SHORT COMMUNICATIONS

The Diet of the Burrowing Owl in Central Chile and Its Relation to Prey Size

ROBERTO P. SCHLATTER[1], JOSÉ L. YÁÑEZ[2], HERMAN NÚÑEZ[2], AND FABIAN M. JAKSIĆ[3,4]
[1]*Instituto de Zoología, Universidad Austral de Chile,* [2]*Museo Nacional de Historia Natural, Chile, and* [3]*Museum of Vertebrate Zoology, University of California, Berkeley, California 94720 USA*

Despite its abundance throughout Chile (Johnson 1965) little quantitative information has been gathered on the diet of the Burrowing Owl, *Athene cunicularia* (see Schlatter 1976, Jaksić et al. 1977, Péfaur et al. 1977, Yáñez and Jaksić 1979). In this paper we report the prey in 770 fresh pellets collected between August 1973 and April 1974 from three Burrowing Owl burrows in La Dehesa (33°21′S, 70°32′W; 875 m elevation; 20 km east of Santiago). The burrows were occupied by two adult pairs. The physiognomy and ornithological fauna of La Dehesa is described by Schlatter (1979).

We measured and dry-weighed a random sample of 221 pellets, rendering the following figures: length, 40.9 ± 0.53 mm ($\bar{x}$ ± SE); width, 14.5 ± 0.16 mm; weight, 1.74 ± 0.05 g. Subsequently, we separated their prey content by hand and combined it with the prey in the unmeasured 549 pellets. Of the 770 pellets, 183 (23.8%) contained only vertebrate remains (usually one specimen in each pellet), 113 (14.7%) contained only arthropods, and the other 474 (61.5%) were of mixed content. Because arthropods were more numerous than vertebrates in the pellets, but contributed little biomass because of their small size, we present our results separately for both prey categories.

Insects comprise the bulk of the arthropod prey of the Burrowing Owl in central Chile, accounting for nearly 94% of total items (Table 1). Beetles (Coleoptera) are the most commonly eaten insects, and those represented in the sample are mainly Carabidae and Scarabaeidae. This may be attributed to the ground-dwelling habits of the members of both Families. Following in importance within the insects are the dragonflies (Odonata), which are hunted by the Burrowing Owl usually in the evenings, when dragonflies tend to become torpid and perch on low vegetation (pers. obs.). The Orthoptera found in the diet were mainly crickets, and the Lepidoptera were principally caterpillars (not adults). The importance of arachnids, chilopods, and crustaceans is negligible and will not be dealth with. It is necessary to point out, however, that crustaceans detected in the pellets were terrestrial pill bugs, because Schlatter (1976) reported that Burrowing Owls near Lake Riñihue in southern Chile eat aquatic crustaceans of the family Aeglidae.

Our results show that central Chile Burrowing Owls tend to feed mainly on ground-dwelling arthropods, eating highly mobile, flying prey like dragonflies only when the flying prey are torpid. It is likely, then, that the Burrowing Owl does not actively search for arthropod prey but simply feeds opportunistically on nearby items. Our results for insect prey are similar to those reported by Marti (1974) in Colorado, except for the low importance of grasshoppers as compared to that of crickets and for the high consumption of dragonflies in Chile.

Our analysis of vertebrate prey is more detailed, at least regarding small mammals. We separated adult from juvenile mammals within each species present in the pellets by comparison with specimens of known age (assessed by reproductive status, teeth wear, and skull size) deposited in the mammal collection of Museo Nacional de Historia Natural (Chile). First, we deal with the general trends exhibited in Table 2.

Mammalian prey comprise about 76% of total items in the diet of the central Chile Burrowing Owl. Anurans are of secondary importance as prey, but in fact they are not a food source for the Burrowing Owl, as they seem to be cast away immediately after ingestion (they are found killed, but undigested). Similar observations have been reported by Thomsen (1971) in California. It is therefore likely that the Burrowing Owl rejects anurans after tasting the seemingly unpalatable secretion of their skins. On the other hand, Errington and Bennett (1935), Sperry (1941), and Bond (1942) have found digested anuran remains in pellets of the Burrowing Owl in North America, thus suggesting that some species are not completely unedible. This is not the case in central Chile, however, and consequently, passeriforms are second in importance as food of Burrowing Owls in the area studied. In spite of their abundance, lizards are very rarely preyed upon.

Inspection of Table 2 also reveals that, within the mammals, the staple prey of central Chile Burrowing

[4] Send reprint requests to Fabian M. Jaksić.

TABLE 1. Arthropod prey of the Burrowing Owl in central Chile.

	Total	%
Insects	(2,331)	93.8
Coleoptera	1,683	
Dermaptera	1	
Hemiptera	1	
Hymenoptera	2	
Lepidoptera	62	
Odonata	509	
Orthoptera	73	
Arachnids	(37)	1.5
Araneae	5	
Scorpionida	32	
Chilopods	(3)	0.1
Unidentified	3	
Crustaceans	(34)	1.4
Isopoda	34	
Arthropods unidentified	(79)	3.2
Total arthropods	2,484	100.0

Owls are rodents (73.5% of total items). In addition, it can be seen that rodents weighing around 158 g or more as adults tend to be consumed only as juveniles, thus rendering a marked underrepresentation of adults of those species in the sample (i.e. *Abrocoma bennetti, Octodon degus, Rattus rattus*). This is probably related to the inability of the Burrowing Owl to kill and handle prey above some critical weight limit. If we estimate that juveniles were half as heavy as the adults of these species, then the upper

TABLE 2. Vertebrate prey of the Burrowing Owl in central Chile. Common names of prey species are reported by Jaksić and Yáñez (1979) and Jaksić et al. (1980). Weights of adult small mammal species are taken from Glanz (1977). Figures are minimal number of prey in the pellets, as estimated by half the number of jaws found.

	Weight (g)	Juveniles	Adults	Total	%
Rodents	—	—	—	(498)	73.5
Abrocoma bennetti	219	10	0	10	
Akodon longipilis	76	8	14	22	
Akodon olivaceus	40	26	80	106	
Octodon degus	230	90	7	97	
Oryzomys longicaudatus	45	22	64	86	
Phyllotis darwini	66	24	100	124	
Rattus rattus	158	5	0	5	
Unidentified	—	—	—	48	
Lagomorphs	—	—	—	(3)	0.4
Oryctolagus cuniculus	1,300[a]	3	0	3	
Marsupials	—	—	—	(12)	1.8
Marmosa elegans	40	1	11	12	
Anurans	—	—	—	(90)	13.3
Bufo chilensis	—	—	—	48	
Pleurodema thaul	—	—	—	42	
Passeriforms	—	—	—	(29)	4.3
Unidentified	—	—	—	29	
Lacertilians	—	—	—	(1)	0.1
Liolaemus fuscus	—	—	—	1	
Vertebrates unidentified	—	—	—	(45)	6.6
Total vertebrates	—	—	—	678	100.0

[a] See text for discussion.

weight limit should be around 115 g (half the weight of *Octodon degus*). In fact, this seems to be an overestimation, as we have been able to calculate a mean body weight of 85 g for *Octodon degus* in the pellets (based on craniometric dimensions; see Jaksić and Yáñez 1977).

Perhaps more interesting than the above phenomenon is the fact that adults of small rodent species occur more often in the diet of the Burrowing Owl than the corresponding juveniles (see Table 2). This could be accounted for by three hypotheses: (1) juvenile rodents are more completely digested by the Burrowing Owl, thus rendering more difficult their detection in the pellets; (2) juvenile rodents are relatively scarcer than adults in the study area; and (3) adult rodents are preyed upon preferentially. We have good reasons for not accepting the first explanation, because we detected more juvenile than adult small rodents in a sample of pellets of Burrowing Owls from northern Chile (Péfaur et al. 1977). The second explanation is the least likely, because it is a well known ecological fact that juveniles in non-declining populations always outnumber the adults. This is undoubtedly so for central Chile rodents (Fulk 1975, see also Péfaur et al. 1977) and has been shown to hold true in areas adjacent to La Dehesa (Jaksić and Yáñez 1978, Le Boulengé and Fuentes 1978). The third explanation suggests that juveniles of small rodents tend to be skipped by the Burrowing Owl, as it preys relatively more heavily upon the corresponding adults. Although this hypothesis is supported by field data (Jaksić et al. 1977, Péfaur et al. 1977), other ecological factors could also generate the same pattern. For example, behavioral differences between age classes within rodent species (e.g. in microhabitat selection, in activity patterns) might well render juveniles less susceptible to attack by the Burrowing Owl. More research is badly needed on this subject [see Jaksić and Yáñez (1979) for a discussion about relations between activity patterns of central Chile rodents and predation by the Barn Owl (*Tyto alba*)]. At any rate, we are reasonably sure that the problem is not that juveniles of small rodents grow so fast that for our standards they become adults too soon, and thereafter are no longer considered to be juveniles. Data of Fulk (1975), and of Le Boulengé and Fuentes (1978) show that adult size in central Chile rodents is not attained until 1 yr following the start of the reproductive season (August–September). Because our study was conducted between August 1973 and April 1974, we found juvenile-sized rodents in the pellets throughout the period.

Similar trends can be seen in the consumption of lagomorphs and marsupials. On the one hand, the European rabbit, a very large-sized prey for the Burrowing Owl, is eaten only as a juvenile. The same situation was noted by Thomsen (1971), regarding predation by the Burrowing Owl upon jack rabbits, and by Marti (1974), regarding predation upon cottontail rabbits. The three rabbits detected in the pellets from central Chile were kittens about 80 g, as judged from skull size. On the other hand, the rather small-sized Caenolestid marsupial, *Marmosa elegans,* is preyed upon mainly in its adult size, a situation closely resembling that exhibited in regard to the rodent, *Akodon olivaceus,* of similar weight. Whether this apparent selection for an optimal size by the Burrowing Owl involves a compromise between pursuing cost and caloric value of differently sized prey, differences in their relative availability, or both, is an open question.

Generally speaking, our results on the diet of the Burrowing Owl in central Chile are comparable to those reported in North America (Coulombe 1971, Thomsen 1971, Marti 1974). We cannot establish further parallels, however, because previous studies have not separated small mammal prey into juvenile and adult categories. As a conclusion of our study, we may state that the Burrowing Owl in central Chile behaves as a generalist feeder, eating prey items ranging in weight from a few milligrams to around 85 g. Regarding arthropods, it seems to feed on them opportunistically. The situation with small mammals is more complicated: there is an upper limit for prey-size eaten, probably dependent on the handling abilities of the Burrowing Owl, and there also seems to be a lower limit, the ultimate cause of which needs to be further investigated.

We thank Harry W. Greene and Oliver P. Pearson for valuable criticisms.

Literature Cited

Bond, R. M. 1942. Food of the Burrowing Owl in western Nevada. Condor 44: 183.

Coulombe, H. N. 1971. Behavior and population ecology of the Burrowing Owl, *Speotyto cunicularia,* in the Imperial Valley of California. Condor 73: 162–176.

Errington, P. L., & L. J. Bennett. 1935. Food habits of Burrowing Owls in northwestern Iowa. Wilson Bull. 47: 125–128.

Fulk, G. W. 1975. Population ecology of rodents in the semiarid shrublands of Chile. Occ. Pap., Mus. Texas Tech Univ. 3: 1–40.

Glanz, W. 1977. Small mammals. Pp. 232–237 *in* Chile-California mediterranean scrub atlas: A comparative analysis (N. J. W. Thrower and D. E. Bradbury, Eds.). Stroudsburg, Pennsylvania, Dowden, Hutchinson, and Ross.

JAKSIĆ, F. M., & J. L. YÁÑEZ. 1977. Estimación de edad y relaciones biométricas en *Octodon degus* (Molina, 1782). Medio Ambiente (Chile) 3: 74–77.

———, & ———. 1978. Variación anual de la composición comunitaria de micromamíferos en Los Domínicos, Santiago. Noticiario Mensual, Museo Nacional Historia Natural (Chile) 23: 10–11.

———, & ———. 1979. The diet of the Barn Owl in central Chile and its relation to the availability of prey. Auk 96: 619–621.

———, ———, & R. P. SCHLATTER. 1980. Prey of the Harris' Hawk in central Chile. Auk 97: 196–198.

———, ———, R. PERSICO, & J. C. TORRES. 1977. Sobre la partición de recursos por las Strigiformes de Chile central. Anales Museo Historia Natural Valparaíso (Chile) 10: 185–194.

JOHNSON, A. W. 1965. The birds of Chile and adjacent regions of Argentina, Bolivia, and Peru. Buenos Aires, Argentina, Platt Establecimientos Gráficos.

LE BOULENGÉ, E., & E. R. FUENTES. 1978. Quelques données sur la dynamique de population chez *Octodon degus* (rongeur hystricomorphe) du Chili central. Terre Vie 32: 325–341.

MARTI, C. D. 1974. Feeding ecology of four sympatric owls. Condor 76: 45–61.

PÉFAUR, J. E., F. M. JAKSIĆ, & J. L. YÁÑEZ. 1977. La alimentación de *Speotyto cunicularia* (Aves: Strigiformes) en la provincia de Coquimbo. Anales Museo Historia Natural Valparaíso (Chile) 10: 178–183.

SCHLATTER, R. P. 1976. Aves observadas en un sector del Lago Riñihue, Provincia de Valdivia, con alcances sobre su ecología. Boletín Sociedad Biología Concepción (Chile) 50: 133–143.

———. 1979. Avances de la ornitología en Chile. Archivos Biología y Medicina Experimentales (Chile) 12: 153–168.

SPERRY, C. C. 1941. Burrowing Owls eat Spadefoot Toads. Wilson Bull. 53: 45.

THOMSEN, L. 1971. Behavior and ecology of Burrowing Owls on the Oakland municipal airport. Condor 73: 177–192.

YÁÑEZ, J. L., & F. M. JAKSIĆ. 1979. Predación oportunista de *Speotyto cunicularia* en el norte chico (Aves: Strigiformes). Noticiario Mensual, Museo Nacional Historia Natural (Chile) 272 (in press).

Received 28 September 1979, accepted 14 November 1979.

Breeding Strategies of Male Yellow-headed Blackbirds: Results of a Removal Experiment

ALLEN T. RUTBERG AND SIEVERT ROHWER
Department of Zoology and Washington State Museum, University of Washington, Seattle, Washington 98195 USA

A male's behavior toward a female and her offspring should depend in part on the probability that he fathered the offspring. Alexander (1974: 331) and others have pointed out the correlation between high confidence of paternity and evolution of male parental investment; without confidence of paternity, males will show neutral behavior, at best, toward females and their offspring. In more extreme cases, males kill immature offspring of other males to gain or hasten reproductive access to the mother, as in lions (Schaller 1972) and other species of mammals, particularly primates (reviewed in Blaffer Hrdy 1979). However, infanticide associated with male reproductive strategies has never, to our knowledge, been reported among birds, in spite of at least one experiment appropriate to discover it (Power 1975).

By means of a removal experiment we investigated the effects of paternity confidence on male behavior toward females and offspring in the Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*). Yellowhead males defend marsh territories during the breeding season and are frequently polygynous. They also make numerous feeding trips for young and mob or attack some potential nest predators, particularly gulls and Long-billed Marsh Wrens (*Telmatodytes palustris*) (Willson 1966; pers. obs.).

We expected several differences in behavior between replacement males and control males. Assuming that males can distinguish between fostered nests and their own, the minimal response of replacement males should be a low investment in eggs and nestlings that were conceived prior to removals; in particular, the effectiveness of guarding should be reduced (resulting in differential rates of nest failure), and effort devoted to the feeding of young should either be reduced or transferred to nestlings conceived