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PREY OF THE HARRIS'S HAWK (*PARABUTEO UNICINCTUS*) IN A SUBURBAN AREA OF SOUTHERN CHILE

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The Harris's Hawk (*Parabuteo unicinctus*) is a large sexually dimorphic raptor (male: 515–880 g, female: 775–1630 g; Bednarz 1995) distributed from southwestern United States to southern Patagonia (Brown and Amadon 1968, Couve and Vidal 2003), inhabiting mainly open lands such as desert, Mediterranean shrublands, savannahs, open woodlands, and prairies with trees (Bednarz 1995). The biology of this hawk including distribution, habitat characteristics, territoriality, social organization, cooperative breeding, social hunting, and diet are relatively well known for North America (e.g., Mader 1975, Whaley 1986, Bednarz and Ligon 1988, Dawson and Mannan 1991, Bednarz 1995). However, quantitative studies about diet of Harris's Hawk in South America are scarce and most data were collected in central Chile (Jaksic et al. 1980, Jiménez and Jaksic 1993). Harris's Hawks prey on a wide spectrum of prey, but most commonly mammals and birds (Whaley 1986, Jiménez and Jaksic 1993, Bednarz 1995). Although information about the diet of diurnal raptors is increasing in southern Chile (e.g., Cabezas and Schlatter 1987, Figueroa and Corales 1999, 2004, 2005, Figueroa et al. 2000), most species remain unstudied, including the Harris's Hawk. Here, we describe the diet of the Harris's Hawk in a suburban area of southern Chile.

STUDY AREA AND METHODS

Our study area was the Carriel Sur Airport (36°46′S, 73°03′W), 6 km north of Concepción city in the Bio Bio region, southern Chile. The landscape around the airport is composed of flatland covered by extensive abandoned pastures mostly characterized by common velvetgrass (*Holcus lanatus*), gewoon stuisgras (*Agrostis tenuis*), and ryegrass (*Lolium* spp.), marshes (*Carex-Juncus* spp.), small patches of native shrubs (e.g., canelo [*Drymis winteri*], arrayán [*Luma apiculata*], lun [*Escallonia revoluta*]); and small plantations of nonnative trees (e.g., Monterey pine [*Pinus radiata*], Tasmanian blue gum [*Eucalyptus globulus*]) along roads or fences. The climate is moist-temperate with a Mediterranean influence (di Castri and Hajek 1976). Mean annual rainfall and temperature are 1330 mm and 13°C, respectively (Martelli 2000).

During breeding season 2003–04, we collected pellets ($N = 23$) and prey remains ($N = 41$) beneath trees and fence posts used as perches by at least two adults and a juvenile Harris's Hawk. Samples were collected between the chick-rearing and fledgling periods (January–April 2004). Although pellets could be confused with those of other sympatric raptors, we only saw Harris's Hawks perched at the collection sites during our study. Prey species in pellets were identified following Figueroa and Corales (1999). Feather remains were identified by comparison of feather coloration patterns with voucher specimens deposited in the Zoology Department of the Universidad Austral of Chile at Valdivia. Small mammal prey were identified on the basis of skulls or dentary pairs following keys in Pearson (1995). Insect prey were identified by head capsules or elytra following keys in Peña (1986). Prey species in remains were determined on the basis of feathers, skeletons, skulls, beaks, mandibles, feet, tails, and fur. We identified prey items to the finest possible taxonomic category. Because Harris's Hawks plucked and quartered large prey at a number of ''butcher'' sites, our prey remains were not independent. In addition, duplication may occur when prey items are counted separately from pellets and prey remains processed by the same individual hawks. Thus, we estimated the minimum number of individual prey from both pellets and prey remains by reconstruction of only identifiable body parts (Bednarz 1988a). To assess biases in diet, the results obtained separately from pellets and remains were compared and then the data were pooled, as recom-

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mended by several authors (e.g., Simmons et al. 1991, Mersmann et al. 1992, Oro and Tella 1995, Redpath et al. 2001).

Biomass contribution of the prey consumed was estimated by multiplying number of prey taken by the mean mass of prey type (Marti 1987, Bednarz 1987). Because we found no remains that were obviously juvenile birds and lagomorphs and only a few juvenile rodents, all individuals of each prey species were assumed to be adult-sized. Masses of prey were taken from literature and unpublished data of the authors (Table 1). We assumed that masses of unidentified prey were similar to the mean mass of the most closely related identified taxon. Geometric mean weight of vertebrate prey (Marti 1987) was calculated as follows: GMWVP = antilog $(\Sigma n_i \log w_i / \Sigma n_i)$, where n_i was the number of individuals of the ith species and w_i was the mean weight. Excepting lizards (*Liolaemus* spp.), only prey items identified to species level were included to estimate GMWVP. Because of the limited sample size, biomass and GMWVP were estimated only from pooled results of pellets and prey remains.

Concurrent to the collection of prey remains and pellets, we evaluated prey abundance in abandoned pastures. To estimate small mammal prey abundance, four transects each with 10 medium-sized Sherman live traps ($24 \times 9 \times 8$ cm; 10–15 m apart) were established during April 2004 with all operating three nights (total effort = 120 trap-nights). To estimate bird abundance 11 fixed-band (150 m long, 40 m wide; 60 m apart) line transects were established; counts were made once each month during January–March 2004.

RESULTS AND DISCUSSION

Whole pellets averaged 37.2 ± 2.0 mm length $\times$ 23.0 ± 1.2 mm width and had a mean dry mass of 2.32 ± 0.25 g ($N = 17$, $\bar{x} \pm$ SE). Although dimensions were similar to those given by Jaksic et al. (1980) for central Chile (44.4 ± 1.7 mm length $\times$ 20.5 ± 0.9 mm width, $N = 34$), pellets from Carriel Sur Airport were somewhat lighter than those from central Chile (3.0 ± 0.4 g, $N = 34$). This difference could be an artifact of our smaller sample size or pellets may have collectivelly consisted of lighter remains. Mammalian prey were overrepresented among pellets compared to prey remains, and the reverse occurred with avian prey (Table 1). Reptilian and insect prey were similarly represented among pellets and prey remains (Table 1). These results differ with those reported by Jaksic et al. (1980) and Jiménez and Jaksic (1993) for central Chile, who found that mammalian prey were equally represented among pellets and prey remains. Similar to Jiménez and Jaksic (1993), we also found that pellets underestimated avian prey. Several studies on raptors have demonstrated that the combination of two or more diet assessment methods may yield less biased estimates of the composition of the diet than reliance on one technique (e.g., Simmons et al. 1991, Mersmann et al. 1992, Oro and Tella 1995). Thus, results of pellets and remains, if they can be obtained, should be pooled to evaluate the diet of the Harris's Hawks, particularly when sample sizes are small.

In total, we identified 68 individual prey among pooled pellets and prey remains including four rodent species, two lagomorph species, nine bird species, one lizard, and two orders of insect. Both by number and biomass, mammals were the most common prey of the Harris's Hawk (Table 1). Avian preys were the second most important prey, comprising almost a third of all individual prey and biomass (Table 1). Among mammals, rodents were an important part of the diet, with the long-tailed pygmy rice rat (*Oligoryzomys longicaudatus*) being the most frequent (Table 1). However, lagomorphs accounted for the most of biomass with European hare (*Lepus europeaus*) contributing almost 60% to the dietary mass (Table 1). Both by number and biomass, the contribution of reptiles and insects was minor (Table 1). Overall, the diet of Harris's Hawks in our study area was very similar to that documented elsewhere (Mader 1975, Brannon 1980, Whaley 1986, Jiménez and Jaksic 1993, Bednarz 1995). All previous studies have demonstrated that the Harris's Hawk prey heavily on mammals with lagomorphs being important prey both by number and biomass. Lagomorphs may be particularly important prey during breeding season (Bednarz 1995, Gerstell and Bednarz 1999). Consistently, birds appear to be the secondary prey of Harris's Hawks throughout its distributional range (e.g., Whaley 1986, Bednarz 1988a, 1995, Jiménez and Jaksic 1993).

Our results showed that the GMWVP (85.4 ± 5.1 g; $\bar{x} \pm$ SD) at the Carriel Sur Airport was markedly lower than that reported by Jaksic and Braker (1983; 202.4 ± 1.5 g) and Jiménez and Jaksic (1993; 257.1 ± 4.0 g) in central Chile. These differences may be due to a higher consumption of smaller prey by Harris's Hawks in southern Chile compared to those of central Chile; Harris's Hawks mostly preyed on long-tailed pygmy rice rats (26 g) in southern Chile and primarily on fence degu rats (*Octodon degus*, 184 g; Jiménez and Jaksic 1993) in central Chile. It is possible that some large prey were taken by cooperative hunting, as documented for Harris's Hawks in North America (e.g., Mader 1975, Bednarz 1988b, Coulson and Coulson 1995), but we did not witness this social foraging behavior in Carriel Sur Airport.

Consumption of rodent species by Harris's Hawk in our study area was not in agreement with concurrent sampling of rodent populations. The most abundant species was the olivaceus field mouse (*Abrothrix olivaceus*) accounting for 92% of the available rodents by number; the long-tailed pygmy rice rat made up only 8% of all individuals captured. We do not believe that trap size could have affected capturability, as medium-sized Sherman traps are effective in capturing both olivaceus field mice and long-tailed pygmy rice rats (Murúa and González 1986). It is possible that our small trapping effort did not reflect the true abundance of the latter species in the abandoned pastures. Rather, we suggest that overrepresentation of the

Table 1. Prey of the Harris's Hawk (*Parabuteo unicinctus*) in the Carriel Sur Airport of Concepción, southern Chile.

Prey Species	Mass[a] (g)	Pellets	Remains	Total	
		Percent Frequency	Percent Frequency	Percent Frequency	Percent Biomass
All mammals		78.2	36.4	64.7	70.6
Rodentia					
Long-haired mouse (*Abrothrix longipilis*)	41	2.2	0	1.5	0.2
Olivaceus field mouse (*Abrothrix olivaceus*)	23	8.7	0	5.9	0.4
Long-tailed pygmy rice rat (*Oligoryzomys longicaudatus*)	26	54.2	0	36.7	3.0
Norwegian rat (*Rattus norvegicus*)	200	2.2	13.6	5.9	3.8
Unidentified rodents[b]	30	10.9	0	7.3	0.7
Lagomorpha					
European rabbit (*Oryctolagus cuniculus*)	1300	0	4.6	1.5	6.1
European hare (*Lepus europeaus*)	3000	0	18.1	5.9	56.4
All birds		8.7	63.6	26.4	29.3
Tinamiformes					
Chilean Tinamou (*Nothoprocta perdicaria*)	400	0	9.0	2.9	3.8
Anseriformes					
Speckled Teal (*Anas flavirostris*)	400	0	4.6	1.5	2.0
Yellow-billed Pintail (*Anas georgica*)	700	0	4.6	1.5	3.3
Charadriiformes					
Southern Lapwing (*Vanellus chilensis*)	270	0	22.7	7.3	6.3
Gruiformes					
Red-gartered Coot (*Fulica armillata*)	1000	0	4.6	1.5	4.7
White-winged Coot (*Fulica leucoptera*)	800	0	9.0	2.9	7.5
Passeriformes					
Rufous-tailed Plantcutter (*Phytotoma rara*)	48	0	4.6	1.5	0.2
Rufous-collared Sparrow (*Zonotrichia capensis*)	22	2.2	0	1.5	0.1
Long-tailed Meadowlark (*Sturnella loyca*)	96	2.2	4.6	2.9	0.9
Unidentified passerines[b]	55	4.3	0	2.9	0.5
All reptiles		2.2	0	1.5	0.05
Sauria					
Lizards (*Liolaemus* spp.)	8	2.2	0	1.5	0.05
All insects		10.9	0	7.4	0.04
Orthoptera	1	2.2	0	1.5	0.01
Coleoptera	1	8.7	0	5.9	0.03
Total individual prey		46	22	68	
Total biomass (g)					21268
Total pellets		23			
Total prey remains			41		

[a] Masses were obtained from Martínez (1993) for rodents, Jiménez and Jaksic (1993) for *O. cuniculus*, Figueroa and Corales (1999) and Egli (1996) for birds, except for *F. armillata* and *F. leucoptera* (unpubl. data). Masses of remaining taxa were obtained from authors' unpubl. data.

[b] Mean mass of the most closely related identified taxon.

latter species in the diet could be explained by Harris's Hawks tendency to use habitats with a greater density of trees because it mostly hunts from perches (Barros 1962, Jiménez and Jaksic 1993, Bednarz 1995). Habitats with a greater density of tree/shrubs are also preferred by long-tailed pygmy rice rats (Murúa and González 1986), which would increase the probability of encounters between it and Harris's Hawks. Unfortunately, we did not sample rodents in native shrublands in Carriel Sur Airport; thus, the abundance of long-tailed pygmy rice rats in this cover type was unknown. It is probable that Southern Lapwings (*Vanellus chilensis*), the bird most frequent in prey remains, were captured relative to their abundance. This was one of the most frequent birds (9–28% of all individual birds counted) on the line transects. Further investigation is necessary to determinate if Harris's Hawks behave as a selective or opportunist predator (Jaksic et al.1980, Bednarz 1988a, Gerstell and Bednarz 1999) in southern Chile.

PRESAS DE *PARABUTEO UNICINCTUS* EN UN AREA SUBURBANA DEL SUR DE CHILE

RESUMEN.—La dieta de *Parabuteo unicinctus* fue analizada utilizando 23 egagrópilas y 41 restos de presa recolectados durante la temporada reproductiva 2003–04 en el Aeropuerto Carriel Sur de Concepción, en el sur de Chile. Los mamíferos formaron la mayor parte de la dieta (64.7% por frecuencia, 70.6% por biomasa). Aunque *Oligoryzomys longicaudatus* fue la presa consumida (36.7%) con mayor frecuencia, los lagomorfos representaron la mayor parte de la biomasa(62.5%). Las aves siguieron a los mamíferos en importancia (26.4% por frecuencia, 29.3% por biomasa). La contribución de los reptiles e insectos fue menor. El peso geométrico promedio de las presas vertebradas (85.4 g) fue marcadamente más bajo en nuestro sitio de estudio que en Chile central (202.4–257.1 g). En general, la composición de la dieta de *P. unicinctus* en nuestro sitio de estudio fue muy similar a la documentada para otras localidades en Chile y Norte América.

[Traducción del equipo editorial]

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