Research Article

The seasonal diet and variation in the prey selection of the little owl (*Athene noctua*) in the Northeast of Iran

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Abstract

Information on the dietary niche is an integral and challenging part of conservation planning, and it is essential for understanding the status of a species in biological communities and conservation. In this study, to investigate the diet of little owls *Athene noctua* (Strigiformes: Strigidae) in northeastern Iran's Khorasan Razavi Province, a total of 402 pellets were collected during 2019-2020. The results indicated that during four seasons, the diets of the studied little owls (contained: 72.9% rodents, 12% insects, 10.1% eulipotyphla, 2.9% birds, and 2.1% reptiles). Rodents, included Muridae, Dipodidae, and Cricetidae families. Muridae had the highest percentages in the pellets (*Mus musculus*) and (*Meriones sp.*) with 48.2% and 33.1% relative abundance, respectively). The percentage of rodents in winter, with 82.8% was superior in comparison to other seasons, and then in autumn with 77.3%, and in spring and summer with 62.9%. Simpson Biodiversity Index was 0.653 for the whole year. Spring and winter had the highest (0.758), and lowest biodiversity index (0.542), respectively. The implication of the results of this study might be in the conservation and management programs, as well.
Keywords: Biodiversity, birds of prey, dietary niche, middle East, pellet

Introduction

The knowledge of food habits and food preferences in animals is essential to perform detailed studies on feeding behavior to develop conservation strategies. It has already been revealed that population decline is due to limited feeding possibilities and limited food availability (Génot et al. 2002). Food access during the breeding season plays an essential role in reproductive output and thus, population dynamics (Thorup et al. 2010). Moreover, diet content studies help to determine

the distribution and abundance of prey and hunting strategies of birds of prey (Torre et al. 2004). For decades, the comparison between diet and prey availability was one of the ecologists' interests. One of the most reasons to do such analyses is to know the food habits and the dietary specialization of the birds of prey or their opportunity and the adaptability to prey availability. Interestingly, even for the same raptor species, the food preferences may differ between habitats (Canova 1989, Comay 2018). Birds of prey predate small mammals that they usually swallow in the whole and regurgitate bones, teeth, fur as compact pellets (Shad et al. 2014). Although the prey selection may be affected by different factors(de Arruda Bueno et al. 2008), the studies on the pellets provide information about the predatory birds' diet, as well as rare prey-species abundance or distribution, habitat preferences, cyclic population dynamics, or seasonal changes (Kryštufek et al. 2009; Haddadian Shad et al. 2014; Boitani et al. 2016).

Feeding habits usually reveal a considerable variation among owl species. Moreover, landscape structure, climatical variables, geographic location, vegetation cover, snow cover, seasons of life, food availability, prey individual's body mass, prey activity are of the most known variables that contribute in the food selection. Diet preferences cause differences in the morphological and physiological traits, and consequently affect other behavior of animals (Oudman et al. 2016).Therefore, investigation of food habits and food selection and the factors affect them in different groups of mammals using different techniques, are done by the animal ecologists (Amr et al. 2016, Oudman et al. 2016, Comay 2018).

The Little owl (*Athene noctua*) is one of the smallest sized members of the Strigiformes with a flat-topped head, a plump, compact body and a short tail, and the facial disc above the eyes. The plumage is greyish-brown, spotted, streaked and barred with white. It is usually 22 centimeters (8.7 in) in length with a wingspan of 56 centimeters (22 in) for both sexes, and weighs about 180 grams (Witherby 1943) . They mainly found in open habitats and forests. Nesting occurs in tree holes, rock cavities, farm buildings, or even holes in the ground. Their primary diet usually consists of small mammals and invertebrates (Génot et al. 2002). The little owl is, however, the only owl species also feeding on plant material (Lanszki 2006). The distribution of *Athene noctua* ranges from the Atlantic to the Pacific Ocean, and from 20° to 55° N. The geographic range of this species is different, which may consequently influence its prey composition (Génot et al. 2002).

In Iran, *Athene noctua* is often found around villages in rural areas. It is widely distributed, but absent in Southern Hormozgan and Baluchestan provinces, where it is replaced by spotted little owl *Athene brama* (Khaleghizadeh et al. 2017).

There are many different methods of studies on the prey preferences of birds of prey (Duffy et al. 1986). Pellet analysis is a frequently used method in the investigation of the feeding strategies in

birds of prey. Pellets usually contain small vertebrates, insects, mandibles and post cranial skeletal elements, which are employed for prey 'identification (Zarei et al. 2021). Therefore, additional information about the small mammals' in the habitats can be provided, as well (Yalden 2009). Owls' pellets measure between 2.5 and 10 cm and can contain up to 10 times more bones than those of diurnal raptors such as eagles, vultures, hawks and falcons (Marks et al. 2001). Therefore, their pellets are good indicators of the prey consumed. Since the bones are much easier to identify than fur or feathers, the bones remaining in the owl pellets are a great way to learn about the prey items and the predator/prey relationships (Page et al. 1975). Pellet analysis is used for a wide range of studies, such as investigation of food habits, food niche overlap and competitions, and other feeding behavior. Although, some studies on pellets are only intended to examine the percentage of prey remains (to know the food habitats), some studies have focused on the conservation and management purposes. For instance, using the pellet analysis technique, Šálek (2012) studied spatial ecology and habitat selection of little owl during the breeding season in Central European farmland. Moreover, Schaub et al. (2006) studied local population dynamics and the impact of scale and isolation on different little owls populations. Access to dietary data is essential for understanding the status of a species in biological communities and effective management of the ecosystem (Bradley et al. 2007). Additionally, knowledge of the diet any niche of guild species can be used specifically for planning of conservation strategies (Marrero et al. 2004).

Several studies have been already carried out on little owl in the Mediterranean region, Western Europe, and the Middle East. For instance, Rey-Rodríguez et al. (2019), implicated a modern analysis on Barn Owls pellets in the Middle East (Rey-Rodríguez et al. 2019); Obuch and Khaleghizadeh (2011), have performed some regional investigations on the identification of rodents' fauna based on the pellets of the Barn Owl in Iran (Obuch et al. 2011); and, Alivizatos et al. (2006), studied Comparative temporal prey use by Barn owl and Little owl in northeastern Greece. In the present study, the diet of little owls was investigated in the Northeast of Iran (Khorasan Razavi Province). The present study aims to improve our knowledge of the little owls' food habits, including food selection, food preferences and variation in the seasonal selection, as well. Additionally, it provides valuable data on this poorly-known biodiversity of the study area.

Material and methods

Study area

Razavi Khorasan province, located in the northeast of Iran, has a total area of 129,043 km^2 (Fig.1). Khorasan Razavi province has topographical and climatical variation: 49.2% of the province is mountainous areas and 50.8% is plains, but in general, its climate is arid to semi-arid with rainfall of 209.5 mm/year (Joodavi et al., 2021).

Data Collection

To investigate prey availability, sampling was done using live box traps and applying a Random –Systematics method for rodents. A total of 60 traps were used and bated. Two lines of 30 metal-box live traps, 10 meters apart, were set. Trapping done for four continues weeks (sessions) in each season. Each trapping session has taken 1200 trap night and the baits were released after being identified. To investigate food use of little owl, 402 pellets have been collected during the autumn of 2019, winter, spring, and summer of 2020. 139 pellets collected in autumn 2019 (October 52 pellets, November 22 pellets, and December 65 pellets), 46 pellets collected in winter 2020 (January 15 pellets, February 9 pellets, and March 22 pellets), 27 pellets collected in spring 2020 (April 16 pellets, May 6 pellets and Jun 5 pellets), and 62 pellets collected in summer 2020 (July 12 pellets, August 35 pellets, and September 15 pellets). *Athene noctua* pellets were collected from 28 natural sites which regularly used for pellet' dropping, at the roosting places (Fig. 1, Supp.1).
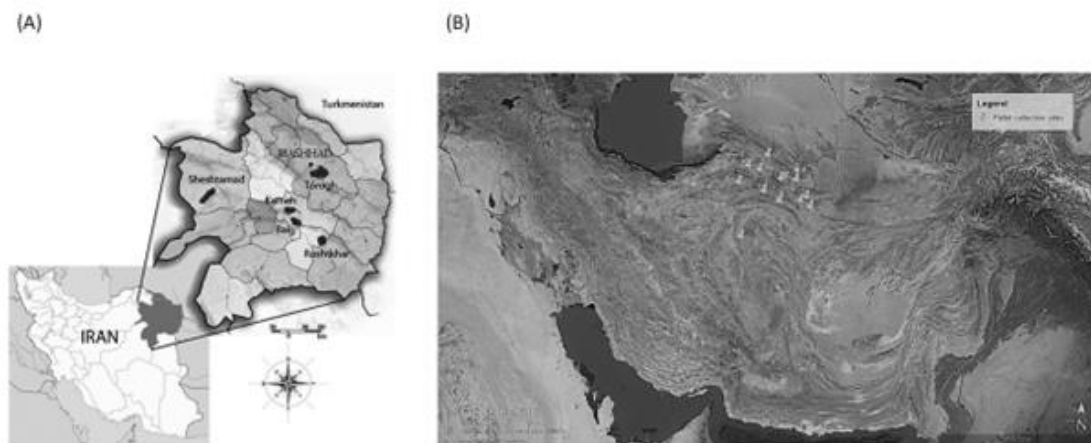

Figure 1. (A) Geographic location of the studied area, Khorasan Razavi province, Iran, (B) Pellet collection sites in northeastern Iran

Intact and dry pellets were collected in separate Ziploc bags and we labeled the bags with geographic coordinates of each collection and then transferred to the laboratory of the Faculty of Natural Resources and Environment, Ferdowsi University of Mashhad (FUM) for recording the size (weight, length, and diameter) and the external aspect. No fixator was used. After the previous analysis, the pellets were sent to IPHES (Institut Català de Paleoecologia Humana i Evolució Social, Tarragona, Spain) where the pellets' contents were sorted by hand under microscope for identification and counting the skeletal elements.

Statistical analysis

All the obtained data, including the length (L), weight (W) and diameter (D) of the pellets, were analysed using SPSS statistical software ver. 26 (Corp, 2019). The following records were

calculated for the collected pellets of each season: Mean, Mean Deviation, Std. Deviation, Variance, Minimum, Maximum, the mean standard error (Std. Error of Mean).

The differences in the appearance of the pellets between the seasons were analysed using one-way ANOVA (analysis of variance). The existence of significant differences between the means statistically evaluated, using the Tukey post- hoc test at a significance level of 0.05. To evaluate the seasonal biodiversity, the "simpson index" was calculated.

Pellet analysis

Before processing, each pellet was individualized with a number, photographed (including the scale, in centimeters), measured with a caliper (length and width, in millimeters), and weighed with a balance (in grams). To avoid damage the skeletal elements, the pellets were soaked in water for five minutes, following (Rey-Rodríguez et al. 2019).

The soaked pellets were disintegrated by hand and using tweezers. The elements were separated, dried and were organized in minigrip bags. The remains of the preyed items were identified as accurate as possible (at level of genus or species), based upon the identification keys the literature: *Crocidura* genus (Krystufek et al. 2005), *Suncus* genus (Krystufek et al. 2005; Rey-Rodríguez et al., 2019), *Microtus* genus (Krystufek et al. 2009), *Chionomys* genus (Rey-Rodríguez et al., 2020), *Cricetulus* genus (Krystufek et al. 2009; Bogicevic et al., 2011; Sandor, 2018), *Meriones* genus (Coşkun, 1999; Darvish, 2011; Stoetzel et al., 2017), *Tatera indica sp.* (Hashemi et al., 2006; Krystufek & Vohralík, 2009), *Ellobius* genus (Maul et al., 2015; Rey-Rodríguez et al., 2021), *Allactaga* genus (Shenbrot, 2009; Tarahomi et al., 2010), *Apodemus* genus (Krystufek et al. 2009; Bogicevic et al., 2011; Darvish et al., 2014; Amori et al., 2016) and *Mus* genus (Darvish et al., 2006; Krystufek et al. 2009). The remained parts of the skeleton including the mandibles, teeth rows, broken bones were photographed, using a Dino-Lite microscope (model AM7915MZTL) (Fig. 2). The separated elements were counted. Using the most abundant skeletal element present in the samples, the Minimal Number of Individuals (MNI), was estimated (Rey-Rodríguez et al., 2019; Zarei et al., 2021).

Bonferroni confidence interval analysis was done to evaluate prey (small mammals' species) selection by Little owl in the studied area. If the expected usage (availability, pio) by the raptor is greater than the upper confidence interval estimate, the prey species was consumed less than expected (-). If pio is lower than the lower confidence interval estimate suggests that the prey species was consumed more than expected (+). If an expected proportion fell within the confidence interval, prey items were consumed in proportion to their availability (=).
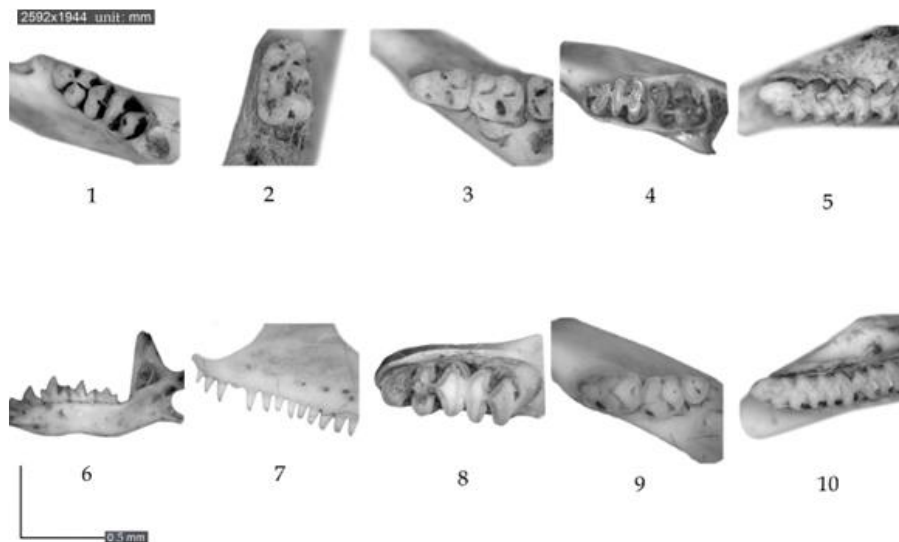
Figure 2. Collected mandibles and teeth row from the investigated pellets: 1- *Tatera sp*; 2- *Apodemus witherbyi*; 3- *Cricetulus migratorius*, left lower mandible; 4- *Allactaga elater*, left lower mandible; 5- *Chionomys nivalis*, right mandible; 6- *Crocidura suaveolens*; 7- Lizard; 8- *Meriones* b, rightlower mandible; 9- *Mus musculus*, left lower mandible; 10- *Microtus* sp. right lower mandible.

Results

A total of 402 pellets were investigated, and 274 minimal number of individuals were identified. According to the pellets measurements, the average length of the pellets (in mm) during four seasons was as follows: summer (30.8) >autumn (29.44)> winter (26.45)> spring (25.7)

For the diameter: spring=autumn (13.5) > winter (13.28) > summer (12.9), and with respect to the weight variable (in gr): autumn (1.37) > summer (1.30)> spring= winter 1 (Table1). In summer, the pellets have the maximum length in average (30.82 mm) and the lowest diameter (12.97 mm), comparing other seasons (Table1).

Table 1. Measurement of little owls' pellet size

Seasons	Spring(n=26)			Summer(n=48)			Autumn(n=131)			Winter(n=43)			Total(n=248)		
Paramet	L	D	W	L	D	W	L	D	W	L	D	W	L	D	W
Mean	25.	13.	1.0	30.	12.	1.3	29.	13.	1.37	26.	13.2	1.0	28.	13.	1.2
Std. Error of	1.0	.50	.05	1.2	.23	.06	.72	.13	.037	.82	.290	.04	.49	.11	.02
Median	25.	13.	.96	28.	12.	1.2	28.	13.	1.32	25.	13.1	.95	27.	13.	1.1
Std.	5.5	2.5	.26	8.4	1.5	.46	8.2	1.5	.429	5.4	1.90	.30	7.7	1.7	.43
Variance	30.	6.6	.06	71.	2.5	.21	68.	2.2	.184	29.	3.64	.09	60.	3.0	.18
Range	23.	11.	1.0	45.	8.0	2.1	61.	7.0	2.46	21.	10.2	1.2	62.	13.	2.5
Minimum	11.	6.9	.57	21.	8.5	.49	12.	10.	.61	16.	10.5	.53	11.	6.9	.49
Maximum	35.	18.	1.6	66.	16.	2.6	73.	17.	3.07	37.	20.7	1.7	73.	20.	3.0

The results of the one-way ANOVA showed that the pellets lengths were significantly different

Table 2. One-way analysis of variance - length, diameter and weight of pellets (Significant differences marked with a star)

variables	Source of variation	Sum of squares	Degree of freedom	Mean square	F	Sig.
Lengths	Between Group	762.82	3	242.27		
	Within Group	14280.19	244	58.53	4.14	0.007*
	Total	15007.01	247			
Diameter	Between Group	12.64	3	4.21		
	Within Group	736.51	244	3.02	1.40	0.245
	Total	749.15	247			
Weight	Between Group	6.46	3	2.15		
	Within Group	39.63	244	0.16	13.25	0.000*
	Total	46.08	247			

among the seasons ($P < 0.05$) (Table 2). Based on the Tukey post-hoc test, there is a significant difference between "spring" and "summer", "summer" and "winter" Regardless of the sign, the most significant difference is related to spring and summer (Table3). The results of the one-way ANOVA on the weight of the pellets showed that the differences in this variable was significant among the seasons ($P < 0.05$) (Table 2). According to the Tukey post-hoc test, between "spring" and "summer and autumn", "summer" and "winter", and also "autumn" and "winter" a significant difference was observed. A considerable difference was observed between the autumn and winter seasons (Table 4). According to the significance level of the difference (P>0.05), there is no significant difference among the pellet's diameter (Table 2).

Table 3. Pairwise Comparison of means using Tukey post- hoc test for the pellet length (Significant Differences marked with a star)

Seasons	Spring	Summer	Autumn	Winter
Spring		-5.06*	-3.67	-0.68
Summer			1.39	4.38*
Autumn				2.99

Table 4. Pairwise Comparison of means using Tukey post hoc test for pellet weight. * Significance at the level of 5% and with 95% confidence

Seasons	Spring	Summer	Autumn	Winter
Spring		-0.30*	-0.37*	0.000
Summer			-0.08	0.30*
Autumn				0.38*
Winter				

In the study of the little owl diet, we have observed that noticeably the rodents constitute the highest percentage of preyed items, in all seasons (Fig. 3). In a more detailed study, we observed that the percentage of rodents in winter with 82.8%, was superior to other seasons, and then in autumn with 77.3% and spring and summer were both 62.9% (Table 5). In all seasons, mice (*Mus* spp.) are dominated by numbers in the owl's diet, followed by insects which are the second or third food priority of this bird in average, however in summer, with 24% frequency, insects were superior to other seasons. Although Eulipotyphla has the second or third food priority, but they were absent in the prey' remains in winter, which can be due to the low number of samples. The least common prey items were birds and reptiles in all four seasons. Among the seasons, in spring with 7.4% frequency, birds and reptiles both had the highest presence in prey remains, and among reptiles, lizards were the most abundant. Overall, the results indicated that during the four seasons, the diet of the studied little owls (contained: 72.9% rodents, 12% insects, 10.1% Eulipotyphla (7.6% lesser white-toothed shrew (*Crocidura suaveolens)* and 2.5% Etruscan shrew (*Suncus etruscus*)), 2.9% birds, 2.1% reptiles (*Lacertilia*)) (Fig. 3).
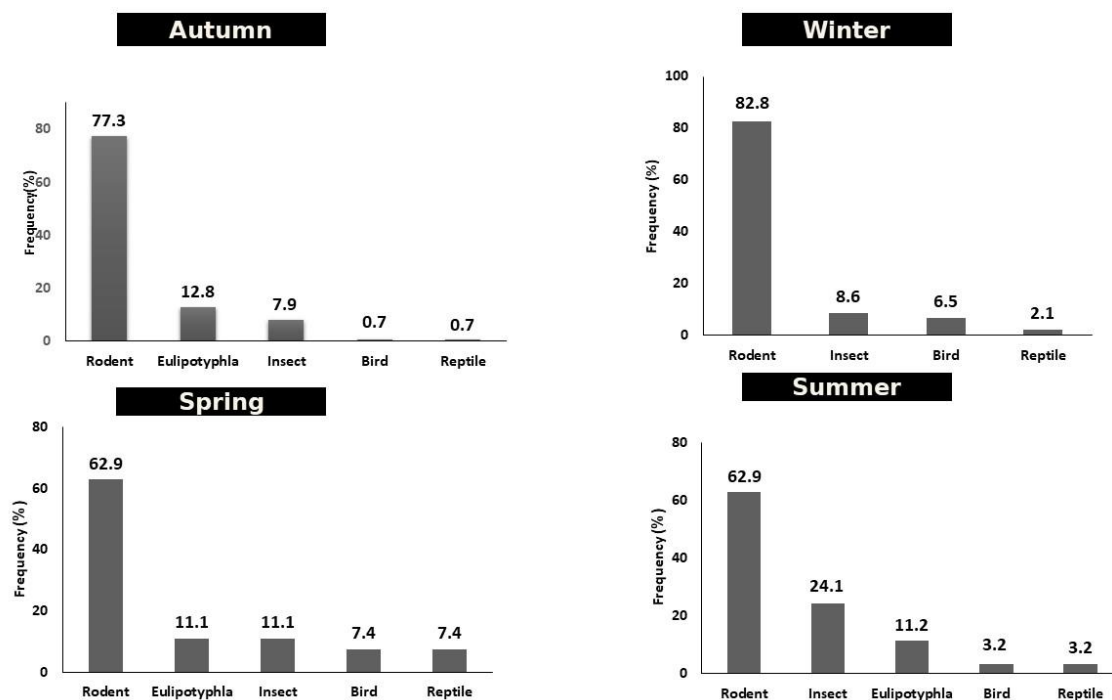
Figure 3. Plots showing abundance of the preyed items by little owls, seasonally

Among the rodents i.e., Muridae, Dipodidae and Cricetidae families, Muridae formed a supplementary part of the diet: (48.2% House Mouse (*Mus musculus*), and 33.1% Jirds (*Meriones*)), 7% Grey dwarf hamster (*Cricetulus migratorius*), 5% Voles (*Microtus* sp.), 2.5% Indian gerbil (*Tatera indica*) and finally European snow vole (*Chionomys nivalis*), Southern mole vole (*Ellobius fuscocapillus*), Steppe field mouse (*Apodemus witherbyi*) and Small five-toed jerboa (*Allactaga elater*) with 1%, had the lowest frequency among rodent remains in the studied pellets (Fig. 4).

Mus musculus was the first food priority in all seasons, and *Meriones* was the second food priority. *Allactaga elater* only in autumn, *Ellobius fuscocapillus* only in autumn and spring, *Chionomys nivalis* only in winter, and *Apodemus witherbyi* only in spring were observed among the identified prey items. *Cricetulus migratorius* was present in all seasons in the little owls diet with a small percentage of frequency. Species that were observed only in autumn or winter, it can be because of less cover that may cause visibility of the prey and subsequently increase predatory chance. Regarding the prey items that have been seen only in spring, it might be relevant to relative abundance of them in this season (Fig. 4).
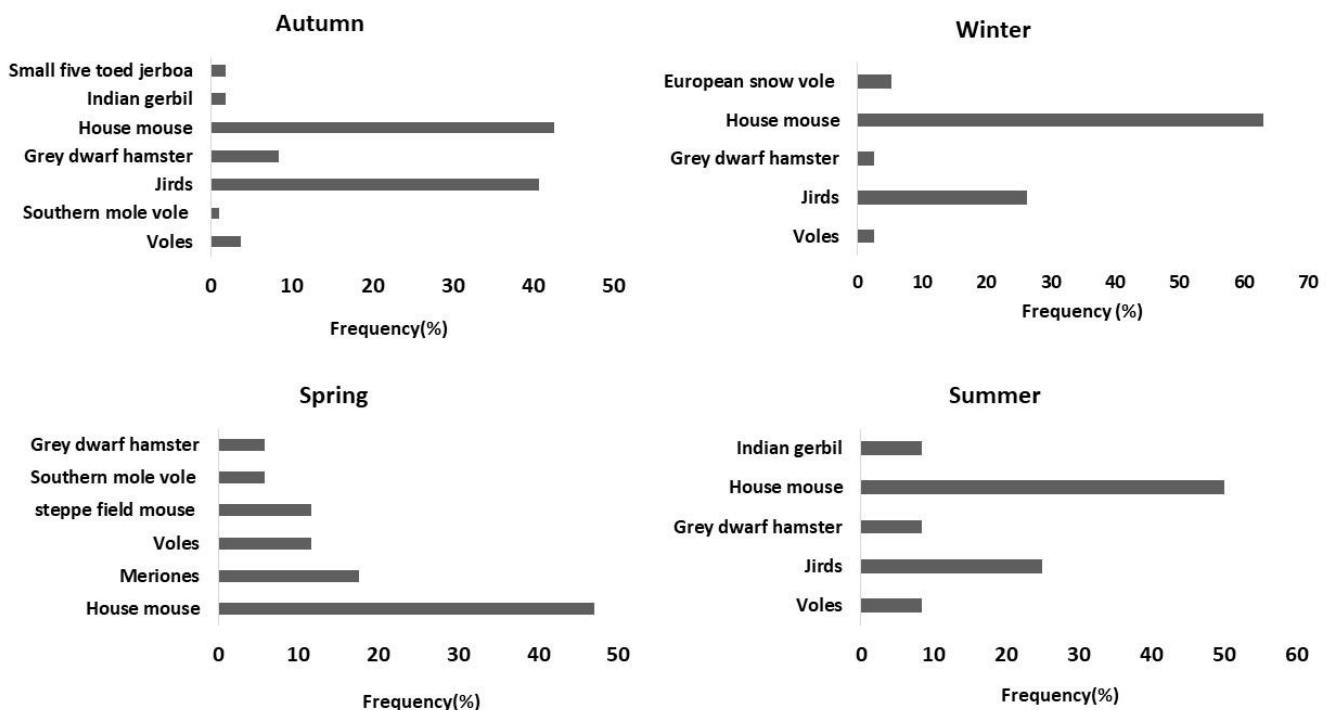

Figure 4. Plots showing rodent abundance in little owls' diet, seasonally

A total of 65 small mammals were captured by our live traps that most of them released at field after identification. Persian Jird (*Meriones persius*) contains more than 35% of trapped small

mammals, followed by House mouse (*Mus musculus*, with 32%), Voles (*Microtus* sp. with 10%), Steppe field mouse (*Apodemus witherbyi*, with almost 6%), and Indian Gerbil (*Tatera indica* sp. 3%). Shrews in total composed less than 5% of the trapped prey (Fig. 5, Table 6).

The Little owls consumed three prey species (Jirds, Indian gerbil and shrews) in proportion to their availability, although voles and steppe field mouse was consumed less and House mouse and hamsters were consumed more than expected by chance (Fig. 5, Table 6).
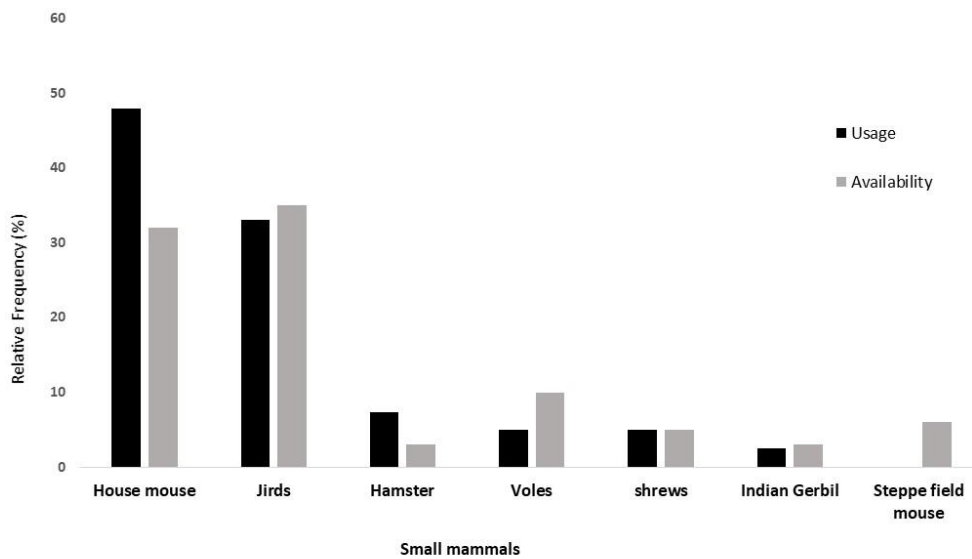

Figure 5. Relative frequency of the captured small mammals vs. their availability

Table 6. Bonferroni confidence intervals and comparison of prey items (small mammals) availability in the field and observed usage by little owl.

Small mammals (Prey species)	Observed usage (Pi)	Expected usage (Availability) Pio	Bonferroni Confidence Interval for Pi	Selection
Jirds	0.33	0.35	0.314≤Pi≤ 0.378	=
House mouse	0.48	0.32	0.453≤Pi≤ 0.519	+
Hamster	0.073	0.03	0.0592≤Pi≤ 0.913	+
Voles	0.05	0.1	0.034≤Pi≤ 0.067	_
Steppe field mouse	0	0.06	0.000≤Pi≤0.0100	_
Indian Gerbil	0.025	0.03	0.022≤Pi≤ 0.039	=
Shrews	0.05	0.05	0.034≤Pi≤ 0.067	=

In the study of the Simpson Biodiversity Index, we reached an index of 0.653 for the whole year, which means that there is a 65% probability that two randomly selected individuals from this community will be from different species. Based on the seasonal results, we observed the highest

and lowest biodiversity index in spring and winter (0.758, 0.542) respectively. Which can be linked to climatic conditions and hibernation or torpor in the winter (Table7).

Table 7. Simpson index test describes the insignificant differences in little owls' diet during four seasons.

seasons	Spring	Summer	Autumn	Winter	Total
The abundance of rodent species	17	36	108	38	**199**
Simpson index (1-D)	0.758	0.686	0.650	0.566	**0.653**

Discussion

The results demonstrated that the little owls mainly feed on rodents throughout the year. This might be relevant to the availability of rodents in the studied area or the nutritional value of small mammals rather than birds and insects per each prey handling effort. The high percentage of rodents in winter food composition can be linked to that the birds are more inclined to hunt rodents to obtain more fat in this season. Additionally, since in winter, the land is barely naked, without any vegetation cover, the visibility of the rodents' increases, and consequently the probability of hunting rodents' increases, as well.

This study's results are in concordance with the results of have obtained by Obuch et al. (2011), Balčiauskienė et al. (2006), Bonvicino et al. (2003), Zhao, (2011),Hámori et al., (2017), Moysi et al., (2018), Rey-Rodriguez et al. (2019), Selçuk et al. (2019), and Saufi et al. (2020), which all concluded that rodents comprising the highest percentage of the diet (Table8). But, our results are not in agreement with(Hounsome et al., 2004) and (Pocora et al. 2012), who found insects to have the highest relative abundance (see table 1, for more details). Differences in the observed results, might be caused by the power of adaptation and flexibility of little owls in the food use. Little owl is an opportunistic predator, meaning that the frequency of a preys' diet is mainly related to the availability of prey species in their habitats (Goutner et al. 2003). The differences in the results obtained by different researchers might be endorsed by the differences in climatic conditions of the study areas (Pocora et al. 2012). Moreover, differences in the number of pellets collected in different seasons of the year, and even different quality of pellets analysis may cause such differences. Our results, in agreement with Canova (1989), showed that the frequency of preyed items in the pellets reflect the relative availability of small mammal species. Our results, in concordance with (Cramp et al., 1992; Šálek et al., 2010), confirm the Little owl is a dietary generalist predator, as well.

Table 8. A systematic review of Strigiformes diet by pellet analysis

No.	Author & Date	Summary of results
1	Bonvicino et al. (2003)	Analysis of regurgitated pellets of one Barn Owl (*Tyto alba*) collected in the Cerrado of central Brazil yielded remains of 12 vertebrate species comprising eight rodents, two marsupials, one passerine bird and one lizard.
2	Hounsome et al. (2004)	A total of 39 individual pellets were collected in the spring, summer and autumn of 1998. Coleopterans were the most frequently observed prey item and some pellets appeared almost entirely composed of their remains. Field Vole was the most frequently observed small in pellets examined.
3	Balčiauskienė et al. (2006)	Diet composition of Tawny Owl (*Strix aluco*) and Long-eared Owl (*Asio otus*), were analysed. *S. aluco*: 14 small mammal (93.1% of the recovered items) and two amphibia (5.2%) species, a few passerine birds (1.1%) and representatives of three Coleoptera groups (0.6%) were recovered, whereas for *A. otus* nine small mammal and two Carabidea species.
4	Zhao et al. (2008)	Comparison of Little owls (*Athene noctua*) and Long-eared Owls (*Asio otus*) diets near the Minqin Desert Experimental Research Station in northwestern China. Diets differed significantly by frequency: Little owls fed mainly on mammals (56%) and beetles (42%), and Long-eared Owls fed almost exclusively on mammals (97%).
5	Obuch et al. (2011)	Pellets regurgitated by Barn Owls in southern Iran. Pellet investigation yielded remains of 2,253 prey items representing 97 different species, Mammals comprised 1,741 prey items (77.3%), while birds comprised 452 (20.1%). The predominant species were mice (*Mus sp.*) (696; 30.9%), Indian Gerbil (*Tatera indica*) (246; 10.9%), Social Vole (*Microtus socialis*) (214; 9.5%) and House Sparrow (*Passer domesticus*) (198; 8.8%).
6	Pocora et al. (2012)	The feeding of Little owl was studied based on 103 pellets collected near Letea village, in the Danube Delta. Pellets were collected near the nest, each month from April until June 2009 and in the owl's diet, several species of insects, mammals and birds were identified. The highest percentage is represented by insects, with species belonging to orders Coleoptera (71.92%), Orthoptera (15.45%) and Dermaptera (5.31%).
7	Hámori et al. (2017)	The feeding of Little owl (*Athene noctua*) was studied in a farmland area of Kiskunság, Central Hungary. For the analyses, a total of 661 Little owl pellets were collected.. The identified prey items represented 15 vertebrate and 39 invertebrate species/taxa. In terms of prey number, dominance of small mammals was observed.
8	Moysi et al. (2018)	This study was based on 1407 regurgitated pellet analysis that were collected from 26 sites representing six major habitat types on central and southern Cyprus, Low prey diversity was found comprised mainly of rodents (overall means 96.2 and 95.7% by number and biomass, respectively). Mice followed by rats were most important prey whereas insectivores, birds and insects were minor components of the owl's diet.
9	Rey-Rodriguez et al. (2019)	A taxonomic and taphonomic study of the small mammal remains found in pellets from Barn Owl (*Tyto alba*) from a poorly known region of South of Turkey at the Syrian border, east of Euphrates River. The studied sample constituted by more than 40 disintegrated pellets provided 2503 rodent skeletal elements. The most common preys are *Meriones tristami*, followed by *Mus musculus*.
10	Selçuk et al. (2019)	In this study, pellet compositions of Long-eared Owl (*Asio otus*) in the Eastern Anatolia (Turkey) were analyzed, Compositions of 130 pellets of Long-eared Owl were used in the study. 147 preys (1.13 preys per pellet) which belong to 9 different taxa were found in pellet composition. A significant part of the diet in study area consisted of small mammals. Only two remains of birds were recorded from pellets. Microtus sp. was found important prey in the diet of Long-eared Owl.
11	Saufi et al. (2020)	This study investigated the diet of introduced Barn Owls (*Tyto alba javanica*, Gmelin) in the urban area of the Main Campus of Universiti Sains Malaysia, Penang, Malaysia. Results showed that commensal Norway rats, *Rattus norvegicus*, made up the highest proportion of the diet (65.37% prey biomass) while common shrews, *Suncus murinus* were the second highest consumed prey (30.12% prey biomass). Common plantain squirrel, *Callosciurus notatus,* made up 4.45% of the diet while insects were taken in a relatively small amount (0.046% prey biomass)

Conclusion

In a conclusion, we confirm that the pellet studies may provide useful information in the fields of behavioral ecology, conservation, and management. Although human settlements provide various habitats for the raptors, land-use change and habitat fragmentation during the last decade have caused the local extinction of these species (Zarei, et al., 2021). By having data about prey species that are consumed by raptors, we may have an ecosystem approach for protecting the habitat

against land-use changes, because those fewer concerned animals contain the main food of birds that have a high conservation value. Since the owl is inhabitants that are not considered in terms of conservation, based upon the obtained results, we suggest to Iran's Department of Environment, as the corresponding organization to conservation, to prevent land-use change in the owl' habitats. Actually, at least due to the role of this bird in the biological control of rodents and plant pests in the ecosystem, monitoring of the populations of this species is recommended.

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