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Food habits of *Pseudalopex* foxes in the Atacama desert, pre-Andean ranges, and the high-Andean plateau of northernmost Chile

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Introduction

The foxes *Pseudalopex griseus* and *P. culpaeus* are distributed all along Chile, encompassing almost 40 latitudinal degrees that represent a variety of different ecosystems. Between 17-27°S in Chile, the Andean mountain ranges enclose a high plateau (> 4000 m elevation) locally known as puna ; farther south these branches merge and become a single rugged belt that gradually decreases in height from about 4000 m to sea level. Along the Pacific lowlands, the barren Atacama desert gives way southward to a sequence of thorn scrub shrublands, evergreen sclerophyllous shrublands, temperate evergreen rainforests, southern beech forests (both deciduous and evergreen), and to the Patagonian steppes.

Pseudalopex griseus is essentially distributed on the coastal lowlands (Fuentes and Jaksic 1979), but is also found deep into the river valleys that drain the pre-Andean ranges of northern and northernmost Chile (up to 3250 m elevation at least ; FMJ and LCC, pers. obs.). *Pseudalopex culpaeus* is distributed all along the Andes and on its outskirts (Fuentes and Jaksic 1979), but is also found on the high Andean plateau (Pearson and Ralph 1978 ; FMJ and LCC, pers. obs.), and in some coastal areas with rugged topography in north-central (Meserve *et al.* 1987 ; Jaksic *et al.* 1992), northern, and northernmost Chile (FMJ and LCC, pers. obs.).

Herein we provide quantitative information on the diet of *P. griseus* from coastal areas of the Atacama desert, on that of either *P. griseus* or *P. culpaeus* from pre-Andean valleys, and on that of *P. culpaeus* from the puna. This report is based on 563 faeces that yielded 1051 prey items. In addition, we report abundances and weights of their major potential prey, that is, the small mammals of this poorly known region.

Material and methods

Fox faeces were labeled by locality and date (Table 1), taken to the laboratory and carefully teased apart. Vertebrate prey was identified to the species level whenever possible, with a dissecting microscope, using existing keys (Hershkovitz 1962 ; Reise 1973) and voucher specimens locally collected. Invertebrates were identified to ordinal level only. The minimum number of individual prey present in faeces was estimated based on the number of known double or single anatomical elements such as crania, mandibles, teeth rows, beaks, feet, elytra, antennae, stings, etc. Small mammal occurrence and abundance was assessed by means of trapping lines and grids consisting of Sherman and Tomahawk live traps (Table 1).

Vegetation at the two coastal sites (Table 1) was on sandy soil, and dominated by tall shrubs of *Tessaria absinthioides* and patchily covered by a herb layer of *Distichlis* sp. Vegetation at the seven pre-Andean sites (Table 1) was mixed, with the shrub *Parastrephia lepidophylla* dominating on sandy soils on flat areas (without a herb layer), and with the dwarf shrubs *Fabiana* sp., *Chuquiraga rotundifolia,* and *Baccharis boliviensis* dominating on rocky slopes, together with a scant cover of *Festuca* sp. bunchgrasses. Vegetation at the five high-Andean sites (Table 1) was similar : alternately dominated by dwarf shrubs of *Parastrephia lucida, P. lepidophylla,* or *Baccharis santelices,* together with bunchgrasses of *Festuca orthophylla,* with interspersed cushions of *Pycnophyllum molle, Azorella compacta, Werneria weddelli* and *W. aretioides.*

Results and discussion

Coastal *P. griseus* were characterized by preying extensively on seabirds *(Pelecanus occidentalis)* and crustaceans, although their primary prey was mammals (Table 2).

TABLE 1. – Faeces of *Pseudalopex* foxes collected in different localities of northernmost Chile. Distances from the city of Arica are by road.

Feces of:	Locality	Elevation	Latitude, Longitude	Dist. Arica	Collected	Traps X nights
P. griseus						
47	Camarones Mouth	<10 m	19º 12' S; 70º 16' W	105 km S	Feb. 1988	48 X 2 = 96
29	Camarones Mouth	<10 m	19º 12' S; 70º 16' W	105 km S	Jan. 1990	48 X 3 = 144
47	Quiuña	750 m	19º 31' S; 70º 02' W	140 km S	Jan. 1990	56 X 1 = 56
Pseudalopex sp.						
3	Timar	2500 m	18º 44' S; 69º 41' W	155 km SE	Feb. 1988	n.d. *
19	Belén-Lupica	3100 m	18º 29' S; 69º 33' W	109 km E	Dec. 1988	n.d.
97	Belén	3240 m	18º 28' S; 69º 31' W	108 km E	Dec. 1988	n.d.
23	Zapahuira	3360 m	18º 20' S; 69º 36' W	77 km E	Feb. 1988	32 X 4 = 128
36	Zapahuira	3360 m	18º 20' S; 69º 36' W	77 km E	Dec. 1988	87 X 4 = 348
26	Pampa Oxaya	3450 m	18º 36' S; 69º 36' W	210 km SE	Feb. 1988	n.d.
5	Putre	3500 m	18º 11' S; 69º 33' W	112 km E	Feb. 1988	n.d.
46	Patapatane	3780 m	18º 06' S; 69º 41' W	110 km E	May 1990	96 X 5= 480
P. culpaeus						
6	Tacora	4100 m	17º 46' S; 69º 43' W	156 km E	Jan. 1990	96 X 5 = 480
2	Surire	4245 m	18º 50' S; 69º 09' W	200 km E	Jan. 1990	96 X 5 = 480
21	Las Cuevas	4450 m	18º 10' S; 69º 25' W	132 km E	Jul. 1987	96 X 5 = 480
33	Las Cuevas	4450 m	18º 10' S; 69º 25' W	132 km E	Nov. 1987	n.d.
120	Ancachalloane	4500 m	18º 10' S; 69º 20' W	180 km E	Oct. 1989	n.d.
3	Japu-Milluni	4320 m	18º 24' S; 69º 16' W	130 km E	Feb. 1988	202 X 4 = 808

* No data collected.

This result is not surprising as these foxes were often seen searching for marine organisms along the coastline (PAM and LCC, pers. obs. ; see also Mann 1945, 1950). The presence of *Akodon olivaceus* and *Rattus rattus* among mammalian prey in the diet was not unexpected, as they were captured in traps (Table 2). *Cavia tschudii*, although frequently sighted by us, was not trapped because our grids were not placed on the dense riparian areas inhabited by cavies (Pine *et al.* 1979). Coastal foxes apparently selected cavies as prey, judging from their high incidence in the diet (Table 2). *Although Marmosa elegans* and *Mus musculus* were trapped in the coastal sites (Table 2), they were

TABLE 2. – Percent numerical representation of prey in the diet of *Pseudalopex* foxes, and percent trapping success (number of mammals captured with a given trapping effort, expressed as number of traps times nights operated) in northernmost Chile. Subtotals for prey classes are in parentheses.

PREY CATEGORIES	WEIGHT (G) X±SD (N)	P. griseus COASTLINE	Pseudalopex PRE-ANDES	P. culpaeus HIGH PLATEAU	Mammals COASTLINE	Mammals PRE-ANDES	Mammals HIGH PLATEAU
Mammals		(44.8)	(91.7)	(52.2)			
Abrocoma cinerea	n.d.*	0.0	5.1	2.6	0.0	0.0	0.0
Akodon albiventer	18.7± 5.0 (10)	0.0	0.4	1.1	0.0	0.6	1.6
Akodon andinus	16.4± 2.6 (10)	0.0	0.4	2.0	0.0	0.1	0.2
Akodon albiventer or andinus	n/a **	0.0	1.8	2.6	n/a	n/a	n/a
Akodon olivaceus	18.0± 3.6 (3)	0.7	0.0	0.0	3.4	0.0	0.0
Andinomys edax	42.3± 7.5 (3)	0.0	16.3	0.2	0.0	0.0	0.0
Auliscomys boliviensis	35.5± 10.6 (7)	0.0	9.7	3.3	0.0	0.0	0.3
Auliscomys sublimis	n.d.	0.0	9.9	0.0	0.0	0.0	0.1
Calomys lepidus	13.8± 3.9 (10)	0.0	0.0	0.0	0.0	0.0	0.6
Cavia tschudii	n.d.	14.0	0.0	0.0	0.0	0.0	0.0
Chenomys gyrinus	188.0±110.6 (3)	0.0	0.0	2.4	0.0	0.0	0.0
Eligmodontia typus	18.8± 9.7 (10)	0.0	3.1	1.8	0.0	0.1	1.3
Laxidium viscacia	1940.0±433.5 (5)	0.0	2.9	3.1	0.0	0.0	0.0
Marmosa elegans	29.5± 2.1 (2)	0.0	0.0	0.0	0.3	0.0	0.0
Microcavia niata	255.2± 40.5 (5)	0.0	0.0	0.0	0.0	0.0	0.0
Mus musculus	15.5± 4.1 (10)	0.0	0.0	0.0	1.0	0.0	0.0
Neotomys ebriosus	51.2± 16.9 (4)	0.0	0.0	0.0	0.0	0.0	0.0
Octodontomys gliroides	129.3± 24.7 (4)	0.0	1.8	0.2	0.0	0.1	0.0
Phyllotis darwini	24.3± 8.1 (10)	1.4	31.1	16.7	0.0	1.6	0.7
Phyllotis magister	59.0-85.0***	0.0	0.2	1.8	0.0	0.0	0.0
Phyllotis darwini or magister	n/a	0.0	2.4	0.0	n/a	n/a	n/a
Rattus rattus	72.0± 31.4 (10)	0.7	0.0	0.0	1.0	0.0	0.0
Cricetidae: unidentified		9.8	3.5	4.2			
Rodentia: unidentified		12.6	2.0	9.3			
Felidae: Felis catus		0.7	0.0	0.0			
Camelidae: Lama or Vicugna		4.9	1.1	0.7			
Mammalia: unidentified		0.0	0.0	0.2			
BIRDS		(23.1)	(1.9)	(12.6)			
Bolborhynchus aurifrons		0.0	0.0	0.9			
Pelecanus occidentalis		21.0	0.0	0.0			
Furnariidae		0.0	0.2	1.1			
Fringillidae		0.0	1.1	0.7			
Passeriformes: unidentified		2.1	0.0	1.3			
Bird egg: unidentified		0.0	0.2	1.1			
Aves: unidentified		0.0	0.4	7.5			
REPTILES		(0.0)	(0.4)	(1.3)			
Philodryas cf. chamissonis		0.0	0.2	0.4			

not found among prey remains, but they were not particularly abundant either. Conversely, *P. darwini* was found among prey (Table 2), but was not trapped. Herbivory was apparent among coastal foxes (Table 2), represented by consumption of fruits of mainly *Schinus* sp., together with a few *Prosopis* sp.

Mountain *Pseudalopex* sp. were essentially mammal-eaters, taking very few birds, reptiles, insects, and arachnids (Table 2). Among mammals, they took primarily *Phyllotis darwini*, and secondarily *Andinomys edax*. The former species was the most com-

monly trapped as well, but the second was not trapped at all (Table 2), likely because we did not place traps at its favored habitat (rocky slopes bordering water courses and meadows ; see Hershkovitz 1962). All five species caught in traps were found among prey in the diet (Table 2). Mountain foxes, however, preyed on other six additional species not caught in traps. Of these, *Abrocoma cinerea* was relatively large-sized for our traps and may be trap-shy. Similarly, the traps used were too small for capturing the large-sized *Lagidium viscacia*. Herbivory among mountain foxes was very low (Table 2), represented by consumption of a fruit that we could not identify. As stated above, we are not sure whether the samples we collected belonged to *P. griseus*, *P. culpaeus*, or both combined.

Puna *P. culpaeus* preyed primarily on mammals and insects, although by biomass, birds were clearly more important than insects (Table 2). The most frequent mammal in the diet was *Phyllotis darwini*. Except for *Auliscomys sublimis* and *Calomys lepidus*, the remaining five species caught in traps were all found among puna foxes' prey (Table 2). Why the former two species were not preyed upon is unclear. Conversely, puna foxes preyed on six additional species not caught in traps. As already stated, our traps may have been too small for capturing *Abrocoma cinerea* and *Lagidium viscacia*, and were clearly inadequate for capturing the fossorial *Ctenomys opimus* (LCC, pers. obs.). However, the absence of the remaining three mammal species from our traps is more difficult to account for. Herbivory was relatively low (Table 2), and represented by consumption of an unidentified fruit.

Comparatively, coastal foxes differed from both mountain and puna foxes in preying on marine organisms. Mountain foxes were the most specialized in food habits, preying almost exclusively on small mammals. Puna foxes differed from the other two populations in preying more extensively on insects. Herbivory was most pronounced among coastal foxes, and least among mountain foxes. On account of their contributed biomass, all three fox populations may be said to rely on small mammals as their primary prey. They appeared to take all locally available mammals, except for a few puzzling exceptions.

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