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Comparative ecology of Darwin's fox (*Pseudalopex fulvipes*) in mainland and island settings of southern Chile

Ecología comparada del zorro de Darwin (*Pseudalopex fulvipes*) en situaciones continentales e insulares del sur de Chile

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ABSTRACT

Using comparable techniques we studied the abundance, habitat use, and diet of Darwin's fox (*Pseudalopex fulvipes*), as well as prey availability in two constrasting settings of southern Chile: on the mainland in the Nahuelbuta ranges, and in Chiloé Island. This fox lives in sympatry with its congener *P. griseus* in Nahuelbuta, but is the sole fox on Chiloé Island. We estimated that Darwin's fox is about twice as abundant in Chiloé than on the mainland. The structure of the habitat where Darwin's fox was found was remarkably similar between the two study sites despite floristic differences. Its diet, however, was markedly dissimilar, with mainland foxes preying extensively on mammals and reptiles and little on insects, and island foxes preying primarily on insects and amphibians, and little on mammals. The low consumption of mammals in Chiloé may be attributed to the low densities reached by that prey on the island as compared to Nahuelbuta (estimated at about double the insular density). Fruit consumption in Chiloé was almost three times higher than in Nahuelbuta, suggesting a lower energy diet for insular foxes. We also report behavioral observations on Darwin's fox provided by knowledgeable sources.

Key words: Darwin's fox, *Pseudalopex fulvipes*, Chiloé Island, Nahuelbuta Ranges, fox abundance, habitat use, diet, prey availability, behavioral observations.

RESUMEN

Usando técnicas comparables, estudiamos la abundancia, uso del hábitat y dieta del zorro de Darwin (*Pseudalopex fulvipes*), así como la disponibilidad de presas en dos situaciones contrastantes del sur de Chile: en el continente, en la cordillera de Nahuelbuta, y en la Isla de Chiloé. Este zorro vive en simpatría con su congénere *P. griseus* en Nahuelbuta, pero es el único zorro en la Isla de Chiloé. Nosotros estimamos que el zorro de Darwin es aproximadamente el doble de abundante en Chiloé que en el continente. La estructura del hábitat donde se encontraron zorros de Darwin era sumamente similar entre los dos sitios de estudio, a pesar de sus diferencias florísticas. La dieta, en cambio, era marcadamente disímil, con los zorros continentales predando principalmente sobre mamíferos y reptiles, y escasamente sobre insectos, y los zorros insulares consumiendo mayoritariamente insectos y anfibios, y pocos mamíferos. El bajo consumo de mamíferos en Chiloé puede atribuirse a las bajas densidades alcanzadas por esas presas en la isla en comparación a Nahuelbuta (estimadas en casi el doble las densidades insulares). El consumo de frutos en Chiloé fue casi tres veces mayor que en Nahuelbuta, sugiriendo una dieta de menor energía para los zorros insulares. También documentamos observaciones conductuales sobre el zorro de Darwin, entregadas por fuentes confiables.

Palabras claves: Zorro de Darwin, *Pseudalopex fulvipes*, Isla de Chiloé, Cordillera de Nahuelbuta, abundancia de zorros, uso de hábitat, dieta, disponibilidad de presas, observaciones conductuales.

INTRODUCCION

In a recent review of the ecology of South American canids by Medel & Jaksić (1988), Darwin's fox (*Pseudalopex fulvipes*) was noted as being the least known species. Even its specific status is disputed: because it is mistakenly considered to be restricted to Chiloé Island (latitude 46°S) in southern Chile, most recent authors consider it an insular form of the grey fox *Pseudalopex griseus* (e.g., Honacki *et al.* 1982, listed under *Dusicyon;* Berta 1987). However, Medel *et al.* (1990) recently documented

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the presence of Darwin's fox on the Chilean mainland, 600 km north of Chiloé Island, in the Nahuelbuta Range (ca. latitude 37°S), in sympatry with its congener the grey fox. Although the evidence is circumstantial and a karyological analysis should be used to verify the taxonomic status of Darwin's fox, it seems reasonable to regard it as a separate species until proven otherwise. Jaksić *et al.* (1990) succintly reported information on the habitat and diet of Darwin's fox in Nahuelbuta, on the Chilean mainland. Herein we expand that information by providing a more detailed account, and report first-hand autecological observations on Darwin's fox on its insular ranges in Chiloé Island, thus enabling comparisons between these two disjunct populations.

MATERIAL AND METHODS

Nahuelbuta

Nahuelbuta National Park, established in 1939, is located 35 km west of Angol (37°45S, 72°44'W) and contains 6,831 ha with elevations from 950 m to 1,462 m. The primary vegetation consists of relatively undisturbed forests of *Nothofagus* beeches and *Araucaria* pines in different stages of growth. Detailed descriptions of the vegetation and fauna of the park are provided in Ferriere (1963), Greer (1965), and Webb & Greer (1969). Six field trips were made to the park (Jaksić *et al.* 1990): February (austral summer) 1987, January (summer) 1988, July (winter) 1988, November (spring) 1988, January (summer) 1989, and March (fall) 1989. Fox feces were collected during all trips except the last; habitat use was evaluated during the third and fourth trip; and small mammal trapping was conducted during the last trip.

Searches for feces were conducted in areas of the Park where Darwin's fox was most often seen, and where the congeneric grey fox *P. griseus* was rarely or never seen (see below). These areas were: the road between the Park's entrance and the Pehuenco section, the path between Pehuenco and Piedra del Aguila, that between the latter and El Aguilucho path, and the El Puma path. During three days in July (winter) 1988, 51 scent stations were placed at intervals of 30 m (total length = 1,500 m) along the path between Pehuenco and Piedra del Aguila (Jaksić *et al.* 1990). This amounts to 153 scent-nights. Stations were alternately baited with sardine, and with the commercial urines Fox N° 1, Bobcat, Skunk (Allagash), Grey Fox, Red Fox, and Fox in Heat. All these urines were from Cronk's Outdoor Supplies (Wiscasset, Maine), and did not specify the species involved. During six days in November (spring) 1988, with the same scents along the same path, 100 scent stations were placed at intervals of 50 or 100 m, encompassing 6,700 m (Jaksić *et al.* 1990). This amounts to 600 scent-nights. Fox feces were collected along the same path, noting the vegetational composition and physiognomy where they were picked up. During March (fall) 1989, small mammals were live-trapped in two types of forests (Jaksić *et al.* 1990): *Araucaria*-dominated and *Nothofagus*-dominated. In both cases, two parallel lines separated by 15 m were set with 21 medium Sherman traps at 15 m intervals. Traps were baited with rolled oats, operated for four nights, and checked every morning (n = 168 trap-nights per forest type). Small mammals captured were identified, marked, and released.

Chiloé

Piruquina (42°24'S; 73°54'W) is located 20 km northwest of Castro, at 400 m elevation. The vegetation of the general area has been described by Armesto & Rozzi (1989). We made three field trips to the site: February (summer) 1988, January (summer) 1989, and January (summer) 1990. We collected fox feces during all these trips, and conducted small mammal trapping during the second and third; during the last trip, we made habitat evaluation.

During five days in January (summer) 1989, we placed 17 scent stations (n = 85 scent-nights) at intervals of 50 m along a

path inside the forest (length = 800 m). These scent stations were baited only with commercial Red Fox urine (Cronk's Outdoor Supplies). During the same time interval we live-trapped small mammals along the path, starting away from the last scent station. Thirty trapping stations each equipped with two medium Sherman traps were placed at 50 m intervals, and operated for five nights (n = 300 trap-nights). During January (summer) 1990 we live-trapped small mammals along the same path as before, this time setting 100 medium Sherman traps at 50 stations 15 m apart, and operated for five nights (n = 500 trap-nights). Trapping procedures were as in Nahuelbuta.

For mammals, we follow the nomenclature of Honacki *et al.* (1982), except for foxes, for which we follow Berta (1987). For birds, we follow Araya & Millie (1988).

RESULTS

Nahuelbuta

Fecal transects, clumps, and dens

Feces were found either singly along paths, or clumped in defecating spots or in dens (Jaksić *et al.* 1990). During July (winter) 1988, fox feces were not uniformly distributed along the 1,500 m scent transect. Two segments of only 300 m each contained, respectively, 33 and 28% of the 18 feces found along the path. During November (spring) 1988, along the 6,700-m scent transect, 31% of 202 fox feces were found in a 700-m segment, and 21% in a 400-m segment. Feces found along paths were on flat rockless places with an overstory vegetation consisting of young *Nothofagus dombeyi* and old *Araucaria araucana* tress, often > 20 m tall (Jaksić *et al.* 1990). A middle stratum consisted of 2-5 m tall trees of *Myrceugenia* sp., *Maytenus magellanica, Azara lanceolata,* and bamboos (*Chusquea coleu*). The understory was dominated by *Drimys winteri* and *Pernettya* sp. The only defecating spot detected in July (winter) 1988, containing four feces, was a conic depression (1.5 m diameter, 1.8 m depth) at the base of a fallen tree of *N. dombeyi,* located alongside the path between Pehuenco and Piedra del Aguila (Jaksić *et al.* 1990). During November (spring) 1988 two new defecating spots were found, one besides the El Puma path, the other nearby Piedra del Aguila. These two defecating spots were slightly concave and sheltered from the rain by an overhanging boulder.

The only den found during July (winter) 1988 was at Piedra del Aguila (Jaksić *et al.* 1990): It was located beneath a boulder of 12 m diameter; its cavity was 2.0 m deep, 1.8 m wide, and 0.7 m high; its floor was made of small rocks and soil. The den's entrance faced southwest and was hidden by bamboos. Inside were 12 fox feces. Near the den were scattered large boulders on the forest floor, together with 10-20 m tall trees of *A. araucana* and of *N. pumilio;* the understory was composed of *C. coleu* and *Pernettya* sp. During November (spring) 1988, no new denning sites were located (Jaksić *et al.* 1990).

Scent stations and tracks

During July (winter) 1988, the scent stations failed to attract foxes or other mammals (Jaksić *et al.* 1990). Neither consumption of bait nor presence of tracks was observed. The failure apparently resulted from the inclement weather that persisted during the three days the scent stations were operated. Opportunistic observations of tracks on the snow (in open areas of the park) demonstrated the following order of decreasing activity/abundance: European rabbit (*Oryctolagus cuniculus*), European hare (*Lepus capensis*), Austral spotted cat (*Felis guigna*), mountain lion (*Felis concolor*), and lastly, pudu deer (*Pudu pudu*) and Darwin's fox. Tracks of hog-nosed skunk (*Conepatus chinga*) and of grison (*Galictis cuja*) were not observed on the snow. It is likely that those species that were poorly represented by tracks in open areas concentrated their activities in the more sheltered forest areas. During November (spring) 1988, the scent stations were successful at attracting not only Darwin's fox but other carnivores as well

(Table 1). The most effective attractant for Darwin's foxes was sardines, followed by the commercial urines Red Fox and Bobcat. Spotted cats were most often attracted by Grey Fox and Red Fox commercial urines; mountain lions primarily by Red Fox commercial urine.

The vegetation surrounding scent stations was dense at the forest floor (74% ground-projected canopy cover, Table 2), and dominated by shrubs of *Drimys winteri, Pernettya* sp., and *M. magellanica.* A middle stratum was less dense (59% canopy cover), and dominated by trees of *Myrceugenia* sp., of bamboos of *C. coleu,* and of young trees of *N. dombeyi.* The upper stratum was the least dense (44% cover) and completely dominated by two trees, *N. dombeyi* and *A. araucana.*

Diet

There was both between-year and between-season variation in the diet of Darwin's fox (Table 3). From the summer of 1987 (January) through that of 1988 (February), and to that of 1989 (January), the proportion of mammalian, avian, reptilian, and insect prey fluctuated markedly. In general, however, as vertebrate prey in the diet increased, the proportion of insect prey decreased. Throughout 1988, the proportion of mammalian prey in the diet remained relatively constant, but during winter (July) avian prey increased, and both reptilian and insect prey decreased. Prey composition in the diet was remarkably similar during summer (January) and spring (November) of 1988, except for a slight increase in avian prey during the latter season. However, the following summer (January 1989), mammalian prey in the diet decreased markedly, with a concomitat three-fold increase in insect prey. The prevalence of plant material in feces (essentially fruits) varied widely and inconsistently between seasons, with both maximum and minimum counts occurring during two consecutive summers (February 1987 and January 1988).

Prey availability and fox consumption

Except for the European rabbit (*O. cuniculus*), mammalian prey in the diet of Darwin's fox was that commonly found in the forests of Nahuelbuta (Greer 1965). The ranking of abundance of forest species in the field (Table 5) generally corresponded with their ranking of occurrence in the

TABLE 1

Number of times scent stations were visited by mammals in Nahuelbuta National Park during November 1988 (600 scent-nights), and in Chiloé Island during January 1989 (85 scent-nights). In parenthesis is the percentage of Darwin's fox visitation/scent-nights.

Número de veces que las estaciones de atracción olfativa fueron visitadas por mamíferos en el Parque Nacional Nahuelbuta durante noviembre de 1988 (600 estaciones-noches) y en la Isla de Chiloé durante enero de 1989 (85 estaciones-noches). Entre paréntesis el porcentaje de visitas del zorro de Darwin/estaciones-noches.

Scent	Darwin's fox	Spotted cat	Mountain lion	Pudu	Total
Nahuelbuta:					
Sardines	5	2	2	0	9
Red Fox	4	5	4	0	13
Bobcat	4	2	1	0	7
Fox Nº 1	3	4	0	0	7
Fox in Heat	2	0	1	0	3
Grey Fox	1	6	2	0	9
Allagash	1	1	1	0	3
Total	20 (3.3)	20	11	0	51
Chiloé:					
Red Fox	6 (7.1)	3 ?	0	2	11

diet of Darwin's foxes (Table 4), with the clear exception of the semifossorial rodent *Notiomys valdivianus*, which reportedly is not susceptible to sampling in Sherman traps (Greer 1965; Reisse & Venegas 1987; but see Meserve *et al.* 1982, Patterson *et al.* 1989, and below). Among avian prey, the chucao (*Scelorchilus rubecula*) was a typical inhabitat of the forest floor, but the Austral parakeet *Enicognathus ferrugineus* was not. Apparently, the fox captured Austral parakeets when they fed on pine cones on the forest floor during winter and early spring. The high representation of *Liolaemus* lizards in the diet was consistent with their high abundance on the forest floor of Nahuelbuta (Webb & Greer 1969). Insect prey were primarily scarabaeid beetles and gryllid crickets, abudant ground-dwellers in the forest (Ferriere 1963).

Miscellaneous observations

Mr. Leonel Pincheira, a park ranger for nearly 30 years, appeared to be a reliable source of information on Darwin's fox. He reported the following observations: Darwin's fox was first seen in the Park during the early 70's, when a wounded individual was captured. It has never been abundant, but appears to have increased starting in 1986, together with pudu deer and rabbits (no linkage is implied). Concurrently, the grey fox has decreased to very low levels. Darwin's fox is a forest fox, whereas the grey fox is only seen in open areas. Darwin's fox has most often been seen along the path between Pehuenco and Piedra del Aguila, and less frequently in the places locally known as Mirador de los Díaz, El Puma, El Aguilucho, Coimallín, and Piedra del Aguila. It has never been seen in northern parts of the Park, likely owing to human interference. On only one occasion have two Darwin's foxes (juveniles) been seen together, at Pehuenco. At this same place an encounter was observed between one Darwin's fox and one grey fox; the former ran away into the forest as the latter approached. Whereas Darwin's fox shows a tendency to defecate in particular spots, and in paths rarely traversed, the grey fox defecates on roads. Feces of Darwin's fox are darker, narrower, and shorter (5-6 cm) than those of the grey fox, and are defecated as single units, unlike those of the grey fox. Darwin's fox is rarely seen eating insects or fruits, whereas the grey fox frequently does. The two species can be seen during both day and night. Most of the above statements by Mr. Pincheira concur with Medel *et al.* (1990) and our personal observations, providing an adequate cross-check on our short-term experience with Darwin's fox.

TABLE 2

Vegetational characterization of the surroundings of scent stations visited by Darwin's fox in Nahuelbuta National Park during November 1988, and around scent/trapping stations in Chiloé Island during January 1990.

Caracterización vegetacional de los alrededores de las estaciones de atracción olfativa visitadas por el zorro de Darwin en el Parque Nacional Nahuelbuta durante noviembre de 1988, y de las estaciones olfativas y de trampeo en la Isla de Chiloé durante enero de 1990.

Strata (m)	% Cover $\bar{x}$ ± 2 SE (n)	% Cover of dominant shrubs and trees
Nahuelbuta:		
< 1.5	74.3 ± 8.6 (14)	13.6 *Drimys*, 13.5 *Pernettya*, 11.1 *Maytenus*.
1.5-6.0	59.3 ± 4.9 (14)	12.9 *Myrceugenia*, 10.0 *Chusquea*, 9.3 *Nothofagus*.
> 6.0	43.6 ± 8.5 (14)	25.7 *Nothofagus*, 17.9 *Araucaria*.
Chiloé:		
< 1.5	57.5 ± 5.1 (50)	32.7 *Chusquea*, 14.9 *Amomyrtus*, 3.4 *Drimys*.
1.5-6.0	52.6 ± 5.6 (50)	21.5 *Chusquea*, 16.7 *Amomyrtus*, 5.1 *Laurelia*.
> 6.0	60.9 ± 5.2 (50)	23.5 *Amomyrtus*, 17.4 *Laurelia*, 13.7 *Drimys*.

Chiloé

Fecal transects, clumps, and dens

We did not find any dens, but did find fecal clumps of up to 11 feces thus forming defecating spots on the forest floor. Few feces were found along the scent stations or trapping lines, and hence it was not feasible to quantify their spatial distribution along the transect. The habitat setting where feces were collected was essentially the same as that along the scent transect (Table 3). Feces were generally found on flat places where the understory and middle vegetation stratum was dominated by bamboos (*C. quila*), and where the upperstory was dominated by tall trees (> 6.0 m) of *Amomyrtus luma, Laurelia philippiana,* and *Drimys winteri.*

Scent stations and tracks

During January (summer) 1989, the scent stations (all baited with commercial Red fox's urine) attracted Darwin's fox and pudu, as well as some unidentified medium-sized mammal (perhaps an Austral spotted cat). The vegetation surrounding these stations (Table 2) had an homogeneous ground-projected cover of about 55% at all levels, dominated by bamboos at the lower and middle strata, and by trees at the upper stratum.

TABLE 3

Prey of Darwin's fox in Nahuelbuta National Park. Figures are percent numerical frequency of prey in fecal samples; subtotals for classes are in parenthesis.

Presas del zorro de Darwin en el Parque Nacional Nahuelbuta. Las cifras son porcentajes numéricos de frecuencia de presas en las muestras fecales; los subtotales por clases van en paréntesis.

Prey	Feb. 1987	Jan. 1988	Jul. 1988	Nov. 1988	Jan. 1989	Total
MAMMALS	(21.3)	(56.0)	(56.1)	(50.6)	(36.2)	(46.1)
Artiodactyla						
Pudu pudu	1.9	0.0	0.0	0.0	0.0	0.2
Lagomorpha						
Oryctolagus cuniculus	0.9	0.0	4.5	0.0	0.8	0.5
Marsupialia						
Dromiciops australis	1.9	8.8	7.6	3.4	0.8	3.6
Rodentia						
Aconaemys fuscus	0.0	2.2	6.1	1.1	0.0	1.3
Akodon longipilis	0.0	0.0	3.0	0.6	0.8	0.6
Akodon olivaceus	1.9	3.3	9.1	3.4	3.8	3.6
Akodon sp. (a)	0.0	0.0	0.0	5.6	2.3	3.6
Auliscomys micropus	0.9	8.8	10.7	4.3	2.3	4.5
Irenomys tarsalis	0.0	4.4	0.0	1.9	0.8	1.6
Notiomys valdivianus	0.0	6.6	4.5	13.9	5.4	9.9
Octodon bridgesi	0.0	6.6	1.5	3.2	2.3	2.9
Oryzomys longicaudatus	0.9	8.8	3.0	2.6	6.2	3.5
Phyllotis darwini	0.9	0.0	0.0	0.0	0.0	0.1
Rattus rattus	0.0	0.0	0.0	0.2	0.0	0.1
Unidentified cricetid	0.0	0.0	6.1	8.0	6.9	6.2
Unidentified octodontid (b)	0.0	0.0	0.0	0.2	0.0	0.1
Unidentified rodent	0.0	0.0	0.0	1.5	3.8	1.4
Unidentified mammal	12.0	6.5	0.0	0.7	0.0	2.4
BIRDS	(1.8)	(7.7)	(19.7)	(13.5)	(6.9)	(11.1)
Apodiformes						
Sephanoides galeritus	0.0	0.0	0.0	0.2	0.0	0.1
Passeriformes						
Scelorchilus rubecula	0.0	0.0	3.0	0.0	0.0	0.2
Unidentified rhinocryptid	0.9	0.0	0.0	0.0	0.0	0.1
Unidentified passerine	0.9	7.7	7.6	4.4	5.3	4.7

Prey	Feb. 1987	Jan. 1988	Jul. 1988	Nov. 1988	Jan. 1989	Total
Psittaciformes						
Enicognathus ferrugineus	0.0	0.0	9.1	6.1	0.8	4.3
Unidentified bird	0.0	0.0	0.0	2.8	0.8	1.7
REPTILES	(14.9)	(25.3)	(19.7)	(24.6)	(19.3)	(22.4)
Sauria						
Liolaemus cf. *pictus*	0.0	0.0	19.7	0.0	0.0	1.4
Liolaemus tenuis	0.0	0.0	0.0	0.0	8.5	1.2
Liolaemus sp. (c)	14.9	25.3	0.0	24.6	10.8	19.8
INSECTS	(62.0)	(11.0)	(4.5)	(11.1)	(36.1)	(20.1)
Coleoptera	22.2	9.9	3.0	8.9	29.2	13.0
Hymenoptera	0.9	0.0	0.0	0.0	0.0	0.1
Orthoptera	38.9	1.1	1.5	1.1	5.4	6.1
Unidentified insect	0.0	0.0	0.0	1.1	1.5	0.9
ARACHNIDS	(0.0)	(0.0)	(0.0)	(0.2)	(1.5)	(0.3)
Scorpionida	0.0	0.0	0.0	0.2	1.5	0.3
TOTAL	108	91	66	537	130	932
TOTAL FECES	34	44	30	252	44	404
% FECES W/PLANT MATERIAL	32.4	0.0	6.7	21.0	13.6	17.8

(a) Either *A. longipilis* or *A. olivaceus.*
(b) Either *A. fuscus* or *O. bridgesi.*
(c) Either *L. pictus* or *L. tenuis.*

TABLE 4

Prey of Darwin's fox in Chiloé Island. Figures are percent numerical frequency of prey in fecal samples: subtotals for classes are in parenthesis.

Presas del zorro de Darwin en la Isla de Chiloé. Las cifras son porcentajes numéricos de frecuencia de presas en las muestras fecales; los subtotales por clases van en paréntesis.

Prey	Feb. 1988	Jan. 1989	Total
MAMMALS	(7.9)	(11.6)	(8.8)
Artiodactyla			
Pudu pudu	4.3	3.3	3.9
Marsupialia			
Dromiciops australis	0.4	0.6	0.5
Rodentia			
Akodon sanborni	1.0	3.9	1.7
Irenomys tarsalis	0.2	0.0	0.2
Notiomys valdivianus	0.6	1.3	0.8
Oryzomys longicaudatus	0.4	0.0	0.3
Unidentified cricetid	0.6	1.9	0.9
Unidentified rodent	0.4	0.6	0.5

Prey	Feb. 1988	Jan. 1989	Total
BIRDS	(3.3)	(1.9)	(3.0)
Columbiformes			
Unidentified dove	0.0	0.6	0.2
Passeriformes			
Unidentified rhinocryptid	0.6	0.0	0.5
Unidentified passerine	2.3	0.7	1.7
Psittaciformes			
Enicognathus ferrugineus	0.0	0.6	0.2
Strigiformes			
Unidentified owl	0.2	0.0	0.2
Unidentified bird	0.2	0.0	0.2
REPTILES	(1.9)	(0.0)	(1.4)
Sauria			
Liolaemus sp.	1.9	0.0	1.4
AMPHIBIANS	(13.1)	(7.1)	(11.5)
Unidentified toad or frog	13.1	7.1	11.5
INSECTS	(72.8)	(78.8)	(74.3)
Coleoptera	66.1	67.2	66.4
Hymenoptera	0.2	0.0	0.2
Orthoptera	6.5	10.3	7.4
Unidentified insect	0.0	1.3	0.3
ARACHNIDS	(1.0)	(0.0)	(0.8)
Aranea	0.4	0.0	0.3
Scorpionida	0.6	0.0	0.5
CHILOPODS	(0.0)	(0.6)	(0.2)
Unidentified centipedes	0.0	0.6	0.2
TOTAL PREY	478	155	633
TOTAL FECES	67	21	88
% FECES W/PLANT MATERIAL	49.3	47.6	48.9

Diet

Insects were numerically the most important dietary item, and remained at similar levels between February 1988 and January 1989. However, mammals were slightly overrepresented, whereas birds, reptiles, and amphibians were slightly underrepresented during the latter date. The prevalence of plant material in the feces (essentially fruits) was remarkably similar between the two years. The single fecal pellet collected in January 1990 contained remains of one pudu, two leptodactylid frogs, five coleopterans, one orthopteran, four insect larvae, one crustacean, and plant material (fruits).

Prey availability and fox consumption

Akodon sanborni was the most frequently captured small mammal (Table 5), and

TABLE 5

Minimum number known alive of small mammals live-trapped in two different forest types of Nahuelbuta National Park, and in two different dates in Chiloé Island.

Número mínimo conocido vivo de micromamíferos trampeados en dos diferentes tipos de bosque en el Parque Nacional Nahuelbuta, y en dos fechas diferentes en la Isla de Chiloé.

Mammal species	Nahuelbuta (March 1989)		Chiloé Island	
	Araucaria	*Nothofagus*	Jan. 1989	Jan. 1990
Akodon longipilis	1	0	0	0
Akodon olivaceus	2	1	0	0
Akodon sanborni	0	0	9	11
Auliscomys micropus	4	5	0	0
Notiomys valdivianus	0	0	1	1
Oryzomys longicaudatus	4	1	0	0
Total number small mammals	11	7	10	12
Number of trap-nights	168	168	300	500
Trapping success (%)	6.6	4.2	3.3	2.4

the only other species was *N. valdivianus* (which, incidentally, was captured by Sherman traps in Chiloé but not in Nahuelbuta). These relative field abundances correspond with the respective representation of the rodent species in the fox's diet (Table 4).

Miscellaneous observations

The following personal communications were obtained from knowledgeable people in Chiloé Island. Park ranger Elbe Aro (Chiloé's National Park at Cucao) reported that Darwin's foxes are present all over the Park, but they are more abundant on the Pacific side, where it is common to see them feeding on shellfish and shorebirds along the coast. Mr. Juan Aguila (Piruquina, near Castro city) has seen up to nine Darwin's foxes together, feeding on brown algae (*Durvillaea antarctica*) and on Southern Lapwings (*Vanellus chilensis*) along the Pacific shores. Mr. Carlos Aguila (also from Piruquina), reported that Darwin's foxes are not afraid of humans. They can be approached very closely and some have actually been captured by hand and kept in captivity for more than three years (they tame well and do not attempt to bite). They may be seen active day and night, in forests and in open areas. Darwin's foxes often raid garbage dumps and poultry roosts near houses, killing chickens, geese, and even lambs of up to 20 kg. They kill pudus by biting their ankles while running until able to exhaust them and reach for their throat; they first lap the pudu's blood, and then proceed to eat their flesh, and finally their hide and bones. Several foxes have been observed feeding on the same carcass. They seem to scavenge whenever given the opportunity. During summer Darwin's foxes eat mainly insects, and during fall and winter they feed extensively on fruits (e.g., *A. luma, Myceugenia planipes, Ugni molinae*). These observations agree generally with ours and those of Medel *et al.* (1990).

DISCUSSION

Based on the number of tracks of Darwin's foxes near scent stations, it appears that they are about twice as abundant in Chiloé (7.1% tracks/scent-night) than in Nahuelbuta (3.3%). The vegetational characterization of the habitat where Darwin's foxes occur is similar in overall ground-projected cover: 59.0% in Nahuelbuta versus 57.0% in Chiloé (all three strata combined). The understory is somewhat more dense in the former site, however. Apparently, then, Darwin's

foxes have found in Nahuelbuta a habitat structurally similar to that in its more typical insular ranges. The diet of Darwin's foxes differs markedly between Nahuelbuta and Chiloé. Overall, Nahuelbuta foxes prey extensively on mammals (46% by number) and reptiles (22%), with insects ranking third as prey (20%). Instead, Chiloé foxes prey mainly on insects (74%), secondarily on amphibians (12%), and thirdly on mammals (9%). The prevalence of vegetation (essentially fruits) in the diet is also markedly different between the two sites: 18% in Nahuelbuta, 49% in Chiloé. It appears, then, that Darwin's foxes in Chiloé survive on a lower-energy diet than their conspecifics in Nahuelbuta. This fact may be related to the apparently low relative abundances reached by small mammals in Chiloé (2.4-3.3% trapping success) in comparison to Nahuelbuta (4.2-6.6%).

In summary, Darwin's foxes in Nahuelbuta dwell in structurally similar habitats as those in Chiloé, but their diet in the former site seems to be energetically richer than in the latter. The apparently lower abundance of Darwin's foxes in Nahuelbuta may derive from the comparatively smaller area of suitable habitat in this site.

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