



Biogeographical patterns in the diet of the wildcat, *Felis silvestris* Schreber, in Eurasia: factors affecting the trophic diversity

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ABSTRACT

Aim To analyse the biogeographical patterns in the feeding habits and trophic diversity of prey of the wildcat, *Felis silvestris* Schreber.

Location The Eurasian distribution range from the Caucasian mountains to the Iberian Peninsula and Scotland.

Methods We reviewed 15 studies to collate data on feeding behaviour across the current wildcat distribution range. We considered nine prey groups and recorded the latitude, whether the location was within a Mediterranean bioclimate area, and rabbit presence. Prey groups were reduced into four PCA factors. Regression analyses were performed to examine the relationships of latitude with PCA factors and trophic diversity. ANOVA was used to test if trophic diversity was higher at locations with Mediterranean climates. We also analysed the relationship between small rodent consumption and both Mediterranean climates and rabbit presence using ANOVA. Finally, we confirmed the relationship between the frequency of Murinae and Microtinae in the diets and the presence of rabbits and with respect to Mediterranean climates controlling for latitude (MANCOVA).

Results Diet diversity was greatest in Mediterranean climates. Trophic diversity decreased when rodents formed the bulk of the diet, but increased with the inclusion of alternative prey such as rabbits and invertebrates. Small rodent consumption was also negatively related to rabbit consumption or presence. The inclusion of Murinae and Microtinae in the diet varied with latitude, with higher ingestion of the former in the southern locations and of the latter in northern areas.

Main conclusions The trophic diversity of the wildcat diet was associated with Mediterranean climatic conditions, being broader at more southern latitudes. At the continental scale, the wildcat cannot be considered a rodent specialist because rabbits were preferred when they were present. Thus, we consider the wildcat to be a facultative specialist. In addition, our results indicate that general trophic patterns in the diet of a species may not be accurately determined if the availability of alternative prey is not taken into account.

Keywords

Biogeographical patterns, diet, feeding habits, *Felis silvestris*, latitudinal gradient, Mediterranean area, rabbit, rodents, trophic diversity, wildcat.

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INTRODUCTION

Feeding ecology is central to an understanding of the ecology and life-history strategies of species. The abundance and

distribution of food can affect a range of life-history traits, including body size, spatial organization or mating system (Partridge & Green, 1985; Vezina, 1985; Gittleman, 1986; Dayan & Simberloff, 1996; Geffen *et al.*, 1996). Feeding

ecology may be studied from several perspectives, including the collation of data from comparative studies among different taxa and those comparing feeding habits of the same species at different locations (Futuyma & Moreno, 1988; Gompfer & Gittleman, 1991). Among the latter, a classical approach is to explain feeding habits of individuals at the local scale by using optimal foraging theory (Partridge & Green, 1985; Stephens & Krebs, 1986). However, comprehensive knowledge of the feeding ecology of a species and its influence on other life-history traits requires alternative or additional approaches. Studies aimed at comparing the feeding habits of a single species across different geographical regions or habitats may be useful for identifying factors associated with changes in feeding behaviour and how these may be associated with other key ecological traits.

For instance, defining a species as a feeding generalist or specialist is only relevant in the context of extensive ecological studies, in which variation in feeding behaviour among populations over a broad range of environmental conditions is considered ('between-factor niche width'; Roughgarden, 1972). The study of niche width thus requires a comparative approach that encompasses a large spatial extent.

For medium-sized carnivores, relatively few studies have compared the diet of a species at biogeographical scales. To date, studies have been performed on the badger, *Meles meles* L. (Roper & Mickevicius, 1995; Goszczynski *et al.*, 2000); the polecat, *Mustela putorius* L. (Lodé, 1997); the common genet, *Genetta genetta* L. (Virgós *et al.*, 1999); and the otter, *Lutra lutra* L. (Clavero *et al.*, 2003). These species share relatively large distributions where they inhabit a range of environments. The results of these studies have identified dietary variation within a species according to the particular features of the locations at which it is found (xericity, heterogeneity, and so on).

A commonly described pattern is that in the Palaearctic, diets are more diverse at lower latitudes, a result also reported for patterns of species richness at the global scale (Rosenzweig, 1995; Cox & Moore, 2005). Another interesting result is the higher diversity of diets in areas with a typical Mediterranean climate (Virgós *et al.*, 1999).

The same biogeographical pattern of diet diversity has been described for other Palaearctic predators, such as various raptor species (e.g. Korpimäki & Marti, 1995; Arroyo, 1997), and in the Nearctic for the mountain lion, *Puma concolor* L., a large carnivore (Iriarte *et al.*, 1990). These studies showed how the presence and abundance of potential prey explained the patterns of diet diversity and composition of generalist predators distributed over large geographical areas (Schoener, 1971).

The European wildcat, *Felis silvestris* Schreber, is a medium-sized carnivore that is widely distributed over the Palaearctic, although as a consequence of habitat loss and persecution by humans the distribution area now has a patchy structure (Sunquist & Sunquist, 2002). Little is known of basic wildcat ecology, but their feeding habits have been examined in some detail at numerous locations (Stahl & Leger, 1992; Sunquist &

Sunquist, 2002). Wildcats consume a large diversity of prey from rodents to small ungulates, but the staple prey species in most locations are small mammals (Condé *et al.*, 1972; Sládek, 1973; Hewson, 1983; Sarmiento, 1996; Moleón & Gil-Sánchez, 2003), or the wild rabbit, *Oryctolagus cuniculus* L. (Corbett, 1979; Aymerich, 1982; Gil-Sánchez, 1998; Gil-Sánchez *et al.*, 1999) where available. Indeed, a recent study in central Spain showed that wildcats may behave as a facultative rodent- or rabbit-specialist depending on the local availability of each prey type (Malo *et al.*, 2004). They also found that wildcats preferred rabbits over other small mammals.

However, the feeding habits of wildcats have not been rigorously examined at large spatial scales covering most of its western Palaearctic distribution range. In this study we describe the pattern of the food spectrum of wildcats at the biogeographical scale by reviewing the available literature. In addition, we test three predictions derived from previous studies on the food ecology of the wildcat and other carnivore species at regional scales:

1. Wildcat diets should be more diverse at low latitudes or in locations with Mediterranean climates.
2. In accord with a regional study in central Spain (Malo *et al.*, 2004), wildcats should show facultative specialization on rabbits in locations where the latter are present. Concomitantly, the consumption of rodents should be lower in areas where rabbits are present.
3. As has been suggested for genets at the continental scale (Virgós *et al.*, 1999) and for wildcats at the national scale (Stahl & Leger, 1992), within the rodent fraction of the diet, the consumption of Murinae should increase, and the consumption of Microtinae should decrease, at low latitudes. This change in the relative importance of both groups of rodents is due to an increase in the abundance of Murinae at southern European locations (see for instance Saint-Girons & Vesco, 1974; Brunet-Lecomte & Delibes, 1984). In making this prediction, we assumed that wildcats behave opportunistically when consuming rodents, taking Murinae or Microtinae in relation to their availability (Stahl & Leger, 1992; Malo *et al.*, 2004).

MATERIAL AND METHODS

Literature review and data standardization

We examined 27 publications covering the geographical distribution of the species in Europe and western Asia. There was large variability in the quality, data source and presentation of results in the studies. To homogenize the sample and standardize the comparison of results from different geographical areas, we created criteria for exclusion from our data base. First, we discarded all studies that had small sample sizes ($n < 25$), had data from only one season, or contained very wide prey categories and hence were not suitable for inter-population comparisons.

We also discarded studies that only reported data as frequency of occurrence (FO) and did not contain sufficient

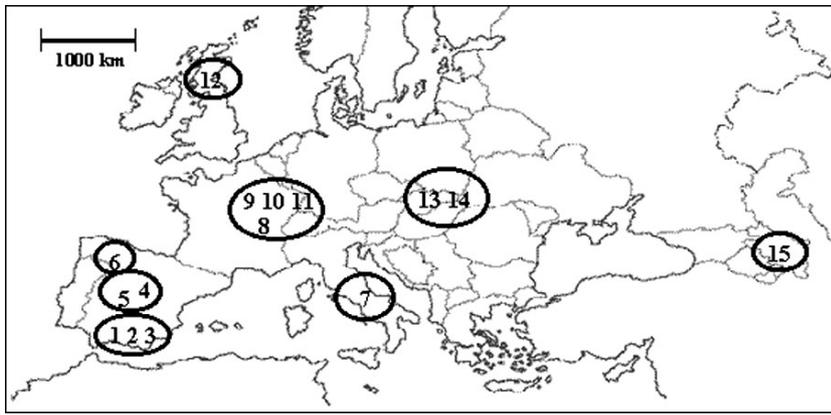


Figure 1 Geographic location of the reviewed studies in western Eurasia. Numbers are cross-referenced with the studies reported in the appendices: 1: Gil-Sánchez *et al.* (1999); 2: Gil-Sánchez (1998); 3: Moleón & Gil-Sánchez (2003); 4: Malo *et al.* (2004); 5: Aymerich (1982); 6: Fernandes (1993); 7: Ragni (1981); 8: Condé *et al.* (1972); 9: Leger (non publ., see Stahl & Leger, 1992); 10: Stahl (1986); 11: Riols (1988); 12: Corbett (1979); 13: Sládek (1973); 14: Kozená (1990); 15: Nasilov (1972).

information to calculate the relative frequency (RF) of different prey categories in relation to the total number of prey. Although FO data are widely used in diet studies of carnivores (Reynolds & Aebischer, 1991), we used RF because (1) they were reported most often in the wildcat studies reviewed; (2) large sample size was associated with lower rates of Type I error, which favored the use of RF instead of FO in our analyses; and (3) RF values are considered to be highly suitable for inter-population comparisons in diet studies (Clavero *et al.*, 2003).

Biomass estimates are the most useful data because they may be considered a direct measure of energetic value of the different prey items consumed (Reynolds & Aebischer, 1991). However, we could not consider biomass data because only a small fraction of the reviewed studies presented this information. Moreover, in those studies reporting biomass data, the high diversity of methods used to calculate biomass and the low accuracy in the taxonomic categories used precluded their use in further geographical comparisons.

For our analyses, we selected 15 studies from the original 27 (Appendices 1 and 2). The geographical distribution of these studies is shown in Fig. 1. The fragmented distribution of the studies mimics the current geographical distribution of wildcats in the western Palearctic, and therefore is not an artifact of non-random sampling (Stahl & Leger, 1992). The study area covered continental Eurasia from the Caucasus Mountains in the east (50° E) to the Iberian Peninsula in the west (8° W) and south (37° N), and including the northern populations of Scotland (57° N).

The different prey groups in the diet studies were rearranged to homogenize the data for comparative purposes, and we recalculated RF values where necessary. Nine prey groups were distinguished: small rodents (smaller than *Rattus norvegicus* Berkenhout), large rodents (*Rattus norvegicus* size or larger), hares (*Lepus* spp.), rabbits, insectivores, birds, herptiles (amphibians and reptiles), invertebrates, and others (secondary prey not in the previous categories, namely ungulates and carnivores).

In the selected studies, there were two potential confounding factors for our inter-population comparisons: (1) some only reported data for two seasons; and (2) the source of analysed

food material varied among the studies (stomachs or scats). It has been suggested that some prey groups are underrepresented in scats compared to stomachs due to differential digestion of different prey groups (Putman, 1984). These factors could potentially invalidate the combined use of samples from different sources or with different sampling periods. To check the potential effects of incomplete sampling and type of material analysed, we used a two-way MANOVA with the sampling period and type of material as fixed factors and the prey groups as response variables.

Variables selected and statistical analyses

In a recent study of wildcats in central Spain, Malo *et al.* (2004) found that feeding habits can differ in nearby locations due to differences in the availability of prey species, particularly rabbits. Hence, despite the small geographical distance between the sites studied by the authors, we considered sites with and without rabbits as ecologically distinct and therefore as different locations in our analysis. For all locations we calculated the trophic diversity using the Shannon–Wiener index, H' (Weaver & Shannon, 1949).

For each location, we estimated latitude to a half degree, taken from information available in the studies or using a geographical data base. When samples were collected over a large area, latitude was estimated for the largest part of the sample. We also recorded whether locations lay within a Mediterranean bioclimate area or in another climate zone (Ozenda, 1982), and we noted whether rabbits were present or absent at each location using the information available in each study.

Non-normal or heteroscedastic variables were transformed prior to analysis (Zar, 1984). When a transformation was unsuccessful, we tested for positive kurtosis, which allows for the assumption of low Type I error rates (Underwood, 1996).

To describe the overall patterns of wildcat diet and to test Prediction 1, we reduced the nine prey groups into orthogonal factors using a principal components analysis (PCA). The PCA factors were used as response variables in regression analyses where latitude was the predictor. The relationship between H' trophic diversity index and latitude was examined by regression, where latitude was also the predictor. Further, ANOVA was

used to study the influence of Mediterranean conditions on trophic diversity, with the Mediterranean conditions as a factor.

To test Prediction 2 we used two procedures. First, to determine whether wildcats are facultative specialists that prefer rabbits over small rodents, we predicted a reduction in the consumption of the latter when rabbits were present. We tested this using a two-way ANOVA in which small rodent RF was used as a response variable and climatic conditions (Mediterranean vs. non-Mediterranean) and rabbit presence were used as fixed factors. Second, it has been suggested that a negative relationship between trophic diversity and the ingestion of the preferred (specialized) prey is an indicator of dietary specialization (Futuyma & Moreno, 1988; Watson, 1997; Fedriani *et al.*, 1998). We thus tested for a negative association between small rodent consumption and trophic diversity, and we also tested for a negative relationship between small rodent consumption and rabbit consumption.

To test Prediction 3, we analysed covariation in the consumption of Murinae and Microtinae in a two-way MANCOVA in which rabbit presence and climatic conditions were used as fixed factors, and latitude was included as a covariate. All statistical analyses were performed using STATISTICA 6.0 (StatSoft, 2001).

RESULTS

We found no significant differences in the consumption of prey groups (including Murinae and Microtinae), nor in values of trophic diversity, among studies with different sampling periods or type of material (scats vs. stomachs) (Table 1). We thus pooled data from studies with different sampling periods (at least two seasons) and type of material for further analyses.

The PCA using the nine prey groups generated four orthogonal factors (varimax normalized rotated) that explained 80.4% of the variance of the original variables (Table 2). The first factor can be interpreted as a gradient from populations with high consumption of the prey comprising the 'others' group (positive scores) to populations with high rabbit consumption (negative scores). The second factor is a gradient from populations with high consumption of hares (positive scores) to populations with high consumption of herptiles and invertebrates (negative scores). The third factor defined a

Table 1 Results of a two-way MANOVA with 12 response variables (the nine main prey groups plus Microtinae and Murinae, and H' diet diversity) and two fixed factors [study period (annual or seasonal) and type of material (stomachs or scats)] ($n = 10$)

	Value	<i>F</i>	d.f. effect	d.f. error	<i>P</i>
Study period	0.02101	7.77	6	1	0.268
Material	0.00932	17.71	6	1	0.1799
Study period × material	0.34387	0.32	6	1	0.8734

Table 2 Results from a principal components analysis (PCA, varimax normalized rotated) using the nine prey groups ($n = 15$)

Variables	Factor 1	Factor 2	Factor 3	Factor 4
Small rodents	0.4	0.18	-0.53*	0.66*
Large rodents	0.34	0.48	-0.03	0.61*
Birds	0.03	0.08	-0.06	-0.91*
Insectivores	0.08	-0.08	0.89*	0.004
Herptiles	-0.27	-0.71*	0.32	0.08
Invertebrates	0.23	-0.82*	0.13	-0.39
Others	0.77*	0.26	0.24	-0.03
Rabbit	-0.76*	0.004	0.33	-0.4
Hares	0.41	0.77*	0.19	-0.11
Eigenvalue	1.761	2.12	1.391	1.969
Explained variance (%)	19.56	23.56	15.46	21.87

*Significant correlation between the original variables with the extracted factors.

Table 3 Pearson correlations of latitude with PCA factors, and of trophic diversity (H') with the nine prey groups ($n = 15$)

	Latitude
Factor 1	-0.07
Factor 2	0.56*
Factor 3	-0.11
Factor 4	0.16
	Trophic diversity (H')
Small rodents	-0.83*
Large rodents	-0.54*
Birds	0.48
Insectivores	0.61*
Herptiles	0.48†
Invertebrates	0.56*
Others	0.06
Rabbit	0.52*
Hares	-0.12

*Significant correlation ($P < 0.05$).

†A marginally non-significant correlation ($P < 0.10$).

gradient from populations where insectivores were relatively important (positive scores) to those where the small rodents constituted the bulk of the diet (negative scores). The fourth factor is a gradient from populations that incorporated high proportions of both large and small rodents (positive scores) to populations where birds were incorporated into the diet to some extent (negative scores).

When the PCA factors were regressed against latitude, only factor 2 was significant (Table 3), having a positive relationship ($r^2 = 0.316$, $F_{1,13} = 6.03$, $P < 0.05$, Fig. 2a). Thus, the consumption of hares by wildcats is higher at high latitudes whereas more herptiles and invertebrates are eaten at lower latitudes.

Our initial test of Prediction 1 in which the H' trophic diversity index was regressed against latitude revealed a

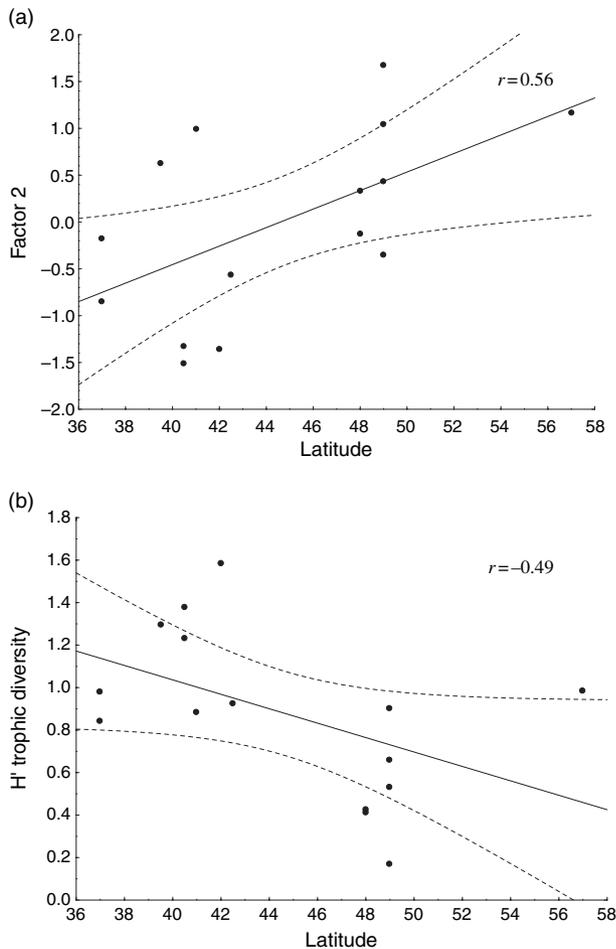


Figure 2 Relationship between latitude and (a) factor 2 from PCA, and (b) H' trophic diversity (marginally non-significant, $P < 0.10$).

marginally non-significant relationship ($r^2 = -0.242$, $F_{1,13} = 4.15$, $P = 0.06$, Fig. 2b). However, the ANOVA with trophic diversity as the response variable and climatic conditions (Mediterranean vs. non-Mediterranean) as the treatment was significant ($F_{1,13} = 13.06$, $P < 0.01$, Fig. 3). Thus, trophic diversity is (1) marginally higher at low latitudes, and (2) higher at locations with Mediterranean climates. Furthermore, we found positive significant correlations between trophic diversity and the consumption of rabbits, insectivores and invertebrates, and negative correlations with rodent consumption (Table 3).

With respect to Prediction 2, we found a significant negative association between small rodent consumption and trophic diversity ($r^2 = 0.686$, $F_{1,13} = 28.37$, $P < 0.001$, Fig. 4a), and a significant negative association of rabbit consumption with small rodent consumption ($r^2 = 0.718$, $F_{1,13} = 33.03$, $P < 0.001$, Fig. 4b). We also found that the consumption of small rodents was significantly lower in locations where rabbits were present (Fig. 5). In addition, there was a significant interaction between rabbit presence and Mediterranean climate (Table 4), indicating that RF values for small rodents in the

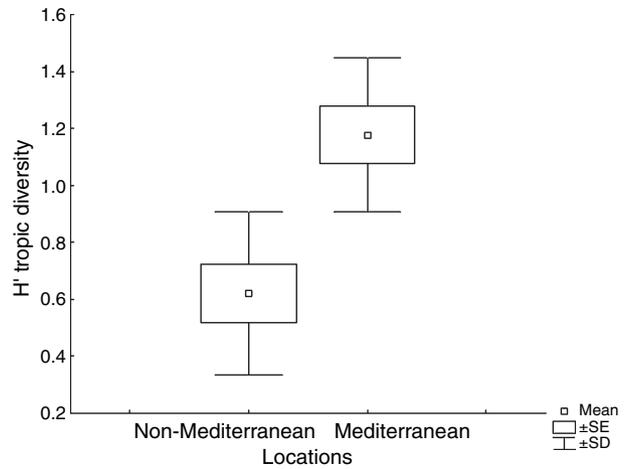


Figure 3 Trophic diversity (H') in non-Mediterranean and Mediterranean climates.

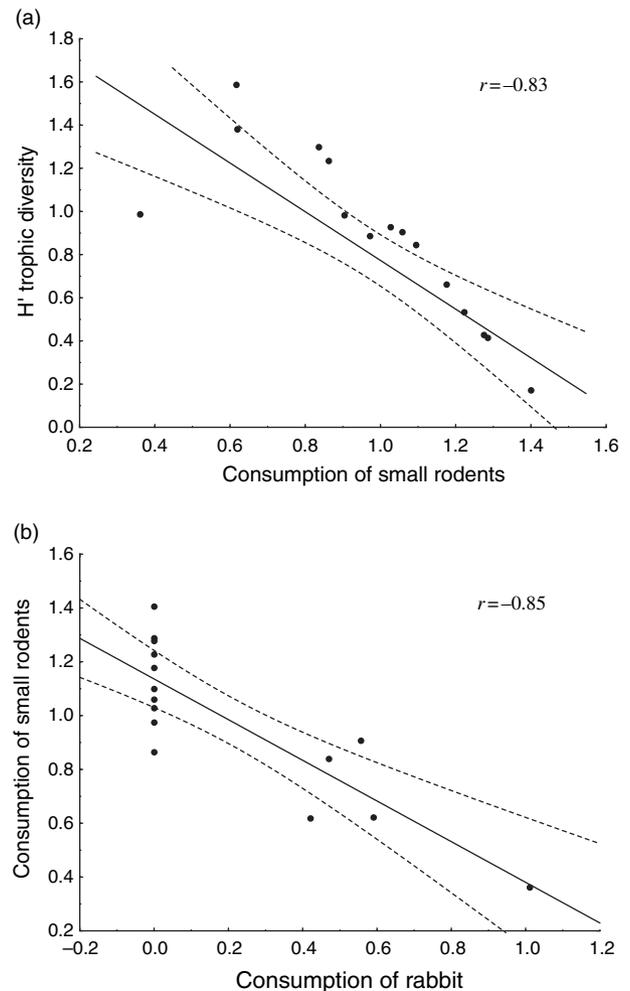


Figure 4 Relationship between small rodent relative frequency (RF) (small rodent consumption) and (a) trophic diversity (H'), and (b) RF for rabbit (rabbit consumption).

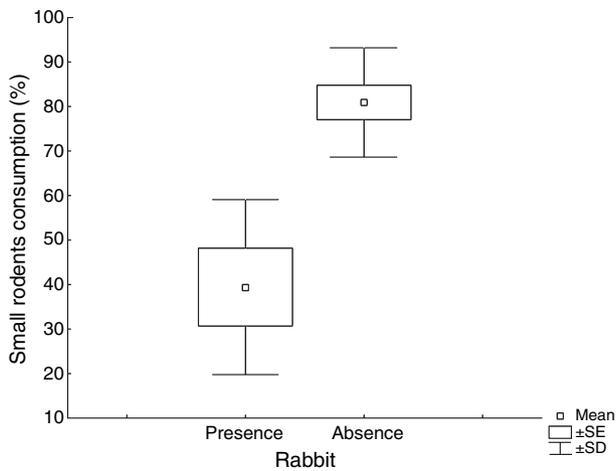


Figure 5 RF values for small rodent consumption in locations with rabbit presence or absence.

Table 4 Two-way ANOVA with the relative frequency (RF) of small rodent consumption as the response variable and rabbit presence and Mediterranean climate conditions as fixed factors ($n = 15$)

	SS	d.f.	MS	<i>F</i>	<i>P</i>
Rabbit presence	0.686	1	0.686	33.898	< 0.001
Climate	0.019	1	0.019	0.918	0.359
Rabbit × climate	0.2	1	0.2	9.88	< 0.01
Error	0.223	11	0.02		

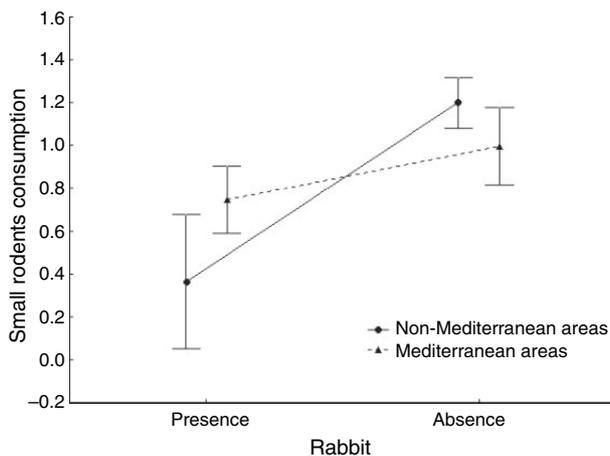


Figure 6 Mean (\pm SE) RF values for small rodent consumption according to Mediterranean climates and the presence or absence of rabbits.

presence of rabbits were lower in non-Mediterranean locations than in Mediterranean areas (Fig. 6). In contrast, in the absence of rabbits, the RF values for small rodents in the non-Mediterranean areas were higher than in Mediterranean areas.

Our test of Prediction 3, in which we used a MANCOVA to analyse RF values of Murinae and Microtinae consumption in relation to Mediterranean climates and rabbit presence inclu-

Table 5 Univariate results from a two-way MANCOVA with relative frequency (RF) of Murinae and Microtinae as response variables and rabbit presence and Mediterranean climate as factors, and including latitude as a linear covariate ($n = 11$)

	d.f. effect	MS effect	d.f. error	MS error	<i>F</i>	<i>P</i>
Murinae						
Latitude	1	0.837	7	0.011	75.6	< 0.001
Rabbit presence	1	0.264	7	0.011	23.89	< 0.01
Climate	1	0.004	7	0.011	0.33	0.585
Microtinae						
Latitude	1	0.814	7	0.01	78.24	< 0.001
Rabbit presence	1	0.262	7	0.01	25.2	< 0.01
Climate	1	0.004	7	0.01	0.35	0.575

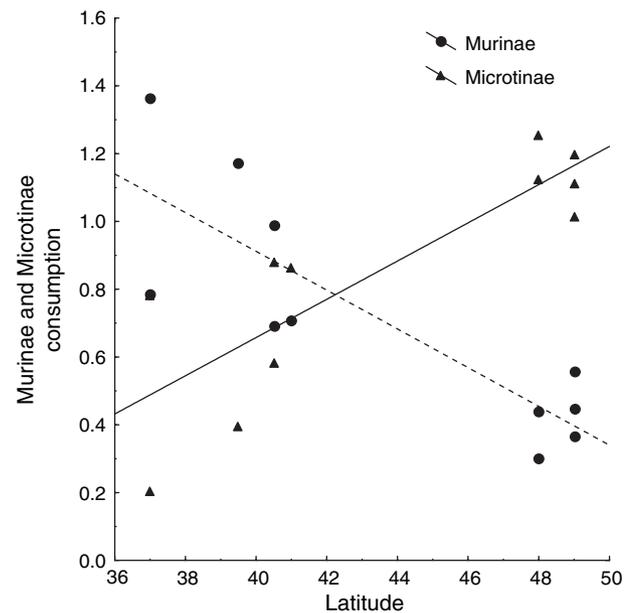


Figure 7 RF values for Murinae and Microtinae consumption in relation to the latitude of each location.

ding latitude as a covariate ($n = 11$ studies) showed again that consumption of both prey groups was lower in areas where rabbits were present, but also indicated that latitude influenced the relative consumption of each rodent subfamily. At high latitudes Microtinae species were more frequently consumed than Murinae species, but the opposite was found at low latitudes (Table 5, Fig. 7).

DISCUSSION

The wildcat is a medium-sized carnivore with the potential to eat a large diversity of prey across its geographic range (Stahl & Leger, 1992; Sunquist & Sunquist, 2002). The diversity of prey communities and abundance of particular species vary along this range, and it has been widely documented that species

richness of potential prey increases at lower latitudes (the latitudinal richness gradient; Rosenzweig, 1995). Variation in the distribution of particular prey species across biogeographical regions has been postulated to affect the feeding habits of wildcats, including the pattern of trophic diversity in the diet (Schoener, 1971).

Although there does not have to be a relationship between higher potential prey diversity and higher diet diversity (Clavero *et al.*, 2003), in a species that is not a strict dietary specialist such as the wildcat (Virgós *et al.*, 1999; Moleón & Gil-Sánchez, 2003; Malo *et al.*, 2004), there should be higher diet diversity at lower latitudes or in locations with a Mediterranean climate, i.e., in areas with higher prey diversity (see Virgós *et al.*, 1999; Malo *et al.*, 2004). Our results support these predictions, particularly the association between higher prey diversity and Mediterranean areas. This result was mainly related to higher inclusion in the diet of prey groups such as herptiles and invertebrates, which also show higher spatial and temporal availability at southern latitudes (Schall & Pianka, 1978; Blondel & Aronson, 1999).

Southern latitudes were also associated with higher rabbit availability, and in these areas rabbits were consumed more by wildcats. This pattern also influenced the higher diet diversity in the southern part of the wildcat's range. In contrast, a reduction in the trophic diversity of the diet was linked to higher rodent consumption, which in turn was related to latitude, with greater consumption in northern parts of the range. Furthermore, Mediterranean climatic conditions affected the consumption of rodents in relation to the presence of rabbits, with a lower consumption of rodents when rabbits were present in the non-Mediterranean areas. Figure 8 schematically presents the main relationships found.

Rodent consumption was negatively associated both with rabbit consumption and diet trophic diversity. A negative correlation between prey group and diet diversity has been interpreted as a good indicator of trophic specialism (Futuyma & Moreno, 1988; Watson, 1997; Fedriani *et al.*, 1998). Under this interpretation, wildcats should be viewed as a rodent specialist, but optimal foraging principles suggest that if wildcats are rodent specialists they should feed on them irrespective of availability of alternative prey (Glasser, 1982; Stephens & Krebs, 1986). The observed shift from rodents to

rabbits when the latter were available does not support the rodent specialization hypothesis. The same pattern and interpretation has also been reported at the regional scale in central Spain (Malo *et al.*, 2004).

In support of our interpretation, we also observed geographical variation in the contribution of rodents to wildcat diet, a fact not easily reconcilable with the rodent specialization hypothesis (see Roper, 1994 for a similar discussion in relation to badgers). Further evidence against rodent specialization comes from the relatively low numbers of rodents ingested at some locations (Appendix 2). We suggest that the negative correlations between trophic diversity and the consumption of a particular prey type in the diet is not always a strong predictor of dietary specialization. Thus, the character of a species' feeding habits cannot be derived solely from this relationship; rather feeding ecology assessments should be based on the study of food availability and consumption of all prey across a range of environments. Large-scale reviews can therefore describe the feeding patterns of a species more completely.

In the case of wildcats, we conclude that they display a facultative feeding strategy, with a specialization on rabbits when present or on rodents when they are abundant and rabbits are not available. We also observed a shift to alternative prey such as invertebrates or herptiles when rabbits were absent and rodents not very abundant, and in these locations wildcats should be viewed at the local scale as true dietary generalists (Malo *et al.*, 2004).

Nevertheless, it would also be interesting to examine feral cats to determine if they show similar feeding habits to wildcats. Moreover the degree of interbreeding between domestic cats and wildcats could affect the trophic behaviour of the different populations. However it seems that introgression is not a generalized phenomenon, and the only known wildcats with this problem considered in our review is the Scottish population (e.g. Pierpaoli *et al.*, 2003). And because diet analyses carried out by Corbett (1979) in Scotland showed that feral domestic cats and wildcats exhibited similar trophic patterns, we doubt that introgression has had a significant influence on the feeding behaviour of wildcats.

On the other hand, our study also revealed an interesting pattern in the consumption of the different rodent subfamilies by wildcat at the continental scale. At low latitudes, Murinae formed the bulk of the rodents consumed by wildcats. In contrast, Microtinae species progressively predominated in the diet at higher latitudes (Fig. 7). Because wildcats prey on different rodents according to their availability (Stahl & Leger, 1992), the latitudinal substitution of the different subfamilies probably reflects their abundance across areas at the continental scale. The small mammal content in scats and raptor pellets has previously been used to describe their distribution patterns (Herrera, 1974; Moreno & Barbosa, 1992; Palomo & Gisbert, 2002). We therefore predict on the basis of our results that Microtinae should be more abundant at more northern latitudes in the Palaearctic, whereas Murinae should be more abundant at lower latitudes.

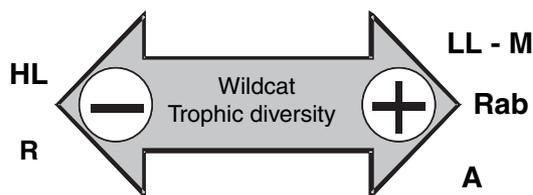


Figure 8 Conceptual model explaining the factors affecting wildcat diet trophic diversity in Eurasia according to results obtained in this review. HL: high latitude; LL: low latitude; M: Mediterranean climates; R: rodents; Rab: rabbit; A: alternative prey.

In summary, the wildcat showed biogeographical variation in its feeding habits that is associated with latitude and the availability of different potential prey across its distribution range. Also, at the continental scale, the species could be considered a facultative specialist, a finding also recently reported at the regional scale (Malo *et al.*, 2004).

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BIOSKETCHES

Jorge Lozano is preparing his PhD thesis on the ecology and conservation of the European wildcat. He is also interested in the ecology of other carnivore species, the conflict between conservation of carnivores and predator control, the current situation of rabbit in Spain and the conservation biology of tropical birds.

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Appendix 1 Studies used in this review with an indication of the length of the study, type of material, the presence or absence of rabbits at the location, whether the study location had a Mediterranean bioclimate, and the country of each study location.

Ref.	Study	Study period	Material	Rabbit presence	Mediterranean bioclimate	Location
1	Gil-Sánchez <i>et al.</i> (1999)	Annual	Scat	Yes	Yes	Spain
2	Gil-Sánchez (1998)	Annual	Scat	Yes	Yes	Spain
3	Moleón & Gil-Sánchez (2003)	Seasonal	Scat	No	Yes	Spain
4	Malo <i>et al.</i> (2004)	Annual	Scat	Yes/No	Yes	Spain
5	Aymerich (1982)	Seasonal	Stomach	Yes	Yes	Spain
6	Fernandes (1993)	Annual	Scat	Yes	Yes	Portugal
7	Ragni (1981)	Annual	Stomach	No	Yes	Italy
8	Condé <i>et al.</i> (1972)	Annual	Stomach	No	No	France
9	Leger (Non-publ.)*	Annual	Scat	No	No	France
10	Stahl (1986)	Annual	Scat	No	No	France
11	Riols (1988)	Annual	Stomach	No	No	France
12	Corbett (1979)	Annual	Scat	Yes	No	Scotland
13	Sládek (1973)	Annual	Stomach	No	No	Slovakia
14	Kozená (1990)	Seasonal	Stomach	No	No	Slovakia
15	Nasilov (1972)	Annual	Stomach	No	No	Azerbaijan

*In Stahl & Leger (1992).

Appendix 2 Wildcat diet as described in the 15 reviewed studies. The information was presented as the relative frequency of each prey group in relation to the minimum total number of identified prey (RF). We also indicate the latitude (Lat., to the nearest half degree) and the value of trophic diversity (Shannon–Wiener index, H') recorded for each location. Data from Malo *et al.* (2004) were divided into locations with and without rabbits.

Location	H'	Lat.	Small		Large										References*
			rodents	rodents	Rabbit	Hares	Birds	Insectivores	Herptiles	Invertebrates	Others	Murinae	Microtinae		
Spain	0.981	37	62.0	0	28.1	0	3.4	3.4	2.7	0	0			1	
Spain		37										95.9	4.1	2	
Spain	0.844	37	79.2	0.2	0	0.7	5.3	0.5	5.2	6.1	3.0	50.0	49.7	3	
Spain	1.379	40.5	33.7	0	31.1	0	3.4	2.3	1.9	27.3	0.4	69.9	30.1	4	
Spain	1.230	40.5	57.7	0	0	0.7	4.1	12.0	5.1	20.1	0.3	40.8	59.2	4	
Spain	1.295	39.5	55.2	0	20.7	2.4	8.6	9.8	3.3	0	0	85.1	14.9	5	
Portugal	1.584	42	33.6	0	16.8	0	15.4	3.5	2.8	26.6	1.4			6	
Italy	0.927	42.5	73.3	0	0	1.4	5.3	4.9	1.0	13.7	0.3			7	
France	0.413	48	92.2	1.3	0	0.2	1.7	1.9	1.3	1.0	0.4	8.7	90.2	8	
France	0.530	49	88.5	0.9	0	0.5	4.5	0.4	3.1	2.2	0	12.8	86.7	9	
France	0.171	49	97.2	0.1	0	0.8	1.3	0.1	0	0.3	0.3	28.0	71.9	10	
France	0.425	48	91.6	0.9	0	0.6	3.6	2.1	0.5	0.4	0.4	18.2	81.3	11	
Scotland	0.984	57	12.6	0.2	71.8	1.6	9.8	1.6	1.2	1.0	0.3			12	
Slovakia	0.659	49	85.2	0.7	0	4.6	5.1	1.1	0.5	0.7	2.2	18.7	80.5	13	
Slovakia	0.901	49	76.1	2.2	0	4.3	2.2	8.7	0	0	6.5			14	
Azerbaijan	0.882	41	68.3	0	0	2.8	24.8	1.4	0	2.1	0.7	42.4	57.6	15	

*See Fig. 1.