

Hunger sweetens the beans: evidence of opportunistic feeding behaviour of the little owl (*Athene noctua*, Scopoli 1769) from Peloponnese, Greece

Hladnému chutí všetko: dôkaz oportunistického potravného správania kuvika obyčajného (*Athene noctua*, Scopoli 1769) z Peloponézu, Grécko

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Abstract: The little owl (*Athene noctua*) is a common raptor in Mediterranean habitats. To acquire more information on its diet, this study identified cranial and post-cranial skeletal material from 70 owl pellets collected during the 2016 and 2017 breeding seasons. The material was used to quantify the little owl's relative prey abundance using MNI (minimum number of individuals), a taphonomical unit. This study is the first to examine the diet of the little owl in the Peloponnese (southern Greece). After examining 3,691 isolated skeletal and exoskeletal remains from the processed pellets, a total of 78 and 108 prey items were recorded for the two consecutive years. This study, in congruence with previous research, showed that in both years the little owl favoured primarily small mammals and arthropods, with a clear predominance of Thomas's pine vole (*Microtus thomasi*) and arthropods from the class Diplopoda. Finally, a redundancy discriminant analysis (RDA) was applied to our two-year results, along with those from similar studies in the Mediterranean region, to examine the relationship between habitat types and prey taxa, which supported the little owl's opportunistic feeding behaviour, depending on variation of ecological factors.

Abstrakt: Kuvik obyčajný (*Athene noctua*) je bežný dravec stredomorských biotopov. S cieľom získania ďalších poznatkov o potrave druhu, sme determinovali kraniálny a postkraniálny materiál so 70 vývržkov, zozbieraných v hniezdnom období v rokoch 2016 a 2017. Materiál bol kvantifikovaný do relatívneho množstva koristi pomocou metódy MNI (minimálny počet jedincov) a tafonomickej jednotky. Táto štúdia je prvou, ktorá skúma potravu kuvika obyčajného na Peloponéze (južné Grécko). Vo vývržkoch z dvoch po sebe nasledujúcich rokov bolo zaznamenaných 3691 kostrových a exoskeletálnych pozostatkov so 78 a 108 zložiek koristi. Táto štúdia v zhode s predchádzajúcim výskumom ukázala, že kuvik v oboch rokoch uprednostňoval drobné cicavce a článkonožce, s jasnou prevahou *Microtus thomasi* a článkonožcov z triedy Diplopoda. Následne boli naše výsledky a výsledky z podobných štúdií v oblasti Stredozemného mora analyzované vo vzťahu k typom biotopu. Výsledná Redundantná diskriminačná analýza (RDA) podporuje teóriu oportunistického získavania potravy kuvika v závislosti od variability ekologických faktorov.

Key words: owl prey, owl pellets, Rodentia, Insecta, mainland Greece

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Acknowledgements: We thank Vassilis Kypraios-Skrekas from the Laboratory of Zoology, Dept. of Biology, University of Patras for providing data on juvenile snake weights from nearby locations in the northern Peloponnese and Dr. Stylianos M. Simaiakis from the Natural History Museum of Crete, University of Crete for his advice on measuring the weights of Diplopoda and *Scolopendra* sp., based on specimens from the Museum's collections.

Introduction

Information on the diet of any owl species can be inferred from the contents of its pellets (Marti et al. 2007). Nonetheless, the study of pellets can also provide important information on the preying habits of a certain species and the group of animals it feeds upon in a particular area. Two elements accentuate the usefulness of pellets in such studies: (a) prey remains in pellets are usually well-preserved, which means that even the most delicate skeletal remains can be isolated from them; and (b) owls can swallow small vertebrates whole, minimising the chances of bone fractures during feeding and digestion.

The little owl (*Athene noctua*) has a wide geographical distribution, extending to Central and Southern Europe and Asia, and northwestern Africa. Besides urban areas (BirdLife International 2022), the species has a wide range that covers different habitats, such as orchards, cultivated fields, steppes and semi-desert, rocky regions (Mikkola 1983). It is considered an important predator for controlling small mammal populations, such as voles. The main threats for the studied species are habitat and nesting site loss due to industrialisation and intensified farming, the use of pesticides and even colliding with traffic (Tucker & Heath 1994, Holt et al. 2014).

The present study attempts to enrich existing knowledge on the feeding behaviour of the species in the Eastern Mediterranean (Al-Melhim et al. 1997, Charter et al. 2006, Paspali et al. 2015, Kayahan & Tabur 2016) and specifically in Greece, where, despite its widespread distribution, data on its diet and hunting behaviour are relatively scarce, with only a handful of published studies to date (Angelici et al. 1997, Goutner & Alivizatos 2003, Alivizatos et al. 2005, 2006). Ours is the first report on the little owl's diet from southern Greece and the first pellet study from a mainland habitat not associated with major wetlands, as had been the case until now (Goutner & Alivizatos 2003, Alivizatos et al. 2005, 2006). It is also the first such study from Greece that uses both cranial and post-cranial skeletal elements to identify and quantify every taxon of the prey retrieved from studied pellets. Although far more laborious, this approach was chosen in order to achieve the most accurate estimates possible concerning the number of prey individuals and, subsequently, biomass consumption, since the inclusion of post-cranial data minimises the probability of underrepresenting species, whose cranial elements are often absent from pellets, in contrast to post-cranial ones, like snake vertebrae. Finally, the data collected during the present study were

compared to previous research on the little owl's diet to explore possible trends emerging from the different habitat types where pellets have been collected (e.g. wetlands, farmlands and phrygic habitats, both from insular and mainland areas) and seasons.

Material and methods

Study area

Our study took place in a rural area of northwestern Peloponnese, southern Greece, specifically Platanovrisi, a village located 18 kilometres south of the city of Patras at the foot of the southwestern extensions of Mt. Panachaiko (elevation 450 metres; Fig. 1). The study area can be described as an agricultural mosaic consisting of olive groves, pastures, cultivated fields, as well as shrub and forest patches dominated by Kermes oaks (*Quercus coccifera*) and Aleppo pines (*Pinus halepensis*).

Pellet sampling and preparation

To examine the little owl feeding habits in the area, 70 pellets were collected between February and May of 2016 and 2017 (35 pellets per year) from a pair of little owls that had been nesting underneath a tree trunk's cavity in an open estate. Our field observations showed the pair to have used the nest only during the breeding season, while throughout the rest of the year they were observed in the surrounding area. The size and density of the studied pellets indicated that it was the adult birds which produced them.

The pellets were initially processed by hand and the remaining hairs were removed after the collected skeletal elements had been soaked in a water bath for 24 hours. One pellet, consisting of a virtually complete house sparrow skeleton with only the skull missing, was placed in a 10% hydrogen peroxide solution to dissolve the remaining tissue without damaging the bones. The extracted skeletal material was identified according to Chinery 1986, Brunet-Lecomte & Nadachowski 1994, Macholán 1996, Venczel 2000, Kryštufek & Vohralík 2001, Leraut 2003, and Olsen 2004.

Material identification and data analysis

The minimum number of individuals (MNI), a standard zooarchaeological unit (Lyman 1994, 2008) was tallied and used to interpret the faunal representation and assess relative species abundance (Lyman 1994). In addition to skulls, mandibles and teeth, which are used in most owl pellet studies (for the little owl: Zerunian et al. 1982, Al-Melhim et al. 1997, Angelici et al. 1997, Hounsborne

Fig 1. Map showing the study area (NW Peloponnese), and Platanovrisi village (red dot) where the pellets were collected.

Obr. 1: Mapa skúmaného územia (SZ Peloponéz) a obec Platanovrisi (červený bod), miesto zebu vývržov.



et al. 2004, Pocora et al. 2012), species were also identified from post-cranial skeletal elements and they were accordingly included in the calculation of the MNI. These values were calculated per pellet and then summed for the year. The skeletal elements of all major limb bones of rodents and birds were identified through direct comparison with reference skeletons in the collection of the Laboratory of Palaeontology and Stratigraphy at the University of Patras. Phalanges, metapodials and vertebrae (except reptilian) could not be attributed to a specific taxon beyond the order/family level and, thus, were not included in the data analysis.

Data analysis

Biomass calculations for each species were performed according to Marti et al. (2007), and for each pellet according to Pezzo & Morimando (1995). Prey weight information was taken from micromammal (Niethammer & Krapp 1978, 1982) and bird (Hume 2002) references and from the weight of juvenile snakes measured at a nearby location in the northern Peloponnese and recorded by the Laboratory of Zoology, Department of Biology, University of Patras. In the case of arthropods, the methodology by Zerunian et al. (1982) was followed to calculate the weight of specimens that could not be identified at the species level. The insects were separated into four distinct categories according to their estimated body-size range, with each category matched to a specific weight value. Categories and their respective weight values were likewise adopted from Zerunian et al. (1982). The weights of Diplopoda taxa and *Scolopendra* sp. were

approximated from specimens in the collections of the Natural History Museum of Crete.

The average prey weight per pellet was calculated by multiplying the MNI of each prey in a pellet by its average weight, adding the values produced for each taxon and dividing the sum by the total number of prey items in each pellet. The average food intake per pellet was calculated by multiplying the MNI of each prey in a pellet by its average weight, adding the values produced for each taxon and dividing the sum by the total number of pellets. Once the calculations had been made, MNI and prey weight values for each pellet were statistically compared for the two sampling years (2016 and 2017), using the non-parametric Mann-Whitney test separately for vertebrate and invertebrate prey taxa.

To examine the relationship between habitat types and prey taxa, a redundancy discriminant analysis (RDA) of prey biomass percentages was performed among the different Mediterranean sites referenced and where little owls' prey biomass percentages were available (Appendix 1). The use of biomass, in lieu of the MNI contribution of the consumed prey, gives a more realistic representation of the little owl's diet when examined under the scope of different habitat types. Thus, we preferred biomass percentages, instead of numerical values, to eliminate the differences in the number of pellet samples collected in each study as a factor that could affect the analysis. In this comparative analysis, data from a total of seven different studies were used, which correspond to pellets collected from 13 sites across different habitat types (e.g. rural areas, cultivated farmland and wetlands)

in Greece, Algeria, Israel, Italy and Spain (Appendix 1). Some of these sites were sampled and studied more than once. Type 2 Scaling was used to visualise better the data points during the plot's construction. Consequently, the distances between the points corresponding to prey taxa should not be interpreted as Euclidean distances, even though the points corresponding to the sites were unaffected. One-way PERMANOVA was used in order to investigate the statistical significance of potential differences between the referenced habitats (Appendix 1). Data analysis was carried out using PAST 4.11 (Hammer et al. 2001). Because the periods during which the comparative surveys in the references took place were either not clearly defined or varied notably, seasonality was not examined as a factor of prey selection and diet variance.

Results

A total of 3,691 skeletal and exoskeletal remains were isolated from the 70 processed pellets. Of these, 2,721 were identified up to species level when possible, while the remaining 970 could not be attributed to any specific taxon. The “unidentifiable elements” mostly corresponded to fragmented parts of the skeleton (phalanges, vertebrae, skull fragments, diaphyses) and they were considered insignificant in the calculation of the MNI index.

Prey size parameters examined for each year (Tab. 1) revealed an increase in both the number of taxa and the number of individuals consumed by the owls in 2017, thereby raising the average prey individuals (MNI, Mann-Whitney U test: $U = 420$, $p = 0.020$) consumed per pellet. The average food intake per pellet remained approximately the same for both years (ca 50 g) (Mann-Whitney U test: $U = 524$, $p = 0.299$), but the average prey weight per pellet decreased from 23.44 g in 2016 to 19.21 g in 2017 (Mann-

Whitney U test: $U = 426$, $p = 0.025$). A shift in favour of the consumption of arthropods was observed, in particular during the second survey year, with regard to both the number of individuals and prey weight (Mann Whitney U test: $U = 314$ for MNI, $U = 307$, for prey weight, $p < 0.001$ in both cases) (Tab. 1 and 2). Thus in 2017, consumed vertebrates only equalled 74.29% of consumed biomass, represented by two mammalian species, whereas in 2016, the percentage was higher by ca 20%, involving four vertebrate taxa (Fig. 2, Tab. 2). The shift in diet was not found to be statistically significant, either in terms of individual consumption or biomass (Mann Whitney U test: $U = 522$, $p = 0.248$ and $U = 524$, $p = 0.264$, respectively).

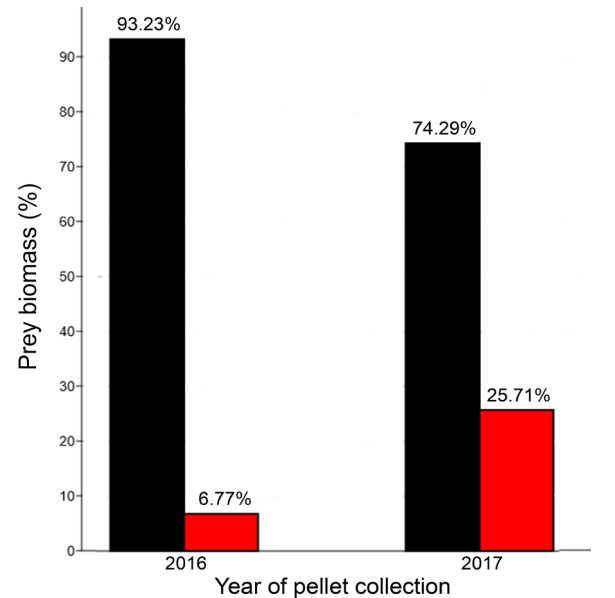


Fig 2. The proportion of biomass for vertebrates (black) and arthropods (red) extracted from the pellets of the little owl for the years 2016 and 2017.

Fig 2. Podiel biomasy pre stavovce (čierna) a článkonožce (červená) extrahovaná z peliet kuvika obyčajného za roky 2016 a 2017.

Tab 1. Prey size parameters of the little owl for the sampling years 2016 and 2017.

Tab 1. Parametre potravy kuvika obyčajného rokov 2016 a 2017.

	2016	2017
Number of taxa	7	14
Total MNI	78	108
Average MNI per pellet	2.2	3.1
Median MNI per pellet	2	3
Min MNI per pellet	1	1
Max MNI per pellet	6	8
Average prey weight per pellet (g)	23.44	19.21
Average food intake per pellet (g)	49.08	50.72

Among the identified taxa, the dominant prey for both years was Thomas’s pine vole (*Microtus thomasi*), with a presence in 2016 and 2017 of 69.23% and 43.5% by numbers and 87.55% and 73.74% by biomass, respectively. Other taxa identified as prey in 2016 were the violet ground beetle (*Carabus violaceus*), Orthoptera (indetermined), Diplopoda (indetermined) and a few other vertebrates (juvenile snakes from the Colubridae family), the western house mouse (*Mus musculus domesticus*), and the house sparrow (*Passer domesticus*). These prey taxa and their numbers are shown in Table 2.

In 2017, the only vertebrate found in the little owls' diet was Thomas's pine vole, save for a single bicoloured white-toothed shrew (*Crocidura leucodon*). The undetermined Diplopoda taxa were the second most important biomass contributor (21.7%), followed by *Scolopendra* sp. (3.15%).

Tab 2. Prey taxa by numbers (MNI) and biomass (%) for 2016 and 2017.

Tab 2. Taxóny koristi kuvika obyčajného podľa počtu (MNI) a biomasy (%) za rok 2016 a 2017.

Year	2016		2017	
Taxon	MNI %	Biomass %	MNI %	Biomass %
VERTEBRATA				
<i>Crocidura leucodon</i>			0.93	0.55
<i>Microtus thomasi</i>	69.23	87.55	43.5	73.74
<i>Mus musculus</i>	3.85	3.19		
<i>Passer domesticus</i>	1.28	1.28		
Colubridae (juv.)	2.56	1.21		
ARTHROPODA				
Insecta - Coleoptera				
<i>Carabus violaceus</i>	12.82	1.47		
<i>Copris hispanus</i>			0.93	0.14
<i>Melolontha melolontha</i>			2.78	0.09
<i>Poecilus cupreus</i>			1.85	0.03
<i>Tenebroides mauritanicus</i>			0.93	<0.10
<i>Tribolium confusum</i>			2.78	0.01
<i>Harpalus</i> sp.			0.93	0.01
Insecta - Dermaptera				
<i>Forficula auricularia</i>			4.63	0.02
Insecta - Hymenoptera				
<i>Camponotus lateralis</i>			1.85	<0.10
Chilopoda- Scolopendromorpha				
<i>Scolopendra</i> sp.			7.41	3.15
Coleoptera (indet.)			12.03	0.18
Orthoptera (indet.)	6.41	0.06	7.41	0.1
Diplopoda (indet.)	3.85	5.24	12.04	21.97
indet. - indeterminate				

The RDA plot of biomass percentage (Fig. 3, based on data in Appendix 1) indicated a significant relationship between habitat types and specific prey taxa ($F = 6.745$ and $p = 0.001$), explaining 40.28% of the constrained variance. A clear formation of sampling clusters emerged, according to the habitat where each study was conducted

(Fig. 3). Four types of habitats stood out: wetlands/saltmarshes, farmlands near urban areas, phrygic areas in islands and cultivated areas (Fig. 3). This can also be inferred by PERMANOVA ($F = 9.037$, $p < 0.001$), since statistically significant differences between habitats (wetland vs urban farmland and insular phrygic) can be observed (Table 3).

Discussion

Our study provides evidence on the prey of the little owl in Southern Greece that confirms its strong tendency towards vertebrates – particularly rodents – as prey items, when they are available. Thomas's pine vole, represented in each pellet by at least one individual, was the dominant prey in both survey years, making it the primary food source for the little owls in our study area. This finding contradicts the general impression that the little owl feeds mainly on insects, especially around the Mediterranean region (Herrera & Hiraldo 1976, Mikkola 1983). However, according to several studies, the little owl may, in fact, base its diet on vertebrates as described, for instance, in Jordan (Al-Melhim et al. 1997), Evros and Axios Delta in Greece (Goutner & Alivizatos 2003, Alivizatos et al. 2005), Bulgaria (Georgiev 2005) and Albania (Paspali et al. 2015). The predominance of vertebrates is even more clearly demonstrated in studies where prey species representation was examined in terms of biomass instead of just numerical abundance of individuals as, for instance, in Spain (Delibes et al. 1984), Italy (Capizzi & Luiselli 1995, Bon et al. 2001), Israel (Charter et al. 2006), Greece (Goutner & Alivizatos 2003, Alivizatos et al. 2006) and Algeria (Chenchouni 2014). Our results thus fall in line with these studies (Fig. 2, Tab. 2), indicating the little owl to be a generalist predator that may opt to prey upon small vertebrates (whenever abundant and therefore relatively easy to capture).

The larger presence and wide variety of arthropods found in the pellets from 2017 (12 out of the 14 identified taxa were arthropods), when vertebrates seemed to contribute less to the little owl's diet and be restricted almost exclusively to the overall dominant prey, i.e. Thomas's pine vole (MNI = 47) (Tab. 2), constitute the main observed differences in diet composition between the two study years. These differences correspond to an increase in the average MNI per pellet in 2017, coupled with a simultaneous drop in the average prey weight per pellet, while the average food intake per pellet remained virtually steady (Tab. 1). This simply shows that the nutritional needs of the little owls (ca 50 g per pellet, Tab. 1) will have to be anyway satisfied, in this

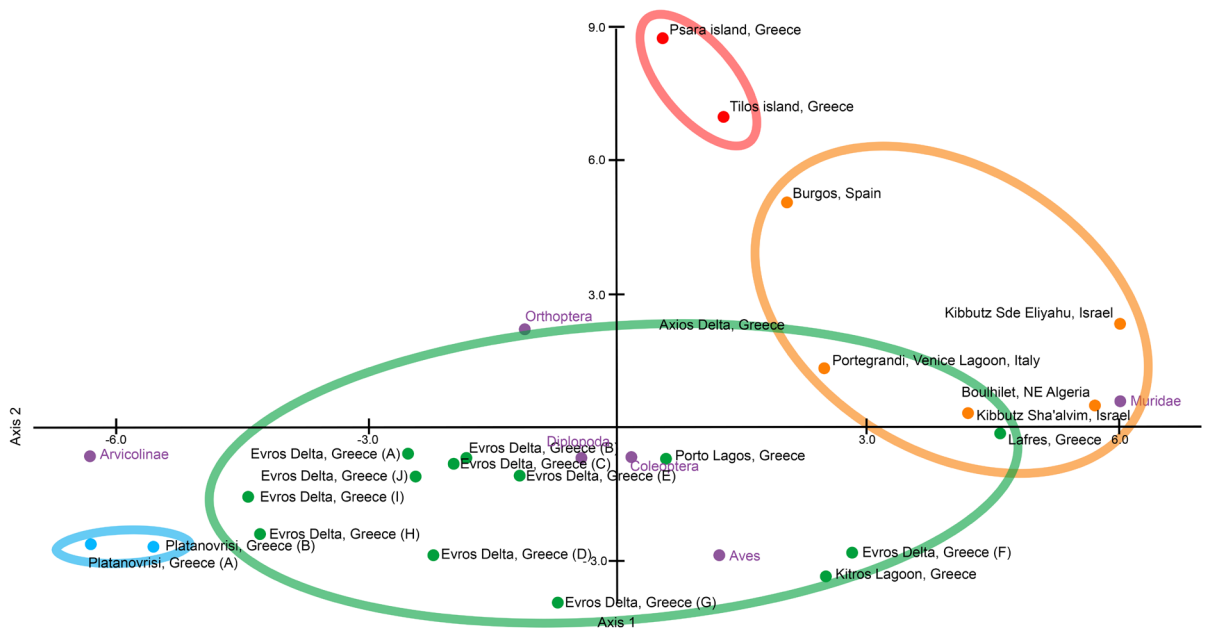


Fig. 3. Redundancy Discriminant Analysis (RDA) of the little owl's diet composition by biomass (%) of prey, identified from 23 different samplings from 13 different localities around the Mediterranean. The colors of each point (and the ellipses) represent the habitat type: green describes wetlands and saltmarshes, orange describes farmlands and crops near urban areas, red describes insular areas with phrygana and blue describes cultivated areas.

Fig. 3. Redundantná diskriminačná analýza (RDA) zloženia stravy sovy obyčajnej podľa biomasy (%) koristi, identifikovanej z 23 rôznych vzoriek z 13 rôznych lokalít okolo Stredozemného mora. Farby každého bodu (a elipsy) predstavujú typ biotopu: zelená - mokrade a slané močiare, oranžová - poľnohospodárska pôda a plodiny v blízkosti mestských oblastí, červená - ostrovné oblasti s Garrigue vegetáciou a modrá - obhospodarované oblasti.

case by switching to prey with lower biomass values (i.e., arthropods) in comparison to micromammals and, consequently, consuming it in larger quantities.

The reduced representation of vertebrates in the little owl's diet in 2017 could have been linked to a potential decrease in the abundance of the dominant prey, Thomas's pine vole, in the study area that year. Even though not specifically examined during this study, such local abundance fluctuations over consecutive years appear rather commonly in this vole species (G. Mitsainas, pers. observation). It would also be worthwhile to examine whether other ecological factors could have been involved in the described differences in prey composition over the two years. For example, there ought to be research conducted into whether varying weather conditions might be related to variations in arthropod availability and abundance between different years, as has been previously suggested (Chenchouni 2014).

Concerning prey availability, all species found in the pellets are commonly present in the study area. Specifically, Thomas's pine voles are generally abundant around the estate whence the pellets were collected, based

on the high density of their characteristic soil mounds (Ph. Katsiyiannis, pers. observation). Although considered a fossorial vole species, they have been occasionally observed to emerge from their burrows during the night and run across open spaces, such as fields or even roads (Mitsainas et al. 2009, Rovatsos et al. 2011), which makes them vulnerable to predators. Together with their common occurrence, this tendency probably explains the very strong representation of this vole species in the pellets. The taxon with the second highest biomass contribution to the diet of the little owl is Diplopoda, a class which includes nocturnal animals that are easy for a little owl to detect and capture.

On the other hand, the presence in the pellets of remains belonging to rather diurnal animals (e.g. *Passer domesticus*, juvenile snakes of the family Colubridae) confirms that the little owl may very well extend its hunting activity into daytime (Mikkola 1983). As prey of the little owl, snakes are of rather little interest since, from the recorded values, they appear to have contributed only a small percentage to the owls' diet. For example, in Greece, only once have reptiles been recorded at a

Tab. 3. Pairwise comparisons of prey biomass (%) (one-way PERMANOVA) between groups corresponding to different habitats.
Tab.3. Párové porovnania biomasy (%) koristi (one-way PERMANOVA) medzi skupinami jednotlivých biotopov.

habitat	Terrestrial cultivated areas	Wetlands and saltmarshes	Farmlands and crops near urban areas		Insular areas with phrygana	
	F	F	F	F	F	F
Terrestrial cultivated areas	-	4.536*	23.12*	47.08		
Wetlands and saltmarshes	4.536*	-	8.462**	9.027**		
Farmlands and crops near urban areas	23.12*	8.462**	-	12.02*		
Insular areas with phrygana	47.08	9.027**	12.02*	-		

*<0.05; **<0.01

higher contribution to prey biomass than the 1.21% of the present study for 2016: one individual of Colubridae recorded in a study from Axios Delta (Alivizatos et al 2005), corresponded to a 4.6% contribution to prey biomass. Additionally, Colubridae (MNI = 1) and *Natrix* sp. (MNI = 1) have been reported in a study conducted in Evros Delta (Alivizatos et al. 2005), contributing 1% to prey biomass. Other Reptilia consumed by little owls were either lizards or unidentified reptiles, both in Greece (Angelici et al. 1997, Goutner & Alivizatos 2003 and references therein, Alivizatos et al. 2005, 2006) and other Mediterranean regions (Herrera & Hiraldo 1976, Delibes et al. 1984, Al-Melhim et al. 1997, Bon et al. 2001, Goutner & Alivizatos 2003 and references therein, Charter et al. 2006).

Viewing the present results in a broader context, the presence of micromammals and arthropods in the little owls' diet is relatively common, yet the numerical dominance observed in this study of the former over the latter had not been frequently documented in other studies from Greece (Angelici et al. 1997, Goutner & Alivizatos 2003, Alivizatos et al. 2005, 2006 – see Appendix 1 for details). The only cases where mammals seem to prevail in the diet of the little owl in Greece concern birds of prey that hunt in terrestrial or semi-terrestrial ecosystems (Goutner & Alivizatos 2003, Alivizatos et al. 2005, this

study). On islands and at/around lagoons, where salinity levels of the water and soil do not favour micromammals, insects are the primary source of prey for the little owl (Angelici et al. 1997, Goutner & Alivizatos 2003, Alivizatos et al. 2006). However, even in such areas, it will probably extend its hunting range to capture small-sized mammalian prey (e.g. rodents from genera *Microtus*, *Mus* and/or *Micromys*) that are readily available and relatively easy to capture, yet rewarding in terms of the biomass they provide (Goutner & Alivizatos 2003, Alivizatos et al. 2005, 2006).

Gradient and statistical analysis shows an obviously clear grouping of studied sites by habitat type (Fig. 3, Tab. 3). Specifically, insular and phryganic habitats (Alivizatos et al. 2005) are grouped, although they are distant from the mainland sites because of the dominance of Orthoptera and Muridae in the island pellets, with a biomass contribution greater than 50%. Wetland and farmland habitats are also separated, which reflects the difference between the dominant prey species in each habitat type: anthropophilic Muridae dominate in farmlands near urban areas where humans are active. Concurrently, Arvicolinae and birds are the main biomass components in wetlands and lagoons where these taxa are more abundant (Alivizatos et al. 2006). Both sampling years in our study area are grouped together because of the prevalence of Arvicolinae in the biomass of the little owls' diet (> 70%). This also explains why their group is located close to what comprises the wetlands and deltas in which the same taxon is also present with a high contribution (> 50%).

However, some exceptions were also observed. The Burgos site (Delibes et al. 1984) is located further away from its cluster, approaching the areas around Tilos and Psara, probably due to the high concentration of Orthoptera in the biomass of the little owls' diet (25.5%), thereby appearing closely correlated with the aforementioned island sites. Similarly, Lafres (Goutner & Alivizatos 2003) is associated with the farmland cluster, possibly because of the high contribution of Muridae that characterises the locality, as well as the group of urban and farmland areas.

This study highlights the importance of micromammals in the diet of the little owl, something too often overlooked in analyses that tend to be derived from the abundance of prey instead of their contribution to the biomass and frequently giving the false impression that the little owls mainly prey upon insects. The present study shows arthropods to be a supplementary food source in mainland localities and the dominant prey on islands, or possibly

habitats sharing the same characteristics with the islands in the above comparison. However, this needs to be further studied.

Finally, all the considerations mentioned above suggest the little owls' hunting behaviour to be opportunistic, according to prey availability and Mediterranean habitat types. This can be seen both at a local scale, such as the observed shift from vertebrate to invertebrate consumption over our study's two consecutive years, as well as at a larger scale, when comparing, sites around the Mediterranean that differ to a varying degree in prey availability and habitat features. However, more work on the hunting and feeding behaviour of the little owl in different habitats and geographical regions needs to be done and so the present study serves as an additional source of information on this topic.

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Received: 9.5.2022

Accepted: 14.2.2023

Appendix 1. Table of parameters that correspond to each geographical site used in the RDA analysis (Fig. 3) including: site name, authors of the study, pellet collection period, dominant prey (per biomass %) and brief habitat description, according to each study. Sites in alphabetical order; study area of this work in bold.

Príloha 1. Tabuľka parametrov, pre použité lokality v RDA analýze (obr. 3) vrátane: názvu lokality, autorov štúdie, obdobia zberu peliet, dominantnej koristi (% biomasy) a stručného popisu biotopu podľa každej štúdií. Stránky v abecednom poradí; študijná oblasť tejto práce tučným písmom.

Site	Study period	Dominant prey	Habitat	Literature
Axios Delta, Greece	Dec 1997 - Aug 2001 (winter)	Arvicolinae, Muridae	wetland and saltmarshes, lagoons, reedbeds, tamarisk and riparian forest, marshes, cultivations	Alivizatos et al. 2005
Boulhilet, NE Algeria	Jan-Feb 2008, 2011	Muridae, Aves	large fields of crops with patchy landscapes of brackish and fresh wetlands, montane habitats, country towns	Chencouni 2014
Burgos, Spain	winter 1976, 1980	Muridae, Orthoptera, Arvicolinae	farmland	Delibes et al. 1984
Evros Delta, Greece (A)	winter 1987	Arvicolinae, Muridae	wetland, saltmarshes, salty grounds, sand dunes and sandy islands, reed beds, tamarisk and riverine forest, temporary and permanent freshwater marshes, extensive cultivation areas	Goutner & Alivizatos 2003
Evros Delta, Greece (B)	summer 1987	Arvicolinae, Muridae	wetland, saltmarshes, salty grounds, sand dunes and sandy islands, reed beds, tamarisk and riverine forest, temporary and permanent freshwater marshes, extensive cultivation areas	Goutner & Alivizatos 2003
Evros Delta, Greece (C)	Dec 1997 - Aug 2001 (winter)	Arvicolinae	wetland and saltmarshes, lagoons, reedbeds, tamarisk and riparian forest, marshes, cultivation	Alivizatos et al. 2005
Evros Delta, Greece (D)	spring 2003	Arvicolinae, Muridae, Aves	extensive saltmarshes, sand dunes, mudflats, lagoons, reedbeds, tamarisk and riparian forests, permanent and temporary freshwater marshes, extensive cultivations	Alivizatos et al. 2006
Evros Delta, Greece (E)	summer 2003	Arvicolinae, Muridae, Aves	extensive saltmarshes, sand dunes, mudflats, lagoons, reedbeds, tamarisk and riparian forests, permanent and temporary freshwater marshes, extensive cultivations	Alivizatos et al. 2006
Evros Delta, Greece (F)	autumn 2003	Muridae, Aves	extensive saltmarshes, sand dunes, mudflats, lagoons, reedbeds, tamarisk and riparian forests, permanent and temporary freshwater marshes, extensive cultivations	Alivizatos et al. 2006
Evros Delta, Greece (G)	winter 2003 - 2004	Arvicolinae, Aves, Muridae	extensive saltmarshes, sand dunes, mudflats, lagoons, reedbeds, tamarisk and riparian forests, permanent and temporary freshwater marshes, extensive cultivations	Alivizatos et al. 2006
Evros Delta, Greece (H)	spring 2004	Arvicolinae, Muridae	extensive saltmarshes, sand dunes, mudflats, lagoons, reedbeds, tamarisk and riparian forests, permanent and temporary freshwater marshes, extensive cultivations	Alivizatos et al. 2006
Evros Delta, Greece (I)	summer 2004	Arvicolinae, Muridae	extensive saltmarshes, sand dunes, mudflats, lagoons, reedbeds, tamarisk and riparian forests, permanent and temporary freshwater marshes, extensive cultivations	Alivizatos et al. 2006

Appendix 1. Continuation

Príloha 1. Pokračovanie

Evros Delta, Greece (J)	autumn 2004	Arvicolinae, Muridae	extensive saltmarshes, sand dunes, mudflats, lagoons, reedbeds, tamarisk and riparian forests, permanent and temporary freshwater marshes, extensive cultivations	Alivizatos et al. 2006
Kibbutz Sde Eliyahu, Israel	Oct 2001 - Nov, 2003	Muridae	quarry, surrounded by agricultural fields, orchards, plantations	Charter et al. 2006
Kibbutz Sha'alvim, Israel	Dec 2001 - Jun 2003	Muridae, Aves	pastureland for domesticated animals around farm buildings of a village	Charter et al. 2006
Kitros Lagoon, Greece	Dec 1997 - Aug 2001 (winter)	Coleoptera, Muridae, Aves	wetland and saltmarshes, lagoons, reedbeds, tamarisk and riparian forest, marshes, cultivations	Alivizatos et al. 2005
Lafres, Greece	summer 1987	Muridae, Aves	two coastal lagoons surrounded by rocky cliffs with extensive grasslands, saltmarshes, sandy beaches and cultivation areas to the north	Goutner & Alivizatos 2003
Platanovrisi, Greece (A)	Feb - May 2016	Arvicolinae, Diplopoda	olive groves and cultivated fields	this study
Platanovrisi, Greece (B)	Feb - May 2017	Arvicolinae, Diplopoda	olive groves and cultivated fields	this study
Portegrandi, Venice Lagoon, Italy	Spring 1990	Arvicolinae, Muridae	typical agricultural environment with maize and soybeans crops, landscape poor of arboreal-shrubby elements, the environments marginal to the cultivated fields more interesting, in particular some wet meadows that develop along the Sile flood plain	Bon et al. 2001
Porto Lagos, Greece	summer 1987	Aves, Muridae, Orthoptera	village within a wide wetland complex, brackish lake in the north, reed beds and forests remnants, extensive coastal lagoons with saltmarshes, sandy beaches and livestock grazing fields in the southwest	Goutner & Alivizatos 2003
Psara island, Greece	Dec 1997 - Aug 2001 (winter)	Orthoptera, Muridae	phrygana, farmland	Alivizatos et al. 2005
Tilos island, Greece	Dec 1997 -Aug 2001 (winter)	Orthoptera, Muridae	phrygana, farmland	Alivizatos et al. 2005