Ornitología Colombiana

Nota Breve

Diet of the Barn Owl *(Tyto alba)* in two ecuadorian dry forest locations

Dieta de la Lechuza campanaria (*Tyto alba*) en de dos localidades en el bosque seco del valle interandino de Ecuador

Héctor Cadena-Ortiz[1], Glenda M. Pozo-Zamora[1] , Jorge Brito[1] & Carles Barriocanal[2]

[1] Instituto Nacional de Biodiversidad, Calle Rumipamba 341 y Av. de los Shyris. Casilla: 17-07-8976. Quito, Ecuador.
[2] Departamento de Geografía, Universidad de Barcelona, Montalegre 6, 08001, Barcelona, España.
✉ fercho_cada@yahoo.es

Abstract

The Barn Owl (*Tyto alba*) is a nocturnal raptor, with an ample distribution worldwide; however, knowledge about its diet in the north of South America is still scarce. In this study, we analyzed 361 pellets and 664 g of pellet debris of *T. alba* from two localities in the dry forest of the interandean valley of Ecuador. We identified a total of 1118 prey items representing 27 taxa grouped into four classes: Insecta, Reptilia, Aves and Mammalia. The most frequent prey item was the rodent *Reithrodontomys soederstroemi* (Cricetidae). A comparative analysis with other studies conducted in northern South America showed a 70.1% similarity between prey groups consumed by this raptor.

Key words: Barn Owl, diet, Ecuador, interandean valley, pellets

Resumen

La Lechuza Campanaria (*Tyto alba*) es una rapaz nocturna con amplia distribución a nivel mundial, sin embargo aun es escaso el conocimiento sobre su dieta en el norte de Sudamérica. En este estudio analizamos 361 egagrópilas y 664 g de material disgregado de *T. alba* proveniente de dos localidades en el bosque seco del valle interandino de Ecuador. Identificamos un total de 1118 ítems de presas representando 27 taxa, agrupados en cuatro clases: Insecta, Reptilia, Aves y Mammalia. La presa más frecuente fue el roedor *Reithrodontomys soederstroemi* (Cricetidae). Una comparación de nuestros resultados con otros diez estudios conducidos en el norte de Sudamérica mostró un 70.1% de similitud entre los grupos de presas consumidos por esta rapaz.

Palabras clave: dieta, Ecuador, egagrópilas, Lechuza Campanaria, valle interandino.

The Barn Owl (*Tyto alba*) is a nocturnal bird of prey with a generalist diet and opportunistic hunting behavior (Bó *et al.* 2007). It is a relatively common species with a wide distribution (König & Weick 2008); however, its natural history in northern South America is poorly documented in contrast to the large number of publications from the south of the continent: Chile, Brazil and Argentina (*e.g.,* Bó *et al.* 2007, Pardiñas & Cirignoli 2002, Rocha *et al.* 2011, Raimilla *et al.* 2012 and references therein). In this study, we describe the target prey of the Barn Owls from two locations on an interandean valley of Ecuador. Additionally, we compared our gathered data with available studies on the Barn Owl diet from Venezuela (Fuentes *et al.* 2015), Colombia (Delgado-V. & Cataño-B. 2004, Delgado-V & Calderon-F 2007, Delgado-V & Ramírez 2009), Ecuador (de Groot 1983, Charpentier & Martínez 2007, Moreno & Román 2013, Brito *et al.* 2015, Vásquez-Avila *et al.* 2018) and Peru (Ramírez *et al.* 2000).

We collected pellets and pellet debris of the Barn

Owls on the roofs and floors of two abandoned buildings during September 2015 and 2016. The first building (00° 01′ S, 78° 25′ W, 2100 m) was located in the vicinity of the town of San Antonio, in an area dominated by native forest, scattered fruit crops and a few houses. The second building (0°07′ S, 78°22′ W, 2370 m) was adjacent to the Mariscal Sucre International Airport (AIMS) and surrounded by native forest. Both houses were in the Pichincha Province, separated by c. 13 km. These localities included native forest with a canopy dominated by *Acacia macracantha* and an understory with a dominance of Bromeliaceae, Poaceae and Cactaceae, typical from interandean valley localities.

We measured each pellet with a caliper (to the nearest 0.01 mm) and weighed them with a digital balance (to the nearest 0.1 g). Then, we soaked the pellets individually in water and broke them up to isolate bones and other prey remains (*e.g.*, Delgado-V & Ramírez 2009, Brito *et al.* 2015). We identified items using reference books (Hershkovitz 1962, Weksler & Percequillo 2011) and by direct comparison to voucher specimens deposited at the Museo Ecuatoriano de Ciencias Naturales del Instituto Nacional de Biodiversidad (MECN). We deposited vertebrate specimens found in pellets in the museum's pellet collection. Based on the presence of unique structures, skulls and pairs of mandibles, we estimated the number of prey per pellet as the minimum number of individuals (MNI). We estimated the percentage of occurrence by dividing the MNI of each species by the total number of individuals of all species. In addition, we calculated the biomass consumption using the mean body mass (in grams) of each species multiplied by its MNI. We used the mean weight of prey items reported in the literature (Ramírez-Jaramillo *et al.* 2015, Tirira 2007) and from the MECN database. For remains not identified up to species level, we estimated the weight by averaging the most likely species occurring in the area, according to a list of birds from the closest dry forest in the interandean valley (Cadena-Ortiz *et al.* 2015).

We followed Marti (1987) to calculate the following dietary parameters: richness, diversity (Shannon's index), and dietary niche breadth (Levin's index). To determine the degree of dietary overlap between zones, we used Pianka's dietary niche overlap index. We performed a Chi-square test (χ^2) to check for differences in the diet composition between the two sites and a Bray-Curtis cluster analysis to assess the similarities with available studies on the Barn Owl's diet in northern Andean countries (Venezuela, Colombia, Ecuador and Peru).

We collected 172 pellets and 550 g of pellet debris from San Antonio; pellet dimensions averaged (± SE) 39.3±4.1 mm in length, 25.2±3.4 mm in width, a weight of 3.3±1.5 g and 4.1±1.1 preys per pellet. We collected 189 pellets and 114 g of pellet debris from AIMS, pellets averaged (± SE) 36.9±11.9 mm in lenght, 22.1±5.5 mm in width, 3.1±2.4 g in weight and 3.8±1.7 preys per pellet. We recorded a total of 1118 prey items grouped into 27 taxa of four classes: Insecta, Reptilia, Aves and Mammalia (Table 1) from the 361 pellets and 664 g debris from both localities.

In the San Antonio location, the most diverse group represented in the Barn Owl diet was birds, with 15 taxa present; at AIMS, we found only three bird taxa. Mammals were the second most diverse group with 9 taxa in both places. We found significant differences in prey distributions between the two locations (χ^2=26.26, P<0.001, 3 d.f.). Pianka's dietary niche overlap showed that San Antonio had a high diet overlap with AIMS (O_i=0.93). We found higher prey diversity at San Antonio both in species richness (prey taxa): 23 prey taxa at San Antonio vs. 13 at AIMS; as well as in terms of prey abundance (Shannon index [base

Table 1. Species diet of Barn Owls from a dry interandean forest in Ecuador (WA=weight average in grams, MNI=Minimum number of individuals).

CLASE/Order/Family/*Species*	WA	San Antonio		AIMS	
		MNI (%)	Biomass (%)	MNI (%)	Biomass (%)
MAMMALIA		617 (80.5)	11773 (76.9)	339 (91.9)	8233 (96.5)
Rodentia		604 (78.8)	10863 (71.0)	285 (77.3)	4453 (52.2)
Cricetidae					
Reithrodontomys soederstroemi	15	383 (50.0)	5745 (37.6)	198 (53.7)	2970 (34.8)
Akodon mollis	15	22 (2.9)	330 (2.2)	3 (0.8)	45 (0.5)
Oligoryzomys spodiurus	18	121 (15.8)	2178 (14.2)	9 (2.4)	162 (1.9)
Phyllotis haggardi	20	31 (4.0)	620 (4.1)	35 (9.5)	700 (8.2)
Thomasomys baeops	30	–	–	1 (0.3)	30 (0.4)
Muridae					
Mus musculus	14	38 (5.0)	532 (3.5)	39 (10.6)	546 (6.4)
Rattus rattus	162	9 (1.2)	1458 (9.5)	–	–
Lagomorpha					
Leporidae					
Sylvilagus andinus (juv.)	70	13 (1.7)	910 (5.9)	54 (14.6)	3780 (44.3)
AVES		82 (10.7)	3447 (15.9)	11 (3.1)	173 (3.3)
Columbiformes					
Columbidae					
Zenaida auriculata	118	–	–	1 (0.3)	118 (1.4)
Spp. not determined	118	19 (2.5)	2242 (14.7)	–	–
Piciformes					
Picidae					
Colaptes rivolii	90	1 (0.1)	90 (0.6)	–	–
Passeriformes					
Furnariidae					
Synallaxis azarae	15	1 (0.1)	15 (0.1)	–	–
Tyrannidae					
Pyrocephalus rubinus	13	1 (0.1)	13 (0.1)	–	–
Hirundinidae					
Progne cf. chalybea	39	1 (0.1)	39 (0.3)	–	–
Pygochelidon cyanoleuca	11	1 (0.1)	11 (0.1)	–	–
Thraupidae					
Sporophila nigricollis	9	1 (0.1)	9 (0.1)	–	–
Tangara vitriolina	25	9 (1.2)	225 (1.5)	–	–
Spp. not determined	17	17 (2.2)	289 (1.9)	–	–
IncertaeSedis					
Saltator striatipectus	38	1 (0.1)	38 (0.2)	–	–
Emberizidae					
Zonotrichia capensis	22	21 (2.7)	462 (3.0)	5 (1.4)	44 (1.3)
Catamenia analis	11			5 (1.4)	11 (0.6)
Fringillidae					
Euphonia cyanocephala	14	1 (0.1)	14 (0.1)	–	–
Passeriformes not determined		8 (1.0)	–	–	–

Table 1 cont. Species diet of Barn Owls from a dry interandean forest in Ecuador (WA=weight average in grams, MNI=Minimum number of individuals).

CLASE/Order/Family/*Species*	WA	San Antonio		AIMS	
		MNI (%)	Biomass (%)	MNI (%)	Biomass (%)
REPTILIA		5 (0.6)	47 (0.3)	1 (0.3)	0
Sauria					
Iguanidae					
Stenocercus guentheri	11	3 (0.4)	33 (0.2)	1 (0.3)	–
Gymnopthalmidae					
Pholidobolus montium	7	2 (0.3)	14 (0.1)	–	–
INSECTA		45 (7.1)	31 (0.2)	18 (4.9)	12 (0.2)
Coleoptera					
Scarabaidae					
Barotheus andinus	0.5	62 (8.0)	31 (0.2)	12 (3.3)	6 (0.1)
Heterogomphus bourcieri	1	–	–	6 (1.6)	6 (0.1)
Total		749 (100)	15298 (100)	369 (100)	8311 (100)

e] San Antonio 1.82 and AIMS 1.54). Levin's index showed that San Antonio (3.5) had a slightly higher niche breadth than AIMS (3.0). Finally, we found a standardized Levin's measure of niche breadth lower than 0.4 in the two sites, which suggests that the Barn Owl has a relatively limited niche.

Owls' diets are commonly studied by pellet examination (Bó *et al.* 2007, Pardiñas & Cirignoli 2002). While it is the most suitable method for studying the diet of owls, it may nevertheless involve biases, especially in the case of invertebrates that are difficult to recover from pellets. Birds could also be underestimated in the diet of the Barn Owl due to their thin and light bones (Noriega *et al.* 1993, Delgado-V. & Ramirez 2009). Additionally, avian prey identification problems arise as a consequence of the similarity among bird bones and the lack of keys and skull museum materials (Noriega *et al.* 1993). We had the advantage of having done research and collected birds from the sampled areas (HC and GP). Nevertheless, we found a high percentage of birds consumed, particularly at the San Antonio location. Hernández-Muñoz & Mancina (2011) found a trend of Barn Owls preying more upon birds in natural habitats than in disturbed sites. Additionally, Barn Owls have an active hunting behavior in open environments (Trejo & Ojeda 2004) such as those in our study sites.

The diversity of prey could be negatively related to human disturbance. We identified 24 taxa in San Antonio, a very scarcely populated area, while 13 taxa were found at AIMS, a scarcely populated area but with high human transit. Our results contrast with those from the city of Cuenca (c. 420,000 residents), where only eight taxa were found (Charpentier & Martínez 2007). Nonetheless, in areas with human disturbance, *T. alba* plays an important role as controller of pests, several studies have demonstrated high consumption of introduced species such as the Black Rat (*Rattus rattus*) and House Mouse (*Mus musculus*) (*e.g.,* Hernández-Muñoz & Mancina 2011, Vásquez-Avila *et al.* 2018).

The observed predominance of mammals as prey, and specifically rodents is consistent with studies conducted at Andean countries (Table 2)

Table 2. Percentages of prey groups on Barn Owl's diet of north Andean territories

Country	Habitat	% MAMMALS	% BIRDS	% REPTILES	% AMPHIBIANS	% ARTHROPODS	Pellets	Items	Reference
Venezuela	Agrarian mosaic	99.8	0.2	0	0	0	592	847	Fuentes *et al. 2015*
Colombia	Agrarian mosaic	62.1	0	0	27.9	10.1	80	158	Delgado & Cataño 2004
Colombia	Urban area	48.9	0	0	37.8	13.3	12	90	Delgado & Calderon 2007
Colombia	Urban area	60.8	0.5	0	19.1	19.6	52	183	Delgado & Ramírez 2009
Colombia	Urban area and secondary	89.1	2	0	7.5	1.4	143	495	Restrepo-Cardona *et al. 2018*
Peru	Rocky arid area	83.8	0.7	15.5	0	0	10	148	Ramírez *et al. 2000*
Ecuador	Galapagos islands	46.8	1.7	0.2	0	51.2	1217	4761	de Groot 1983
Ecuador	Mountain dry shrubs	95.9	4	0	0	0	30	75	Moreno & Román 2013
Ecuador	Urban area	76.8	1.62	0	0	21.7	245	429	Charpentier & Martínez 2007
Ecuador	Agrarian mosaic	98.3	1	0.7	0	0	107	300	Brito *et al. 2015*
Ecuador	Urban area	82.4	10.9	0.7	0	6.0	32	154	Vásquez-Avila *et al. 2018*
Ecuador	Andean dry forest	85.5	8.3	0.5	0	5.6	361	1118	present study

and 38 works on the Barn Owl diet in Argentina (Bó *et al.* 2007). The Ecuadorian harvesting mouse (*Reithrodontomys soederstroemi*) was the most consumed prey (51%) and represented the most important prey species in terms of ingested biomass (37%), along with the other preferred rodent preys: the Long-tailed mouse (*Oligoryzomys spodiurus*) and the Haggard Ear mouse (*Phyllotis haggardi*) (Table 1). All these species have terrestrial life habits, eat fruits, seeds and insects and are usually abundant in dry forests (Brito *et al.* 2019). Additionally, the representation of other food items such as birds, reptiles, amphibians and arthropods varies according to the distribution of the Barn Owl; this is proportional to the diversity and abundance of prey items where the Barn Owl lives because the species is opportunistic (Ramirez *et al.* 2000, Bó *et al.* 2007).

Andean studies present slight differences in the percentages of prey groups (70.1% similarity, Fig. 1). The role of insularity is evident on the Galapagos Islands (de Groot 1983), where arthropods, followed by introduced rodents, are the principal prey items documented in Barn Owl diets, although there are also native rodents. In the other eleven Andean studies, Barn Owl feeds on arthropods in percentages ranging from 5.6% to 21.7%. We found an obvious cluster between the three studies (86.9% similarity) from Colombia (Delgado & Cataño 2004, Delgado & Calderon 2007, Delgado & Ramírez 2009), where the consumption of birds is absent, and amphibians

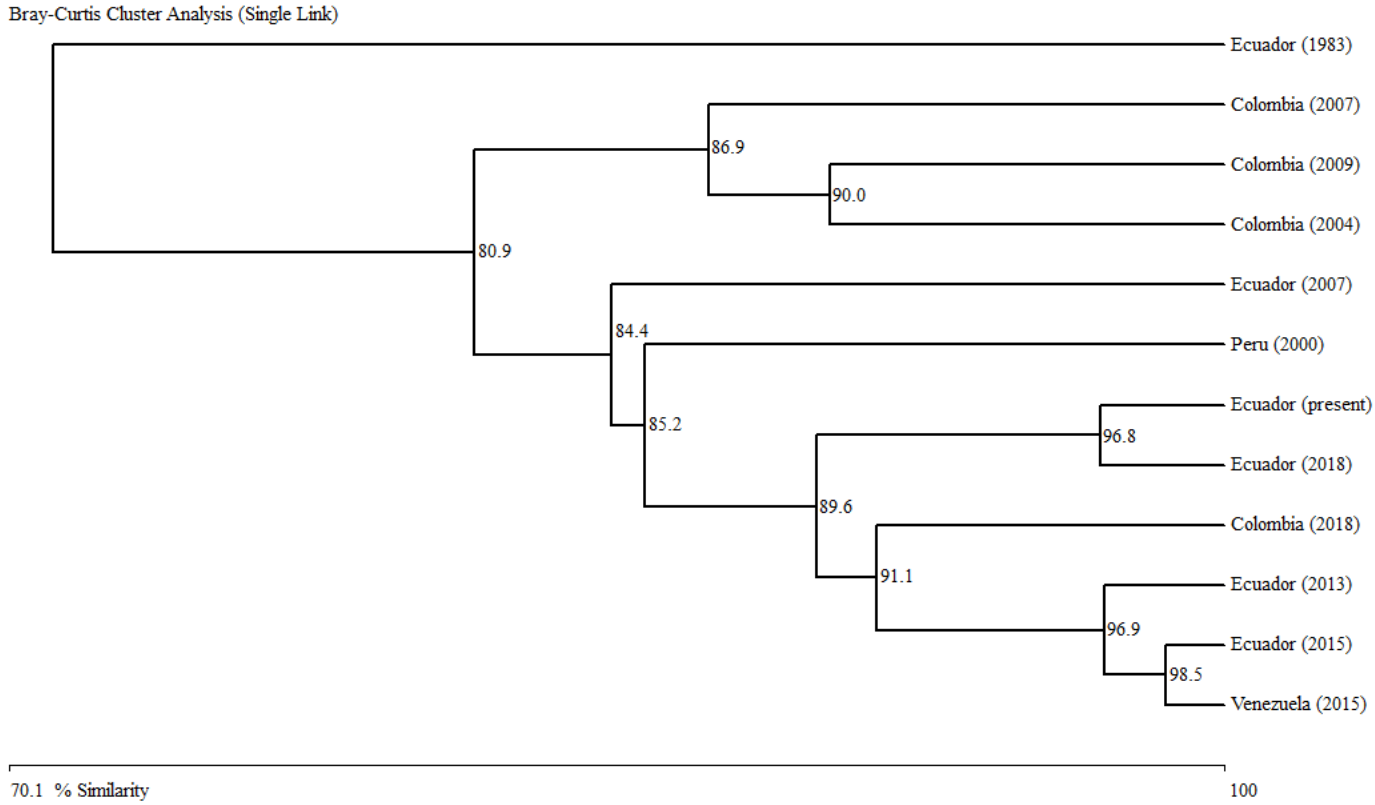

Figure 1. Bray-Curtis cluster analysis for available studies on the Barn Owls diet for north Andean countries. See each study in the text.

are present in percentages between 19.1% and 37.8% (Fig. 1). Our results highlight that the Barn Owl prefers rodents as prey, but take advantage of the resources (birds, reptiles, amphibians and insects) available and more abundant throughout its distribution.

In South America, studies on Barn Owls are more numerous in Argentina, with 142 papers on pellet analysis before 2000 (Pardiñas & Cirignoli 2002), and in Chile, with 22 before 2011 (Raimilla *et al.* 2012). In Ecuador, there have been only five works on the Barn Owl's diet (see Table 2). The study of feeding ecology in Ecuador is still in an initial stage, and we suggest continuing the collection and analysis of pellets in different types of habitats across the distribution of the Barn Owl. We also recommend further analysis of the availability and choice of prey, prey selection in breeding and non-breeding seasons, and other related aspects of trophic ecology of this owl.

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