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FOOD HABITS AND HUNTING RANGES OF SHORT-EARED OWLS (*ASIO FLAMMEUS*) IN AGRICULTURAL LANDSCAPES OF SOUTHERN CHILE

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ABSTRACT.—The diet of the Short-eared Owl (*Asio flammeus*) was quantified by analyzing 400 pellets collected in two agricultural landscapes of southern Chile (Osorno and Chahuilco). Diet composition fluctuated seasonally and included several species of small mammals, birds, and insects. Almost 80% of the annual biomass consumed was from two rodent species (*Akodon olivaceus* and *Rattus norvegicus*) and of a bird (*Vanellus chilensis*). No differences in the composition of the winter diets were detected between the two study sites, and the latter were similar in landscape structure and use by humans. Also, the size of hunting ranges used by Short-eared Owls was similar between the two sites (ca. 250 ha), with a prevalence of landscape elements such as meadows, wetlands, and agricultural fields. Nevertheless, Short-eared Owls concentrated their hunting activity in areas with little human disturbance, such as vegetation fringes along roadsides, ungrazed meadows, and untilled lands. Even though Short-eared Owls perched on the ground, they also used posts along roads and between properties as perches. Although suboptimal or marginal habitat for most other raptors, these human-dominated landscapes appeared to be valuable for the survival and persistence of Short-eared Owl populations, as long as their food and shelter remained unaffected.

KEY WORDS: *Short-eared Owl*; Asio flammeus; *prey selection*; *hunting range*; *Chile*; *temperate agroecosystems.*

Hábitos alimentarios y ámbitos de caza de nucos (*Asio flammeus*) en agroecosistemas del sur de Chile

RESUMEN.—Se cuantificó la dieta del nuco (*Asio flammeus*) analizando 400 egagrópilas recolectadas en dos agroecosistemas del sur de Chile (Osorno y Chahuilco). La composición de la dieta fluctuó estacionalmente e incluyó varias especies de mamíferos, aves e insectos. Sin embargo, casi el 80% de la biomasa total consumida estuvo constituída por sólo dos especies de roedores (*Akodon olivaceus* y *Rattus norvegicus*) y de un ave (*Vanellus chilensis*). No existieron diferencias en la composición de la dieta invernal entre los dos sitios de estudio, y ambos agroecosistemas fueron similares en cuanto a estructura y a uso por humanos. De igual modo, el tamaño estimado del área de caza utilizada por los nucos fue similar entre los dos sitios (ca. 250 ha), predominando en ambos elementos del paisaje tales como praderas, humedales y cultivos. Sin embargo, los nucos concentraron su actividad de caza en áreas con nula o escasa intervención humana, tales como franjas vegetadas a orillas de camino, juncales, praderas no pastoreadas y terrenos baldíos. Si bien los nucos se posaban en el suelo, también utilizaban como perchas los postes de cercos a orillas de caminos y los existentes entre predios. Concluimos que estos ambientes antrópicos, inadecuados para muchas rapaces, permitirían la subsistencia y residencia de parejas de nucos, siempre y cuando sus presas y sitios de crianza no fuesen afectados.

[Traducción Autores]

The Short-eared Owl (*Asio flammeus*) occurs on all continents except Australia and Antarctica. Despite being extensively distributed throughout South America (Clark 1975), literature available on the natural history of this species is chiefly anecdotal (e.g., Housse 1945, Borrero 1962). In Chile, Short-eared Owls are regarded as poorly studied (Glade 1988). Populations are declining in most of the country but are increasing in southernmost Chile (Jaksic and Jiménez 1986). Rau et al. (1992) reported the diet of Short-eared Owls in mainland Chile based on 53 pellets and Fuentes et al. (1993) reported the diet of a population inhabiting Juan Fernández archipelago based on 20 pellets. Thus,

this species is one of the least known owls in Chile (see review in Jaksic 1997).

Short-eared Owls in Chile occupy a variety of open habitats. Urbanization has had negative impacts on many Chilean raptors, which are decreasing due to illegal hunting, habitat alteration, and prey reduction (Jaksic and Jiménez 1986). Although the habitat and prey requirements of most raptors are generally not met in urban environments (Martínez and Jaksic 1996, Petty 1996), the Short-eared Owl is an exception. At least in southern Chile, this owl opportunistically uses suburban environments such as airports, pasturelands, and golf courses. Here, we report the prey identified in 400 pellets of Short-eared Owls collected in two agricultural areas of southern Chile, and provide preliminary data on the size and landscape features of their hunting grounds.

STUDY AREA AND METHODS

We collected 336 Short-eared Owl pellets on a seasonal basis from April (autumn) 1995–February (summer) 1996 in an area located on the outskirts of the city of Osorno (40°35′S, 73°05′W), in southern Chile. The study area included a golf course, a web of fallow vegetation strips between agricultural fields or along roads, an apple orchard, a sedge-rush (*Carex-Juncus* spp.) marsh, pasturelands (some abandoned), an airport, and lawns surrounding the main campus of Universidad de Los Lagos. From June (winter) 1995–February 1996, we also collected 64 Short-eared Owl pellets at Chahuilco (40°42′S, 73°09′W), an area that included pasturelands, a marsh, fallow vegetation along roads and agricultural fields, as well as berry farms. The climate of these two study areas is within the oceanic region with mediterranean influence of di Castri (1975), which is characterized by heavy rainfall (200–300 cm yearly), mostly during winter and decreasing in summer.

Only pellets with identifiable prey remains were considered. From the Osorno sample (336 pellets), we measured and weighed 241 intact pellets. We identified and quantified most vertebrates in the pellets on the basis of skulls, beaks or dentary pairs (Reise 1973), which gave the highest count. For remains such as hair and feathers, we used reference collections and quantified these prey assuming the smallest possible number of individuals (e.g., hair or feathers of a given species were deemed as representing only one individual). For insect identification, we followed Peña (1986) and quantified these prey by counting head capsules and mandibles. We identified prey items to the finest possible taxonomic category in all cases, as recommended by Marti (1987).

In Osorno, we evaluated the relative abundance of small mammals from May–July 1995 (autumn to winter) by live-trapping at an abandoned pasture located inside the owls' hunting area. The mass of most prey species was determined by weighing individuals captured in Osorno. Some mass estimates for mammals were obtained from Pearson (1983) and Martínez (1993). Masses of birds were obtained from Morgado et al. (1987). We estimated the total biomass of each prey species in the diet by multiplying the number of individuals in the pellets by the mean body mass of each species. We assumed that masses of unidentified prey were similar to the mean mass of the most closely related identified taxon. We analyzed the Osorno diet on a seasonal and year-round basis, and compared the results obtained for winter 1995 with those from the sample from Chahuilco with Pianka's symmetrical niche overlap index (O_{jk}), using programs listed in Krebs (1989).

Concomitantly with pellet collections, we estimated the hunting area used by a pair of Short-eared Owls in each of the two study areas. To the best of our knowledge, these were the only pairs present in each site. With a hand-held global positioning system (GPS) receiver (Garmin GPS 38), we determined the location of each previously known roosting place, as evidenced both by sighting and pellet collection at roosts. To determine the size of the area used by Short-eared Owls, the data were expressed in UTM coordinates and analyzed using the minimum convex polygon method (Jenrich and Turner 1969). For Osorno and Chahuilco, we pooled the spatial data available for autumn and winter 1995. The percentage of landscape elements of each range was estimated from 1:30 000 aerial photographs, which were resized to 1:15 000 with a scanner. Ranges of Short-eared Owls, resized accordingly, were overlaid and the area of each cover category included was estimated using a Placom KP-80N digital planimeter. Statistical significance was set at $P < 0.05$ for all tests unless otherwise stated.

RESULTS AND DISCUSSION

The 241 whole pellets we measured averaged 41.6 ± 0.072 mm × 21.4 ± 0.043 mm and had a mean dry mass of 2.8 ± 0.080 g ($\bar{x}$ ± SE). All three measurements were slightly lower than those reported by Holt et al. (1987) for Short-eared Owl pellets in North America.

The 336 pellets from Osorno yielded 812 prey items (Table 1), of which small mammals were numerically the most frequent, followed by insects and birds. Olivaceous field-mice (*Akodon olivaceus*) were the most frequent prey in the diet year-round, although they were somewhat more frequent during winter. This is in close agreement with the autumn–winter peak of these vole-like mice in prairie-scrublands of southern Chile (Murúa and González 1986). Long-tailed rice rats (*Oryzomys longicaudatus*) were also eaten relatively frequently. Although this species is as abundant as the olivaceous field-mouse in southern Chile (Meserve et al. 1991), only its winter consumption by Short-eared Owls coincided with their autumn–winter peak abundance (Murúa and González 1986). Perhaps, the skewed consumption of long-tailed rice rats reflects their high vagility, as well as their pro-

Table 1. Food habits of Short-eared Owls in agricultural landscapes around Osorno, Chile. B% is percent by biomass and *N* is prey by number.

Prey Species	Mass[a] (g)	Autumn		Winter		Spring		Summer		Total	
		B%	(*N*)	B%	(*N*)	B%	(*N*)	B%	(*N*)	B%	(*N*)
Mammals											
Akodon olivaceus	23	24.3	(21)	23.8	(154)	10.1	(62)	26.3	(38)	18.5	(275)
Auliscomys micropus	58	20.5	(7)	7.8	(20)	3.3	(8)	10.5	(6)	7.0	(41)
Geoxus valdivianus	25	0.0	(0)	0.7	(4)	0.5	(3)	0.8	(1)	0.6	(8)
Oryzomys longicaudatus	26	13.1	(10)	11.0	(63)	2.4	(13)	0.8	(1)	6.6	(87)
Mus musculus	21	0.0	(0)	0.1	(1)	0.0	(0)	0.0	(0)	0.1	(1)
Rattus norvegicus	201	10.1	(1)	39.2	(29)	5.7	(4)	24.2	(4)	22.3	(38)
Unidentified rodents	59	17.7	(6)	7.5	(19)	3.4	(8)	1.7	(1)	5.8	(34)
Subtotal mammals		85.7	(45)	90.1	(290)	25.4	(98)	64.3	(51)	60.9	(484)
Birds											
Vanellus chilensis	270	13.6	(1)	9.1	(5)	73.2	(38)	32.5	(4)	37.9	(48)
Sturnella loyca	78	0.0	(0)	0.5	(1)	0.0	(0)	2.4	(1)	0.4	(2)
Unidentified passerines	20	0.0	(0)	0.1	(1)	0.1	(1)	0.0	(0)	0.1	(2)
Subtotal birds		13.6	(1)	9.7	(7)	73.3	(39)	34.9	(5)	38.4	(52)
Insects											
Carabidae	0.84	0.0	(0)	0.0	(0)	1.0	(172)	0.0	(0)	0.4	(172)
Scarabaeidae	0.48	0.2	(3)	<0.1	(31)	<0.1	(5)	0.5	(31)	0.1	(70)
Gryllacridiidae	0.69	0.2	(1)	<0.1	(3)	<0.1	(2)	0.0	(0)	<0.1	(6)
Unidentified insects	0.67	0.3	(6)	<0.1	(5)	<0.1	(2)	0.3	(15)	<0.1	(28)
Subtotal insects		0.7	(10)	0.2	(39)	1.3	(181)	0.8	(46)	0.7	(276)
Total prey items (No.)		56		336		318		102		812	
Total biomass (g)		1980.2		14879.4		14008.6		3318.9		34186.9	
Total pellets (No.)		30		181		89		36		336	

[a] Masses of mammals were obtained from Pearson (1983) for *Auliscomys*, and Martínez (1993) and D.R. Martínez (unpubl. data) for the remaining taxa. Masses of birds were obtained from Morgado et al. (1987). Masses of insects were the mean of representative members of each family collected at the study site (D.R. Martínez unpubl. data).

nounced population fluctuations (Murúa et al. 1986). On a numerical basis, austral greater mice (*Auliscomys micropus*) were the third most frequent prey, but their biomass contribution was higher than that of long-tailed rice rats. Norway rats (*Rattus norvegicus*) were also eaten and, by biomass, they were the staple mammalian food of Short-eared Owls during winter. Other mammal species eaten were the Valdivian mole-mouse (*Geoxus valdivianus*) and house mouse (*Mus musculus*), but their number and biomass were minimal.

In 594 trap-nights, we caught 95 small mammals (recaptures not included). Their number and species composition were as follows: 78 (82.1%) olivaceous field-mice, six (6.3%) long-tailed rice rats, six (6.3%) house mice, and five (5.3%) Norway rats. All species, except for Norway rats, were reported by Rau et al. (1992) as prey of Short-eared Owls, in a similar frequency ranking. The only differences were the long-haired field-mice (*Akodon longipilis*) which was neither consumed nor trapped in Osorno, but preyed upon at Chahuilco, black rats (*Rattus rattus*), and Darwin's leaf-eared mice (*Phyllotis darwini*). These differences may have been attributable to the pooled sample used by Rau et al. (1992), which comprised pellets gathered at sites located as far apart as 100 km. In Colombia, although no quantitative data were provided, Borrero (1962) reported that Short-eared Owls ate mostly Norway, black, and cotton rats (*Sigmodon hispidus*).

By number, birds were unimportant as prey yearround, but by biomass and during spring and partially in summer, Southern Lapwings (*Vanellus chilensis*) were the main food item for Short-eared Owls in our study. Other birds taken were Red-breasted Meadowlarks (*Sturnella loyca*) and unidentified Passeriformes, but their biomass contribution to the diet was minimal. Although we did not observe direct predation on Southern Lapwings, we found eight carcasses on the ground under perches used by owls. Also, on 6 September 1995,

Table 2. Area (in ha) and percent cover of landscape features in two hunting ranges (Osorno and Chahuilco) used by Short-eared Owls in Chile. Also included, linear km of six-strand barbed-wire fences, number of posts, and posts suitable as perches for owls.

	OSORNO		CHAHUILCO	
LANDSCAPE FEATURES	AREA	(%)	AREA	(%)
Roads	5.3	(1.8)	1.6	(0.7)
Roadsides	21.1	(7.4)	2.7	(1.3)
Buildings	3.0	(1.0)	0.3	(0.1)
Orchards	8.4	(3.0)	39.5	(18.0)
Water bodies	8.2	(2.9)	3.6	(1.6)
Meadows	25.7	(9.0)	55.3	(25.1)
Pasturelands	214.3	(74.9)	117.0	(53.2)
Total range	286.0	(100.0)	220.0	(100.0)
Fences (km)	17.0		12.3	
Number of posts	8500		4940	
Number of suitable posts	212		123	

we flushed a Short-eared Owl that was eating a freshly-killed fledgling lapwing (230 g) on a ground perch.

Rau et al. (1992) did not report birds as prey of Short-eared Owls, but Fuentes et al. (1993) found that in Juan Fernández archipelago, they preyed secondarily on birds, particularly on adults and eggs of petrels (*Pterodroma* spp.). In the northern hemisphere, Clark (1975) reported a generally low consumption of birds, chiefly of Western Meadowlarks (*Sturnella neglecta*), but apparently there is higher bird predation among coastal and insular Short-eared Owls (Holt and Leasure 1993). In Europe, Glue (1977) reported that birds were the main source of food during winter for Short-eared Owls inhabiting Great Britain and Ireland.

Insects outnumbered small mammals in the diet during spring, and birds during all seasons. Nevertheless, their biomass contribution was irrelevant on a yearly basis. Coleopterans, particularly Carabidae and Scarabaeidae, were the most frequent items, followed by gryllids and unidentified insect remains.

The 64 pellets from Chahuilco yielded 121 prey items: 34.8% olivaceous field-mouse, 25.6% Norway rat, 11.1% austral greater mouse, 8.9% long-tailed rice rat, 1.7% long-haired field-mouse, 17.8% unidentified rodents, and 0.1% Gryllacrididae. This showed that the diets of Short-eared Owls were similar between Osorno and Chahuilco during the winter of 1995 (symmetrical niche overlap = 91.8%). In both, olivaceous field-mouse was the most frequent and Norway rat the highest biomass-contributor of mammalian prey (Table 1).

Osorno and Chahuilco are 17.5 km apart, but hunting range sizes and landscape features were similar for both populations of Short-eared Owls (Table 2). The similarity in landscape features was likely the result of human colonization of southern Chile in the late 19th century, which resulted in extensive burning of rainforests to clear the land for agricultural use (Martínez and Jaksic 1996). In both areas, pasturelands and sedge-rush marshes were the predominant landscape features, followed by orchards (apple trees), berry farms, water bodies (rivers, streams, ponds), fallow vegetation along roads and fences, paved or gravel roads, and some interspersed old southern beeches (*Nothofagus dombeyi*) in addition to buildings.

In our two study areas, most of the hunting activity of Short-eared Owls was performed near farmland and road borders, where agriculture was not intensive or nonexistent. Fence posts were the most prominent perches for these owls in such a flat landscape, although some saplings and old southern beech trees were used as roosting sites. Owing to widespread construction practices, the number of wooden split posts used per km of fence erected is almost the same everywhere in southern Chile (400–500 posts/km). However, only 2.5% of the posts in both study sites had flat tops and were suitable as perches. Most of the posts were sharpened on their tops. Because of this, suitable posts were easily seen in the field. Either an owl was

perched on them, or white wash, prey remains or scattered pellets were on the ground around them.

Grazed, plowed or mowed areas, although inside their range, were not used for hunting or breeding by Short-eared Owls. Apparently, overgrazing and grass mowing removed cover needed by potential prey. Most of the time, the owls only crossed over these areas, flying straight and steady at about 4 m altitude, in the direction of their hunting grounds. Nesting areas apparently were located in marshy areas where sedge and rush were dense. Due to the high cover, it was difficult to find any nests, but in January (summer) 1997, we found four discarded eggshells of Short-eared Owls on a tiny island with dry ground and tall grasses. In both study areas, marshes were not used by humans, and hunting was prohibited by landowners. Although human-dominated habitats are suboptimal or marginal for many raptors, they seemed to be valuable for the survival and persistence of Short-eared Owls in our study.

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LITERATURE CITED

BORRERO, H.J.I. 1962. Notas varias sobre *Asio flammeus bogotensis* en Colombia. *Rev. Biol. Trop.* 10:45–49.

CLARK, R.J. 1975. A field study of the Short-eared Owl, *Asio flammeus*, in North America. *Wildl. Monogr.* 47:1–67.

DI CASTRI, F. 1975. Esbozo ecológico de Chile. Ministerio de Educación, Santiago, Chile.

FUENTES, M.A., J.A. SIMONETTI, M.S. SEPÚLVEDA AND P.A. ACEVEDO. 1993. Diet of the Red-backed Buzzard (*Buteo polyosoma exsul*) and the Short-eared Owl (*Asio flammeus suinda*) in the Juan Fernández Archipelago off Chile. *J. Raptor Res.* 27:167–169.

GLADE, A.A. [ED.]. 1988. Red list of Chilean terrestrial vertebrates. Corporación Nacional Forestal, Santiago, Chile.

GLUE, D.E. 1977. Feeding ecology of the Short-eared Owl in Britain and Ireland. *Bird Study* 24:70–78.

HOLT, D.W. AND S.M. LEASURE. 1993. Short-eared Owl (*Asio flammeus*). Pages 1–24 *in* A. Poole and F. Gill [EDS.], The birds of North America, No. 62. Acad. Nat. Sci., Philadelphia, PA and Am. Ornithol. Union, Washington, DC U.S.A.

———, L.J. LYON AND R. HALE. 1987. Techniques for differentiating pellets of Short-eared Owls and Northern Harriers. *Condor* 89:929–931.

HOUSSE, R. 1945. Las aves de Chile en su clasificación moderna: su vida y sus costumbres. Ediciones Universidad de Chile, Santiago, Chile.

JAKSIC, F.M. 1997. Ecología de los vertebrados de Chile Ediciones Universidad Católica de Chile, Santiago, Chile.

——— AND J.E. JIMÉNEZ. 1986. The conservation status of raptors in Chile. *Birds Prey Bull.* 3:95–104.

JENNRICH, R.I. AND F.B. TURNER. 1969. Measurement of a noncircular home range. *J. Theor. Biol.* 22:227–237.

KREBS, C.J. 1989. Ecological methodology. Harper and Collins Publ., New York, NY U.S.A.

MARTI, C.D. 1987. Raptor food habits studies. Pages 67–80 *in* B.A. Giron Pendleton, B.A. Millsap, K.W. Kline and D.M. Bird [EDS.], Raptor management techniques manual. Nat. Wildl. Fed., Washington, DC U.S.A.

MARTÍNEZ, D.R. 1993. Food habits of the Rufous-legged Owl (*Strix rufipes*) in temperate rainforests of southern Chile. *J. Raptor Res.* 27:214–216.

——— AND F.M. JAKSIC. 1996. Habitat, relative abundance, and diet of Rufous-legged Owls (*Strix rufipes* King) in temperate forest remnants of southern Chile. *Ecoscience* 3:259–263.

MESERVE, P.L., B.K. LANG, R. MURÚA, A. MUÑOZ-PEDREROS AND L.A. GONZÁLEZ. 1991. Characteristics of a terrestrial small mammal assemblage in a temperate rainforest in Chile. *Rev. Chil. Hist. Nat.* 64:157–169.

MORGADO, E., B. GÜNTHER AND U. GONZÁLEZ. 1987. On the allometry of wings. *Rev. Chil. Hist. Nat.* 60:71–79.

MURÚA, R. AND L.A. GONZÁLEZ. 1986. Regulation of numbers in two Neotropical rodent species in southern Chile. *Rev. Chil. Hist. Nat.* 59:193–200.

———, L.A. GONZÁLEZ AND P.L. MESERVE. 1986. Population ecology of *Oryzomys longicaudatus philippii* (Rodentia: Cricetidae) in southern Chile. *J. Anim. Ecol.* 55:281–293.

PEARSON, O.P. 1983. Characteristics of a mammalian fauna from forests in Patagonia, southern Argentina *J Mammal.* 64:476–492.

PEÑA, L.E. 1986. Introducción a los insectos de Chile. Editorial Universitaria, Santiago, Chile.

PETTY, S.J. 1996. Adaptations of raptors to man-made spruce forests in the uplands of Britain. Pages 201–214 *in* D. Bird, D. Varland and J. Negro [EDS.], Raptors in human landscapes: adaptations to built and cultivated environments. Academic Press, London, U.K.

RAU, J.R., M.C. VILLAGRA, M.L. MORA, D.R. MARTÍNEZ AND M.S. TILLERÍA. 1992. Food habits of the Short-eared Owl (*Asio flammeus*) in southern South America *J Raptor Res.* 26:35–36.

REISE, D. 1973. Clave para la determinación de los cráneos de marsupiales y roedores chilenos. *Gayana: Zool.* 27:1–20.

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