

Diet of the Great Horned Owl (*Bubo virginianus*) during the breeding season in the paramo of Laguna Corazón, Tolima, Colombia

Dieta del búho *Bubo virginianus* durante el período reproductivo en el páramo de la Laguna Corazón, Tolima, Colombia

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Abstract

We examined the diet of the Great Horned Owl (*Bubo virginianus*) through the analysis of pellets and prey remains collected during the breeding seasons of 2014 and 2015 at a nest found in an grassy páramo at an elevation of 4,020 m, municipality of Murillo, Tolima, in the Central Andes of Colombia. We identified 78 food items recovered from 58 pellets and 80 g of other prey remains. Our results suggest that at least during the breeding season, *B. virginianus* is preying mainly on the rabbit *Sylvilagus brasiliensis*, with a frequency of occurrence of 82% in 2014 and 88% in 2015. This rabbit is a large enough prey to give an optimum amount of biomass for reproduction (biomass contribution: 99.92% in 2014 and 99.74% in 2015) compared to other prey species at these elevations. In paramos of the Central Andes, *S. brasiliensis* is an apparently abundant prey that occurs in pastures and grasslands, generating a greater frequency of predation by *B. virginianus*, which generally hunts from perches in open or semi-open areas or by gliding slowly above the ground.

Key words: biomass, Neotropical owl, Páramo, rabbit, Strigidae.

Resumen

Examinamos la dieta del búho *Bubo virginianus* mediante el análisis de egagrópilas y restos óseos colectados durante el periodo reproductivo de 2014 y 2015, en un nido encontrado a 4.020 m de elevación en ecosistema de páramo en el municipio de Murillo, Tolima, Cordillera Central de Colombia. Identificamos 78 ítems alimenticios recuperados de 58 egagrópilas y 80 g de huesos dispersos. Nuestros resultados sugieren que, al menos durante el periodo reproductivo en ecosistemas de páramo de la Cordillera Central de Colombia, *B. virginianus* depreda principalmente conejos *Sylvilagus brasiliensis*, con una frecuencia de ocurrencia de 82% en 2014 y 88% en 2015. Este conejo es una presa lo suficientemente grande que contribuye con una óptima cantidad de biomasa (aportes de biomasa: 99.9% en 2014 y 99.7% en 2015) comparada con otras especies de presas. En páramos de la Cordillera Central de Colombia, *S. brasiliensis* es aparentemente abundante en potreros y pajonales, lo que generaría una mayor frecuencia de depredación por parte de *B. virginianus*, que caza generalmente desde perchas en áreas abiertas o semi-abiertas, o sobrevolando lentamente sobre el suelo.

Palabras clave: biomasa, búho neotropical, conejo, páramo, Strigidae.

The Great Horned Owl (*Bubo virginianus*) is the largest of the 85 species of Strigiformes inhabiting the Neotropics by weight (females 1417-2503 g) and length (45-60 cm) (König *et al.* 2008). Its geographical distribution ranges from Alaska, in North America, to the south including Central America, and parts of South America. In South America it inhabits Venezuela, Colombia, Ecuador, northwestern Peru, southwestern Brazil, Paraguay and Uruguay (Marks *et al.* 1999, König *et al.* 2008). In Colombia, it is found in the lowlands of the Caribbean and Orinoquian regions and in the Andes up to elevations of 4,500 m (Hilty & Brown 1986, Chaparro-Herrera *et al.* 2015). Despite its broad distribution in the country, its biology and ecology are almost unknown due to its nocturnal and crepuscular habits, and probably low abundances.

Bubo virginianus nests in large natural cavities of logs, depressions near the ground, at the base of trees, and also abandoned nests of other birds (e.g., *Tigrisoma mexicanum*, *Egretta rufescens* and *Pandion haliaetus*) (Marks *et al.* 1999, Enríquez & Rangel-Salazar 2003, König *et al.* 2008). In the Neotropics, its trophic habits have been studied in Brazil, Mexico, Argentina and Chile, where this species consumed a variety of prey including mammals, birds, amphibians, reptiles, fishes, arachnids and insects (Jaksic *et al.* 1986, Llinas-Gútiérrez *et al.* 1991, Aragón *et al.* 2002, Tomazzoni *et al.* 2004, Teta *et al.* 2006, Formoso *et al.* 2012). However, very little is known about its dietary and nesting behavior in northern South America. Nesting sites and reproductive information for Colombian populations are practically unknown, with anecdotal records of consumption of *Sylvilagus floridanus* at Riohacha, department of La Guajira, and *Nasuella olivacea* at Popayán, department of Cauca (Lehmann 1946). Here, we describe the diet of *B. virginianus* during two consecutive reproductive periods for a locality in the Central Andes of Colombia.

We studied the diet of *B. virginianus* at a nest found on a rocky shelf at Laguna Corazón (04° 52'N, 75°15'W, elevation 4,020 m), near the border of the protected area Parque Nacional Natural - PNN (National Natural Park) Los Nevados, municipality of Murillo, Tolima department, Colombia. On January 27, 2014, a chick and an adult of *B. virginianus* were found at this nest, whilst another chick was found dead floating in the Laguna Corazón, but when the site was again visited in March 6, no individual was seen. For the next year, on February 25, 2015, the same nest contained two oval white eggs, that by May 9th had not hatched. The measurements and total weight of the eggs were 60 x 54 mm and 56.4 g, and 64 x 55 mm and 57.4 g.. (no need to number eggs, as they were not followed thereafter). Considering that owls are faithful to their nesting site (Marti *et al.* 2007), we presume the same breeding pair used the nest during both periods.

The nest was found 5 m above the ground on a rocky shelf, approximately 40 cm in diameter, 2 m away from shore of Laguna Corazón. The area is classified as Paramo ecosystem dominated by frailejones *Espeletia* spp., reed grass *Calamagrostis* sp. and chusquea bamboo *Chusquea tessellata* (Rangel-Ch 2000). The PNN Los Nevados conserves habitats mainly above 3,000 m of elevation, with an average annual temperature of 2-3°C, an average annual rainfall of 3,000 mm, high relative humidity, strong winds and frequent fog (Loteró *et al.* 2006).

Between January and April of 2014 and 2015, in a non-systematic way, we collected *B. virginianus* pellets and prey remains over an area of 20 m² around the nest, which were then soaked in a NaOH / H₂O solution to sort bone material from fur (Marti *et al.* 2007). We identified each food item to the nearest possible taxonomic category, comparing it with museum specimens of the

mammal collection of the Colección Teriologica de la Universidad de Antioquia (CTUA) and the Natural History Collection in the Centro de Museos de la Universidad de Caldas (MHN-UCa). We deposited the studied material in MHN-UCa.

We calculated niche breadth with the Levins index: $B = 1/\sum p_i^2$, where p_i is the proportion of each category of prey i . To compare with results obtained in other studies, we also used the standardized Levins index: $B_{sta} = (B - 1) / (n - 1)$, where n is the number of prey categories (Levins 1968); B_{sta} values range between 0 (minimum niche breadth and, consequently, maximum selectivity) and 1 (maximum niche breadth, minimum selectivity; Krebs 1999). We calculated the biomass contribution of each prey category according to Marti (1987) as: $B_i = 100 [(Sp_i N_i) / \sum (Sp_i N_i)]$, where Sp_i is the weight of species i , N_i is the number of individuals consumed of species i , and B_i is the percentage of total biomass contributed by species i . In addition, we took the average weight of each prey species from specimens in the CTUA collection and literature (Tirira 2007). To evaluate whether there were significant differences between the frequencies of the prey consumed, we used a Chi-square test.

We identified 78 food items in total recovered from 28 pellets and 80 g of prey remains collected in 2014 and 30 pellets collected in 2015. The most frequent prey in the diet was *Sylvilagus brasiliensis* (82% in 2014 and 88% in 2015), and to a lesser extent unidentified sigmodontinae rats and the *Caenolestes fuliginosus*. The Levins' index (B) and the standardized (B_{sta}) values were 1.26-1.43 and 0.21-0.26, respectively (3 categories of prey). Prey weights identified ranged from 24.5 g to 965 g. In terms of biomass, the contribution of *S. brasiliensis* in both periods was higher than any other prey recorded (Table 1) (year 2014: $X^2 = 99.71$, $df = 1$, $P < 0.05$, and 2015: $X^2 = 98.99$, $df = 1$, $P < 0.05$).

To our knowledge, this is the first study of nest site and diet for *B. virginianus* at such a high elevation. Elsewhere, *B. virginianus* feeds on an extensive variety of prey items including native rodents, marsupials, bats, birds, reptiles, arthropods and insects (Marks 1999, König *et al.* 2008). In the Neotropics, the consumption of lagomorphs by *B. virginianus* has been recorded for Argentina (Donázar *et al.* 1997, Trejo & Grigera 1998, Formoso *et al.* 2012), Chile (Jaksic *et al.* 1986) and Mexico (Llinas-Gutiérrez *et al.* 1991), ranking from 0.2 to 16.5% of total prey consumed. We found that consumption of *S. brasiliensis* is crucial for *B. virginianus* at Laguna Corazón, where its frequency as prey was much higher (84.6%) than those reported elsewhere.

Vertebrate prey weights consumed by *B. virginianus* vary widely. For example, in Argentina these vary from 12-326 g (Teta *et al.* 2006) and in Chile from 21.5-2000 g (Jaksic *et al.* 1986). The ranges depend mostly on the prey species that make up the assembly in the hunting areas where *B. virginianus* individuals feed. In Laguna Corazón the ranges of prey weights also vary widely, and include small sigmodontinae rats *Caenolestes fuliginosus* and a marsupial shrew which were consumed on few occasions and make up a small percent in the diet (Table 1). In Chile, Jaksic *et al.* (1986) determined standardized Levins index (B_{sta}) between 0.24 and 0.66 in a latitudinal gradient; at Laguna Corazón, B_{sta} values were lower (0.21 for 2014 and 0.26 for 2015), meaning that this species fed almost exclusively on *S. brasiliensis* during both breeding seasons. On the other hand, some studies in Mexico and Argentina consider *B. virginianus* an opportunistic predator, since it feeds on the most abundant species found in its hunting area (Teta *et al.* 2006, Aragón *et al.* 2002). In the paramos within the PNN Los Nevados, *S. brasiliensis*, is apparently abundant (obs. pers.) and occurs in pastures and reed grass (Insuasty *et al.* 2008), generating a

Table 1. Great Horned Owl (*Bubo virginianus*) prey items during two breeding seasons (Jan-Apr 2014, 2015) at Laguna Corazón (4,020 m a.s.l.) paramo ecosystem, municipality of Murillo, Tolima department, Colombia. Weight (g), number of prey individuals (N), numerical percent (F%), biomass percent (B%), Levins' index (B) and standardized Levins' index (Bsta).

Prey	2014				2015		
	Weight (g)	N	F%	B%	N	F%	B%
Class Mammalia							
Order Rodentia		7	15.9		4	11.7	
<i>Thomasomys</i> sp.	36.6				2	5.8	0.25
Sigmodontinae unidentified		3	6.8		1	2.9	
Rodentia unidentified		4	9.0		1	2.9	
Order Paucituberculata		1	2.2				
<i>Caenolestes fuliginosus</i>	24.5	1	2.2	0.07			
Order Lagomorpha		36	81.8		30	88.2	
<i>Silvilagus brasiliensis</i>	965.0	36	81.8	99.92	30	88.2	99.74
Number of prey		44			34		
B		1.26			1.43		
Bsta		0.21			0.26		

greater frequency of predation by *B. virginianus*, which usually hunts from perches in open or semi-open areas (Marks *et al.* 1999, König *et al.* 2008), or by gliding slowly above the ground (Mikkola 2012).

Our results suggest that at least during the breeding season in this paramo of the Central Andes of Colombia, *B. virginianus* is preying mainly on *S. brasiliensis*, a large enough prey to give it an optimum amount of biomass for reproduction compared to smaller prey species at these elevations. However, the limited number of pellets and prey remains studied suggest that this result should be taken with caution. To achieve a more precise understanding on the food habits of *B. virginianus* from paramo and high Andean ecosystems, it is important to systematically search for nests and individuals, collect more pellets and estimate the availability of prey species and abundances through time in each location.

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