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Temática: Ornitología

CONTRIBUTION TO THE DIET OF THE BARN-OWL (*Tyto alba*) (AVES: STRIGIFORMES) DURING BREEDING SEASON IN NORTHWESTERN GUERRERO, MEXICO

CONTRIBUCIÓN A LA DIETA DE LA LECHUZA DE CAMPANARIO (*Tyto alba*) (AVES: STRIGIFORMES) DURANTE LA ANIDACIÓN AL NOROESTE DE GUERRERO, MÉXICO

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INFORMACIÓN SOBRE EL ARTÍCULO

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ABSTRACT. Knowledge of Mexican nocturnal raptors diet is scarce. We evaluated the diet of the Barn-owl *Tyto alba* during its breeding season in a small agricultural area the northwestern state of Guerrero, Mexico, from November 2016 to February 2017. We analyzed 24 owl-pellets with 44 prey items from two nests. Small mammals are the principal food item of these birds; represent 48% of the total frequency and 55% of biomass. The trophic feeding overlap index was 83% similitude of the diet among both nests. Further research on pellets at other *T. alba* nesting sites may help to explain the feeding ecology in an agricultural area, and the potential effects to control crop pests.

KEYWORDS: Nocturnal Raptors, Pellets, Small Mammals, Strigiformes, Trophic Niche.

RESUMEN. En México el conocimiento de la dieta de las rapaces nocturnas es insuficiente. Durante noviembre 2016 a febrero 2017, evaluamos la dieta la lechuza *Tyto alba* durante la época reproductiva en una pequeña área agrícola al noroeste del estado de Guerrero, México. Analizamos un total de 24 egagrópilas y 44 elementos en la dieta para dos nidos. Los mamíferos de talla pequeña son la principal presa de la lechuza con el 48% de la frecuencia y el 55% de la biomasa. Ocurrió un índice de traslape trófico del 83% entre las dos parejas de lechuzas. Futuros estudios en otros sitios de anidación de *T. alba* puede ayudar a explicar la ecología de forrajeo en áreas agrícolas y los efectos potenciales en el control de las plagas de cultivos.

PALABRAS CLAVE: Rapaces Nocturnas, Egagrópilas, Mamíferos Pequeños, Strigiformes, Nicho Trófico.

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INTRODUCTION

Diet studies on Mexican nocturnal raptors are reported for some species for example in *Bubo virginianus*, *Athene cunicularia*, and *Asio flammeus* (Enríquez & Vázquez-Pérez, 2017). Food is critical factor during breeding season (Newton, 1998). Studying these groups of birds´ diets throughout the breeding season can help answer issues including: ¿what are the foraging strategies (specialists or generalists) in a specific habitat? Which prey species are the most common? Or is there a prey-specific dependency? Pellets, indigestible material, can be analyzing to answer these issues (Hernández-Muñoz & Mancina, 2011; Andrade *et al*., 2016).

The Barn-owl *Tyto alba* (Temminck, 1827) is a widespread bird of prey inhabiting different ecosystems including urban areas, agricultural fields, grasslands, and forests (Bruce, 1999). *Tyto alba* is known to eat rodents, birds, reptiles, amphibians, bats, and insects, according to the literature (Andrade *et al*., 2002; Carmona *et al*., 2006; Vale-Gonçalves *et al*., 2015; Moysi *et al*., 2018; Horváth *et al*., 2018; Cadena-Ortiz *et al*., 2019, Viganò *et al*., 2020). However, more of these studies report higher biomass of rodent consumption (65 - 85%).

In Mexico, studies based on *T. alba* pellets report that this species has a flexible diet based on prey availability (Hernández, 1997; López-Forment, 1997; Morales, 1997; Jorgense *et al*., 1998; Soto, 1998; Aragón *et al*., 2002; Álvarez-Castañeda *et al*., 2004; Zarza & Cruzado, 2004; Santos-Moreno & Alfaro Espinosa, 2009). On the other hand, some studies suggest that *T. alba* shows prefers particular prey taxa (Velarde *et al*., 2007; Lavariega *et al*., 2016). Despite numerous food-habit studies in Mexico, few have been undertaken during the breeding season. The aim of this study was to advance our understanding of the *T. alba* diet during the breeding season. Pellets of this owl were collected and analyzed their content to: (1) to report prey composition, (2) to estimate frequency and biomass for each prey in the diet, and (3) to assess food-niche breadth in the Northwestern state of Guerrero.

METODOLOGY

Study Area: The study was conducted in Charco Encantado, a nesting area for this owl located in the sub-province of the Rio Balsas-Zirandaro Basin, in the Municipality of Tlalchapa, Guerrero, in the locality of Colonia Cuauhtémoc (18º21´30.5´´N-100º21´46.7´´W; 450 masl; Figure 1). The climate is sub-humid warm with rain in summer, with an annual temperature higher than 26°C; the mean annual precipitations is 1150 mm (INEGI, 2017). Colonia Cuauhtemoc is a small agricultural area of almost 626 hectares with non-technified temporary mixed crops for sowing of corn (*Zea mays*), sorghum (*Sorghum bicolor*) and sesame (*Sesamum indicum*). Corn is planted seeds during July and it is harvested in November-December. Sorghum and sesame are planted seeds during July and they are harvested in November (INEGI, 2017). Despite the agrarian area, natural elements of the tropical deciduous forest remain, with the dominant species of trees being *Bursera grandifolia*, *B. copallifera*, *Vachellia farnesiana*, *Lysiloma acapulcensis*, and *Guazuma ulmifolia* (Rzedowski, 2006).

Field and Laboratory Methods

Tyto alba pellets were collected from two nests within a flooded canyon approximately 500 m long, and 8 m depth. We identified the nests (Figure 2) in crevasses in the canyon wall, separated by 15 m. This nesting site consists of a mosaic of agricultural areas and native vegetation. The nesting site was 2.5 km from the center of the agricultural and was surrounded by remnants of tropical deciduous forest and areas without vegetation. Nests were active from November 2016 to end of February 2017 (breeding season), where we collected 24 complete owl-pellets after the nesting period was over, not affect incubation and chick development.

Tyto alba pellets were put in individual tagged plastic bags and nest information and date of collection were noted. Nest 1 yielded 11, and nest 2, 13 pellets. In the laboratory, each pellet was weighed and processed individually. With a sieve, we separated bone pieces. We identified each food item to the nearest taxonomic

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category (Figure 3), compared it with reference materials from the Zoological Collections of the Escuela Nacional de Ciencias Biológicas of the Instituto Politecnico Nacional, and specialized literature (García & Ceballos, 1994; Álvarez-Castañeda *et al*., 2015). We quantified taxa in five groups: rodents, birds, reptiles, amphibians and insects, and identified amphibian bones up to family level. To compare our materials with other studies, we: 1) calculated the frequency and biomass of each taxon present, 2) counted the number of individuals in each pellet, 3) measured the width of the trophic level, and 4) calculated the diversity of prey. We did these analyses for each nest.

Statistical Analyses

We calculated the diversity of prey through Shannon-Wiener's index ($H´ = -\Sigma pi\ lnpi$) and we compared the diversity of prey in the nests using the student's *t*-test modified by Hutchenson ($t = H´_1 - H´_2 / (SH´_1 + SH´_2)^{1/2}$; where S*H* is the variance) (Hutcheson, 1970). The trophic niche breadth indicates the specialization of the use on one type of prey (Krebs, 1999). For this, Levins´ index was used ($B = 1/\Sigma pi2$; where pi is the proportion of every type of prey (ni/N); Levins, 1968). We also used Levins' standardized index ($Bs = (B–1)/n-1$) to interpret the amplitude of the niche in a scale from 0 (narrow food niche) to 1 (wide food niche). In this case, values less than 0.60 are considered a specialized diet with the use of few resources (Krebs, 1999). Lastly, we estimated the similitude of the diet among both nests with Czekanowski's index ($QS = 2c/a+b$; where c is the number of shared preys, a-b are the number of preys of nest 1 and 2, respectively). We performed all analyses using free Past statistics software package (Hammer *et al*., 2001).

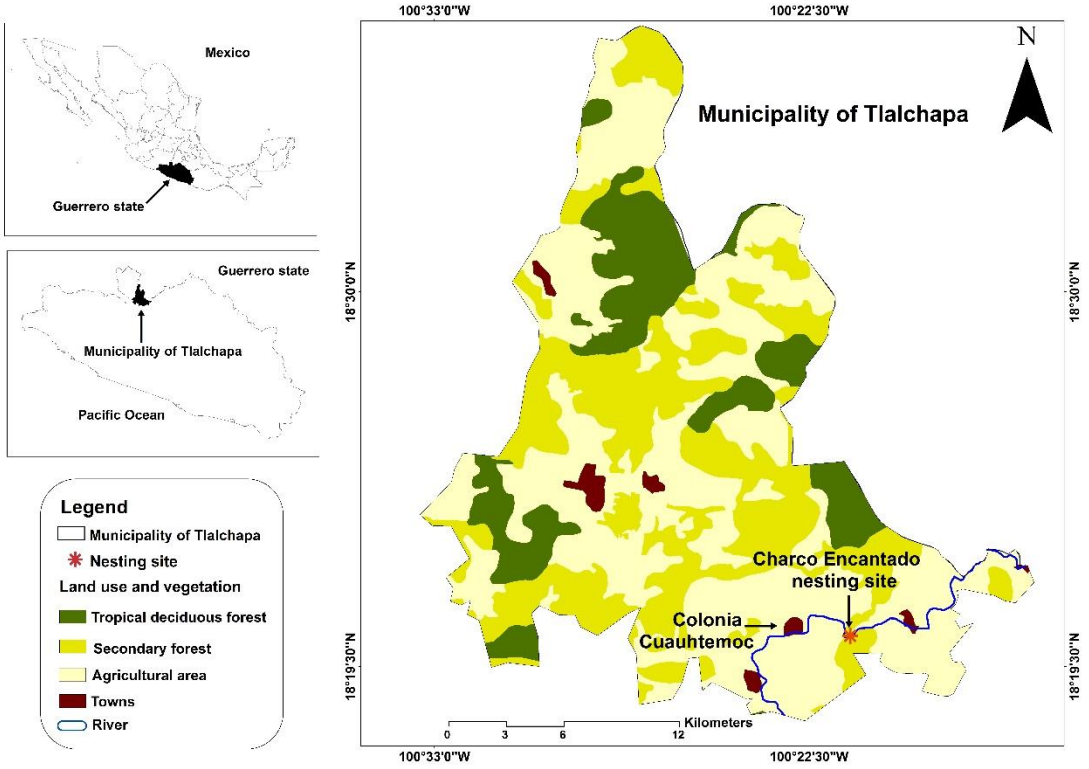

Figure 1. Geographical location of Barn-owl nesting site at Colonia Cuauhtémoc town, Tlalchapa, Guerrero, Mexico.

RESULTS

Composition of the diet

The diet composition range was analyzed from a total of 44 prey items among both nests. Small mammals such as rodents (*Sigmodon* sp. and *Peromyscus* sp.) were the

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principal food resource of *T. alba* accounting highest frequency percentage (48%) and biomass (55%) (Table 1). Another component of the diet of this owl was the iguana *Ctenosauria pectinata* and the quail *Philortyx fasciatus*, which added 30% and 14% respectively to the total biomass (Table 1). Invertebrates had a similar contribution to biomass. The biomass total calculated was 5412.1 g (Table 1).

Nest 1 had 17 prey items, a mean of 1.5 ± 0.5 prey and a variation of 1 – 2 prey items per pellet. The most common rodent was *Sigmodon* sp. (24% frequency), followed by *C. pectinata* and insects of the family Acrididae (18% frequency for both, Table 1), but the largest biomass was *C. pectinata* (61%). For nest 2 we counted 27 prey items, with a mean of 2.2 ± 1.6 prey and a larger range of 1 – 7 prey items per pellet. Rodents were mainly preyed; of these *Sigmodon* sp. had the highest contribution in frequency (41%) and biomass (67%) (Table 1). The bird *P. fasciatus* and amphibian Hylidae had similar frequency (15%), but the bird contributed greater biomass (19%) (Table 1). Pellets lacked reptiles and bats' parts.

Diet diversity, trophic niche and overlap

Shannon-Wiener diversity values was higher of *T. alba* in nest 1 with $H´ = 2.70$ than *T. alba* in nest 2 with $H´ = 2.15$, and this difference was significant ($t_{23} = 28.9$, $P < 0.05$). Levins´ index showed that the owl of nest 1 had an extensive trophic niche breadth ($B = 6.15$) than the nest 2 ($B = 3.90$). The Levins' standardized index of nest 2 showed a narrower food-niche breath ($Bs = 0.11$) containing more taxonomic categories preys than the nest 1 ($Bs = 0.30$). Nevertheless, Czekanowski's index trophic niche overlap revealed a high 83% similitude of the diet among both nests ($QS = 0.83$).

Table 1. Diet of the Barn-owl *Tyto alba* registered in an agricultural area in northwestern Guerrero, Mexico. F = frequency, B = Biomass. *Indicates statistically significant differences (P< 0.05) according to the student's *t*-test.

Prey	Nets 1				Nets 2				Both Nets			
	F	%F	B(g)	%B	F	%F	B(g)	%B	F	%F	B(g)	%B
MAMMALS												
Sigmodon sp.	4	24	670	25	11	41	1842.5	67	15	34	2512.5	47
Peromyscus sp.	1	6	75	3	5	19	375	14	6	14	450	8
BIRDS												
Philortyx fasciatus	2	12	260	10	4	15	520	19	6	14	780	14
REPTILES												
Ctenosaura pectinata	3	18	1611	61	-	-	-	-	3	7	1611	30
AMPHIBIANS												
Hylidae	2	13	14.2	0.7	4	15	28.4	0.1	6	14	42.6	0.8
INVERTEBRATES												
Orthoptera (Acrididae)	3	18	6	0.2	3	11	6	0.2	6	14	12	0.2
Coleoptera	2	12	4	0.2	-	-	-	-	2	5	4	0.1
Total of prey and biomass	17		2640.2		27		2771.9		44		5412.1	
Total of pellets			11				13				24	
Average of prey per pellet ± SD			1.5 ± 0.5 (range: 1 - 2)				2.2 ± 1.6 (range: 1 - 7)				1.9 ± 1.3 (range: 1 - 7)	
Levins Index (*B*)			6.15				3.90				5.07	
Levins Index standardized (*Bs*)			0.30				0.11				0.09	
Shannon-Wiener Index (*H´*)			2.70*				2.15				2.56	

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DISCUSION

Composition of the diet

The diet of *T. alba* in our study area included mammals, birds, reptiles, amphibians, and invertebrates. These prey taxa are common prey of this owl. However, the results of the present study show that small mammals of the genus *Peromyscus* sp. and *Sigmodon* sp. were the most important prey in the *T. alba* diet during the breeding season in an agriculture area Northwestern Guerrero (Table 1). In other regions of the Americas, similar trends have been reported, such as Northern Belize (75.6% of the diet; Platt *et al*., 2009), Urabá in Colombia (40% of the diet; Delgado-V & Calderón-F, 2007), the Atacama Desert in Chile (76.2% of the diet; Carmona & Rivadeneira, 2006), Río Negro in Argentina (74.5-76.8% of the diet; Andrade *et al*., 2002) and Río Araguaia in Central Brazil (91.6% of the diet; Rocha *et al*., 2011). As a result, our findings, as well as those of previous studies, indicate that *T. alba* is specialists in capturing small mammals.

Tyto alba also feeds on reptiles, such as the iguana *C. pectinata* and birds such as *P. fasciatus*. Yet in our owl-pellets we did not register components in the diet of this owl, such as bats (Delgado-V. & Calderon-F, 2007; Santos-Moreno & Alfaro Espinosa, 2009; Hernández-Muñoz & Mancina, 2011; Khalafalla & Iudica, 2012; Fuentes *et al*., 2015).

Figure 2. Chicks found in nest 1 during December 2010 in Colonia Cuauhtémoc, Tlalchapa, Guerrero. Photo: MADLH.

The average of 1.9 prey per pellet in our study is similar to that observed in different regions of America, such as Baja California Sur (average 2.5; Álvarez-Castañeda *et al*., 2004), and Oaxaca (average 1.8; Lavariega *et al*., 2016) to Mexico, the Calabozo in Venezuela (average 1.5; Fuentes *et al*., 2015), in Europe for Italy (average 1.4; Catalisano and Massa, 1987), in Asia for Israel (average 1.7, Charter *et al*., 2007), and Lebanon (average 2.15; Abi-Said *et al*., 2014).

The food-niche breadth

A point to consider is the high index of trophic overlap (83%) in the diet of both *T. alba*, mainly due to the consumption of rodents of the genera *Sigmodon* and *Peromyscus* sp. This overlap is probably due to the larger amount of food these birds of prey need during reproduction and the rearing of young. Another possibility is that rodents are nocturnal, and the probability of being captured is more significant than that of birds, reptiles, and amphibians that are mainly diurnal.

On the other hand, our study suggests that *T. alba* behave as a flexible predator by consuming different preys and also making prey choices based on feeding of rodents in this agricultural area, similar to that reported in other studies (Velarde *et al*., 2007; Lavariega *et al*., 2016). Nevertheless, the feeding strategies and the distribution of some prey would allow the coexistence of both birds and reduce interspecific competition during breeding season. In the analysis, we register a larger width of niche and prey richness for nest 1, compared to nest 2, possibly due to the absence of reptiles and coleopteran insects in the food of the owls in nest 2.

We recommend carry out studies in more agricultural area of Mexico, where this owl inhabits. *T. alba* is a natural predator of rodents and has an important ecological paper regulating the increase of populations of these rodents, considered pests of agricultural fields (Kross *et al*., 2016).

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Figure 3. Owl pellet on the left, and separation of bones encountered. Photo: AHG.

CONCLUSION

Tyto alba prey composition during the breeding season in a small agricultural area in Northwestern state of Guerrero, Mexico was composed primarily of small mammals. *Sigmodon* sp. and *Peromyscus* sp. rodents was the most common prey in terms of frequency and biomass. Birds, reptiles, amphibians, and insects were also preyed upon but comprised little of the prey eaten. Further research on pellets at other *T. alba* nesting sites may help to explain the feeding ecology in an agricultural area, and the potential effects to control crop pests.

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