HATS+SEAS ~scale (%_AFRFOR_500) + I(scale(%_AFRFOR_500^2)) + (1|Local)	2494.507	0.152	0.136
Percentage of Cover Artificial Zones CBM 500	~HATS+SEAS ~scale (%_ART _500) + (1|Local)	2493.006	0.197	0.134
	~HATS+SEAS ~scale (%_ART _500) + I(scale(%_ART _500^2)) + (1|Local)	2491.492	0.421	0.143
Percentage of Cover Open areas CBM 500	~HATS+SEAS ~scale (%_OPEN_500) + (1|Local)	2492.815	0.306	0.135
	~HATS+SEAS ~scale (%_OPEN_500) + I(scale(%_OPEN_500^2)) + (1|Local)	2494.182	0.155	0.136
Number of patches Agriculture CBM 1000	~HATS+SEAS ~scale (Np_AGR_1000) + (1|Local)	2491.950	0.387	0.136
	~HATS+SEAS ~scale (Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + (1|Local)	2493.590	0.171	0.138
Number of patches Forest CBM 1000	~HATS+SEAS ~scale (Np_FOR_1000) + (1|Local)	2490.954	0.484	0.139
	~HATS+SEAS ~scale (Np_FOR_1000 + I(scale(Np_FOR_1000^2)) + (1|Local)	2492.922	0.181	0.139
Number of patches Bodies of water CBM 1000	~HATS+SEAS ~scale (Np_WB_1000) + (1|Local)	2492.395	0.360	0.136
	~HATS+SEAS ~scale (Np_WB_1000) + I(scale(Np_WB_1000^2)) + (1|Local)	2949.469	0.127	0.136
Number of patches Shrub CBM 1000	~HATS+SEAS ~scale (Np_SHR_1000) + (1|Local)	2493.292	0.250	0.133
	~HATS+SEAS ~scale (Np_SHR_1000) + I(scale(Np_SHR_1000^2)) + (1|Local)	2493.833	0.191	0.137
Number of patches Pastures CBM 1000	~HATS+SEAS ~scale (Np_PAST_1000) + (1|Local)	2493.780	0.235	0.132
	~HATS+SEAS ~scale (Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + (1|Local)	2495.580	0.095	0.133
Number of patches Agroforestry CBM 1000	~HATS+SEAS ~scale (Np_AGRFOR_1000) + (1|Local)	2493.767	0.204	0.132
	~HATS+SEAS ~scale (Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + (1|Local)	2493.628	0.219	0.138
Number of patches Artificial Zones CBM 1000	~HATS+SEAS ~scale (Np_ART_1000) + (1|Local)	2490.403	0.518	0.140
	~HATS+SEAS ~scale (Np_ART_1000) + I(scale(Np_ART_1000^2)) + (1|Local)	2492.213	0.209	0.141
Number of patches Open areas CBM 1000	~HATS+SEAS ~scale (Np_OPEN_1000) + (1|Local)	2492.040	0.393	0.136
	~HATS+SEAS ~scale (Np_OPEN_1000) + I(scale(Np_OPEN_1000^2)) + (1|Local)	2494.125	0.138	0.137
Percentage of Cover Agriculture CBM 1000	~HATS+SEAS ~scale (%_AGR_1000) + (1|Local)	2493.680	0.246	0.132
	~HATS+SEAS ~scale (%_AGR_1000) + I(scale(%_AGR_1000^2)) + (1|Local)	2495.732	0.088	0.133
Percentage of Cover Forest CBM 1000	~HATS+SEAS ~scale (%_FOR_1000) + (1|Local)	2492.933	0.294	0.134
	~HATS+SEAS ~scale (%_FOR_1000) + I(scale(%_FOR_1000^2)) + (1|Local)	2494.180	0.157	0.136
Percentage of Cover Bodies of water CBM 1000	~HATS+SEAS ~scale (%_WB_1000) + (1|Local)	2492.105	0.368	0.136
	~HATS+SEAS ~scale (%_WB_1000) + I(scale(%_WB_1000^2)) + (1|Local)	2493.553	0.178	0.138
Percentage of Cover Shrub CBM 1000	~HATS+SEAS ~scale (%_SHR_1000) + (1|Local)	2492.574	0.312	0.135
	~HATS+SEAS ~scale (%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	2493.449	0.201	0.138
Percentage of Cover Pastures CBM 1000	~HATS+SEAS ~scale (%_PAST_1000) + (1|Local)	2492.786	0.324	0.135
	~HATS+SEAS ~scale (%_PAST_1000) + I(scale(%_PAST_1000^2)) + (1|Local)	2494.898	0.113	0.135

Percentage of Cover Agroforetry CBM 1000	~HATS+SEAS ~scale (%_AFRFOR_1000) + (1|Local)	2493.584	0.231	0.133
	~HATS+SEAS ~scale (%_AFRFOR_1000) + I(scale(%_AFRFOR_1000^2)) + (1|Local)	2494.158	0.173	0.136
Percentage of Cover Artificial Zones CBM 1000	~HATS+SEAS ~scale (%_ART_1000) + (1|Local)	2492.588	0.294	0.135
	~HATS+SEAS ~scale (%_ART_1000) + I(scale(%_ART_1000^2)) + (1|Local)	2492.961	0.244	0.139
Percentage of Cover Open areas CBM 1000	~HATS+SEAS ~scale (%_OPEN_1000) + (1|Local)	2492.437	0.146	0.135
	~HATS+SEAS ~scale (%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	2489.467	0.642	0.148
Edge Density LBM 500	~HATS+SEAS ~scale (ED_500) + (1|Local)	2491.521	0.438	0.138
	~HATS+SEAS ~scale (ED_500) + I(scale(ED_500^2)) + (1|Local)	2493.553	0.159	0.138
Modified Simpson Diversity Index LBM 500	~HATS+SEAS ~scale (MSDI_500) + (1|Local)	2492.639	0.336	0.135
	~HATS+SEAS ~scale (MSDI_500) + I(scale(MSDI_500^2)) + (1|Local)	2494.672	0.122	0.135
Number of Patches LBM 500	~HATS+SEAS ~scale (NP_500) + (1|Local)	2490.191	0.496	0.141
	~HATS+SEAS ~scale (NP_500) + I(scale(NP_500^2)) + (1|Local)	2491.416	0.269	0.143
Patch Richness LBM 500	~HATS+SEAS ~scale (PR_500) + (1|Local)	2491.777	0.418	0.137
	~HATS+SEAS ~scale (PR_500) + I(scale(PR_500^2)) + (1|Local)	2493.903	0.144	0.137
Edge density LBM 1000	~HATS+SEAS ~scale (ED_1000) + (1|Local)	2491.183	0.441	0.138
	~HATS+SEAS ~scale (ED_1000) + I(scale(ED_1000^2)) + (1|Local)	2492.604	0.216	0.140
Modified Simpson Diversity Index LBM 1000	~HATS+SEAS ~scale (MSDI_1000) + (1|Local)	2492.647	0.333	0.135
	~HATS+SEAS ~scale (MSDI_1000) + I(scale(MSDI_1000^2)) + (1|Local)	2494.542	0.129	0.136
Number of patches LBM 1000	~HATS+SEAS ~scale (NP_1000) + (1|Local)	2490.444	0.456	0.140
	~HATS+SEAS ~scale (NP_1000) + I(scale(NP_1000^2)) + (1|Local)	2491.290	0.299	0.143
Patch Richness LBM 1000	~HATS+SEAS ~scale (PR_1000) + (1|Local)	2493.060	0.300	0.134
	~HATS+SEAS ~scale (PR_1000) + I(scale(PR_1000^2)) + (1|Local)	2495.187	0.104	0.134
European rabbit occupancy	~HATS+SEAS ~scale (RAB)	2493.322	0.306	0.133
Granada hare occupancy	~HATS+SEAS ~scale (HAR)	2493.344	0.304	0.133

Table A11 - List of every univariate occupancy probability (*Psi*) covariable model, specific to the European badger's detection history while keeping the best previously determined detection model constant, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. The sampled hunting area ID was included as random effect to account for the biogeographic differences among sites.

Covariate	Occupancy submodel formula	AICc	AICc-weights	adj-R2
Hunting Administrative Type	~HFP+SEAS~HAT + (1|Local)	881.360	0.19	0.155
Season	~HFP+SEAS~SEAS + (1|Local)	883.457	0.076	0.149
Footprint	~HFP+SEAS~HFP + (1|Local)	880.349	0.239	0.147
Altitude	~HFP+SEAS~scale (ALT) + (1|Local)	871.498	0.724	0.169
	~HFP+SEAS~scale (ALT) + I(scale(ALT^2)) ~HFP+SEAS~ (1|Local)	873.596	0.254	0.169
Number of patches Agriculture CBM 500	~HFP+SEAS~scale (Np_AGR_500) + (1|Local)	878.219	0.442	0.152
	~HFP+SEAS~scale (Np_AGR_500) + I(scale(Np_AGR_500^2)) + (1|Local)	880.187	0.165	0.152
Number of patches Forest CBM 500	~HFP+SEAS~scale (Np_FOR_500) + (1|Local)	880.530	0.239	0.146
	~HFP+SEAS~scale (Np_FOR_500) + I(scale(Np_FOR_500^2)) + (1|Local)	882.583	0.086	0.146
Number of patches Bodies of water CBM 500	~HFP+SEAS~scale (Np_WB_500) + (1|Local)	880.219	0.230	0.147
	~HFP+SEAS~scale (Np_WB_500) + I(scale(Np_WB_500^2)) + (1|Local)	880.343	0.216	0.152
Number of patches Shrub CBM 500	~HFP+SEAS~scale (Np_SHR_500) + (1|Local)	878.714	0.402	0.151
	~HFP+SEAS~scale (Np_SHR_500) + I(scale(Np_SHR_500^2)) + (1|Local)	880.811	0.141	0.151
Number of patches Pastures CBM 500	~HFP+SEAS~scale (Np_PAST_500) + (1|Local)	880.548	0.234	0.146
	~HFP+SEAS~scale (Np_PAST_500) + I(scale(Np_PAST_500^2)) + (1|Local)	882.234	0.101	0.147
Number of patches Agroforestry CBM 500	~HFP+SEAS~scale (Np_AGRFOR_500) + (1|Local)	880.499	0.241	0.146
	~HFP+SEAS~scale (Np_AGRFOR_500) + I(scale(Np_AGRFOR_500^2)) + (1|Local)	882.457	0.090	0.147
Number of patches Artificial Zones CBM 500	~HFP+SEAS~scale (Np_ART_500) + (1|Local)	878.716	0.399	0.151
	~HFP+SEAS~scale (Np_ART_500) + I(scale(Np_ART_500^2)) + (1|Local)	880.723	0.146	0.151
Number of patches Open areas CBM 500	~HFP+SEAS~scale (Np_OPEN_500) + (1|Local)	880.186	0.229	0.147
	~HFP+SEAS~scale (Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + (1|Local)	880.196	0.228	0.152
Percentage of Cover Agriculture CBM 500	~HFP+SEAS~scale (%_AGR_500) + (1|Local)	879.926	1.47	0.148
	~HFP+SEAS~scale (%_AGR_500) + I(scale(%_AGR_500^2)) + (1|Local)	881.453	3.00	0.149
Percentage of Cover Forest CBM 500	~HFP+SEAS~scale (%_FOR_500) + (1|Local)	879.981	0.258	0.148
	~HFP+SEAS~scale (%_FOR_500) + I(scale(%_FOR_500^2)) + (1|Local)	880.618	0.188	0.151
Percentage of Cover Bodies of water CBM 500	~HFP+SEAS~scale (%_WB_500) + (1|Local)	879.996	0.264	0.147
	~HFP+SEAS~scale (%_WB_500) + I(scale(%_WB_500^2)) + (1|Local)	880.927	0.166	0.151
Percentage of Cover Shrub CBM 500	~HFP+SEAS~scale (%_SHR_500) + (1|Local)	873.935	0.675	0.163
	~HFP+SEAS~scale (%_SHR_500) + I(scale(%_SHR_500^2)) + (1|Local)	875.852	0.258	0.164

Percentage of Cover Pastures CBM 500	~HFP+SEAS~scale (%_PAST_500) + (1|Local)	878.207	0.370	0.152
	~HFP+SEAS~scale (%_PAST_500) + I(scale(%_PAST_500^2)) + (1|Local)	878.611	0.303	0.156
Percentage of Cover Agroforestry CBM 500	~HFP+SEAS~scale (%_AFRFOR_500) + (1|Local)	875.281	0.604	0.160
	~HFP+SEAS~scale (%_AFRFOR_500) + I(scale(%_AFRFOR_500^2)) + (1|Local)	876.871	0.273	0.161
Percentage of Cover Artificial Zones CBM 500	~HFP+SEAS~scale (%_ART _500) + (1|Local)	880.316	0.242	0.147
	~HFP+SEAS~scale (%_ART _500) + I(scale(%_ART _500^2)) + (1|Local)	881.351	0.144	0.149
Percentage of Cover Open areas CBM 500	~HFP+SEAS~scale (%_OPEN_500) + (1|Local)	880.503	0.242	0.146
	~HFP+SEAS~scale (%_OPEN_500) + I(scale(%_OPEN_500^2)) + (1|Local)	882.606	0.085	0.146
Number of patches Agriculture CBM 1000	~HFP+SEAS~scale (Np_AGR_1000) + (1|Local)	877.328	0.474	0.154
	~HFP+SEAS~scale (Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + (1|Local)	878.56	0.256	0.157
Number of patches Forest CBM 1000	~HFP+SEAS~scale (Np_FOR_1000) + (1|Local)	879.410	0.190	0.149
	~HFP+SEAS~scale (Np_FOR_1000 + I(scale(Np_FOR_1000^2)) + (1|Local)	877.460	0.504	0.159
Number of patches Bodies of water CBM 1000	~HFP+SEAS~scale (Np_WB_1000) + (1|Local)	880.545	0.239	0.146
	~HFP+SEAS~scale (Np_WB_1000) + I(scale(Np_WB_1000^2)) + (1|Local)	882.648	0.083	0.146
Number of patches Shrub CBM 1000	~HFP+SEAS~scale (Np_SHR_1000) + (1|Local)	879.504	0.308	0.149
	~HFP+SEAS~scale (Np_SHR_1000) + I(scale(Np_SHR_1000^2)) + (1|Local)	880.682	0.171	0.151
Number of patches Pastures CBM 1000	~HFP+SEAS~scale (Np_PAST_1000) + (1|Local)	879.960	0.235	0.148
	~HFP+SEAS~scale (Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + (1|Local)	879.702	0.267	0.154
Number of patches Agroforestry CBM 1000	~HFP+SEAS~scale (Np_AGRFOR_1000) + (1|Local)	880.141	0.272	0.147
	~HFP+SEAS~scale (Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + (1|Local)	882.207	0.097	0.147
Number of patches Artificial Zones CBM 1000	~HFP+SEAS~scale (Np_ART_1000) + (1|Local)	879.109	0.338	0.150
	~HFP+SEAS~scale (Np_ART_1000) + I(scale(Np_ART_1000^2)) + (1|Local)	880.210	0.195	0.152
Number of patches Open areas CBM 1000	~HFP+SEAS~scale (Np_OPEN_1000) + (1|Local)	880.548	0.224	0.146
	~HFP+SEAS~scale (Np_OPEN_1000) + I(scale(Np_OPEN_1000^2)) + (1|Local)	881.515	0.138	0.149
Percentage of Cover Agriculture CBM 1000	~HFP+SEAS~scale (%_AGR_1000) + (1|Local)	879.534	0.323	0.149
	~HFP+SEAS~scale (%_AGR_1000) + I(scale(%_AGR_1000^2)) + (1|Local)	881.478	0.122	0.149
Percentage of Cover Forest CBM 1000	~HFP+SEAS~scale (%_FOR_1000) + (1|Local)	877.783	0.397	0.153
	~HFP+SEAS~scale (%_FOR_1000) + I(scale(%_FOR_1000^2)) + (1|Local)	878.218	0.319	0.157
Percentage of Cover Bodies of water CBM 1000	~HFP+SEAS~scale (%_WB_1000) + (1|Local)	880.100	0.194	0.147
	~HFP+SEAS~scale (%_WB_1000) + I(scale(%_WB_1000^2)) + (1|Local)	878.836	0.365	0.156
Percentage of Cover Shrub CBM 1000	~HFP+SEAS~scale (%_SHR_1000) + (1|Local)	871.379	0.696	0.170
	~HFP+SEAS~scale (%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	873.177	0.283	0.170
Percentage of Cover Pastures CBM 1000	~HFP+SEAS~scale (%_PAST_1000) + (1|Local)	879.287	0.349	0.149
	~HFP+SEAS~scale (%_PAST_1000) + I(scale(%_PAST_1000^2)) + (1|Local)	881.378	0.123	0.149

Percentage of Cover Agroforetry CBM 1000	~HFP+SEAS~scale (%_AFRFOR_1000) + (1|Local)	875.817	0.599	0.158
	~HFP+SEAS~scale (%_AFRFOR_1000) + I(scale(%_AFRFOR_1000^2)) + (1|Local)	877.643	0.241	0.159
Percentage of Cover Artificial Zones CBM 1000	~HFP+SEAS~scale (%_ART_1000) + (1|Local)	880.422	0.249	0.146
	~HFP+SEAS~scale (%_ART_1000) + I(scale(%_ART_1000^2)) + (1|Local)	882.519	0.087	0.146
Percentage of Cover Open areas CBM 1000	~HFP+SEAS~scale (%_OPEN_1000) + (1|Local)	880.222	0.261	0.147
	~HFP+SEAS~scale (%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	882.001	0.107	0.148
Edge Density LBM 500	~HFP+SEAS~scale (ED_500) + (1|Local)	880.548	0.237	0.146
	~HFP+SEAS~scale (ED_500) + I(scale(ED_500^2)) + (1|Local)	882.544	0.087	0.146
Modified Simpson Diversity Index LBM 500	~HFP+SEAS~scale (MSDI_500) + (1|Local)	880.144	0.269	0.147
	~HFP+SEAS~scale (MSDI_500) + I(scale(MSDI_500^2)) + (1|Local)	882.014	0.106	0.148
Number of Patches LBM 500	~HFP+SEAS~scale (NP_500) + (1|Local)	880.033	0.271	0.147
	~HFP+SEAS~scale (NP_500) + I(scale(NP_500^2)) + (1|Local)	881.486	0.131	0.149
Patch Richness LBM 500	~HFP+SEAS~scale (PR_500) + (1|Local)	880.492	0.219	0.146
	~HFP+SEAS~scale (PR_500) + I(scale(PR_500^2)) + (1|Local)	880.939	0.175	0.150
Edge density LBM 1000	~HFP+SEAS~scale (ED_1000) + (1|Local)	880.531	0.234	0.146
	~HFP+SEAS~scale (ED_1000) + I(scale(ED_1000^2)) + (1|Local)	882.149	0.104	0.147
Modified Simpson Diversity Index LBM 1000	~HFP+SEAS~scale (MSDI_1000) + (1|Local)	880.533	0.240	0.146
	~HFP+SEAS~scale (MSDI_1000) + I(scale(MSDI_1000^2)) + (1|Local)	882.631	0.084	0.146
Number of patches LBM 1000	~HFP+SEAS~scale (NP_1000) + (1|Local)	880.013	0.263	0.147
	~HFP+SEAS~scale (NP_1000) + I(scale(NP_1000^2)) + (1|Local)	880.959	0.164	0.150
Patch Richness LBM 1000	~HFP+SEAS~scale (PR_1000) + (1|Local)	878.960	0.349	0.150
	~HFP+SEAS~scale (PR_1000) + I(scale(PR_1000^2)) + (1|Local)	880.041	0.203	0.153
European rabbit occupancy	~HFP+SEAS~scale (RAB)	879.0853	0.422	0.150
Granada hare occupancy	~HFP+SEAS~scale (HAR)	879.076	0.423	0.150

Table A12 – List of every univariate occupancy probability (*Psi*) covariable model, specific to the beech marten's detection history while keeping the best previously determined detection model constant, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. The sampled hunting area ID was included as random effect to account for the biogeographic differences among sites.

<table>
<tr><th>Covariate</th><th>Occupancy submodel formula</th><th>AICc</th><th>AICc-weights</th><th>adj-R2</th></tr>
<tr><td>Hunting Administrative Type</td><td>~HFP+SEAS~HAT + (1|Local)</td><td>925.978</td><td>0.094</td><td>0.209</td></tr>
<tr><td>Season</td><td>~HFP+SEAS~SEAS + (1|Local)</td><td>920.002</td><td>0.672</td><td>0.223</td></tr>
<tr><td>Footprint</td><td>~HFP+SEAS~HFP + (1|Local)</td><td>923.102</td><td>0.273</td><td>0.206</td></tr>
<tr><td rowspan="2">Altitude</td><td>~HFP+SEAS~scale (ALT) + (1|Local)</td><td>923.345</td><td>0.089</td><td>0.205</td></tr>
<tr><td>~HFP+SEAS~scale (ALT) + I(scale(ALT^2)) ~HFP+SEAS~ (1|Local)</td><td>919.279</td><td>0.680</td><td>0.220</td></tr>
<tr><td rowspan="2">Number of patches Agriculture CBM 500</td><td>~HFP+SEAS~scale (Np_AGR_500) + (1|Local)</td><td>923.202</td><td>0.140</td><td>0.205</td></tr>
<tr><td>~HFP+SEAS~scale (Np_AGR_500) + I(scale(Np_AGR_500^2)) + (1|Local)</td><td>920.571</td><td>0.522</td><td>0.217</td></tr>
<tr><td rowspan="2">Number of patches Forest CBM 500</td><td>~HFP+SEAS~scale (Np_FOR_500) + (1|Local)</td><td>923.105</td><td>0.273</td><td>0.206</td></tr>
<tr><td>~HFP+SEAS~scale (Np_FOR_500) + I(scale(Np_FOR_500^2)) + (1|Local)</td><td>925.115</td><td>0.100</td><td>0.206</td></tr>
<tr><td rowspan="2">Number of patches Bodies of water CBM 500</td><td>~HFP+SEAS~scale (Np_WB_500) + (1|Local)</td><td>922.412</td><td>0.324</td><td>0.207</td></tr>
<tr><td>~HFP+SEAS~scale (Np_WB_500) + I(scale(Np_WB_500^2)) + (1|Local)</td><td>923.962</td><td>0.149</td><td>0.209</td></tr>
<tr><td rowspan="2">Number of patches Shrub CBM 500</td><td>~HFP+SEAS~scale (Np_SHR_500) + (1|Local)</td><td>923.105</td><td>0.246</td><td>0.206</td></tr>
<tr><td>~HFP+SEAS~scale (Np_SHR_500) + I(scale(Np_SHR_500^2)) + (1|Local)</td><td>923.640</td><td>0.188</td><td>0.209</td></tr>
<tr><td rowspan="2">Number of patches Pastures CBM 500</td><td>~HFP+SEAS~scale (Np_PAST_500) + (1|Local)</td><td>922.438</td><td>0.160</td><td>0.207</td></tr>
<tr><td>~HFP+SEAS~scale (Np_PAST_500) + I(scale(Np_PAST_500^2)) + (1|Local)</td><td>919.873</td><td>0.576</td><td>0.218</td></tr>
<tr><td rowspan="2">Number of patches Agroforestry CBM 500</td><td>~HFP+SEAS~scale (Np_AGRFOR_500) + (1|Local)</td><td>923.522</td><td>0.222</td><td>0.205</td></tr>
<tr><td>~HFP+SEAS~scale (Np_AGRFOR_500) + I(scale(Np_AGRFOR_500^2)) + (1|Local)</td><td>924.318</td><td>0.149</td><td>0.208</td></tr>
<tr><td rowspan="2">Number of patches Artificial Zones CBM 500</td><td>~HFP+SEAS~scale (Np_ART_500) + (1|Local)</td><td>921.879</td><td>0.360</td><td>0.209</td></tr>
<tr><td>~HFP+SEAS~scale (Np_ART_500) + I(scale(Np_ART_500^2)) + (1|Local)</td><td>923.158</td><td>0.190</td><td>0.211</td></tr>
<tr><td rowspan="2">Number of patches Open areas CBM 500</td><td>~HFP+SEAS~scale (Np_OPEN_500) + (1|Local)</td><td>917.856</td><td>0.654</td><td>0.218</td></tr>
<tr><td>~HFP+SEAS~scale (Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + (1|Local)</td><td>919.893</td><td>0.236</td><td>0.218</td></tr>
<tr><td rowspan="2">Percentage of Cover Agriculture CBM 500</td><td>~HFP+SEAS~scale (%_AGR_500) + (1|Local)</td><td>923.119</td><td>0.268</td><td>0.206</td></tr>
<tr><td>~HFP+SEAS~scale (%_AGR_500) + I(scale(%_AGR_500^2)) + (1|Local)</td><td>924.897</td><td>0.110</td><td>0.206</td></tr>
<tr><td rowspan="2">Percentage of Cover Forest CBM 500</td><td>~HFP+SEAS~scale (%_FOR_500) + (1|Local)</td><td>915.156</td><td>0.705</td><td>0.224</td></tr>
<tr><td>~HFP+SEAS~scale (%_FOR_500) + I(scale(%_FOR_500^2)) + (1|Local)</td><td>917.120</td><td>0.264</td><td>0.225</td></tr>
<tr><td rowspan="2">Percentage of Cover Bodies of water CBM 500</td><td>~HFP+SEAS~scale (%_WB_500) + (1|Local)</td><td>922.693</td><td>0.053</td><td>0.207</td></tr>
<tr><td>~HFP+SEAS~scale (%_WB_500) + I(scale(%_WB_500^2)) + (1|Local)</td><td>917.152</td><td>0.847</td><td>0.225</td></tr>
<tr><td rowspan="2">Percentage of Cover Shrub CBM 500</td><td>~HFP+SEAS~scale (%_SHR_500) + (1|Local)</td><td>920.507</td><td>0.498</td><td>0.212</td></tr>
<tr><td>~HFP+SEAS~scale (%_SHR_500) + I(scale(%_SHR_500^2)) + (1|Local)</td><td>922.434</td><td>0.190</td><td>0.212</td></tr>
</table>

Percentage of Cover Pastures CBM 500	~HFP+SEAS~scale (%_PAST_500) + (1|Local)	921.709	0.345	0.209
	~HFP+SEAS~scale (%_PAST_500) + I(scale(%_PAST_500^2)) + (1|Local)	922.284	0.259	0.213
Percentage of Cover Agroforestry CBM 500	~HFP+SEAS~scale (%_AFRFOR_500) + (1|Local)	922.153	0.355	0.208
	~HFP+SEAS~scale (%_AFRFOR_500) + I(scale(%_AFRFOR_500^2)) + (1|Local)	924.041	0.138	0.208
Percentage of Cover Artificial Zones CBM 500	~HFP+SEAS~scale (%_ART _500) + (1|Local)	921.837	0.366	0.209
	~HFP+SEAS~scale (%_ART _500) + I(scale(%_ART _500^2)) + (1|Local)	923.193	0.186	0.210
Percentage of Cover Open areas CBM 500	~HFP+SEAS~scale (%_OPEN_500) + (1|Local)	915.102	0.72	0.225
	~HFP+SEAS~scale (%_OPEN_500) + I(scale(%_OPEN_500^2)) + (1|Local)	917.221	0.25	0.224
Number of patches Agriculture CBM 1000	~HFP+SEAS~scale (Np_AGR_1000) + (1|Local)	923.352	0.249	0.205
	~HFP+SEAS~scale (Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + (1|Local)	925.095	0.104	0.206
Number of patches Forest CBM 1000	~HFP+SEAS~scale (Np_FOR_1000) + (1|Local)	923.211	0.261	0.205
	~HFP+SEAS~scale (Np_FOR_1000 + I(scale(Np_FOR_1000^2)) + (1|Local)	925.050	0.104	0.206
Number of patches Bodies of water CBM 1000	~HFP+SEAS~scale (Np_WB_1000) + (1|Local)	923.525	0.217	0.205
	~HFP+SEAS~scale (Np_WB_1000) + I(scale(Np_WB_1000^2)) + (1|Local)	924.036	0.168	0.208
Number of patches Shrub CBM 1000	~HFP+SEAS~scale (Np_SHR_1000) + (1|Local)	917.785	0.660	0.218
	~HFP+SEAS~scale (Np_SHR_1000) + I(scale(Np_SHR_1000^2)) + (1|Local)	919.862	0.234	0.218
Number of patches Pastures CBM 1000	~HFP+SEAS~scale (Np_PAST_1000) + (1|Local)	923.225	0.258	0.205
	~HFP+SEAS~scale (Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + (1|Local)	924.892	0.112	0.206
Number of patches Agroforestry CBM 1000	~HFP+SEAS~scale (Np_AGRFOR_1000) + (1|Local)	921.56	0.310	0.209
	~HFP+SEAS~scale (Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + (1|Local)	921.71	0.335	0.214
Number of patches Artificial Zones CBM 1000	~HFP+SEAS~scale (Np_ART_1000) + (1|Local)	923.331	0.241	0.205
	~HFP+SEAS~scale (Np_ART_1000) + I(scale(Np_ART_1000^2)) + (1|Local)	924.451	0.138	0.207
Number of patches Open areas CBM 1000	~HFP+SEAS~scale (Np_OPEN_1000) + (1|Local)	918.308	0.613	0.217
	~HFP+SEAS~scale (Np_OPEN_1000) + I(scale(Np_OPEN_1000^2)) + (1|Local)	920.037	0.258	0.218
Percentage of Cover Agriculture CBM 1000	~HFP+SEAS~scale (%_AGR_1000) + (1|Local)	921.766	0.394	0.209
	~HFP+SEAS~scale (%_AGR_1000) + I(scale(%_AGR_1000^2)) + (1|Local)	923.808	0.142	0.209
Percentage of Cover Forest CBM 1000	~HFP+SEAS~scale (%_FOR_1000) + (1|Local)	911.488	0.691	0.233
	~HFP+SEAS~scale (%_FOR_1000) + I(scale(%_FOR_1000^2)) + (1|Local)	913.132	0.304	0.234
Percentage of Cover Bodies of water CBM 1000	~HFP+SEAS~scale (%_WB_1000) + (1|Local)	923.484	0.193	0.205
	~HFP+SEAS~scale (%_WB_1000) + I(scale(%_WB_1000^2)) + (1|Local)	922.810	0.270	0.211
Percentage of Cover Shrub CBM 1000	~HFP+SEAS~scale (%_SHR_1000) + (1|Local)	918.522	0.381	0.216
	~HFP+SEAS~scale (%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	917.859	0.530	0.223
Percentage of Cover Pastures CBM 1000	~HFP+SEAS~scale (%_PAST_1000) + (1|Local)	919.372	0.569	0.214
	~HFP+SEAS~scale (%_PAST_1000) + I(scale(%_PAST_1000^2)) + (1|Local)	921.204	0.228	0.215

Percentage of Cover Agroforetry CBM 1000	**~HFP+SEAS~scale (%_AFRFOR_1000) + (1|Local)**	922.810	0.298	0.206
	~HFP+SEAS~scale (%_AFRFOR_1000) + I(scale(%_AFRFOR_1000^2)) + (1|Local)	924.823	0.109	0.207
Percentage of Cover Artificial Zones CBM 1000	**~HFP+SEAS~scale (%_ART_1000) + (1|Local)**	921.960	0.353	0.208
	~HFP+SEAS~scale (%_ART_1000) + I(scale(%_ART_1000^2)) + (1|Local)	923.223	0.188	0.210
Percentage of Cover Open areas CBM 1000	**~HFP+SEAS~scale (%_OPEN_1000) + (1|Local)**	917.689	0.653	0.218
	~HFP+SEAS~scale (%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	919.636	0.247	0.219
Edge Density LBM 500	**~HFP+SEAS~scale (ED_500) + (1|Local)**	923.465	0.209	0.205
	~HFP+SEAS~scale (ED_500) + I(scale(ED_500^2)) + (1|Local)	923.393	0.216	0.210
Modified Simpson Diversity Index LBM 500	**~HFP+SEAS~scale (MSDI_500) + (1|Local)**	922.635	0.311	0.207
	~HFP+SEAS~scale (MSDI_500) + I(scale(MSDI_500^2)) + (1|Local)	924.505	0.122	0.207
Number of Patches LBM 500	**~HFP+SEAS~scale (NP_500) + (1|Local)**	922.762	0.300	0.206
	~HFP+SEAS~scale (NP_500) + I(scale(NP_500^2)) + (1|Local)	924.629	0.118	0.207
Patch Richness LBM 500	**~HFP+SEAS~scale (PR_500) + (1|Local)**	922.805	0.271	0.206
	~HFP+SEAS~scale (PR_500) + I(scale(PR_500^2)) + (1|Local)	923.504	0.191	0.210
Edge density LBM 1000	**~HFP+SEAS~scale (ED_1000) + (1|Local)**	921.437	0.233	0.205
	~HFP+SEAS~scale (ED_1000) + I(scale(ED_1000^2)) + (1|Local)	924.917	0.115	0.206
Modified Simpson Diversity Index LBM 1000	**~HFP+SEAS~scale (MSDI_1000) + (1|Local)**	922.718	0.307	0.207
	~HFP+SEAS~scale (MSDI_1000) + I(scale(MSDI_1000^2)) + (1|Local)	924.763	0.110	0.207
Number of patches LBM 1000	**~HFP+SEAS~scale (NP_1000) + (1|Local)**	923.292	0.252	0.205
	~HFP+SEAS~scale (NP_1000) + I(scale(NP_1000^2)) + (1|Local)	924.968	0.109	0.206
Patch Richness LBM 1000	**~HFP+SEAS~scale (PR_1000) + (1|Local)**	923.438	0.245	0.205
	~HFP+SEAS~scale (PR_1000) + I(scale(PR_1000^2)) + (1|Local)	925.495	0.088	0.205
European rabbit occupancy	**~HFP+SEAS~scale (RAB)**	921.400	0.505	0.210
Granada hare occupancy	**~HFP+SEAS~scale (HAR)**	923.524	0.26	0.205

Table A13 – List of every univariate occupancy probability (*Psi*) covariable model, specific to the Egyptian mongoose's detection history while keeping the best previously determined detection model constant, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. The sampled hunting area ID was included as random effect to account for the biogeographic differences among sites.

Covariate	Occupancy submodel formula	AICc	AICc-weights	adj-R2
Hunting Administrative Type	~1~HAT + (1|Local)	571.657	0.181	0.111
Season	~1~SEAS + (1|Local)	570.537	0.279	0.114
Footprint	~1~HFP + (1|Local)	570.597	0.413	0.101
Altitude	~1~scale (ALT) + (1|Local)	576.092	0.550	0.112
	~1~scale (ALT) + I(scale(ALT^2)) ~1~ (1|Local)	569.148	0.197	0.112
Number of patches Agriculture CBM 500	~1~scale (Np_AGR_500) + (1|Local)	570.581	0.157	0.101
	~1~scale (Np_AGR_500) + I(scale(Np_AGR_500^2)) + (1|Local)	568.578	0.428	0.114
Number of patches Forest CBM 500	~1~scale (Np_FOR_500) + (1|Local)	569.563	0.234	0.104
	~1~scale (Np_FOR_500) + I(scale(Np_FOR_500^2)) + (1|Local)	568.507	0.396	0.114
Number of patches Bodies of water CBM 500	~1~scale (Np_WB_500) + (1|Local)	570.177	0.260	0.102
	~1~scale (Np_WB_500) + I(scale(Np_WB_500^2)) + (1|Local)	570.900	0.181	0.106
Number of patches Shrub CBM 500	~1~scale (Np_SHR_500) + (1|Local)	570.201	0.272	0.102
	~1~scale (Np_SHR_500) + I(scale(Np_SHR_500^2)) + (1|Local)	571.620	0.134	0.104
Number of patches Pastures CBM 500	~1~scale (Np_PAST_500) + (1|Local)	569.482	0.328	0.104
	~1~scale (Np_PAST_500) + I(scale(Np_PAST_500^2)) + (1|Local)	570.784	0.171	0.107
Number of patches Agroforestry CBM 500	~1~scale (Np_AGRFOR_500) + (1|Local)	5664.562	0.671	0.120
	~1~scale (Np_AGRFOR_500) + I(scale(Np_AGRFOR_500^2)) + (1|Local)	566.604	0.242	0.120
Number of patches Artificial Zones CBM 500	~1~scale (Np_ART_500) + (1|Local)	570.547	0.249	0.101
	~1~scale (Np_ART_500) + I(scale(Np_ART_500^2)) + (1|Local)	572.282	0.105	0.102
Number of patches Open areas CBM 500	~1~scale (Np_OPEN_500) + (1|Local)	570.263	0.241	0.102
	~1~scale (Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + (1|Local)	570.480	0.216	0.108
Percentage of Cover Agriculture CBM 500	~1~scale (%_AGR_500) + (1|Local)	570.682	0.042	0.101
	~1~scale (%_AGR_500) + I(scale(%_AGR_500^2)) + (1|Local)	564.707	0.840	0.126
Percentage of Cover Forest CBM 500	~1~scale (%_FOR_500) + (1|Local)	570.593	0.248	0.101
	~1~scale (%_FOR_500) + I(scale(%_FOR_500^2)) + (1|Local)	572.557	0.093	0.101
Percentage of Cover Bodies of water CBM 500	~1~scale (%_WB_500) + (1|Local)	568.055	0.471	0.109
	~1~scale (%_WB_500) + I(scale(%_WB_500^2)) + (1|Local)	570.104	0.177	0.109
Percentage of Cover Shrub CBM 500	~1~scale (%_SHR_500) + (1|Local)	570.352	0.266	0.102
	~1~scale (%_SHR_500) + I(scale(%_SHR_500^2)) + (1|Local)	572.136	0.109	0.103

Percentage of Cover Pastures CBM 500	~1~scale (%_PAST_500) + (1|Local)	570.303	0.114	0.102
	~1~scale (%_PAST_500) + I(scale(%_PAST_500^2)) + (1|Local)	566.915	0.623	0.119
Percentage of Cover Agroforestry CBM 500	~1~scale (%_AFRFOR_500) + (1|Local)	567.375	0.427	0.111
	~1~scale (%_AFRFOR_500) + I(scale(%_AFRFOR_500^2)) + (1|Local)	567.796	0.346	0.116
Percentage of Cover Artificial Zones CBM 500	~1~scale (%_ART _500) + (1|Local)	570.269	0.275	0.102
	~1~scale (%_ART _500) + I(scale(%_ART _500^2)) + (1|Local)	572.218	0.104	0.102
Percentage of Cover Open areas CBM 500	~1~scale (%_OPEN_500) + (1|Local)	570.669	0.243	0.101
	~1~scale (%_OPEN_500) + I(scale(%_OPEN_500^2)) + (1|Local)	572.709	0.088	0.101
Number of patches Agriculture CBM 1000	~1~scale (Np_AGR_1000) + (1|Local)	570.643	0.238	0.101
	~1~scale (Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + (1|Local)	572.088	0.115	0.103
Number of patches Forest CBM 1000	~1~scale (Np_FOR_1000) + (1|Local)	570.506	0.251	0.101
	~1~scale (Np_FOR_1000 + I(scale(Np_FOR_1000^2)) + (1|Local)	572.107	0.113	0.103
Number of patches Bodies of water CBM 1000	~1~scale (Np_WB_1000) + (1|Local)	570.675	0.242	0.101
	~1~scale (Np_WB_1000) + I(scale(Np_WB_1000^2)) + (1|Local)	572.663	0.090	0.101
Number of patches Shrub CBM 1000	~1~scale (Np_SHR_1000) + (1|Local)	568.918	0.221	0.106
	~1~scale (Np_SHR_1000) + I(scale(Np_SHR_1000^2)) + (1|Local)	567.181	0.526	0.118
Number of patches Pastures CBM 1000	~1~scale (Np_PAST_1000) + (1|Local)	565.386	0.642	0.117
	~1~scale (Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + (1|Local)	567.422	0.232	0.117
Number of patches Agroforestry CBM 1000	~1~scale (Np_AGRFOR_1000) + (1|Local)	564.535	0.359	0.120
	~1~scale (Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + (1|Local)	563.528	0.595	0.129
Number of patches Artificial Zones CBM 1000	~1~scale (Np_ART_1000) + (1|Local)	570.639	0.18	0.101
	~1~scale (Np_ART_1000) + I(scale(Np_ART_1000^2)) + (1|Local)	569.433	0.33	0.111
Number of patches Open areas CBM 1000	~1~scale (Np_OPEN_1000) + (1|Local)	570.437	0.262	0.101
	~1~scale (Np_OPEN_1000) + I(scale(Np_OPEN_1000^2)) + (1|Local)	572.489	0.094	0.102
Percentage of Cover Agriculture CBM 1000	~1~scale (%_AGR_1000) + (1|Local)	570.650	0.114	0.101
	~1~scale (%_AGR_1000) + I(scale(%_AGR_1000^2)) + (1|Local)	567.418	0.574	0.117
Percentage of Cover Forest CBM 1000	~1~scale (%_FOR_1000) + (1|Local)	570.601	0.248	0.101
	~1~scale (%_FOR_1000) + I(scale(%_FOR_1000^2)) + (1|Local)	572.569	0.093	0.101
Percentage of Cover Bodies of water CBM 1000	~1~scale (%_WB_1000) + (1|Local)	569.404	0.254	0.105
	~1~scale (%_WB_1000) + I(scale(%_WB_1000^2)) + (1|Local)	568.632	0.374	0.114
Percentage of Cover Shrub CBM 1000	~1~scale (%_SHR_1000) + (1|Local)	570.173	0.262	0.102
	~1~scale (%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	570.978	0.175	0.106
Percentage of Cover Pastures CBM 1000	~1~scale (%_PAST_1000) + (1|Local)	569.688	0.169	0.104
	~1~scale (%_PAST_1000) + I(scale(%_PAST_1000^2)) + (1|Local)	567.338	0.546	0.118

Percentage of Cover Agroforetry CBM 1000	**~1~scale (%_AFRFOR_1000) + (1|Local)**	569.611	0.315	0.104
	~1~scale (%_AFRFOR_1000) + I(scale(%_AFRFOR_1000^2)) + (1|Local)	570.801	0.174	0.107
Percentage of Cover Artificial Zones CBM 1000	**~1~scale (%_ART_1000) + (1|Local)**	566.908	0.508	0.113
	~1~scale (%_ART_1000) + I(scale(%_ART_1000^2)) + (1|Local)	568.115	0.278	0.115
Percentage of Cover Open areas CBM 1000	**~1~scale (%_OPEN_1000) + (1|Local)**	570.226	0.264	0.102
	~1~scale (%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	571.326	0.152	0.105
Edge Density LBM 500	**~1~scale (ED_500) + (1|Local)**	569.961	0.303	0.103
	~1~scale (ED_500) + I(scale(ED_500^2)) + (1|Local)	571.989	0.110	0.103
Modified Simpson Diversity Index LBM 500	**~1~scale (MSDI_500) + (1|Local)**	566.822	0.399	0.113
	~1~scale (MSDI_500) + I(scale(MSDI_500^2)) + (1|Local)	566.629	0.440	0.120
Number of Patches LBM 500	**~1~scale (NP_500) + (1|Local)**	569.497	0.341	0.104
	~1~scale (NP_500) + I(scale(NP_500^2)) + (1|Local)	571.353	0.135	0.105
Patch Richness LBM 500	**~1~scale (PR_500) + (1|Local)**	569.648	0.306	0.104
	~1~scale (PR_500) + I(scale(PR_500^2)) + (1|Local)	570.606	0.189	0.107
Edge density LBM 1000	**~1~scale (ED_1000) + (1|Local)**	570.478	0.256	0.101
	~1~scale (ED_1000) + I(scale(ED_1000^2)) + (1|Local)	572.266	0.104	0.102
Modified Simpson Diversity Index LBM 1000	**~1~scale (MSDI_1000) + (1|Local)**	569.249	0.367	0.105
	~1~scale (MSDI_1000) + I(scale(MSDI_1000^2)) + (1|Local)	571.221	0.137	0.105
Number of patches LBM 1000	**~1~scale (NP_1000) + (1|Local)**	569.962	0.302	0.103
	~1~scale (NP_1000) + I(scale(NP_1000^2)) + (1|Local)	571.907	0.114	0.103
Patch Richness LBM 1000	**~1~scale (PR_1000) + (1|Local)**	570.367	0.268	0.102
	~1~scale (PR_1000) + I(scale(PR_1000^2)) + (1|Local)	572.421	0.096	0.102
European rabbit occupancy	**~1~scale (RAB)**	570.361	0.297	0.102
Granada hare occupancy	**~1~scale (HAR)**	568.273	0.546	0.108

Table A14 - List of every univariate occupancy probability (*Psi*) covariable model, specific to the common genet's detection history while keeping the best previously determined detection model constant, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. The sampled hunting area ID was included as random effect to account for the biogeographic differences among sites.

Covariate	Occupancy submodel formula	AICc	AICc-weights	adj-R2
Hunting Administrative Type	~HFP+SEAS~HAT + (1|Local)	900.344	0.971	0.139
Season	~HFP+SEAS~SEAS + (1|Local)	913.321	0.048	0.104
Footprint	~HFP+SEAS~HFP + (1|Local)	909.421	0.239	0.103
Altitude	~HFP+SEAS~scale (ALT) + (1|Local)	906.579	0.333	0.111
	~HFP+SEAS~scale (ALT) + I(scale(ALT^2)) ~HFP+SEAS~ (1|Local)	906.012	0.442	0.118
Number of patches Agriculture CBM 500	~HFP+SEAS~scale (Np_AGR_500) + (1|Local)	908.818	0.287	0.105
	~HFP+SEAS~scale (Np_AGR_500) + I(scale(Np_AGR_500^2)) + (1|Local)	910.550	0.121	0.106
Number of patches Forest CBM 500	~HFP+SEAS~scale (Np_FOR_500) + (1|Local)	909.446	0.239	0.103
	~HFP+SEAS~scale (Np_FOR_500) + I(scale(Np_FOR_500^2)) + (1|Local)	911.538	0.084	0.103
Number of patches Bodies of water CBM 500	~HFP+SEAS~scale (Np_WB_500) + (1|Local)	908.583	0.245	0.105
	~HFP+SEAS~scale (Np_WB_500) + I(scale(Np_WB_500^2)) + (1|Local)	908.159	0.303	0.112
Number of patches Shrub CBM 500	~HFP+SEAS~scale (Np_SHR_500) + (1|Local)	908.225	0.346	0.106
	~HFP+SEAS~scale (Np_SHR_500) + I(scale(Np_SHR_500^2)) + (1|Local)	910.325	0.121	0.106
Number of patches Pastures CBM 500	~HFP+SEAS~scale (Np_PAST_500) + (1|Local)	908.400	0.236	0.106
	~HFP+SEAS~scale (Np_PAST_500) + I(scale(Np_PAST_500^2)) + (1|Local)	907.508	0.368	0.114
Number of patches Agroforestry CBM 500	~HFP+SEAS~scale (Np_AGRFOR_500) + (1|Local)	909.456	0.237	0.103
	~HFP+SEAS~scale (Np_AGRFOR_500) + I(scale(Np_AGRFOR_500^2)) + (1|Local)	911.437	0.088	0.103
Number of patches Artificial Zones CBM 500	~HFP+SEAS~scale (Np_ART_500) + (1|Local)	909.456	0.238	0.103
	~HFP+SEAS~scale (Np_ART_500) + I(scale(Np_ART_500^2)) + (1|Local)	911.553	0.084	0.103
Number of patches Open areas CBM 500	~HFP+SEAS~scale (Np_OPEN_500) + (1|Local)	909.456	0.131	0.103
	~HFP+SEAS~scale (Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + (1|Local)	906.807	0.494	0.116
Percentage of Cover Agriculture CBM 500	~HFP+SEAS~scale (%_AGR_500) + (1|Local)	909.387	0.244	0.103
	~HFP+SEAS~scale (%_AGR_500) + I(scale(%_AGR_500^2)) + (1|Local)	911.487	0.085	0.103
Percentage of Cover Forest CBM 500	~HFP+SEAS~scale (%_FOR_500) + (1|Local)	909.048	0.272	0.104
	~HFP+SEAS~scale (%_FOR_500) + I(scale(%_FOR_500^2)) + (1|Local)	911.138	0.096	0.104
Percentage of Cover Bodies of water CBM 500	~HFP+SEAS~scale (%_WB_500) + (1|Local)	908.362	0.334	0.106
	~HFP+SEAS~scale (%_WB_500) + I(scale(%_WB_500^2)) + (1|Local)	909.999	0.143	0.107
Percentage of Cover Shrub CBM 500	~HFP+SEAS~scale (%_SHR_500) + (1|Local)	908.557	0.297	0.106
	~HFP+SEAS~scale (%_SHR_500) + I(scale(%_SHR_500^2)) + (1|Local)	909.726	0.165	0.108

Percentage of Cover Pastures CBM 500	~HFP+SEAS~scale (%_PAST_500) + (1|Local)	908.844	0.288	0.105
	~HFP+SEAS~scale (%_PAST_500) + I(scale(%_PAST_500^2)) + (1|Local)	910.763	0.110	0.105
Percentage of Cover Agroforestry CBM 500	~HFP+SEAS~scale (%_AFRFOR_500) + (1|Local)	908.281	0.313	0.106
	~HFP+SEAS~scale (%_AFRFOR_500) + I(scale(%_AFRFOR_500^2)) + (1|Local)	909.253	0.192	0.109
Percentage of Cover Artificial Zones CBM 500	~HFP+SEAS~scale (%_ART _500) + (1|Local)	909.092	0.179	0.104
	~HFP+SEAS~scale (%_ART _500) + I(scale(%_ART _500^2)) + (1|Local)	907.489	0.398	0.114
Percentage of Cover Open areas CBM 500	~HFP+SEAS~scale (%_OPEN_500) + (1|Local)	909.173	0.222	0.104
	~HFP+SEAS~scale (%_OPEN_500) + I(scale(%_OPEN_500^2)) + (1|Local)	909.126	0.228	0.110
Number of patches Agriculture CBM 1000	~HFP+SEAS~scale (Np_AGR_1000) + (1|Local)	905.562	0.559	0.114
	~HFP+SEAS~scale (Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + (1|Local)	907.484	0.214	0.114
Number of patches Forest CBM 1000	~HFP+SEAS~scale (Np_FOR_1000) + (1|Local)	908.989	0.252	0.104
	~HFP+SEAS~scale (Np_FOR_1000 + I(scale(Np_FOR_1000^2)) + (1|Local)	909.669	0.180	0.108
Number of patches Bodies of water CBM 1000	~HFP+SEAS~scale (Np_WB_1000) + (1|Local)	908.933	0.282	0.105
	~HFP+SEAS~scale (Np_WB_1000) + I(scale(Np_WB_1000^2)) + (1|Local)	911.030	0.099	0.105
Number of patches Shrub CBM 1000	~HFP+SEAS~scale (Np_SHR_1000) + (1|Local)	909.385	0.236	0.103
	~HFP+SEAS~scale (Np_SHR_1000) + I(scale(Np_SHR_1000^2)) + (1|Local)	910.818	0.115	0.105
Number of patches Pastures CBM 1000	~HFP+SEAS~scale (Np_PAST_1000) + (1|Local)	906.385	0.507	0.111
	~HFP+SEAS~scale (Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + (1|Local)	908.427	0.183	0.112
Number of patches Agroforestry CBM 1000	~HFP+SEAS~scale (Np_AGRFOR_1000) + (1|Local)	909.454	0.041	0.103
	~HFP+SEAS~scale (Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + (1|Local)	903.434	0.841	0.125
Number of patches Artificial Zones CBM 1000	~HFP+SEAS~scale (Np_ART_1000) + (1|Local)	906.722	0.459	0.110
	~HFP+SEAS~scale (Np_ART_1000) + I(scale(Np_ART_1000^2)) + (1|Local)	908.296	0.209	0.112
Number of patches Open areas CBM 1000	~HFP+SEAS~scale (Np_OPEN_1000) + (1|Local)	908.527	0.233	0.106
	~HFP+SEAS~scale (Np_OPEN_1000) + I(scale(Np_OPEN_1000^2)) + (1|Local)	907.705	0.351	0.113
Percentage of Cover Agriculture CBM 1000	~HFP+SEAS~scale (%_AGR_1000) + (1|Local)	909.416	0.234	0.103
	~HFP+SEAS~scale (%_AGR_1000) + I(scale(%_AGR_1000^2)) + (1|Local)	910.877	0.113	0.105
Percentage of Cover Forest CBM 1000	~HFP+SEAS~scale (%_FOR_1000) + (1|Local)	909.312	0.242	0.103
	~HFP+SEAS~scale (%_FOR_1000) + I(scale(%_FOR_1000^2)) + (1|Local)	910.761	0.117	0.105
Percentage of Cover Bodies of water CBM 1000	~HFP+SEAS~scale (%_WB_1000) + (1|Local)	907.152	0.427	0.109
	~HFP+SEAS~scale (%_WB_1000) + I(scale(%_WB_1000^2)) + (1|Local)	908.782	0.189	0.111
Percentage of Cover Shrub CBM 1000	~HFP+SEAS~scale (%_SHR_1000) + (1|Local)	908.734	0.300	0.105
	~HFP+SEAS~scale (%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	910.834	0.105	0.105
Percentage of Cover Pastures CBM 1000	~HFP+SEAS~scale (%_PAST_1000) + (1|Local)	909.120	0.241	0.104
	~HFP+SEAS~scale (%_PAST_1000) + I(scale(%_PAST_1000^2)) + (1|Local)	909.732	0.178	0.108

Percentage of Cover Agroforetry CBM 1000	**~HFP+SEAS~scale (%_AFRFOR_1000) + (1|Local)**	906.993	0.444	0.110
	~HFP+SEAS~scale (%_AFRFOR_1000) + I(scale(%_AFRFOR_1000^2)) + (1|Local)	908.718	0.187	0.111
Percentage of Cover Artificial Zones CBM 1000	**~HFP+SEAS~scale (%_ART_1000) + (1|Local)**	909.413	0.159	0.103
	~HFP+SEAS~scale (%_ART_1000) + I(scale(%_ART_1000^2)) + (1|Local)	907.593	0.396	0.114
Percentage of Cover Open areas CBM 1000	**~HFP+SEAS~scale (%_OPEN_1000) + (1|Local)**	909.396	0.203	0.103
	~HFP+SEAS~scale (%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	909.084	0.237	0.110
Edge Density LBM 500	**~HFP+SEAS~scale (ED_500) + (1|Local)**	909.450	0.128	0.103
	~HFP+SEAS~scale (ED_500) + I(scale(ED_500^2)) + (1|Local)	906.704	0.507	0.116
Modified Simpson Diversity Index LBM 500	**~HFP+SEAS~scale (MSDI_500) + (1|Local)**	907.900	0.010	0.107
	~HFP+SEAS~scale (MSDI_500) + I(scale(MSDI_500^2)) + (1|Local)	898.633	0.978	0.137
Number of Patches LBM 500	**~HFP+SEAS~scale (NP_500) + (1|Local)**	909.448	0.128	0.103
	~HFP+SEAS~scale (NP_500) + I(scale(NP_500^2)) + (1|Local)	906.684	0.510	0.116
Patch Richness LBM 500	**~HFP+SEAS~scale (PR_500) + (1|Local)**	907.362	0.425	0.109
	~HFP+SEAS~scale (PR_500) + I(scale(PR_500^2)) + (1|Local)	909.448	0.150	0.109
Edge density LBM 1000	**~HFP+SEAS~scale (ED_1000) + (1|Local)**	908.812	0.287	0.105
	~HFP+SEAS~scale (ED_1000) + I(scale(ED_1000^2)) + (1|Local)	910.556	0.120	0.106
Modified Simpson Diversity Index LBM 1000	**~HFP+SEAS~scale (MSDI_1000) + (1|Local)**	909.451	0.170	0.103
	~HFP+SEAS~scale (MSDI_1000) + I(scale(MSDI_1000^2)) + (1|Local)	908.006	0.349	0.113
Number of patches LBM 1000	**~HFP+SEAS~scale (NP_1000) + (1|Local)**	905.478	0.572	0.114
	~HFP+SEAS~scale (NP_1000) + I(scale(NP_1000^2)) + (1|Local)	907.529	0.205	0.113
Patch Richness LBM 1000	**~HFP+SEAS~scale (PR_1000) + (1|Local)**	904.685	0.575	0.116
	~HFP+SEAS~scale (PR_1000) + I(scale(PR_1000^2)) + (1|Local)	906.162	0.275	0.118
European rabbit occupancy	**~HFP+SEAS~scale (RAB)**	909.306	0.275	0.103
Granada hare occupancy	**~HFP+SEAS~scale (HAR)**	902.461	0.921	0.122

Table A15 -Coorelation matrix for every covariable evaluated in all models, covariates with a correlation coefficient of ≥0,5 were highlighted as orange for further modelling selection while all 1's were greyed out **(meaning these** covariates related to themselves)

	Human.footprint	Altitude	NPAgriculture 500	NPForest 500	NPBodies of water 500
Human.footprint	1	-0.451	0.282	0.031	-0.019
Altitude	0.451	1	0.014	0.086	-0.298
NPAgriculture 500	0.282	0.014	1	0.242	-0.060
NPForest 500	0.031	0.086	0.242	1	-0.053
NPBodies of water 500	0.019	-0.298	-0.060	-0.053	1
NPShrub500	0.173	0.406	0.138	0.265	-0.092
NPPastures500	0.091	-0.118	0.039	0.083	0.060
NPAgroforestry 500	0.100	-0.280	-0.058	0.037	0.299
NPArtificial Zones500	0.485	-0.172	0.396	0.079	-0.048
NPOpen areas500	0.070	0.223	-0.088	-0.033	-0.012
%Agriculture500	0.178	-0.145	0.452	0.066	0.147
%Forest500	0.079	-0.136	-0.232	-0.154	-0.185
%Bodies of water500	0.046	-0.269	-0.104	-0.029	0.652
%Shrub500	0.209	0.446	0.045	0.088	-0.071
%Pastures500	0.012	-0.227	-0.069	0.133	0.093
%Agroforestry 500	0.087	-0.209	-0.106	0.003	0.212
%Artificial500	0.502	-0.217	0.352	0.086	-0.083
%OpenAreas500	0.102	0.284	-0.119	-0.052	-0.035
NPAgriculture 1000	0.294	0.064	0.759	0.267	-0.095
NPForest1000	0.105	0.115	0.376	0.553	-0.049
NPBodies of water 1000	0.006	-0.376	-0.089	-0.041	0.527
NPShrub1000	0.113	0.376	0.194	0.278	-0.197
NPPastures1000	0.107	-0.179	-0.057	0.027	0.178
NPAgroforestry 1000	0.054	-0.336	-0.087	-0.043	0.341
NPArtificial Zones1000	0.594	-0.175	0.529	0.121	-0.103
NPOpen areas1000	0.106	0.268	-0.057	-0.041	-0.044
%Agriculture 1000	0.248	-0.199	0.563	0.038	0.153
%Forest1000	0.051	-0.128	-0.265	-0.109	-0.198
%Bodies of water1000	0.099	-0.279	-0.161	-0.084	0.550
%Shrub1000	0.279	0.527	0.040	0.072	-0.086
%Pastures1000	0.029	-0.258	-0.120	0.114	0.085
%Agroforestry 1000	0.107	-0.249	-0.152	0.003	0.258
%Artificial1000	0.658	-0.227	0.395	0.096	-0.082
%OpenAreas1000	0.118	0.365	-0.136	-0.084	-0.056
EdLBM500	0.149	0.033	0.591	0.572	0.103
MsidiLBM500	0.115	-0.160	0.397	0.481	0.202
NpLBM500	0.142	0.070	0.674	0.631	0.084
PrLBM500	0.093	-0.183	0.245	0.235	0.320
EdLBM1000	0.228	0.025	0.660	0.517	0.038
MsidiLBM1000	0.195	-0.235	0.389	0.391	0.200
NpLBM1000	0.261	0.024	0.641	0.433	-0.003
PrLBM1000	0.138	-0.296	0.006	0.132	0.186
European rabbit occupancy	0.315	-0.322	-0.014	0.156	-0.058
Granada hare occupancy	0.220	-0.119	-0.163	-0.079	0.082

%Forest500	%Agriculture500	NPOpen areas500	NPArtificial Zones500	NPAgroforestry 500	NPPastures500	NPShrub500
0.079	0.178	-0.070	0.485	-0.100	-0.091	-0.173
-0.136	-0.145	0.223	-0.172	-0.280	-0.118	0.406
-0.232	0.452	-0.088	0.396	-0.058	0.039	0.138
-0.154	0.066	-0.033	0.079	0.037	0.083	0.265
-0.185	0.147	-0.012	-0.048	0.299	0.060	-0.092
-0.169	-0.003	0.081	-0.103	-0.210	-0.020	1
-0.183	0.120	0.020	-0.136	0.309	1	-0.020
-0.219	0.173	0.047	-0.095	1	0.309	-0.210
-0.009	0.195	-0.046	1	-0.095	-0.136	-0.103
-0.207	-0.078	1	-0.046	0.047	0.020	0.081
-0.430	1	-0.078	0.195	0.173	0.120	-0.003
1	-0.430	-0.207	-0.009	-0.219	-0.183	-0.169
-0.134	0.017	-0.020	-0.068	0.229	-0.033	-0.018
-0.662	-0.119	0.163	-0.117	-0.251	-0.141	0.322
-0.173	-0.021	0.004	-0.103	0.227	0.591	-0.073
-0.276	0.014	0.046	-0.094	0.651	0.210	-0.203
-0.014	0.150	-0.053	0.721	-0.020	-0.118	-0.133
-0.218	-0.088	0.843	-0.061	0.011	0.004	0.101
-0.183	0.376	-0.088	0.335	-0.118	-0.029	0.165
-0.248	0.192	0.049	0.150	0.004	0.109	0.286
-0.203	0.197	-0.083	-0.100	0.301	0.241	-0.193
-0.045	0.032	0.015	-0.142	-0.205	-0.022	0.703
-0.135	0.151	0.064	-0.135	0.474	0.637	-0.110
-0.167	0.252	-0.016	-0.123	0.706	0.354	-0.237
0.085	0.242	-0.070	0.728	-0.136	-0.136	-0.067
-0.263	-0.056	0.810	-0.021	0.057	0.029	0.063
-0.434	0.904	-0.072	0.213	0.190	0.117	-0.039
0.946	-0.407	-0.202	-0.031	-0.221	-0.211	-0.213
-0.203	-0.044	0.031	0.051	0.135	-0.038	-0.014
-0.605	-0.125	0.163	-0.132	-0.290	-0.122	0.422
-0.144	0.019	0.003	-0.155	0.263	0.655	-0.086
-0.256	0.021	0.052	-0.108	0.711	0.224	-0.213
0.025	0.172	-0.047	0.754	-0.120	-0.141	-0.123
-0.256	-0.097	0.757	-0.056	-0.024	-0.029	0.088
-0.437	0.365	0.085	0.292	0.131	0.282	0.460
-0.487	0.321	0.133	0.191	0.319	0.335	0.331
-0.381	0.350	0.097	0.367	0.202	0.350	0.499
-0.327	0.224	0.188	0.162	0.437	0.446	0.204
-0.375	0.384	0.047	0.320	0.076	0.227	0.407
-0.451	0.270	0.123	0.196	0.284	0.353	0.293
-0.267	0.411	0.053	0.304	0.124	0.228	0.303
-0.170	0.114	0.115	0.006	0.352	0.394	0.035
-0.055	-0.213	-0.050	0.100	-0.174	0.125	0.019
0.045	0.064	0.289	-0.191	0.306	0.380	-0.174

NPAgriculture 1000	%OpenAreas500	%Artificial500	%Agroforestry 500	%Pastures500	%Shrub500	%Bodies of water500
0.294	-0.102	0.502	-0.087	-0.012	-0.209	-0.046
0.064	0.284	-0.217	-0.209	-0.227	0.446	-0.269
0.759	-0.119	0.352	-0.106	-0.069	0.045	-0.104
0.267	-0.052	0.086	0.003	0.133	0.088	-0.029
-0.095	-0.035	-0.083	0.212	0.093	-0.071	0.652
0.165	0.101	-0.133	-0.203	-0.073	0.322	-0.018
-0.029	0.004	-0.118	0.210	0.591	-0.141	-0.033
-0.118	0.011	-0.020	0.651	0.227	-0.251	0.229
0.335	-0.061	0.721	-0.094	-0.103	-0.117	-0.068
-0.088	0.843	-0.053	0.046	0.004	0.163	-0.020
0.376	-0.088	0.150	0.014	-0.021	-0.119	0.017
-0.183	-0.218	-0.014	-0.276	-0.173	-0.662	-0.134
-0.118	-0.029	-0.069	0.196	-0.003	-0.059	1
0.062	0.175	-0.132	-0.213	-0.188	1	-0.059
-0.111	-0.014	-0.114	0.156	1	-0.188	-0.003
-0.118	0.033	-0.071	1	0.156	-0.213	0.196
0.298	-0.057	1	-0.071	-0.114	-0.132	-0.069
-0.114	1	-0.057	0.033	-0.014	0.175	-0.029
1	-0.114	0.298	-0.118	-0.111	0.062	-0.118
0.452	-0.015	0.139	-0.008	-0.003	0.164	-0.059
-0.152	-0.084	-0.113	0.226	0.299	-0.103	0.312
0.238	-0.007	-0.175	-0.236	-0.082	0.213	-0.146
-0.076	0.027	-0.132	0.368	0.365	-0.215	0.015
-0.124	-0.029	-0.081	0.516	0.280	-0.296	0.177
0.512	-0.067	0.645	-0.137	-0.148	-0.201	-0.119
-0.066	0.733	-0.058	0.047	0.025	0.225	-0.048
0.487	-0.098	0.204	0.059	-0.014	-0.085	0.012
-0.240	-0.216	-0.027	-0.269	-0.153	-0.621	-0.140
-0.194	0.016	0.002	0.098	0.026	0.116	0.689
0.060	0.196	-0.144	-0.236	-0.165	0.938	-0.042
-0.110	-0.006	-0.146	0.210	0.790	-0.192	-0.010
-0.155	0.032	-0.086	0.933	0.224	-0.237	0.234
0.393	-0.058	0.793	-0.117	-0.140	-0.126	-0.102
-0.116	0.886	-0.056	0.004	-0.021	0.257	-0.048
0.509	0.067	0.256	0.036	0.239	0.127	0.085
0.312	0.113	0.196	0.196	0.379	0.078	0.202
0.540	0.059	0.276	0.065	0.183	0.084	0.024
0.196	0.130	0.097	0.244	0.341	-0.044	0.205
0.689	0.028	0.285	0.007	0.137	0.103	0.009
0.370	0.077	0.186	0.185	0.355	0.092	0.160
0.762	-0.007	0.251	0.039	0.053	0.001	-0.096
0.022	0.094	-0.016	0.187	0.358	-0.106	0.113
-0.018	-0.101	0.127	-0.155	0.272	0.166	-0.034
-0.230	0.246	-0.163	0.196	0.229	-0.271	0.030

NPOpen areas1000	NPArtificial Zones1000	NPAgroforestry 1000	NPPastures1000	NPShrub1000	NPBodies of water 1000	NPForest1000
-0.106	0.594	-0.054	-0.107	-0.113	0.006	0.105
0.268	-0.175	-0.336	-0.179	0.376	-0.376	0.115
-0.057	0.529	-0.087	-0.057	0.194	-0.089	0.376
-0.041	0.121	-0.043	0.027	0.278	-0.041	0.553
-0.044	-0.103	0.341	0.178	-0.197	0.527	-0.049
0.063	-0.067	-0.237	-0.110	0.703	-0.193	0.286
0.029	-0.136	0.354	0.637	-0.022	0.241	0.109
0.057	-0.136	0.706	0.474	-0.205	0.301	0.004
-0.021	0.728	-0.123	-0.135	-0.142	-0.100	0.150
0.810	-0.070	-0.016	0.064	0.015	-0.083	0.049
-0.056	0.242	0.252	0.151	0.032	0.197	0.192
-0.263	0.085	-0.167	-0.135	-0.045	-0.203	-0.248
-0.048	-0.119	0.177	0.015	-0.146	0.312	-0.059
0.225	-0.201	-0.296	-0.215	0.213	-0.103	0.164
0.025	-0.148	0.280	0.365	-0.082	0.299	-0.003
0.047	-0.137	0.516	0.368	-0.236	0.226	-0.008
-0.058	0.645	-0.081	-0.132	-0.175	-0.113	0.139
0.733	-0.067	-0.029	0.027	-0.007	-0.084	-0.015
-0.066	0.512	-0.124	-0.076	0.238	-0.152	0.452
0.080	0.220	-0.046	0.099	0.322	-0.096	1
-0.114	-0.140	0.388	0.259	-0.237	1	-0.096
0.024	-0.072	-0.229	-0.106	1	-0.237	0.322
0.087	-0.150	0.510	1	-0.106	0.259	0.099
0.020	-0.161	1	0.510	-0.229	0.388	-0.046
-0.060	1	-0.161	-0.150	-0.072	-0.140	0.220
1	-0.060	0.020	0.087	0.024	-0.114	0.080
-0.074	0.317	0.270	0.141	0.031	0.226	0.197
-0.259	0.027	-0.179	-0.173	-0.066	-0.208	-0.281
0.006	-0.081	0.112	-0.043	-0.130	0.374	-0.096
0.214	-0.203	-0.336	-0.223	0.244	-0.149	0.182
0.048	-0.192	0.366	0.527	-0.067	0.309	0.047
0.061	-0.160	0.555	0.405	-0.239	0.246	-0.011
-0.044	0.738	-0.165	-0.162	-0.140	-0.120	0.200
0.762	-0.069	-0.043	-0.011	-0.007	-0.100	-0.059
0.076	0.296	0.063	0.161	0.387	0.047	0.588
0.135	0.144	0.221	0.257	0.218	0.164	0.478
0.095	0.364	0.089	0.197	0.378	0.016	0.560
0.225	0.110	0.381	0.427	0.141	0.225	0.314
0.075	0.437	0.057	0.186	0.430	0.017	0.691
0.153	0.187	0.269	0.315	0.252	0.207	0.514
0.109	0.492	0.156	0.297	0.438	-0.003	0.740
0.209	0.070	0.414	0.495	0.066	0.315	0.163
-0.013	0.108	-0.149	0.008	0.044	0.004	0.188
0.233	-0.241	0.344	0.611	-0.085	0.176	-0.115

%Artificial1000	%Agroforestry 1000	%Pastures1000	%Shrub1000	%Bodies of water1000	%Forest1000	%Agriculture 1000
0.658	-0.107	-0.029	-0.279	0.099	0.051	0.248
-0.227	-0.249	-0.258	0.527	-0.279	-0.128	-0.199
0.395	-0.152	-0.120	0.040	-0.161	-0.265	0.563
0.096	0.003	0.114	0.072	-0.084	-0.109	0.038
-0.082	0.258	0.085	-0.086	0.550	-0.198	0.153
-0.123	-0.213	-0.086	0.422	-0.014	-0.213	-0.039
-0.141	0.224	0.655	-0.122	-0.038	-0.211	0.117
-0.120	0.711	0.263	-0.290	0.135	-0.221	0.190
0.754	-0.108	-0.155	-0.132	0.051	-0.031	0.213
-0.047	0.052	0.003	0.163	0.031	-0.202	-0.072
0.172	0.021	0.019	-0.125	-0.044	-0.407	0.904
0.025	-0.256	-0.144	-0.605	-0.203	0.946	-0.434
-0.102	0.234	-0.010	-0.042	0.689	-0.140	0.012
-0.126	-0.237	-0.192	0.938	0.116	-0.621	-0.085
-0.140	0.224	0.790	-0.165	0.026	-0.153	-0.014
-0.117	0.933	0.210	-0.236	0.098	-0.269	0.059
0.793	-0.086	-0.146	-0.144	0.002	-0.027	0.204
-0.058	0.032	-0.006	0.196	0.016	-0.216	-0.098
0.393	-0.155	-0.110	0.060	-0.194	-0.240	0.487
0.200	-0.011	0.047	0.182	-0.096	-0.281	0.197
-0.120	0.246	0.309	-0.149	0.374	-0.208	0.226
-0.140	-0.239	-0.067	0.244	-0.130	-0.066	0.031
-0.162	0.405	0.527	-0.223	-0.043	-0.173	0.141
-0.165	0.555	0.366	-0.336	0.112	-0.179	0.270
0.738	-0.160	-0.192	-0.203	-0.081	0.027	0.317
-0.044	0.061	0.048	0.214	0.006	-0.259	-0.074
0.231	0.033	0.010	-0.121	-0.064	-0.469	1
-0.024	-0.272	-0.167	-0.617	-0.231	1	-0.469
0.031	0.149	-0.005	0.073	1	-0.231	-0.064
-0.170	-0.266	-0.237	1	0.073	-0.617	-0.121
-0.182	0.252	1	-0.237	-0.005	-0.167	0.010
-0.139	1	0.252	-0.266	0.149	-0.272	0.033
1	-0.139	-0.182	-0.170	0.031	-0.024	0.231
-0.055	0.001	-0.019	0.264	-0.013	-0.255	-0.118
0.230	0.031	0.194	0.148	0.025	-0.435	0.373
0.136	0.209	0.338	0.098	0.155	-0.489	0.323
0.286	0.059	0.158	0.107	-0.012	-0.411	0.382
0.097	0.282	0.348	-0.044	0.207	-0.355	0.228
0.337	0.010	0.175	0.113	-0.044	-0.440	0.452
0.229	0.221	0.431	0.080	0.216	-0.548	0.362
0.332	0.034	0.122	0.000	-0.139	-0.339	0.484
0.007	0.272	0.414	-0.103	0.152	-0.229	0.101
0.157	-0.128	0.304	0.127	0.098	-0.068	-0.184
-0.225	0.208	0.316	-0.267	-0.024	0.050	0.019

MsidiLBM1000	EdLBM1000	PrLBM500	NpLBM500	MsidiLBM500	EdLBM500	%OpenAreas1000
0.195	0.228	0.093	0.142	0.115	0.149	-0.118
-0.235	0.025	-0.183	0.070	-0.160	0.033	0.365
0.389	0.660	0.245	0.674	0.397	0.591	-0.136
0.391	0.517	0.235	0.631	0.481	0.572	-0.084
0.200	0.038	0.320	0.084	0.202	0.103	-0.056
0.293	0.407	0.204	0.499	0.331	0.460	0.088
0.353	0.227	0.446	0.350	0.335	0.282	-0.029
0.284	0.076	0.437	0.202	0.319	0.131	-0.024
0.196	0.320	0.162	0.367	0.191	0.292	-0.056
0.123	0.047	0.188	0.097	0.133	0.085	0.757
0.270	0.384	0.224	0.350	0.321	0.365	-0.097
-0.451	-0.375	-0.327	-0.381	-0.487	-0.437	-0.256
0.160	0.009	0.205	0.024	0.202	0.085	-0.048
0.092	0.103	-0.044	0.084	0.078	0.127	0.257
0.355	0.137	0.341	0.183	0.379	0.239	-0.021
0.185	0.007	0.244	0.065	0.196	0.036	0.004
0.186	0.285	0.097	0.276	0.196	0.256	-0.056
0.077	0.028	0.130	0.059	0.113	0.067	0.886
0.370	0.689	0.196	0.540	0.312	0.509	-0.116
0.514	0.691	0.314	0.560	0.478	0.588	-0.059
0.207	0.017	0.225	0.016	0.164	0.047	-0.100
0.252	0.430	0.141	0.378	0.218	0.387	-0.007
0.315	0.186	0.427	0.197	0.257	0.161	-0.011
0.269	0.057	0.381	0.089	0.221	0.063	-0.043
0.187	0.437	0.110	0.364	0.144	0.296	-0.069
0.153	0.075	0.225	0.095	0.135	0.076	0.762
0.362	0.452	0.228	0.382	0.323	0.373	-0.118
-0.548	-0.440	-0.355	-0.411	-0.489	-0.435	-0.255
0.216	-0.044	0.207	-0.012	0.155	0.025	-0.013
0.080	0.113	-0.044	0.107	0.098	0.148	0.264
0.431	0.175	0.348	0.158	0.338	0.194	-0.019
0.221	0.010	0.282	0.059	0.209	0.031	0.001
0.229	0.337	0.097	0.286	0.136	0.230	-0.055
0.034	-0.006	0.079	0.013	0.045	0.001	1
0.721	0.862	0.552	0.872	0.844	1	0.001
0.840	0.710	0.629	0.741	1	0.844	0.045
0.686	0.830	0.597	1	0.741	0.872	0.013
0.630	0.508	1	0.597	0.629	0.552	0.079
0.780	1	0.508	0.830	0.710	0.862	-0.006
1	0.780	0.630	0.686	0.840	0.721	0.034
0.646	0.884	0.499	0.745	0.555	0.711	-0.035
0.507	0.325	0.651	0.285	0.407	0.269	0.080
0.352	0.164	0.176	0.075	0.218	0.144	-0.122
0.057	-0.039	0.244	-0.021	0.046	-0.021	0.242

Granada hare occupancy	European rabbit occupancy	PrLBM1000	NpLBM1000
-0.220	0.315	0.138	0.261
-0.119	-0.322	-0.296	0.024
-0.163	-0.014	0.006	0.641
-0.079	0.156	0.132	0.433
0.082	-0.058	0.186	-0.003
-0.174	0.019	0.035	0.303
0.380	0.125	0.394	0.228
0.306	-0.174	0.352	0.124
-0.191	0.100	0.006	0.304
0.289	-0.050	0.115	0.053
0.064	-0.213	0.114	0.411
0.045	-0.055	-0.170	-0.267
0.030	-0.034	0.113	-0.096
-0.271	0.166	-0.106	0.001
0.229	0.272	0.358	0.053
0.196	-0.155	0.187	0.039
-0.163	0.127	-0.016	0.251
0.246	-0.101	0.094	-0.007
-0.230	-0.018	0.022	0.762
-0.115	0.188	0.163	0.740
0.176	0.004	0.315	-0.003
-0.085	0.044	0.066	0.438
0.611	0.008	0.495	0.297
0.344	-0.149	0.414	0.156
-0.241	0.108	0.070	0.492
0.233	-0.013	0.209	0.109
0.019	-0.184	0.101	0.484
0.050	-0.068	-0.229	-0.339
-0.024	0.098	0.152	-0.139
-0.267	0.127	-0.103	0.000
0.316	0.304	0.414	0.122
0.208	-0.128	0.272	0.034
-0.225	0.157	0.007	0.332
0.242	-0.122	0.080	-0.035
-0.021	0.144	0.269	0.711
0.046	0.218	0.407	0.555
-0.021	0.075	0.285	0.745
0.244	0.176	0.651	0.499
-0.039	0.164	0.325	0.884
0.057	0.352	0.507	0.646
0.015	0.082	0.363	1
0.312	0.290	1	0.363
-0.159	1	0.290	0.082
1	-0.159	0.312	0.015

Table A16 - List of the multivariate models comprised of combinations of the best univariate models regarding detection (p) and occupancy probabilities (*Psi*) gathered from previous steps, specific to the European rabbit, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. Still maintaining the sampled hunting area ID as random effect to account for the biogeographic differences among sites.

Multivariate Detection-Occupancy model formula	AICc	AICc-weights	adj-R2
~HAT+SEAS ~ 1 + (1|Local)	1119.415	0.000	0.350
~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + (1|Local)	1114.532	0.002	0.367
~HAT+SEAS ~ scale(%_SHR_500) + (1|Local)	1115.331	0.001	0.362
~HAT+SEAS ~ scale(Np_WB_1000) + (1|Local)	1117.063	0.000	0.358
~HAT+SEAS ~ scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + (1|Local)	1115.833	0.001	0.365
~HAT+SEAS ~ scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1115.497	0.001	0.365
~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(%_SHR_500) + (1|Local)	1110.883	0.010	0.378
~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(Np_WB_1000) + (1|Local)	1113.335	0.003	0.373
~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + (1|Local)	1113.160	0.003	0.377
~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1111.077	0.010	0.381
~HAT+SEAS ~ scale(%_SHR_500) + scale(Np_WB_1000) + (1|Local)	1112.014	0.006	0.372
~HAT+SEAS ~ scale(%_SHR_500) + scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + (1|Local)	1111.516	0.008	0.376
~HAT+SEAS ~ scale(%_SHR_500) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1112.160	0.006	0.375
~HAT+SEAS ~ scale(Np_WB_1000) + scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + (1|Local)	1114.344	0.002	0.371
~HAT+SEAS ~ scale(Np_WB_1000) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1111.801	0.007	0.376
~HAT+SEAS ~ scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1112.146	0.006	0.379
~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(%_SHR_500) + scale(Np_WB_1000) + (1|Local)	1108.823	0.029	0.385
~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(%_SHR_500) + scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + (1|Local)	1109.683	0.019	0.387
~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(%_SHR_500) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1108.304	0.038	0.390
~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(Np_WB_1000) + scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + (1|Local)	1112.567	0.005	0.382
~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(Np_WB_1000) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1108.599	0.033	0.389
~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1109.640	0.019	0.391
~HAT+SEAS ~ scale(%_SHR_500) + scale(Np_WB_1000) + scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + (1|Local)	1109.349	0.023	0.384
~HAT+SEAS ~ scale(%_SHR_500) + scale(Np_WB_1000) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1107.768	0.050	0.387
~HAT+SEAS ~ scale(%_SHR_500) + scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1108.715	0.031	0.389
~HAT+SEAS ~ scale(Np_WB_1000) + scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1109.531	0.021	0.388
~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(%_SHR_500) + scale(Np_WB_1000) + scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2))+ (1|Local)	1108.507	0.034	0.393
~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(%_SHR_500) + scale(Np_WB_1000) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1105.222	0.178	0.399
~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(%_SHR_500) + scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1107.104	0.069	0.400

~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(Np_WB_1000) + scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1107.943	0.046	0.398
~HAT+SEAS ~ scale(%_SHR_500) + scale(Np_WB_1000) + scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1105.622	0.145	0.398
~HAT+SEAS ~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(%_SHR_500) + scale(Np_WB_1000) + scale(Np_PAST_1000) + I(scale(Np_PAST_1000^2)) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	1105.028	0.196	0.407

Table A17 – List of the multivariate models comprised of combinations of the best univariate models regarding detection (p) and occupancy probabilities (*Psi*) gathered from previous steps, specific to the Iberian hare including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. Still maintaining the sampled hunting area ID as random effect to account for the biogeographic differences among sites.

Multivariate Detection-Occupancy model formula	AICc	AICc-weights	adj-R2
~HFP+HATS~ 1 + (1|Local)	692.022	0.000	0.107
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + (1|Local)	689.729	0.000	0.125
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + (1|Local)	675.934	0.000	0.164
~HFP+HATS~ scale(%_SHR_500) + (1|Local)	687.271	0.000	0.126
~HFP+HATS~ scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + (1|Local)	684.831	0.000	0.139
~HFP+HATS~ scale(Np_PAST_1000) + (1|Local)	678.630	0.000	0.151
~HFP+HATS~ scale(PR_500) + (1|Local)	692.254	0.000	0.112
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + (1|Local)	674.515	0.000	0.180
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(%_SHR_500) + (1|Local)	682.669	0.000	0.151
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + (1|Local)	682.534	0.000	0.158
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_PAST_1000) + (1|Local)	674.827	0.000	0.173
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(PR_500) + (1|Local)	689.711	0.000	0.131
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + (1|Local)	666.980	0.000	0.194
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + (1|Local)	669.146	0.000	0.194
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(Np_PAST_1000) + (1|Local)	661.555	0.001	0.209
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(PR_500) + (1|Local)	675.247	0.000	0.172
~HFP+HATS~ scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + (1|Local)	679.885	0.000	0.159
~HFP+HATS~ scale(%_SHR_500) + scale(Np_PAST_1000) + (1|Local)	676.422	0.000	0.163
~HFP+HATS~ scale(%_SHR_500) + scale(PR_500) + (1|Local)	687.911	0.000	0.131
~HFP+HATS~ scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + (1|Local)	674.116	0.000	0.175
~HFP+HATS~ scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(PR_500) + (1|Local)	685.703	0.000	0.143
~HFP+HATS~ scale(Np_PAST_1000) + scale(PR_500) + (1|Local)	680.688	0.000	0.151
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + (1|Local)	664.750	0.000	0.211
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + (1|Local)	667.158	0.000	0.211
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(Np_PAST_1000) + (1|Local)	659.902	0.002	0.224
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(PR_500) + (1|Local)	673.250	0.000	0.189
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + (1|Local)	675.732	0.000	0.182
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(%_SHR_500) + scale(Np_PAST_1000) + (1|Local)	670.620	0.000	0.190
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(%_SHR_500) + scale(PR_500) + (1|Local)	684.033	0.000	0.153
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + (1|Local)	670.955	0.000	0.195
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(PR_500) + (1|Local)	683.184	0.000	0.162

~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_PAST_1000) + scale(PR_500) + (1|Local)	676.954	0.000	0.173
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + (1|Local)	658.775	0.003	0.227
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + scale(Np_PAST_1000) + (1|Local)	654.817	0.023	0.232
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + scale(PR_500) + (1|Local)	666.151	0.000	0.202
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + (1|Local)	658.637	0.003	0.227
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(PR_500) + (1|Local)	670.215	0.000	0.197
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(Np_PAST_1000) + scale(PR_500) + (1|Local)	663.338	0.000	0.210
~HFP+HATS~ scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + (1|Local)	672.236	0.000	0.186
~HFP+HATS~ scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(PR_500) + (1|Local)	681.183	0.000	0.161
~HFP+HATS~ scale(%_SHR_500) + scale(Np_PAST_1000) + scale(PR_500) + (1|Local)	678.511	0.000	0.163
~HFP+HATS~ scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + scale(PR_500) + (1|Local)	676.170	0.000	0.175
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + (1|Local)	656.883	0.008	0.243
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + scale(Np_PAST_1000) + (1|Local)	652.017	0.092	0.250
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + scale(PR_500) + (1|Local)	664.948	0.000	0.217
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + (1|Local)	657.041	0.007	0.242
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(PR_500) + (1|Local)	667.768	0.000	0.215
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + (1|Local)	657.041	0.007	0.243
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + (1|Local)	666.864	0.000	0.212
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(PR_500) + (1|Local)	677.569	0.000	0.183
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(%_SHR_500) + scale(Np_PAST_1000) + scale(PR_500) + (1|Local)	672.579	0.000	0.191
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + scale(PR_500) + (1|Local)	673.096	0.000	0.195
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + (1|Local)	651.440	0.123	0.251
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(PR_500) + (1|Local)	659.879	0.002	0.230
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + scale(Np_PAST_1000) + scale(PR_500) + (1|Local)	656.557	0.010	0.233
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + scale(PR_500) + (1|Local)	660.631	0.001	0.228
~HFP+HATS~ scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + scale(PR_500) + (1|Local)	674.345	0.000	0.186
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + (1|Local)	648.741	0.474	0.269
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(PR_500) + (1|Local)	658.502	0.004	0.244
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + scale(Np_PAST_1000) + scale(PR_500) + (1|Local)	654.178	0.031	0.250

~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + scale(PR_500) + (1|Local)	659.099	0.003	0.243
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + scale(PR_500) + (1|Local)	668.885	0.000	0.212
~HFP+HATS~ scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + scale(PR_500) + (1|Local)	653.468	0.045	0.252
~HFP+HATS~ scale(Np_SHR_500) + I(scale(Np_SHR_500^2)) + scale(Np_OPEN_500) + I(scale(Np_OPEN_500^2)) + scale(%_SHR_500) + scale(Np_AGR_1000) + I(scale(Np_AGR_1000^2)) + scale(Np_PAST_1000) + scale(PR_500) + (1|Local)	650.917	0.160	0.269

Table A18 – List of the multivariate models comprised of combinations of the best univariate models regarding detection (p) and occupancy probabilities (*Psi*) gathered from previous steps, specific to the red fox, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. Still maintaining the sampled hunting area ID as random effect to account for the biogeographic differences among sites.

Multivariate Detection-Occupancy model formula	AICc	AICc-weights	adj-R2
~HATS+SEAS ~ 1 + (1|Local)	2491.684	0.003	0.132
~HATS+SEAS ~ scale(Np_SHR_500) + (1|Local)	2487.231	0.028	0.148
~HATS+SEAS ~ scale(Np_ART_500) + (1|Local)	2486.737	0.035	0.149
~HATS+SEAS ~ scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	2489.467	0.009	0.148
~HATS+SEAS ~ scale(Np_SHR_500) + scale(Np_ART_500) + (1|Local)	2483.007	0.228	0.163
~HATS+SEAS ~ scale(Np_SHR_500) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	2485.043	0.082	0.163
~HATS+SEAS ~ scale(Np_ART_500) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	2485.036	0.083	0.163
~HATS+SEAS ~ scale(Np_SHR_500) + scale(Np_ART_500) + scale(%_OPEN_1000) + I(scale(%_OPEN_1000^2)) + (1|Local)	2481.316	0.532	0.176

Table A19 - List of the multivariate models comprised of combinations of the best univariate models regarding detection (p) and occupancy probabilities (*Psi*) gathered from previous steps, specific to the European badger, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. Still maintaining the sampled hunting area ID as random effect to account for the biogeographic differences among sites.

Multivariate Detection-Occupancy model formula	AICc	AICc-weights	adj-R2
~HFP+SEAS~ 1 + (1|Local)	878.457	0.003	0.146
~HFP+SEAS~ scale(ALT) + (1|Local)	871.498	0.098	0.169
~HFP+SEAS~ scale(%_SHR_500) + (1|Local)	873.935	0.029	0.163
~HFP+SEAS~ scale(%_AGRFOR_500) + (1|Local)	875.281	0.015	0.160
~HFP+SEAS~ scale(ALT) + scale(%_SHR_500) + (1|Local)	870.267	0.181	0.178
~HFP+SEAS~ scale(ALT) + scale(%_AGRFOR_500) + (1|Local)	869.584	0.254	0.179
~HFP+SEAS~ scale(%_SHR_500) + scale(%_AGRFOR_500) + (1|Local)	871.886	0.080	0.174
~HFP+SEAS~ scale(ALT) + scale(%_SHR_500) + scale(%_AGRFOR_500) + (1|Local)	869.997	0.341	0.186

Table A20 - List of the multivariate models comprised of combinations of the best univariate models regarding detection (p) and occupancy probabilities (*Psi*) gathered from previous steps, specific to the beech marten, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. Still maintaining the sampled hunting area ID as random effect to account for the biogeographic differences among sites.

Multivariate Detection-Occupancy model formula	AICc	AICc-weights	adj-R2
~HFP+SEAS ~ 1 + (1|Local)	921.437	0.000	0.205
~HFP+SEAS ~ scale(%_OPEN_500) + (1|Local)	915.102	0.000	0.225
~HFP+SEAS ~ scale(np_8_CBM_500) + I(scale(np_8_CBM_500^2)) + (1|Local)	919.893	0.000	0.218
~HFP+SEAS ~ scale(Np_SHR_1000) + (1|Local)	917.785	0.000	0.218
~HFP+SEAS ~ scale(%_FOR_1000) + (1|Local)	911.488	0.001	0.233
~HFP+SEAS ~ scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	917.859	0.000	0.223
~HFP+SEAS ~ scale(%_PAST_1000) + (1|Local)	919.372	0.000	0.214
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_OPEN_500) + (1|Local)	911.087	0.001	0.244
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(Np_SHR_1000) + (1|Local)	913.980	0.000	0.237
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_FOR_1000) + (1|Local)	907.989	0.004	0.251
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	914.006	0.000	0.242
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_PAST_1000) + (1|Local)	913.816	0.000	0.237
~HFP+SEAS ~ scale(%_OPEN_500) + scale(Np_SHR_1000) + (1|Local)	911.268	0.001	0.238
~HFP+SEAS ~ scale(%_OPEN_500) + scale(%_FOR_1000) + (1|Local)	907.079	0.006	0.248
~HFP+SEAS ~ scale(%_OPEN_500) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	911.768	0.001	0.242
~HFP+SEAS ~ scale(%_OPEN_500) + scale(%_PAST_1000) + (1|Local)	913.900	0.000	0.232
~HFP+SEAS ~ scale(Np_SHR_1000) + scale(%_FOR_1000) + (1|Local)	907.586	0.005	0.247
~HFP+SEAS ~ scale(Np_SHR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	917.132	0.000	0.230
~HFP+SEAS ~ scale(Np_SHR_1000) + scale(%_PAST_1000) + (1|Local)	916.191	0.000	0.227
~HFP+SEAS ~ scale(%_FOR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	912.391	0.000	0.241
~HFP+SEAS ~ scale(%_FOR_1000) + scale(%_PAST_1000) + (1|Local)	911.465	0.001	0.238
~HFP+SEAS ~ scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + scale(%_PAST_1000) + (1|Local)	914.163	0.000	0.236
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_OPEN_500) + scale(Np_SHR_1000) + (1|Local)	907.734	0.004	0.256
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_OPEN_500) + scale(%_FOR_1000) + (1|Local)	903.648	0.032	0.265
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_OPEN_500) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	908.039	0.004	0.260
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_OPEN_500) + scale(%_PAST_1000) + (1|Local)	908.709	0.003	0.254
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(Np_SHR_1000) + scale(%_FOR_1000) + (1|Local)	904.295	0.023	0.264
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(Np_SHR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	914.162	0.000	0.246
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(Np_SHR_1000) + scale(%_PAST_1000) + (1|Local)	911.243	0.001	0.248
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_FOR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	907.835	0.004	0.261
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_FOR_1000) + scale(%_PAST_1000) + (1|Local)	906.958	0.006	0.258
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + scale(%_PAST_1000) + (1|Local)	908.980	0.002	0.258

~HFP+SEAS ~ scale(%_OPEN_500) + scale(Np_SHR_1000) + scale(%_FOR_1000) + (1|Local)	903.015	0.045	0.262
~HFP+SEAS ~ scale(%_OPEN_500) + scale(Np_SHR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	910.699	0.001	0.249
~HFP+SEAS ~ scale(%_OPEN_500) + scale(Np_SHR_1000) + scale(%_PAST_1000) + (1|Local)	910.541	0.001	0.245
~HFP+SEAS ~ scale(%_OPEN_500) + scale(%_FOR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	908.177	0.003	0.255
~HFP+SEAS ~ scale(%_OPEN_500) + scale(%_FOR_1000) + scale(%_PAST_1000) + (1|Local)	907.314	0.005	0.252
~HFP+SEAS ~ scale(%_OPEN_500) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + scale(%_PAST_1000) + (1|Local)	908.997	0.002	0.253
~HFP+SEAS ~ scale(Np_SHR_1000) + scale(%_FOR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	911.097	0.001	0.248
~HFP+SEAS ~ scale(Np_SHR_1000) + scale(%_FOR_1000) + scale(%_PAST_1000) + (1|Local)	907.988	0.004	0.251
~HFP+SEAS ~ scale(Np_SHR_1000) + scale(np_5_CBM_1000) + scale(%_PAST_1000) + (1|Local)	917.945	0.000	0.228
~HFP+SEAS ~ scale(%_FOR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + scale(%_PAST_1000) + (1|Local)	913.163	0.000	0.244
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_OPEN_500) + scale(Np_SHR_1000) + scale(%_FOR_1000) + (1|Local)	899.747	0.228	0.278
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_OPEN_500) + scale(Np_SHR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	907.992	0.004	0.265
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_OPEN_500) + scale(Np_SHR_1000) + scale(%_PAST_1000) + (1|Local)	905.865	0.011	0.265
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_OPEN_500) + scale(%_FOR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	903.771	0.031	0.274
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_OPEN_500) + scale(%_FOR_1000) + scale(%_PAST_1000) + (1|Local)	902.890	0.047	0.272
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_OPEN_500) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + scale(%_PAST_1000) + (1|Local)	903.991	0.027	0.274
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(Np_SHR_1000) + scale(%_FOR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	907.030	0.006	0.267
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(Np_SHR_1000) + scale(%_FOR_1000) + scale(%_PAST_1000) + (1|Local)	903.851	0.029	0.269
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(Np_SHR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + scale(%_PAST_1000) + (1|Local)	909.182	0.002	0.262
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(np_1_CBM_1000) + I(scale(np_1_CBM_1000^2)) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + scale(%_PAST_1000) + (1|Local)	912.921	0.000	0.259
~HFP+SEAS ~ scale(%_OPEN_500) + scale(Np_SHR_1000) + scale(%_FOR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	906.909	0.006	0.263
~HFP+SEAS ~ scale(%_OPEN_500) + scale(Np_SHR_1000) + scale(%_FOR_1000) + scale(%_PAST_1000) + (1|Local)	903.640	0.033	0.265
~HFP+SEAS ~ scale(%_OPEN_500) + scale(Np_SHR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + scale(%_PAST_1000) + (1|Local)	907.663	0.004	0.261
~HFP+SEAS ~ scale(%_OPEN_500) + scale(%_FOR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + scale(%_PAST_1000) + (1|Local)	908.887	0.002	0.258
~HFP+SEAS ~ scale(Np_SHR_1000) + scale(%_FOR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + scale(%_PAST_1000) + (1|Local)	912.013	0.000	0.251
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_OPEN_500) + scale(Np_SHR_1000) + scale(%_FOR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + (1|Local)	903.060	0.044	0.281
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_OPEN_500) + scale(Np_SHR_1000) + scale(%_FOR_1000) + scale(%_PAST_1000) + (1|Local)	899.474	0.262	0.284
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_OPEN_500) + scale(Np_SHR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + scale(%_PAST_1000) + (1|Local)	903.825	0.030	0.279
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(%_OPEN_500) + scale(%_FOR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + scale(%_PAST_1000) + (1|Local)	904.041	0.027	0.279
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2)) + scale(Np_SHR_1000) + scale(%_FOR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + scale(%_PAST_1000) + (1|Local)	907.712	0.004	0.270

~HFP+SEAS ~ scale(%_OPEN_500) + scale(Np_SHR_1000) + scale(%_FOR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + scale(%_PAST_1000) + (1|Local)	**907.524**	**0.005**	**0.266**
~HFP+SEAS ~ scale(%_WB_500) + I(scale(%_WB_500^2))+ scale(%_OPEN_500) + scale(Np_SHR_1000) + scale(%_FOR_1000) + scale(%_SHR_1000) + I(scale(%_SHR_1000^2)) + scale(%_PAST_1000) + (1|Local)	**903.363**	**0.037**	**0.285**

Table A21 – List of the multivariate models comprised of combinations of the best univariate models regarding detection (p) and occupancy probabilities (*Psi*) gathered from previous steps, specific to the Egyptian mongoose, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. Still maintaining the sampled hunting area ID as random effect to account for the biogeographic differences among sites.

Multivariate Detection-Occupancy model formula	AICc	AICc-weights	adj-R2
~1~ 1 + (1|Local)	568.641	0.006	0.101
~1~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + (1|Local)	564.707	0.043	0.126
~1~ scale(Np_PAST_1000) + (1|Local)	565.386	0.031	0.117
~1~ scale(Np_AGRFOR_1000) + (1|Local)	564.535	0.047	0.120
~1~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(Np_PAST_1000) + (1|Local)	562.246	0.148	0.140
~1~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(Np_AGRFOR_1000) + (1|Local)	560.608	0.337	0.145
~1~ scale(Np_PAST_1000) + scale(Np_AGRFOR_1000) + (1|Local)	564.385	0.051	0.127
~1~ scale(%_AGR_500) + I(scale(%_AGR_500^2)) + scale(Np_PAST_1000) + scale(Np_AGRFOR_1000) + (1|Local)	560.610	0.336	0.151

Table A22 – List of the multivariate models comprised of combinations of the best univariate models regarding detection (p) and occupancy probabilities (*Psi*) gathered from previous steps, specific to the common genet, including each model's AICc, delta AICc, AICc-weights and the adjusted R^2. Still maintaining the sampled hunting area ID as random effect to account for the biogeographic differences among sites.

Multivariate Detection-Occupancy model formula	AICc	AICc-weights	adj-R2
~HFP+SEAS~ 1 + (1|Local)	907.365	0.000	0.103
~HFP+SEAS~ HAT+ (1|Local)	900.344	0.000	0.139
~HFP+SEAS~ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + (1|Local)	903.434	0.000	0.125
~HFP+SEAS~ scale(MSDI_500) + I(scale(MSDI_500^2)) + (1|Local)	898.633	0.000	0.137
~HFP+SEAS~ scale(PR_1000) + (1|Local)	904.685	0.000	0.116
~HFP+SEAS~ scale(RAB) + (1|Local)	909.306	0.000	0.103
~HFP+SEAS~ HAT+ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + (1|Local)	894.304	0.003	0.165
~HFP+SEAS~ HAT+ scale(MSDI_500) + I(scale(MSDI_500^2)) + (1|Local)	889.007	0.040	0.178
~HFP+SEAS~ HAT+ scale(PR_1000) + (1|Local)	896.816	0.001	0.153
~HFP+SEAS~ HAT+ scale(RAB) + (1|Local)	900.090	0.000	0.145
~HFP+SEAS~ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + scale(MSDI_500) + I(scale(MSDI_500^2)) + (1|Local)	898.586	0.000	0.149
~HFP+SEAS~ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + scale(PR_1000) + (1|Local)	903.898	0.000	0.129
~HFP+SEAS~ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + scale(RAB) + (1|Local)	905.532	0.000	0.125
~HFP+SEAS~ scale(MSDI_500) + I(scale(MSDI_500^2)) + scale(PR_1000) + (1|Local)	895.592	0.002	0.151
~HFP+SEAS~ scale(MSDI_500) + I(scale(MSDI_500^2)) + scale(RAB) + (1|Local)	900.748	0.000	0.137
~HFP+SEAS~ scale(PR_1000) + scale(RAB) + (1|Local)	906.784	0.000	0.116
~HFP+SEAS~ HAT+ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + scale(MSDI_500) + I(scale(MSDI_500^2)) + (1|Local)	887.038	0.108	0.194
~HFP+SEAS~ HAT+ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + scale(PR_1000) + (1|Local)	893.578	0.004	0.172
~HFP+SEAS~ HAT+ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + scale(RAB) + (1|Local)	895.450	0.002	0.168
~HFP+SEAS~ HAT+ scale(MSDI_500) + I(scale(MSDI_500^2)) + scale(PR_1000) + (1|Local)	885.174	0.275	0.193
~HFP+SEAS~ HAT+ scale(MSDI_500) + I(scale(MSDI_500^2)) + scale(RAB) + (1|Local)	888.955	0.042	0.184
~HFP+SEAS~ HAT+ scale(PR_1000) + scale(RAB) + (1|Local)	897.286	0.001	0.157
~HFP+SEAS~ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + scale(MSDI_500) + I(scale(MSDI_500^2)) + scale(PR_1000) + (1|Local)	898.451	0.000	0.154
~HFP+SEAS~ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + scale(MSDI_500) + I(scale(MSDI_500^2)) + scale(RAB) + (1|Local)	900.607	0.000	0.149
~HFP+SEAS~ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + scale(PR_1000) + scale(RAB) + (1|Local)	905.891	0.000	0.130
~HFP+SEAS~ scale(MSDI_500) + I(scale(MSDI_500^2)) + scale(PR_1000) + scale(RAB) + (1|Local)	897.655	0.001	0.151
~HFP+SEAS~ HAT+ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + scale(MSDI_500) + I(scale(MSDI_500^2)) + scale(PR_1000) + (1|Local)	886.201	0.165	0.201
~HFP+SEAS~ HAT+ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + scale(MSDI_500) + I(scale(MSDI_500^2)) + scale(RAB) + (1|Local)	888.045	0.065	0.197
~HFP+SEAS~ HAT+ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + scale(PR_1000) + scale(RAB) + (1|Local)	895.170	0.002	0.174
~HFP+SEAS~ HAT+ scale(MSDI_500) + I(scale(MSDI_500^2)) + scale(PR_1000) + scale(RAB) + (1|Local)	885.728	0.209	0.197
~HFP+SEAS~ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + scale(MSDI_500) + I(scale(MSDI_500^2)) + scale(PR_1000) + scale(RAB) + (1|Local)	900.257	0.000	0.155
~HFP+SEAS~ HAT+ scale(Np_AGRFOR_1000) + I(scale(Np_AGRFOR_1000^2)) + scale(MSDI_500) + I(scale(MSDI_500^2)) + scale(PR_1000) + scale(RAB) + (1|Local)	887.645	0.080	0.203

Table A23 – Additional information of each study area

Study Areas	Administrative figure	Hunting modalities	Big game hunting	Wild boar hunting period	Hunting data available	Artificial feeding	Fancing	Big animals present (ungulates and carnivores)
Castreja (CJ)	Associative hunting ground	Montaria and individual hunting	Yes	out-feb	Yes	No	No	Red deer, roe deer, wild boar, Iberian ibex, Iberian wolf
Lombada (LB)	National hunting ground	Montaria and individual hunting	Yes	out-feb	Yes	No	No	Red deer, roe deer, wild boar, Iberian wolf
Porcas de Murça (PM)	Municipal hunting ground	Montaria and individual hunting	Yes	out-feb	Yes	No	No	Roe deer, wild boar
Castelo Melhor (CM)	Associative hunting ground	Montaria and individual hunting	Yes	out-feb	Yes	No	No	Roe deer, wild boar
Aveiro (AV)	Municipal hunting ground	Montaria and individual hunting	Yes	out-feb	Yes	No	No	Wild boar
Cubeira (CB)	Touristic hunting ground	Montaria and individual hunting	Yes	out-feb	Yes	Yes	Yes	Red deer, wild boar
Penela (PL)	Municipal hunting ground	Montaria and individual hunting	Yes	out-feb	Yes	No	No	Red deer, roe deer, wild boar
Pedrógão (PD)	Touristic hunting ground	Montaria and individual hunting	Yes	out-feb	Yes	Yes	Yes	Fallow deer, wild boar
Sudoeste Alentejano (SA)	Associative hunting ground	Montaria and individual hunting	Yes	out-feb	Yes	No	No	Wild boar
Tapada Nacional de Mafra (TM)	National hunting ground	Montaria and individual hunting	Yes	out-feb	Yes	Yes	Yes	Red deer, Fallow deer, wild boar
Tolosa (TL)	Associative hunting ground	Montaria and individual hunting	Yes	out-feb	Yes	No	No	Red deer, Fallow deer, wild boar
Parque Natural da Serra da Arrábida (AR)	Natural Park (cosnidered a national hunting zone)	No	No	No	No	No	No	Wild boar
Hortas das Laranjeiras (HL)	Touristic hunting ground	Montaria/individual hunting	Yes	out-feb	Yes	Yes	Yes	Red deer, wild boar, Iberian lynx
Alcoutim (AL)	Municipal hunting ground	Montaria/individual hunting	Yes	out-feb	Yes	No	No	Red deer, wild boar, Iberian lynx
São Brás (SB)	Associative hunting ground	Montaria/individual hunting	Yes	out-feb	Yes	No	No	Red deer, wild boar
Vila Nova de Paiva (VNP)	Associative hunting ground	Montaria	Yes	out-feb	Yes	No	No	Roe deer, wild boar, Iberian wolf