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## FOOD HABITS OF THE RUFOUS-LEGGED OWL (*STRIX RUFIPES*) IN THE MEDITERRANEAN SCLEROPHYLLOUS FOREST OF CENTRAL CHILE

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KEY WORDS: *Rufous-legged Owl*; *Strix rufipes*; *food habits*; *Mediterranean sclerophyllous forest*, *central Chile*.

The Rufous-legged Owl (*Strix rufipes*) inhabits old-growth temperate rainforest of southern South America (Housse 1945, Goodall et al. 1946, Johnson 1967, Vuilleumier 1985, Martínez and Jaksic 1996, 1997). Infor-

mation on the species is limited, and only plumage, habitat and distribution have been described (Housse 1945, Goodall et al. 1946, Johnson 1967, Vuilleumier 1985, Araya and Millie 1989). Martínez (1993a, 1996) and Martínez and Jaksic (1996, 1997) have recently reported on population density, specific habitat requirements and diet of the Rufous-legged Owl in temperate rainforests of

southern Chile. They pointed out similarities in habitat requirements of this species and the Northern Spotted Owl (*Strix occidentalis*) of North America.

In Chile, the range of the Rufous-legged Owl extends from Santiago to Magallanes, (33°S–55°S) (Goodall et al. 1946, Araya and Millie 1989). In the northern limit of distribution, it inhabits hydrophyllous and sclerophyllous forest of the Mediterranean zone. Relative to southern Chile, abundance in central Chile is lower (Housse 1945, Jaksic and Jiménez 1986), and numbers appear to be declining as a result of habitat loss (Jaksic and Jiménez 1986).

From a conservation viewpoint, the Rufous-legged Owl has been catalogued as inadequately studied and in need of further research (Glade 1993). Historical records documenting the presence of Rufous-legged Owls in mountainous old-growth forest of central Chile (Housse 1945) date from the past century (specimens present at the National Museum of Natural History from Central Chile are MNHM 153 Aculeo 1865, MNHM 150 San Francisco del Monte 1869, MNHM 4338 Quebrada de Ramón 1947). Since the arrival of Spanish colonials, forests of the Central Valley and Andean range in Chile have largely been destroyed (Elizalde 1970, Mooney et al. 1972, Hoffmann 1998). During this century, forests near Santiago have virtually disappeared (Lara 1998), having been cut for firewood in Santiago and nearby towns. Trees older than 250 yr are scarce and may only be found along deep ravines in remote mountainous areas.

This study is the first report of the food habits of Rufous-legged Owl in the Mediterranean sclerophyllous forest near the northern limit of its distribution in Chile.

#### STUDY AREA AND METHODS

The study was conducted in Río Clarillo National Reserve (33°45'S, 70°26'W), located 45 km southeast of Santiago in the foothills of the Andean range. The reserve covers 10 185 ha of mountainous landscapes, with slopes of approximately  $\geq 45^\circ$  and 870–3050 m in altitude (ICSA 1983). The climate at 870 m is Mediterranean with mean annual rainfall of 648 mm and a long dry season from September to May (CONAF 1996).

The reserve supports sclerophyllous forest <1500 m that are dominated by *Cryptocarya alba* (Lauraceae), *Persea lingue* (Lauraceae), *Drimys winteri* (Winteraceae), *Lithraea caustica* (Anacardiaceae), *Quillaja saponaria* (Rosaceae), and *Acacia caven* (Mimosaceae) (CONAF 1996, ICSA 1983). Between 1500–2000 m, *Kageneckia angustifolia* (Rosaceae) and *Austrocedrus chilensis* (Cupressaceae) are dominant. Above 2000 m, shrubs such as *Chuquiraga* sp. and *Mulinum* sp. grow to a height of 50 cm (ICSA 1983). According to local inhabitants, the location of the reserve was very remote until the middle of the century. However, around the turn of the century, the forest began to be exploited for firewood and charcoal, and open areas were used for cattle grazing during the summer (CONAF 1996, ICSA 1983). Exploitation was intensified in 1972, when indiscriminate tree removal began, and many parts of the reserve were burned and cleared

(CONAF 1996). In 1978, hunting was prohibited and, in 1982, the area was designated a national reserve (CONAF 1996, ICSA 1983).

A total of eight surveys were conducted on a periodic basis (one survey each two or three months) from February 1994–October 1995, in a forest patch less than 1 ha in size located at 1100 m altitude that was occupied by a Rufous-legged Owl pair. In all, 210 pellets were collected and their contents were identified to species level through comparisons with the mammal skull collection in the National Museum of Natural History, Santiago, Chile. A reference collection was also used to identify insects found in pellets. Data were pooled by season and the results expressed separately for each season as a percentage of the total prey mass consumed. The following equation was used to calculate the percentage of the total prey mass consumed represented by each species in the diet (Martínez 1993a), assuming that the entire body mass of each individual prey species caught was consumed by the owl:

$$B\% = (100Sp_iN_i) / \sum Sp_iN_i$$

where  $Sp_i$  is the mass of the  $i$ th species,  $N_i$  is the number of individuals of  $i$ th species consumed and  $B\%$  is the percentage of the total prey mass consumed for each season contributed by the  $i$ th species. The mass of each prey species was obtained by capturing and weighing individuals of different taxa present in the Rufous-legged Owl diet. For mammals, body mass was obtained from Jaksic (1986).

#### RESULTS AND DISCUSSION

The diet of Rufous-legged Owl consisted of 10 mammalian species, one lizard and four invertebrate families (Table 1). In spite of the large number of invertebrates consumed, they composed only 2.1% of the total prey biomass. Mammals made up 98% of prey biomass in the Rufous-legged Owl diet (62% of the total number of prey items consumed). The species most frequently consumed were *Abrocoma bennetti* and *Octodon lunatus*, comprising 16.5% and 15.2% of the total prey biomass, respectively. In addition, 29% of the prey biomass (13% of individual prey items identified) was attributed to mammals identified from remains retrieved from pellets which did not contain skulls or teeth. These pellets contained large femurs or humeri ( $\bar{x} = 32.2 \pm 0.7$  and  $27.6 \pm 0.3$  mm, respectively) identified as adult *A. bennetti* and *O. lunatus*, the only large rodents in the area (CONAF 1996, Díaz and Sarmiento 1999). These species constituted 35% of the total number of prey items identified, 51% of the mammals captured and the 61% of the total prey biomass consumed. Both are primarily terrestrial species which live in caves among rocks covered by shrubs (Mann 1978), and occasionally climb trees (C. Veloso pers. comm.). Lizards in central Chile are diurnal (Donoso-Barros 1966), and were probably consumed only occasionally.

In contrast to data presented by Martínez (1993a) and Martínez and Jaksic (1996, 1997) on Rufous-legged Owls in forests of southern Chile, prey species in this study

Table 1. Food habits of the Rufous-legged Owl (*Strix rufipes*) in sclerophyllous forest in Río Clarillo National Reserve, central Chile. Data from 1994 and 1995 are pooled by season. B% is a percent of total prey mass consumed and (N) is prey number by season.

PREY	Mass (g)	SUMMER		AUTUMN		WINTER		SPRING		TOTAL	
		B%	(N)	B%	(N)	B%	(N)	B%	(N)	B%	(N)
<b>Mammals</b>											
<i>Abrocoma bennetti</i>	219 <sup>a</sup>	30.0	(15)	20.0	(9)	0	(0)	14.0	(5)	19.0	(29)
<i>Abrocoma bennetti</i> *	169 <sup>b</sup>	6.2	(4)	1.8	(1)	27.0	(8)	4.2	(2)	7.5	(15)
<i>Octodon lunatus</i>	180 <sup>b</sup>	9.9	(6)	26.0	(14)	7.2	(2)	11.0	(5)	14.0	(27)
<i>Octodon lunatus</i> *	140 <sup>b</sup>	0	(0)	0	(0)	8.4	(3)	0	(0)	1.2	(3)
<i>Oryzomys longicaudatus</i>	45 <sup>a</sup>	0.4	(1)	1.9	(4)	1.8	(2)	5.0	(9)	2.1	(16)
<i>Abrothrix longipilis</i>	76 <sup>a</sup>	2.8	(4)	3.9	(5)	0	(0)	1.9	(2)	2.5	(11)
<i>Abrothrix olivaceus</i>	40 <sup>a</sup>	0.4	(1)	0.4	(1)	3.2	(4)	2.0	(4)	1.2	(10)
<i>Phyllotis darwini</i>	66 <sup>a</sup>	0.6	(1)	4.1	(6)	7.9	(6)	4.1	(5)	3.5	(18)
Cricetidae unident.	40 <sup>b</sup>	0.4	(1)	0.4	(1)	2.4	(3)	0.5	(1)	0.7	(6)
<i>Rattus norvegicus</i>	220	4.0	(2)	0	(0)	0	(0)	0	(0)	1.3	(2)
<i>Rattus rattus</i>	158 <sup>a</sup>	2.9	(2)	3.3	(2)	3.1	(1)	0	(0)	2.3	(5)
<i>Thylamys elegans</i>	40 <sup>a</sup>	2.2	(6)	2.9	(7)	3.2	(4)	3.0	(6)	2.7	(23)
<i>Oryctolagus cuniculus</i> *	408 <sup>b</sup>	7.5	(2)	0	(0)	16.0	(2)	0	(0)	4.9	(4)
Unident. large mammals	200 <sup>b</sup>	24.0	(13)	27.0	(13)	16.0	(4)	45.0	(18)	29.0	(48)
Unident. small mammals	58 <sup>b</sup>	6.4	(12)	5.4	(9)	2.3	(2)	7.9	(11)	5.9	(34)
Subtotal mammals		97.8	(70)	97.6	(72)	98.5	(41)	97.8	(68)	97.8	(251)
<b>Reptilians</b>											
Squamata unident.	10 <sup>b</sup>	0	(0)	0	(0)	0.2	(1)	0	(0)	0.03	(1)
Subtotal reptilians		0	(0)	0	(0)	0.2	(1)	0	(0)	0.03	(1)
<b>Insects</b>											
Cerambicidae											
<i>Acanthinodera cummingii</i>	11 <sup>b</sup>	1.1	(11)	0.6	(5)	0.4	(2)	0.7	(5)	0.8	(23)
Scarabeidae	0.3 <sup>b</sup>	0	(0)	0	(0)	0	(0)	0	(9)	0	(9)
Gryllacridiidae	3.2 <sup>b</sup>	0.4	(15)	1.7	(50)	0	(0)	0.8	(20)	0.8	(85)
Insecta unident.	4 <sup>b</sup>	0.6	(15)	0.1	(3)	0.9	(11)	0.7	(14)	0.5	(43)
Subtotal insects		2.1	(41)	2.4	(58)	1.3	(13)	2.2	(48)	2.1	(160)
Scorpions	0.8 <sup>b</sup>	0.1	(11)	0	(3)	0	(1)	0	(1)	0	(16)
Total prey items		122		133		56		117		428	
Total prey mass		10 882		9643		5025		8077		33 627	
Total pellets		59		55		29		67		210	

<sup>a</sup> Prey biomass obtained from Jaksic (1986).

<sup>b</sup> Prey biomass obtained from I. Díaz (unpubl. data).

\* Young specimens.

were larger and primarily terrestrial. In southern Chile, 72.4% of the total prey mass consumed were scansorial mammals weighing 26–42 g (Martínez 1993a) while, in this study, adults of the dominant prey species, *A. bennetti* and *O. lunatus*, weighed between 180–219 g, and young individuals weighed over 100 g. In central Chile, *Abrothrix longipilis*, *A. olivaceus*, and *Oryzomys longicaudatus* made up a relatively small proportion of species consumed by Rufous-legged Owls, in contrast to southern Chile where they were consumed in large quantities (Martínez 1993a, Martínez and Jaksic 1996, 1997).

The sizes of prey species identified in this study are larger than the optimal prey size predicted by Bozinovic and Medel (1988) for owls of a similar size. Therefore, it is probable that individuals of Rufous-legged Owl did not select prey species according to optimal size, but according to prey species abundance. Large prey may have been eaten in pieces, instead of being swallowed whole. I have observed this behavior in Great Horned Owls (*Bubo virginianus*) when they caught and ate European rabbits (*Oryctolagus cuniculus*). Less palatable body parts or heads of large mammals which may have been too large to swal-

low may have been avoided. This could explain the high percentage of pellets found which did not contain teeth or skulls (Table 1).

The forest patch in Río Clarillo provided an open understory and forest floor which may have enhanced Rufous-legged Owls' ability to see and capture terrestrial mammals. The opposite is true in the southern Chilean rainforest, where dense understory provides cover for terrestrial mammals, and owls forage mainly on arboreal and scansorial mammals (Martínez 1993a, 1993b, Martínez and Jaksic 1997). In the Río Clarillo National Reserve forest patch, some *Persea lingue* and *Cryptocarya alba* trees are >200 years old and reach 13–15 m height. They provide 70% canopy cover, similar to that reported by Martínez and Jaksic (1996) in southern Chile. The Rufous-legged Owl pair studied in Río Clarillo was frequently observed outside forest patches during night hours, giving territorial vocalizations in open shrublands with a canopy <6 m in height. However, during the day they were always observed inside the forest patch and pellets were found only in the forest. It is my opinion that Rufous-legged Owls use forest patches for nesting and for protection and shelter during daylight hours, and forage in forest and shrublands during the night.

RESUMEN.—Este es el primer análisis cuantitativo de la dieta del Concón (*Strix rufipes*) en un bosque esclerófilo, cerca del límite norte de la distribución de esta especie en Chile. Se analizó el contenido de 210 egagrópilas recolectadas en un remanente de bosque esclerófilo entre 1994 y 1995. Los resultados indican que el Concón consumió mayoritariamente los roedores *Abrocoma bennetti* y *Octodon lunatus*, además de otras ocho especies de mamíferos, un lagarto y cuatro familias de artrópodos. El tamaño de las presas consumidas es de tres a cuatro veces mayor que el tamaño de las presas consumidas por esta misma especie en el sur de Chile. Las presas consumidas son fundamentalmente terrícolas, a diferencia de las especies arborícolas y escansoriales consumidas en el sur. Probablemente el Concón captura estas grandes presas y las consume por trozos. Se han detectado ejemplares fuera de los remanentes de bosque, en matorrales, por lo cual el Concón podría usar los bosques para descansar durante el día y anidar, y por la noche capturaría sus presas en bosques y matorrales vecinos.

[Traducción del Autor]

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## FOOD HABITS OF THE CINEREOUS HARRIER (*CIRCUS CINEREUS*) IN THE ARAUCANÍA, SOUTHERN CHILE

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KEY WORDS: *Cinereous Harrier*; *Circus cinereus*; *food*; *Chile*.

The Cinereous Harrier (*Circus cinereus*) is widespread in South America, ranging from northern Colombia to Tierra del Fuego in open areas such as marshes, grasslands, shrublands, and steppes (Jiménez and Jaksic 1988, and references therein). In Chile, it is a resident along its entire distributional range from Copiapó (30°S) to Tierra del Fuego (57°S) (Hellmayr 1932, Johnson 1965). Its status varies from “rare” in northern Chile, to “frequent” in central and southern Chile, to “abundant” in southernmost Chile (Jaksic and Jiménez 1986). Although historical forest cutting and establishment of croplands has favorably affected the Cinereous Harrier in southern Chile, current increases of exotic pine and eucalyptus plantations and marsh draining for urban and agricultural development appear to negatively impact harriers by decreasing their hunting habitat, prey availability and nest sites (Jaksic and Jiménez 1986).

Little is known about the biology of this South American harrier, except for studies conducted by Jiménez and Jaksic (1988) in Chile and by Saggese and De Lucca (1995) in Argentina. Data on its diet in the Magellanic steppe were reported by Jiménez and Jaksic (1988) and

reanalyzed by Iriarte et al. (1990). Here, we report the first quantitative data on food habits of the Cinereous Harrier in an agricultural landscape of the Araucanía region (ca. 38°S) in southern Chile.

### STUDY AREA AND METHODS

We studied two pairs of Cinereous Harriers in a 200-ha area at Tricauco Farm, located approximately 6 km south of Traiguén city (38°14'S, 72°38'W) in the Araucanía Region of Chile. The landscape comprised croplands of wheat and corn, grasslands, marshlands, exotic tree plantations of *Pinus* spp. and *Eucalyptus* spp. and remnants of the original deciduous *Nothofagus* forest. The climate is moist-temperate with a Mediterranean influence (di Castri and Hajek 1976) and mean annual rainfall and temperature are 1400 mm and 12°C, respectively. Although originally the Araucanía region extended from Maule Province to Seno Reloncaví, the current Administrative Araucanía Region extends from the Renaico River (37°30'S) to Calafquén Lake (38°47'S).

During August 1996 (austral winter), we collected 68 pellets in abandoned pastures and marshes where harriers hunted and perched. Pellets were collected both from open ground in pasture-marshes and under trees, fences and stumps used as perches by harriers. Avian prey were identified mainly on the basis of feathers, using two com-