

SHORT REPORT

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Winter diet of the long-eared owl *Asio otus* (Strigiformes: Strigidae) in the grasslands of Janos, Chihuahua, Mexico

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Abstract

Background: The long-eared owl (*Asio otus*) has a Holarctic distribution, including much of North America. This nocturnal species is considered to be extremely secretive, and poorly known in the Great Plains of the United States and Canada, as well as to México, where no previous studies on its diet have been conducted.

Findings: We analyzed 120 pellets collected during January 2007 in roosts in a 2–3 m height mesquite scrub within a grassland area of Reserva Ecológica El Uno, located in the Natural Protected Area Janos. We registered and identified three orders, four families, eight genera and ten species of mammals and two orders and one family of insects. Winter diet is dominated by mammals, especially rodents in both frequency and biomass. Cricetidae and *Perognathus flavus* were the most frequent family and species, respectively. On the other hand, when analyzing biomass, *Sigmodon* species were dominant, achieving almost 70% of the consumed biomass. Levin's standardized niche breadth based on frequency was calculated as 0.40, while based on biomass was 0.38. Also, two previously unrecorded rodent species were identified as long-eared owl prey.

Conclusion: Although 18 different types of items were identified, the long-eared owl tends to be selective, with a single genera (*Sigmodon*) comprising almost 70% of its consumed biomass during winter. *Perognathus flavus* was also important in frequency (21%); however, it barely constitutes 2% of the consumed biomass.

Keywords: Winter diet, Long-eared owl, Grasslands, Janos, México

Resumen

El búho orejas largas es una especie Holártica, que se distribuye en gran parte de Norteamérica y que ha sido poco estudiada, especialmente en las Grandes Planicies de Estados Unidos y en México, donde no existe un estudio previo sobre su dieta invernal. Se colectaron y analizaron 120 egagrópilas en la Reserva Ecológica El Uno, dentro del Área Natural Protegida Reserva de la Biósfera Janos. Se identificaron un total de 18 tipos de presa, pero la especie mostró selectividad por dos géneros/especies, ya que cerca del 70% de la biomasa consumida fueron especies del género *Sigmodon*, mientras que el 21% de las muestras contenían *Perognathus flavus*. Además, dos especies de roedores identificadas constituyen nuevos registros de presa para la especie.

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Findings

Introduction

The long-eared owl is a Holarctic species, distributed on the temperate regions of North America, Europe and Asia [1, 2]. It inhabits dense vegetation, such as forests, riparian woodlands, and shrublands next to open areas used for low-height and ground foraging. Its diet has been thoroughly studied, mostly in the United States and Europe, reporting to be over 90% based on rodents, mainly voles (*Microtus* spp.), and to a lesser extent birds [1, 3]. However, its feeding ecology on arid areas is far less known, especially during the winter. In Mexico, there are no previous studies of the diet of the long-eared owl. This is the first work to present the frequency of occurrence and biomass of the prey items present in the long-eared owls pellets during the winter in northwestern Chihuahua, México.

Methods

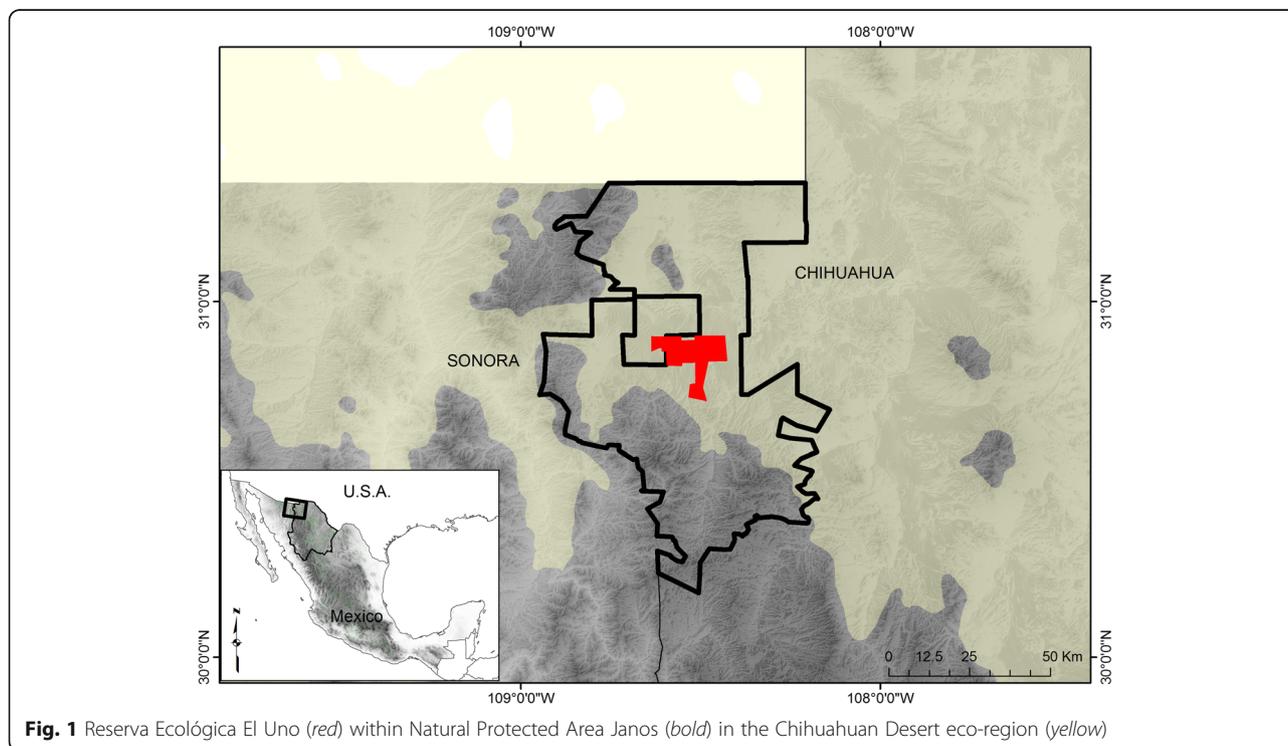
We collected 120 pellets during January 2007 in several roosts of 2–3 m height mesquite scrub within a grassland area of Reserva Ecológica El Uno (30°53'13.23"N, 108°30'25.87"W), within the Natural Protected Area Reserva de la Biósfera Janos (Fig. 1). Pellets were storage in plastic containers and posteriorly processed using a NaOH solution (8%) to remove hair and other matter [4]. We separated the remaining items in general groups: invertebrates (insects), reptiles, birds and mammals; although the latter were the predominant. For mammals'

identification, we followed Anderson [5] and Roest [6], and Wilson and Reeder [7] for taxonomic arrangement. For insects, we used Borror et al. [8] criteria. Direct comparisons were also made with material from the Mammals and Entomological Collections of the Facultad de Ciencias Biológicas of the Universidad Autónoma de Nuevo León. We obtained relative frequency of occurrence [9] for every identified taxonomic level of the items. We also calculated biomass, using mid-points of weight ranges reported for mammals of Mexico [10], to avoid overestimations [11].

Finally, we calculated Levins's standardized niche breadth [12] from frequency and biomass data, using the following formula: $B_A = (B-1)/(n-1)$; where $B = 1/\sum p_i^2$ is the Levin's measure of niche breadth [13]; n = number of prey items, p_i^2 = proportion of individuals of each type of prey item. Values oscillate from 0 (minimum niche breadth an maximum selectivity) to 1 (maximum niche breadth and minimum selectivity) [14].

Results

We found a total of 141 items, from which a 13.48% was unidentified. We recorded three orders, four families, eight genera and ten species of mammals and two orders and one family of insects. A total of 95.74% of the long-eared winter diet is comprised by mammals, the rest, birds, reptiles and insects were not significant, obtaining less than 5% of occurrence in the pellets. Among mammals, rodents were the prevailing prey, with 94.33% of



the frequency and 90.90% of the biomass. Cricetidae was dominant with a frequency of 56.03% and 80.69% of biomass. Although *P. flavus* was the most frequent species (20.57%), its biomass is below 2%, while the most important prey in terms of biomass were *Sigmodon* species, with 69.12%: *S. hispidus* 25.75% and *S. fulviventer* 21.68%. Previously described selectivity, was also noticeable on the niche breadth, based on both frequency ($B_A = 0.40$) and biomass ($B_A = 0.38$).

Discussion

The dominance of rodents (94.3%) as the main long-eared prey is consistent with data from a worldwide review with 91.7%; although such value was variable, obtaining the highest for northern Europe (93.3%) and the lowest for Asia (79.5%), where birds were also an important part of its diet (19.1%) [15]. Cricetidae were dominant with a frequency of 54.61%, below the range reported by several authors and worldwide (88–97%), with the exception of Africa/Middle East (71.5%) and Asia (59.8%), where Muridae was the most frequently consumed rodent family [1, 3, 11, 15–17]. On the other hand, biomass percentage is consistent (80.69%) with known range of values (86–98%) [9]. The second most important family in frequency was Heteromyidae (27.66%), lower than the range reported for arid environments in North America during winter (45–98%) [18–20]. Biomass was even smaller with a 10.20%, compared to 20–58% range for its diet during the breeding season [21, 22]. *Sigmodon* was undoubtedly the most important prey for the long-eared owl during the winter, with a 43.26% of frequency and 69.12% of biomass. This contrast with the vast majority of the published research, where *Microtus* is the most frequent prey in North America (60.8% [1], 78–79% [11], 23.8% [15], 80–96% [3]), as well as Europe where it can comprise up to 99.7% of its diet [15]; however, *Mus* is the most important genus in Africa with up to 90.9% and Asia with a maximum of 77.4% [15]. In North America, *Microtus* has also shown the highest biomass (34–60% [16], 87–88% [11]). However; our data coincides with the frequency of winter roosts in Kansas (32.3% [23]) and Texas (36% [24]). On the latter, *Sigmodon* comprised the highest biomass prey for the long-eared owl (79.8%).

On the species level, *S. fulviventer* and *D. spectabilis* are new records of species consumed by the long-eared owl. *P. flavus*, showed the highest frequency (20.57%; Table 1), which is consistent with previous research conducted on desert areas of Arizona (*Perognathus* spp. 70.4% [25] and 67.3% [26]), Oregon (*P. parvus* 36.8% [18]), and southern California (*Perognathus* spp. 60% [19]). It is noteworthy that on the southern California study, its frequency was highly variable among years and sites (18–88%), which may be related to the known population fluctuations of the species [27]; which has

Table 1 Frequency of occurrence and biomass of 120 long-eared owl pellets from wintering roosts in Janos, Chihuahua, México collected in 2007

Prey	FR	FR%	Biomass (gr)	B%
Mammals	135	95.74	11059	100
Soricidae	1	0.71	5	0.04
Leporidae	1	0.71	1002	9.06
Desert cottontail (<i>Sylvilagus audubonii</i>)	1	0.71	1002	9.06
Cricetidae	77	54.61	8924	80.69
White-throated woodrat (<i>Neotoma albigula</i>)	6	4.26	1035	9.36
Southern grasshopper mouse (<i>Onychomys torridus</i>)	8	5.67	200	1.81
North american deer mouse (<i>Peromyscus maniculatus</i>)	2	1.42	45	0.41
Tawny-bellied cotton rat ^a (<i>Sigmodon fulviventer</i>)	22	15.60	2398	21.68
Hispid cotton rat (<i>Sigmodon hispidus</i>)	17	12.06	2848	25.75
Cotton rat (<i>Sigmodon</i> sp.)	22	15.60	2398	21.68
Heteromyidae	39	27.66	1129	10.20
Merriam's kangaroo rat (<i>Dipodomys merriami</i>)	1	0.71	43	0.38
Ord's kangaroo rat (<i>Dipodomys ordii</i>)	4	2.84	292	2.64
Banner-tailed kangaroo rat ^a (<i>Dipodomys spectabilis</i>)	4	2.84	534	4.83
Kangaroo kat (<i>Dipodomys</i> sp.)	1	0.71	43	0.38
Silky pocket mouse (<i>Perognathus flavus</i>)	29	20.57	218	1.97
Unidentified rodents	17	12.06	-	-
Unidentified birds	1	0.71	-	-
Insects	4	2.84	-	-
Orthoptera: Acrididae	3	2.13	-	-
Coleoptera	1	0.71	-	-
Vertebrates	137	97.16	-	-
Invertebrates	4	2.84	-	-

^aNew records of prey for the long-eared owl

been reported to be absent for several years at a time, and then successfully reappeared to be one of the most abundant species [28]. On the other hand, although this genus and species comprise <2% of the prey biomass, along with *Dipodomys* sp., are generally the main preys in arid areas [18, 19, 21, 22, 26, 29].

Based on biomass, *Sigmodon* species (69.11%): *S. hispidus* (25.75%), *S. fulviventer* (21.68%) and *Sigmodon* sp. (21.68%) were the most important prey in Reserva Ecológica El Uno. The importance of *S. hispidus* coincides only with few studies that have found this species among the two most consumed preys, one made on a winter roost in Texas with an even higher dominance of

frequency and biomass (36.4% and 79.8% [24]), two studies in Kansas with 56% and 32.3% of occurrence [23] and a winter-spring roost in Missouri with 35.6% of occurrence [30]. From the rest of published studies, only three have mentioned this species and/or genus with a frequency lesser than 10% [17].

The vast majority of the studies found to be voles (*Microtus*) and especially *M. pennsylvanicus* the main long-eared owl prey in North America [1, 3, 11, 15]. One of the reasons for this pattern is that *Microtus* species are not distributed in Janos-Casas Grandes area in Chihuahua [31], although there are records for the State of a relict subspecies (*M. p. chihuahuensis* [32, 5]) that is now possibly extinct [10], and *M. mexicanus* that is distributed on higher elevations of the western part of Chihuahua [5]. A study conducted on the mammals of the Janos-Casas Grandes area between 1993 and 1999, recorded *S. hispidus* but not in significant numbers to estimate a density, while *S. fulviventor* density was low (1.4 inds/ha), compared to *P. flavus* (8.1 inds/ha [31]). However, the *S. hispidus* has been observed having irruptive high populations over several-years intervals followed by rapid declines [30]. Our study may be indicative of important numbers of *S. hispidus* and *S. fulviventor* during the year of data collection; however, since we did not estimate prey abundance during our study we cannot conclude if the high frequency of consumption of *Perognathus* and *Sigmodon* are due to a high availability and/or preference of this rodents. The pattern that seems clear is that the long-eared owl shows a narrow diet niche with 2–3 most frequently (>10%) consumed rodent species within each study area (our data, [20, 33–35]). Studies conducted over several years and including prey availability should shed light on specific patterns of prey consumption of the long-eared owl, especially on the little studied desert areas of Southwestern United States and northern Mexico.

Acknowledgements

We thank Natalie Nereyda Cruz Maldonado, Javier Cruz Nieto and María Magdalena Salinas Rodríguez for their logistic support during fieldwork.

Funding

Not applicable.

Availability of data and materials

The authors declare that the data supporting the findings of this study are available within the article.

Author's contributions

JIGR conceived and coordinated the study. HPR collected pellets and identified items. IRO, MACN, RCC and AGV participated on data analysis and interpretation, as well as manuscript writing. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interest.

Consent for publication

Not applicable.

Ethics approval and consent to participate

Not applicable.

Received: 9 August 2016 Accepted: 18 January 2017

Published online: 28 January 2017

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