Short Communication

Association of the polecat *Mustela putorius* in eastern Spain with montane pine forests

Emilio Virgós

Abstract Populations of European polecat *Mustela putorius* have suffered a significant decline over the last few decades, although this trend may be reversing in some regions. In Mediterranean areas, which are generally at the edge of the species' range, there is little information on the distribution and conservation requirements of this species. This study analyses the relationship between habitat types and polecat distribution in the Valencia region of eastern Spain. Validated responses to questionnaires sent to naturalists, forestry agents, hunters and other groups likely to have seen polecats were used to record the presence of polecats in 10 * 10 km squares. Polecats were recorded only in areas of low human population density located at high altitudes, in contrast to the more well-studied populations of polecats elsewhere in Europe, where the species is associated more with human-modified environments. Montane pine forests appear to be the preferred habitat type for polecats in eastern Spain, and their absence from the extensive areas of low-lying scrubland, which are produced by a continuous history of fire disturbance, may be due to the relatively low diversity and abundance of potential prey in this habitat.

Keywords Landscape, Mediterranean, *Mustela putorius*, pine forests, polecat, scrubland, Spain.

This paper contains supplementary material that can only be found online at http://journals.cambridge.org

Populations of European polecat *Mustela putorius* have suffered a significant decline over the last few decades (Blandford, 1987; Birks & Kitchener, 1999), although this trend may be reversing in some places, such as lowland Britain (Blandford, 1987; Birks, 1995; Birks & Kitchener, 1999). In Mediterranean areas information about the distribution, ecology and conservation of this species is lacking or scant (but see Blas-Aritio, 1970; Ruiz-Olmo, 1995).

Although the species shows a preference for watercourses or nearby areas (Blandford, 1987; Brzezinski *et al*., 1992; but see Blandford, 1987; Weber, 1989; Lodé, 1993), polecat habitat requirements are poorly known, and most research on the species has concerned the factors influencing population declines (Blandford, 1987; Weber, 1989; Mason & Weber, 1990; Shore *et al*., 1996; Birks & Kitchener, 1999). Little is known about the association between landscape composition, topography or elevation and polecat presence in a region. Landscape composition may affect food resources, human disturbance, shelter and other key resources for polecats, and knowledge of the association between these factors and polecat presence could help the establishment of suitable management and conservation practices for the species.

During 1996–2000 the Valencia Government and the Spanish Society for the Conservation of Mammals (SECEM) initiated a study of the polecat in the Valencia region of eastern Spain, at the edge of the species range, with the aim of investigating the relationship between the species and its habitat. In this region, polecat distribution appears to be very fragmented and population numbers are probably low, with an apparent marked decline over the last 30 years (Roncadell-SECEM, 1997).

The Valencia region (Fig. 1) was subdivided into 10 * 10 km squares ($n = 302$) and the presence of polecats in each was recorded using questionnaires (Appendix), which were sent out during 1996–1997 to naturalists, forestry agents, hunters and other groups likely to have seen polecats. Records of polecat presence obtained from the questionnaires was validated by volunteers who had experience in wildlife studies. They searched for the original sources of data and checked the quality of the reports. Records were classified into four types according to reliability: 1) unequivocal observation by the informant ($n = 17$); 2) observations by persons other than the informant ($n = 23$); 3) unclear observations ($n = 6$); 4) scats, footprints and other unclear or indirect evidence ($n = 23$). Only evidence of type 1 and convincing, validated reports of type 2 (for example, coinciding reports from different

Emilio Virgós Escuela Superior de Ciencias Experimentales y Tecnología, Dpto. Matemáticas, Física Aplicada y CC. Naturales, Área de Biodiversidad y Conservación Universidad Rey Juan Carlos, E-28933 Móstoles (Madrid), Spain. E-mail: evirgos@escet.urjc.es

Received 5 February 2002. Revision requested 10 June 2002. Accepted 16 June 2003.

© 2003 FFI, *Oryx*, **37**(4), 484–487 DOI: 10.1017/S0030605303000863 Printed in the United Kingdom

https://doi.org/10.1017/S0030605303000863 Published online by Cambridge University Press

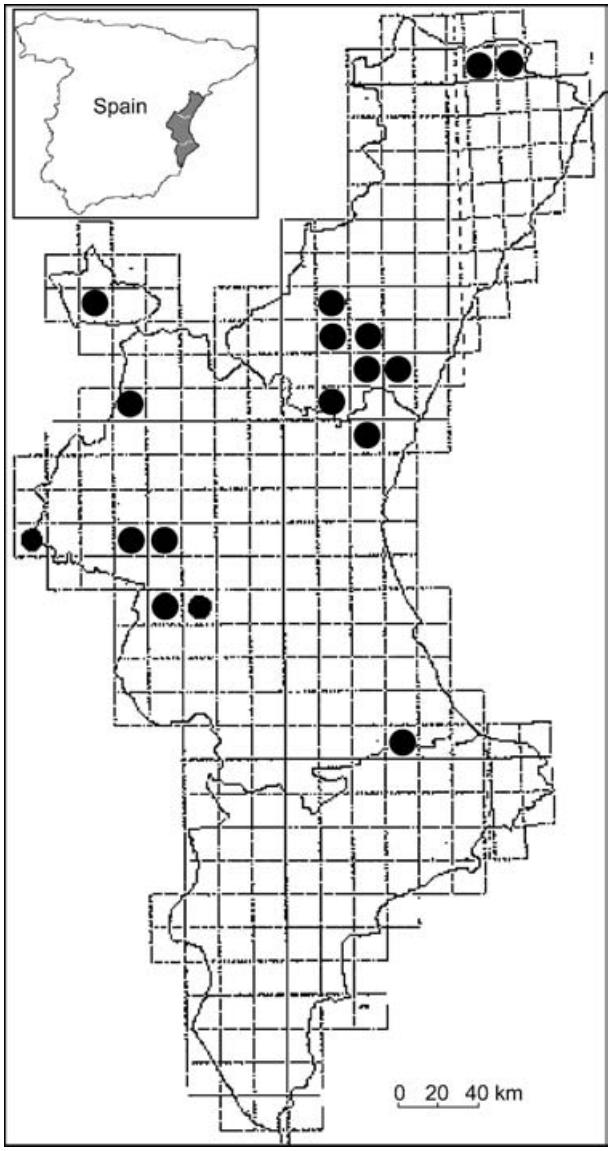

Fig. 1 Records of polecats (black dots) in 10 * 10 km squares in the Valencia region. The inset indicates the location of the main figure in eastern Spain.

people or reports from people known to have a good knowledge of the species) were included in the analysis. In addition, only data for 1992–1997 was considered.

In each 10 * 10 km square the percentage cover of the following habitat types was determined: cropland, cropland-scrubland, fruit tree cultivation, fruit tree-scrubland, vineyard, vineyard-scrubland, orchard, pasture-scrubland, scrubland, oak forests, oak-pine forests, pine forest, and pine-scrubland. Habitat types were quantified by overlaying on a 1:50.000 scale land-use and vegetation map a grid containing 100 evenly spaced points on each of the 10 * 10 km squares. In addition, in each square the mean elevation was calculated from the 100 points, and a 'roughness' index was calculated as the number of 20 m elevation contours recorded in each square.

In order to analyse any association of polecat distribution with landscape descriptors (i.e. habitat types and topography), the data was subdivided into two sub-samples: squares in which polecats had been observed ($n = 17$), and a stratified sub-sample of squares in which there were no records of polecats ($n = 32$). The latter sub-sample was selected in proportion to the surface area of each province in the region (Castellón, Valencia and Alicante), and randomly within each province. The association between polecat presence and landscape descriptors was investigated using forward stepwise logistic regression (Norusis, 1991). As the landscape descriptors were not independent of each other, a Principal Components Analysis (PCA) was used to obtain new, uncorrelated variables, which were then used as the independent variables in the regression analysis.

Responses were received to 80% of the questionnaires sent out, with 69 reported records of polecats. There were only 30 records of types 1 and 2 during 1992–1997, in 17 squares (5.7% of the area, Fig. 1) and all were validated. There were 18 observations of live individuals, 10 observations of live animals by individuals other than the reporter, one road casualty and one animal killed by a hunter. All reported records were made either by naturalists working with SECEM, by other naturalists, or by wildlife agents and farmers. A complete description of the habitat type was available for only 21 of these records. In seven of the observations, polecats were seen besides rivers, small streams or in marshes, and the other 14 records were in habitat types away from watercourses.

The PCA produced six varimax rotated factors that explained 77.5% of the variance in the landscape descriptors. Factor 1 ranked landscapes from high altitudes to low-lying areas, Factor 2 distinguished orchard areas from other landscape types, Factor 3 described a gradient from landscapes covered by pine-scrubland mosaic with oak forests through to homogeneous pine forests, Factor 4 separated croplands from other cultivated areas, Factor 5 distinguished areas covered by scrublands and mosaics of vineyards with scrublands from continuous pine forests, and Factor 6 ranked landscapes from those dominated by oak forests to those dominated by pine forests.

In the regression only Factors 1 and 5 were significant and therefore included in the final regression model (Table 1). Polecats appeared to be mostly associated with montane pine forests, which are areas with a low human population density, and were not associated with either the scrublands or the extensive cultivated areas of the lowlands. Scrubland areas at high altitude had a low occurrence of polecats. Historical data (Blas-Aritio, 1970)

https://doi.org/10.1017/S0030605303000863 Published online by Cambridge University Press

Table 1 Results of a forward stepwise multiple logistic regression* with polecat presence/absence as the dependent variable and the six Principal Component Analysis factors (see text for further details) as predictors (only final regression model shown).

Variables	*b*	Wald statistic	d.f.	P	*R*
PCA Factor 1 (elevation gradient)	3.319	2.868	1	0.09	0.138
PCA Factor 5 (pine-scrubland gradient)	2.817	5.781	1	0.02	0.288
Constant	−0.769	0.874	1	0.38	

*$G_{model} = 28.07$, d.f. = 2, $P < 0.001$.

indicates that polecats were formerly more widely distributed, especially in the central and southern provinces of the region, but the general pattern of distribution and habitat associations were similar to those recorded in this study.

Although the relatively small number of records precludes drawing a definitive conclusion about the habitat preferences of polecats in the Valencia Region, the results indicated that habitat associations are different from those of the well-studied populations of polecat elsewhere in Europe, where the species is associated with human-modified environments (Blandford, 1987). The extensive areas of scrubland in eastern Spain appear to be of low conservation value for polecats. These areas have a continuous history of fire disturbance (Generalitat Valenciana, 1998) and generally have a lower floristic diversity and a lower abundance of rodents than forests (Costa, 1986; Fuentes *et al*., 1998) and thus a generally low diversity and abundance of potential prey.

The findings of this study indicate that management and conservation of the polecat in eastern Spain, at the edge of the species' range, will need to concentrate on montane pine forests. Although such forests have generally been considered to be low priority habitats for the conservation of biodiversity in Spain (Tellería, 1992), they appear to be the most important habitat for the polecat. Conservation of the species in the Valencia region will also require further detailed examination of the polecat's preferred habitat types, possibly using camera-trapping and/or radio tracking.

Acknowledgements

J. Barona, J. M. de Alba and Y. Cortés helped with questionnaires. Validation of the data was carried out with the help of a large number of volunteers from the Roncadell association. J. Jiménez, G. Calabuig and M. V. Fuentes provided help in various ways, and P. Chanin and J. D. S. Birks made useful suggestions on an earlier version of the manuscript. This project was funded by the Conselleria de Medi Ambient of the Generalitat of Valencia, and EV received a grant from the project 1FD97-2299 during preparation of the manuscript.

References

Birks, J. (1995) Recovery of the European polecat (*Mustela putorius*) in Britain. *Small Carnivore Conservation*, **12,** 9.

Birks, J. & Kitchener, A.C. (1999) *The Distribution and Status of the Polecat* Mustela putorius *in Britain in the 1990s*. Vincent Wildlife Trust, Herefordshire, UK.

Blandford, P.R.S. (1987) Biology of the polecat *Mustela putorius*: a literature review. *Mammal Review*, **17,** 155–198.

Blas-Aritio, L. (1970) *Vida y Costumbres de los Mustélidos Españoles*. Servicio de Pesca Continental, Caza y Parques Nacionales, Madrid, Spain.

Brzezinski, M., Jedrzejewski, W. & Jedrzejewska, B. (1992) Winter home ranges and movements of polecats *Mustela putorius* in Bialowieza primeval forest, Poland. *Acta Theriologica*, **37,** 181–191.

Costa, M. (1986) *La vegetació al Pais Valencià*. Colección Cultura Universitaria Popular, n° 5. Universitat de València, València, Spain.

Fuentes, M.V., Galán-Puchades, M.T. & Cerezuela, A.M. (1998) Insectívoros y roedores de la Sierra Calderona (Comunitat Valenciana). Dinámicas de recolonización y estudio helmintológico postincendio. *Galemys*, **10,** 37–58.

Generalitat Valenciana (1998) *Los incendios en la Comunidad Valenciana*. Conselleria d'agricultura i pesca. Generalitat Valenciana, Valencia, Spain.

Lodé, T. (1993) Stratégies d'utilisation de l'espace chez le Putois européen *Mustela putorius* L. dans l'ouest de la France. *Revue d'Ecologie (Terre et Vie)*, **48,** 305–322.

Mason, C.F. & Weber, D. (1990) Organochlorine residues and heavy metals in kidneys of polecats (*Mustela putorius*) from Switzerland. *Bulletin of Environmental Contamination and Toxicology*, **45,** 689–696.

Mason, C.F. & Weber, D. (1990) Organochlorine residues and heavy metals in kidneys of polecats (*Mustela putorius*) from Switzerland. *Bulletin of Environmental Contamination and Toxicology*, **45,** 689–696.

Norusis, M.J. (1991) *SPSS/PC + TM update for V 3.0 and 3.1 for the IBM PC/XT/AT and PS/2*. SPSS Inc. Chicago, USA.

Roncadell-SECEM (1997) *Atlas provisional de los carnívoros de la Comunidad Valenciana*. Dirección General del Medio Natural, Generalitat de Valencia, Valencia, Spain.

Ruiz-Olmo, J. (1995) Turó. In *Els grans mamífers de Catalunya i Andorra* (eds J. Ruiz-Olmo & A. Aguilar), pp. 77–81. Lynx Edicions. Generalitat de Catalunya, Departament d'Agricultura, Ramaderia i Pesca, Barcelona, Spain.

Shore, R.F., Birks, J.D.S., Freestone, P. & Kitchener, A.C. (1996) Second-generation rodenticides and polecats (*Mustela putorius*). *Environmental Pollution*, **3,** 279–282.

Tellería, J.L. (1992) Gestión forestal y conservación de aves en España peninsular. *Ardeola*, **39,** 99–114.

https://doi.org/10.1017/S0030605303000863 Published online by Cambridge University Press

Weber, D. (1989) The ecological significance of resting sites and the seasonal habitat change in polecats (*Mustela putorius*). *Journal of Zoology, London*, **217,** 629–638.

Appendix

The appendix for this article is available online at http://journals.cambridge.org

Biographical sketch

Emilio Virgós is currently studying the ecology of red-ledged partridge and wild rabbits. He is also the head of the Terrestrial Carnivore Conservation Group of the Spanish Society of Mammalogists, studying badger and polecat conservation problems in Spain.

https://doi.org/10.1017/S0030605303000863 Published online by Cambridge University Press