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Diets and selectivity of two Chilean predators in the northern semi-arid zone

Hábitos alimenticios y selectividad de dos depredadores chilenos en la zona semiárida nortina

PETER L. MESERVE, EDWARD J. SHADRICK, and DOUGLAS A. KELT

Department of Biological Sciences, Northern Illinois University, DeKalb, Illinois 60115-2861, USA

ABSTRACT

The diets of two common Chilean predators, the culpeo *(Dusicyon culpaeus),* and the Burrowing Owl or pequén *(Athene cunicularia)* were analyzed by identification of the contents of 53 scats, and 19 pellets, respectively, collected during June 1985 in Parque Nacional Fray Jorge, Coquimbo Province (IV Región), Chile. Small mammals made up the majority of prey items for both predators. Comparisons of proportions of identified small mammal prey remains with availability of small mammals in the semi-arid thorn scrub community as determined by snap-trapping indicated strong selectivity for some prey species. Skulls and teeth of the degu *(Octodon degu),* and the chinchilla rat *(Abrocoma bennetti)* were significantly overrepresented in the scats/pellets of both predators. This indicates that certain prey types may be more common in predator diets due to attributes such as body size and/or their vulnerability in the natural community. Although European hares *(Lepus capensis)* are present in the park, no remains were found in the scats/pellets of either predator. Small mammals in this community are significantly smaller than their counterparts in central mediterranean scrub communities: since they are still utilized, other aspects such as time of activity may influence incorporation into predator diets.

Key words: *Athene cunicularia, Dusicyon culpaeus,* predators, small mammals, predator diets, Chile, mediterranean ecosystems.

RESUMEN

Las dietas de dos depredadores comunes en Chile, el culpeo *(Dusicyon culpaeus)* y el pequén *(Athene cunicularia)* fueron analizadas por identificación de los contenidos de 53 fecas y 19 regurgitados (respectivamente) colectadas en junio de 1985 en el Parque Nacional Fray Jorge (IV Región). Los micromamíferos constituyeron la mayoría de las presas de ambos depredadores. Comparaciones entre las proporciones de micromamíferos en las dietas y en el terreno (estas últimas determinadas por trampeos de remoción en la comunidad arbustiva espinosa del área), indicaron fuerte selectividad de los depredadores por ciertas presas. Los cráneos y mandíbulas de degus *(Octodon degus)* y ratas chinchilla *(Abrocoma bennetti)* estaban significativamente sobrerrepresentadas en las fecas y regurgitados de ambos depredadores. Esto indica que ciertos tipos de presas pueden ser más comunes en las dietas de depredadores en relación a atributos tales como tamaño corporal o vulnerabilidad de las presas. Aunque las liebres europeas *(Lepus capensis)* estaban presentes en el Parque, no se encontraron restos de ellas en las fecas y regurgitados de ninguno de los depredadores. Los micromamíferos en esta comunidad semiárida del norte son significativamente más pequeños que aquellos en la comunidad de matorral de Chile Central. Considerando que pese a su pequeño tamaño son utilizados como presas en el norte, aspectos tales como su período de actividad pueden influir en su incorporación a las dietas de los depredadores.

Palabras claves: *Athene cunicularia; Dusicyon culpaeus,* depredadores, micromamíferos, dietas, Chile, ecosistemas mediterráneos.

INTRODUCTION

Various recent studies have emphasized the need for additional studies on patterns of predation in Southern Hemispheric areas *(e.g.* Jaksić & Yáñez 1979, Jaksić *et al.* 1981, Jaksić & Ostfeld 1983). These and other studies have suggested that predators may be particularly important in some communities such as the mediterranean scrub which is characteristic of much of central Chile. In order to make

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generalizations about the relative importance of a biological interaction in structuring communities however, it is necessary to have a corroborative body of evidence gathered from as many independent sources as possible. Most reports about the diets and selectivity of Chilean predators, for example, have come from central Chile close to the capital city of Santiago. However, Fulk (1976) and Péfaur *et al.* (1977) reported on the diets of three, strigiformes, the Burrowing Owl or pequén *(Athene cunicularia* [= *Speotyto cunicularia]), the* Short-eared Owl *(Asio flammeus),* and the Barn Owl *(Tyto alba),* in northern Chile which differed considerably from those reported by Jaksić, Yáñez (1979), and Jaksić *et al.* (1981) for owls from central Chile. Similarly, Simonetti *et al.* (1984) and Durán *et al.* (1987) reported on diets of Chilean foxes. *Dusicyon griseus* and *D. culpaeus (= Canis griseus* and *C. culpaeus)* in northern Chile; the results of the former study differed considerably from those of Yáñez, Jaksić (1978) and Jaksić *et al.* (1980) while the results of the latter were broadly similar. This probably reflects differing availabilities of prey in the two regions, but represents at least independent tests of the degree of selectivity exhibited by predator species. At the same time, it is essential to have estimates of prey availability in the environment in order to assess the availability of prey items to important predators. Too often, such estimates are not available or are taken inappropriately.

Herein, we report on preliminary results obtained from the analysis of a small sample of pellets and scats collected concurrently with data on small mammal abundances in a semi-arid thorn scrub community on the northern fringe of the mediterranean zone. We compare the relative proportions of the small mammals in the diets and in the community, as well note differences and similarities with results reported for the same predators in other, more central mediterranean scrub communities in Chile.

STUDY SITE AND METHODOLOGY

The area of scat/pellet collection and small mammal sampling was in "Quebrada de las Vacas" (200 m elevation) located on the east side of the coastal range (500 m elevation) in Parque Nacional Fray Jorge (71°40'W. 30°38'S.; Chile: IV Region [Coquimbo Province]). The vegetation in this region has been previously described *(e.g.* Muñoz & Pisano 1947, Meserve 1981, Meserve *et al.* 1984) and can be generally characterized as semi-arid thorn scrub with a mixture of spiny drought-deciduous and evergreen shrubs. Precipitation is generally low ($\bar{X}$ = 68.9 ± 78.5 mm [SD]), but highly variable between years, and predominantly in cool winter months (90% between May and September; Meserve & Le Boulengé *in press).*

Scats and pellets were collected on 14 June 1985 along approximately 3 km of a dirt road running NW-SE along the valley floor. Samples were individually bagged and labeled and later dried at 30°C. The scats analyzed were those of the culpeo *(Dusicyon culpaeus)* which was seen frequently during the collection period and the previous three days. Park personnel indicated that individuals of the smaller chilla *(D. griseus)* are extremely rare, and none were seen during our stay in the park. The pellets were collected outside of two active holes of Burrowing Owls or pequén *(Athene cunicularia)* along the roadside, and individuals were occasionally seen during our stay. Since the most recent significant rainfall was in early July 1984, the culpeo scats probably represented an accumulation over the previous 11 months, although fresh scats were more frequent and older scats often did not contain skeletal remains due to the action of numerous carabid beetles observed during the collection period. The pequén pellets appeared to have been cast much more recently, probably within the previous two months; numerous partially broken pellets were evident, but were not utilized in this analysis. After desiccation, scats and pellets were dissected and the presence of insect parts, bones, teeth, hair, or feathers noted. Crainia, mandibles, and teeth of small mammals were separated and identified using a reference collection of skulls from animals obtained in the vicinity of the study area. The number of individuals contained in scats or pellets was determined by reconstructing tooth rows in order to estimate the minimum number of individuals present in a given sample based on non-replicated teeth.

Small mammal sampling was conducted in the surrounding vegetational community for three nights and two days between 11-14 June 1985; a line of 50 Museum Special snap traps set in 25 pairs approximately 10 m apart was utilized. Traps were baited with rolled oats or carrots, and checked each morning and late afternoon. All specimens collected were prepared as study skins, skulls, and skeletons. Data from this sampling effort was used to assess small mammal abundance in the surrounding community. Since previous work had shown that larger rodents such as *Octodon degus* and *Abrocoma bennetti* may be seriously underrepresented when only smaller Museum Special snap traps are used for sampling, we have also utilized results from more intensive earlier sampling conducted throughout the year during 1974-1976 in which larger Victor 4-way traps were also employed (Meserve & Le Boulengé *in press).* These results provide a reference point for comparing other small mammal abundances between the two time periods. We have standardized small mammal abundances to number/100 trap-nights of effort to facilitate comparisons with different trapping efforts. While it is recognized that prey remains contained in pellets/scats up to 11 months old may represent varying degrees of predator selectivity perhaps influenced by fluctuating small mammal abundances over time, we assume that summing them together gives an overall view of predator diet that is useful in comparison with similar time scales of trapping data.

RESULTS AND DISCUSSION

The results of the scat and pellet analysis are presented in Table 1. *Athene cunicularia* was notable in consuming considerable numbers of small mammals even though the sample size is small. Fully 84% of the pellets of this species contained at least some small mammal remains as compared to 42% with insect parts. This contrasts markedly with figures for other areas in which between 70% and 96% of the pellets contain insects and other invertebrates (Jaksić & Marti 1981). However, Péfaur *et al.* (1977, 1979) also reported finding *A. cunicularia* pellets to contain only small mammals and no insects or other invertebrates near Ovalle, Coquimbo Province, Chile. Many of the small mammal remains in *Athene* pellets in Fray Jorge were non-cranial parts and lacked teeth, thus accounting for their lower identifiability, and suggesting that single prey may be utilized for several meals or only partially eaten at any one time.

TABLE 1

Summary of contents of *Athene cunicularia* pellets and *Dusicyon culpaeus* scats collected in Parque Nacional Fray Jorge in June 1985.

Resumen de contenidos de regurgitados de *Athene cunicularia* y fecas de *Dusicyon culpaeus* colectados en el Parque Nacional Fray Jorge, en junio de 1985.

	Athene cunicularia	*Dusicyon culpaeus*
Number of pellets/scats	19	53
Number containing only insects	3	0
Number containing some insects	5	1
Number containing small mammals	16	53
Number of small mammal individuals	29	68
Number of identified small mammals	17	50

Prey remains in *Dusicyon culpaeus* scats were almost entirely those of small mammals (Table 1). Only one scat contained insect parts and none had feathers, scales, or parts of other vertebrates. This parallels the predominance of mammals in the diets of culpeos reported elsewhere (Fuentes & Jaksić 1979, Jaksić *et al.* 1981, Durán *et al.* 1987), but no remains of hares (*Lepus capensis*) were found even though this species is fairly abundant in the park (Schamberger & Fulk 1974); the rabbit *(Oryctolagus cuniculus)* is apparently absent within the park boundary (Schamberger & Fulk 1974).

A comparison of numbers of identified small mammals found in owl pellets and fox scats with those determined from trapping in the vegetational community yielded some interesting trends (Table 2). For example, although there were some differences in proportions of less abundant species between years, either *Akodon olivaceus* or *Phyllotis darwini* was the most common small mammal in each year, and total numbers of individuals/100 trap-nights varied relatively little between years. Schamberger & Fulk (1974) reported a similar predominance of these two species in trapping in the

semi-arid scrub community of Fray Jorge in 1972. In comparisons of small mammal abundances with pellet/scat results using X^2 goodness of fit tests, it was necessary to sum frequencies of most smaller *(i.e.* < 80 g) nocturnal rodents *(i.e. Akodon longipilis, Oryzomys longicaudatus, Phyllotis darwini,* and *Marmosa elegans),* and those of *Octodon degu* + *Abrocoma bennetti* in order to maintain minimum expected cell frequencies (Siegel 1956). The degu and *Abrocoma bennetti* were significantly over-represented in owl pellets for 1985 only, and in fox scats for both sets of trapping data *(i.e.* 1974-1976, and 1985; $P < 0.001$; $X^2 = 13.42$, 2 df; Table 2). Many of the degus appeared to be younger individuals (< 6 months old and approximately 80-120 g; Meserve *et al.* 1984, Meserve & Le Boulengé *in press)* especially in the pellets of *A. cunicularia.* Since breeding had not yet begun, these prey individuals were born no later than the previous summer (November-December) in this seasonally reproducing species (Meserve *et al.* 1984). Finally, it should be noted that two relatively rare semi-fossorial species, *Spalacopus cyanus* and *Notiomys megalonyx,* were not recorded in the pellets/scats of either predator although present in the park (Pine *et al.* 1979).

TABLE 2

Small mammal trapping result (number/100 trap-nights, and percentage of total catch in parentheses) and results of pellet/scat analysis for two predators in Parque Nacional Fray Jorge.

Resultados de trampeo de micromamíferos (número/100 trampas-noches, y porcentaje de la captura total entre paréntesis), y resultados del análisis de regurgitados/fecas para dos depredadores en el Parque Nacional Fray Jorge.

Species	Weight, g $\bar{x} \pm SD$ (N)	Trapping Results 1974-1976	1985	*Athene pellets*	*Dusicyon scats*
Akodon olivaceus	32.3 ± 5.3 (70)	3.35 (17.9)	13.33 (54.1)	3	0
Akodon longipilis	54.3 ± 8.8 (38)	2.60 (13.9)	2.00 (8.1)	1	0
Oryzomys longicaudatus	24.4 ± 3.0[1] (14)	0.95 (5.1)	0.67 (2.7)	3	1
Phyllotis darwini	58.2 ± 13.7 (124)	7.44 (39.7)	5.33 (21.6)	3	0
Marmosa elegans	22.6 ± 9.5[1] (5)	0.37 (2.0)	0	0	0
Octodon degus	140.9 ± 20.9 (46)	3.98 (21.3)	3.33 (13.5)	6	37
Abrocoma bennetti	201.2 ± 46.1[1] (12)	0.03 (0.2)	0	1	12
		18.72	24.66	17	50

[1] includes data from live-trapped individuals

With respect to the evidence for strong selection for certain prey types and sizes among these two predators, it should be noted that body sizes of small mammals in Fray Jorge are considerably smaller than those reported by Glanz (1977) and Jaksić *et al.* (1981) for central Chilean populations (Table 2). For example, body sizes of *Akodon olivaceus, A. longipilis, Oryzomys longicaudatus, Abrocoma bennetti* and *Octodon degus* collected in 1973-1975 averaged 23, 40, 97, 9, and 63 percent smaller, respectively, than those reported in Jaksić *et al.* (1981) even when only adult animals were considered (defined as individuals greater than 20 g for the first three species above, and greater than 120 g for the two caviomorphs). However, Jaksić *et al.* (1981) followed Glanz's (1977) procedure in which the 10 largest

individuals were utilized to calculate mean body sizes; when a similar procedure is used for Fray Jorge individuals, the differences are considerably less (*i.e.* 7, 19, 76, 1, and 32 percent smaller, respectively, for the species listed above).

Interestingly, although the mean size for all *Phyllotis darwini* captured in Fray Jorge is about 13 percent less than Glanz's (1977) and Jaksić *et al.* 's (1981) figure, the size of the ten largest individuals is 30 percent *greater* than their figures. Recently, Iriarte & Jaksić (pers. comm.) recalculated mean body sizes for central Chilean small mammals based on live-trap results; their mean body weights are still considerably higher than those listed in Table 2 except for *Phyllotis darwini* whose body weights are very similar for central and northern Chilean representatives (*i.e.* $\bar{X}$ = 61.5, and 58.2 g, respectively). Fulk (1975) and Péfaur *et al.* (1979) reported similar body sizes to those reported in Table 2 for *A. olivaceus, P. darwini,* and *O. longicaudatus* in Fray Jorge and elsewhere in Coquimbo Province. Animals caught in June 1985 during the time of the pellet/scat collection were even smaller for all above species except *A. longipilis* reflecting the impact of drought-related desiccation and seasonal acclimatization as shown by Meserve (1978). Thus, the spectrum of prey sizes available to predators is considerably different in Fray Jorge and probably in other northern semi-arid areas as compared to those in central Chile. There are virtually no mammalian prey available above 200 g except for *Abrocoma bennetti* which is rare, and the lagomorphs which are not present/utilized by these predators. Virtually no *Octodon degus* was captured over 200 g even though this is well below the average weight indicated for central Chilean degu populations (Jaksić *et al.* 1981). A calculation of mean small mammal prey size utilizing the method of Jaksić *et al.* (1980) yields a mean of 85.0 + 58.5, g (SD), and 153.0 + 31.9 g for the pequen and culpeo, respectively, in Fray Jorge. The former is somewhat higher than figures reported in Jaksić *et al.* (1981) for the pequén, but the latter is substantially smaller (*i.e.* 43-184 g) than those for the culpeo in central Chile (Jaksić *et al.* 1980, 1981).

Interestingly, Fuentes & Jaksić (1979) have shown the presence of a latitudinal cline in body sizes of *D. culpaeus* with the smallest individuals present in the northernmost latitudes (although foxes from the latitude of Fray Jorge were not examined). While it is suggested that body size divergence in the culpeo and the macrosympatric *D. griseus* represents a form of resource partitioning in southern areas where altitudinal habitat partitioning is not possible, it also seems feasible that smaller body size particularly in *D. culpaeus* may be a regional response to the smaller spectrum of prey sizes available to such predators. Chillas although much rarer than the culpeo in Fray Jorge are present and do not appear to exhibit the strong altitudinal separation proposed by Fuentes & Jaksić (1979). Simonetti *et al.* (1984) reported *Dusicyon griseus* diets at a site approximately 530 km N Fray Jorge (30 km N Chañaral; 700 m elevation); chillas here consumed primarily *Phyllotis darwini* and other smaller rodents as well as a variety of invertebrates and plants. Thus, chillas are not in fact absent from higher elevations nor from lower ones such as in Fray Jorge. The explanation of the smaller size of the culpeo in more northernly latitudes thus may have a more parsimonious explanation than the one proposed by Fuentes & Jaksić (1979).

Finally, although *A. cunicularia* appears to have a more generalized diet as compared to that of *D. culpaeus* here, both species are utilizing larger bodied (*i.e.* > 80 g) diurnal and nocturnal caviomorph rodents (*O. degus,* and *A. bennetti,* respectively) more frequently than expected. Since *A. cunicularia* is primarily diurnal in hunting activity (Coulombe 1971, Jaksić & Marti 1981), it is perhaps surprising that a number of nocturnal to crepuscular (*cf.* Jaksić *et al.* 1981) small mammals are utilized at all (*e.g. Akodon olivaceus, A. longipilis, Phyllotis darwini,* and *Oryzomys longicaudatus).* Significantly, Fulk (1975) reported that *A. olivaceus* demonstrated considerable diurnal activity in Fray Jorge. Further, the predominance of small mammals in the diet of this owl as indicated by this albeit small sample is at odds with the previously reported importance of insects in pequén diets (Jaksić & Marti 1981), but agrees with those of Péfaur *et al.* (1977, 1979) for owls in the northern semi-arid zone. Schlatter *et al.* (1980) noted the presence of many younger degu in the small

mammal portions of pequén diets in central Chile; in Fray Jorge, such individuals would range between 80-120 g in body weight based on known growth rates and times of last reproduction (Meserve & Le Boulengé *in press).* Significantly, perforate females have been recorded at 127 g (Meserve & Le Boulengé *in press)* suggesting sexual competency at relatively low body weights for degu in northern Chile. Fulk (1976) reported that the nocturnal *Tyto alba* and diurnal/crepuscular *Asio flammeus* consumed mostly nocturnal small mammals including *Abrocoma bennetti,* but few diurnal *Octodon degus* in Fray Jorge; based on Fulk's (1976) description of pellet collection sites, however, it appears that most of the pellets may have been those of *T. alba* (F. M. Jaksić, pers. comm.). *T. alba* in central Chile consume more diurnal degu as well as *Abrocoma* (Jaksić *et al.* 1981).

In conclusion, we have noted a number of similarities and differences in the feeding patterns of two widespread Chilean predators in both the central mediterranean and northern semi-arid zone communities, and the presence of major differences in the spectrum of prey body sizes available to them. *Octodon. degus* is not numerically the most abundant small mammal in the community except at times of peak recruitment, but it can make up 50-80% of the small mammal biomass (Meserve & Le Boulengé *in press).* The presence of some noteable similarities in predator diet composition in different communities populated by the same prey species with different body sizes suggest that other features of the prey may be more crucial to their utilization by predators —such as time of activity and vulnerability in the vegetational community. Thus, caution should be used in generalizing about regional patterns of predator-prey relationships based purely on body size relations without adequate documentation studies.

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Examples of animals hunted in the semi-arid northeastern region of Brazil. A: Euphractus sexcinctus, B: Conepatus semistriatus, C: Skin of Leopardus tigrinus, D: Puma yagouaroundi, E: Icterus jamacaii, F: Paroaria dominicana, G: Tupinambis merianae and H: Boa constrictor (Photos â€“ A, B, G, H: Washington Vieira; C, D, E: LÃvia MendonÃ§a and F: HÃ©lder AraÃºjo).Â To use this calling technique, the hunter will walk through the forest until he hears the singing of a bird and he will follow the sound while at the same time trying to call the bird in with the "arremedo". Figure 4. Whistles used by hunters in the semi-arid region of Paraiba State, Brazil. These two studies reported that maximum fruit consumpt i on occurrs bet ween Apri l and August, a period of low availability of animal prey. The phytochemical database (2001) report s t hat peppert rees cont ai n t anni ns, alkaloids, flavonoids, steroidal saponins, sterols, terpenes, gums, and essential oils, while their fruits are rich in triterpenes, sesquiterpenes and monoterpenes (see also Cipollini 2000).Â MESERVE PL, EJ SHADRICK & DA KELT (1987) Diet and selectivity of two Chilean predators in the northern semi-arid zone. Revista chilena de Historia Natural 60: 93-99. MILLER S & J ROTTMANN (1976) Gua para el reconocimiento de mamferos chilenos. First, four specimens from two localities (Rio Lluta and Quebrada Parca) in the Tarapaci Re-. 380. THE WILSON.Â Fed., Washington, D.C. MESERVE,P. L., E. J. SHADRICK, AND D. A. KELT. 1987. Diets and selectivity of two Chilean predators in the northern semi-arid zone. Revista Chilena de Historia Natural 60: 93-99. Meyer de schauensee,r. 1982.