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Winter–spring food habits of an island population of Coyote *Canis Latrans* in Baja California, México

S.T. Álvarez-Castañeda*, P. González-Quintero

Centro de Investigaciones Biológicas del Noroeste (CIBNOR), Mar Bermejo 195, Playa Palo Santa Rita, La Paz, Baja California Sur 23090, México

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Abstract

Food habits of the coyote (*Canis latrans*) on San Luis Gonzaga Island of Baja California, Mexico were investigated. We collected 239 scat samples for analysis on 14 May 1997. Samples ranged from fresh to approximately 2 months old. Frequency of diet components was 48.9% birds, 21.9% fish, 14.8% plants, 3.6% mammals, 4.0% insects, 0.7% reptiles, 0.5% arachnids, and 5% crustaceans. The last group had not previously been recorded in this region. Great blue herons (*Ardea herodias*) composed 11% of the diet. Other members of the Ardeidae family accounted for an additional 23.4%. From March through May, the large coyote population on the island depends mainly on scavenging bird carcasses, and has minimal impact on endemic rodent species on the island, some of them listed as threatened by the Mexican government.

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*Corresponding author. Tel.: +52-612-12-583-86; fax: +52-612-12-536-25.
E-mail address: sticul@cibnor.mx (S.T. Álvarez-Castañeda).

1. Introduction

The coyote (*Canis latrans*) is one of the more widely distributed carnivores in North America (Bekoff, 1977; Hall, 1981), including the Baja California Peninsula and some islands in the Gulf of California, such as Tiburon Island and San Luis Gonzaga Island (or Willard Island, López-Forment et al., 1996; Álvarez-Castañeda, 2000; Lawlor et al., 2002), and Margarita Island in the Pacific Ocean (Álvarez-Castañeda, 2000). Studies are not available on the ecology or biology of coyotes in these island areas.

The coyote is considered an omnivorous opportunist (Ortega, 1987; Elliot and Gueting, 1990; Windberg and Mitchell, 1990; Reichel, 1991; Servín and Huxley, 1993). Cattle and game species also have been recorded in the diet (Andelt et al., 1987; Hernández et al., 1994; Cypher et al., 1996; Samson and Crete, 1997; Pierce et al., 2000).

We analysed coyote scat of San Luis Gonzaga Island to evaluate the importance of the bird carcasses to the feeding habits of coyotes on the island, to evaluate if a large population of coyotes can depend on scavenging, and to determine whether part of the diet in winter–spring season is composed of rodents endemic to the island, some of them are “threatened” species (Norma Oficial Mexicana, 2002).

Study Site. San Luis Gonzaga Island, about 2 km² in size, (Gastil et al., 1983) is in the northern Gulf of California at 29°48'N, 114°20'W (INEGI, 1996). The island is roughly conical-shaped (150 m elevation) with an overall 30° slope. There are two canyons, one on the western face, and the other on the northern face (Álvarez-Castañeda, 2000, Fig. 1). The island is within San Luis Gonzaga Bay, 1 km from the mainland coast (Gastil et al., 1983). The climate is a hot, dry desert (García, 1981), with annual mean high temperature of 26 °C, and an annual minimum of 18 °C. It supports a microphyllous desert shrub community dominated by *Larrea tridentata* with *Fouquieria splendens*, *Cercidium microphyllum*, *Olneya tesota*, and *Bursera microphylla* (Wiggins, 1980).

2. Methods

On 14 May 1997, we collected 239 samples of coyote scat on San Luis Gonzaga Island, placing each sample in separate paper bags. The samples were determined as fresh to 2 months old (Rodríguez-Estrella et al., 2000). Analysis of scat samples in our laboratory followed the technique described by Reynolds and Aebischer (1991). Each sample was weighed, and separated into principal components: hair, feathers, scales, bone, vegetable matter, invertebrates, stones, and unidentifiable materials. These components were placed in labeled bags. Components were compared with specimens from the zoological collections at the Centro de Investigaciones Biológicas del Noroeste (CIB) and the Instituto de Ecología y Alimentos of the Universidad Autónoma de Tamaulipas (IEA-UAT).

Mammals were identified by osteological characteristics and aspects of fur; birds by color and size of feathers, as well as by presence of raquis and other feather structures; reptiles and fish by scales and bones; invertebrates by head, thorax, and appendages and plants by leaf, seed, and stem structures.

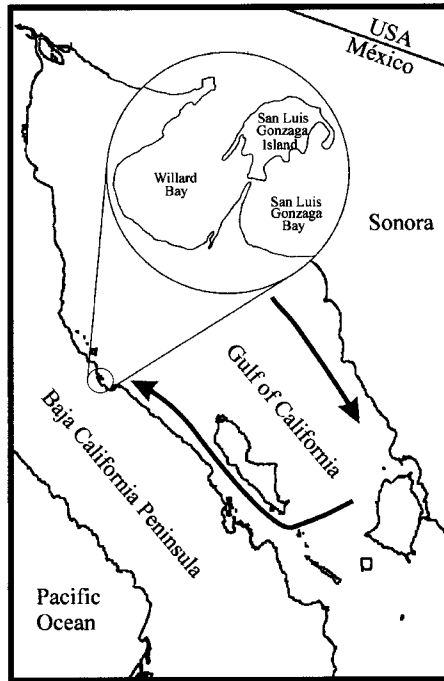


Fig. 1. Location of San Luis Gonzaga Island (Willard Island) in the Gulf of California. Arrows represent clockwise Gulf of California circulation during winter–spring that moves seabird carcasses from the important nesting sites on the Midriff Islands to San Luis Gonzaga Island.

The results are presented as frequency [$F = (n_i / \sum n_i)$], and percentage of frequency [$PF = (n_i / \sum n_i)(100)$]. Number of prey per scat was calculated by adding the frequency of prey per scat and dividing the total prey by the number of analysed scats (Sokal and Rohlf, 1995). The mean, median, variance, and standard deviation of the size of the scats were obtained. Correlation analyses were made between the frequency of the species and the weight of scat.

All scat were assigned to coyotes and we eliminated the possibility of dogs because coyotes have been frequently seen on the island and no dogs have been observed. Records of coyotes on the island are scarce (Lawlor et al., 2002), so other potential scavengers-predators, such as bobcat and fox were not considered. Additionally, scats of these carnivores are morphologically different. Interviews with local inhabitants and fishermen confirm the presence of coyotes, but no dogs.

3. Results

On San Luis Gonzaga Island, 239 coyote scat were analysed. Coyotes on the island have very low diversity in their diet (on average, 1.7 items per scat). Scat usually contained one species of mammal, bird, reptile, crustacean, or fish.

Occasionally more than one species of insect or plant was found. We found up to three insect and plant species in one scat sample from each group, but occurrence varied. Bird fragments had the highest frequency and percentage of frequency. Fish had a frequency of 21.9%, plant parts occurred in 14.8%, and other components were in percentages lower than 6% (Table 1).

The minimum number of items per scat was: one item in 84 samples (49.4%), two items in 65 samples (38.2%), three items in 12 samples (7.0%), four items in 7 samples (4.1%), five items in one sample (0.6%), and six items in one sample (0.6%). Frequency of species was not significantly correlated ($p < 0.05$) with the weight of scat samples.

4. Discussion and conclusions

When we surveyed the area around San Luis Gonzaga Bay, we found large number of indicators of coyote activity on the island. Vegetation is scarce, densities of small mammals are low, and no medium-sized prey is available. Many bird carcasses littered the shore. Conversely, across the channel on the peninsula, we found low activity levels, more abundant vegetation, high densities of small- and medium-sized mammals, and an absence of bird carcasses. Higher densities of coyotes in coastal areas relative to areas in the interior mainland have been reported previously (Rose and Polis, 1998).

This is the first study of coyote diet on an island in the Gulf of California. Coyotes are common on the island, and they frequently cross the channel. This is supported by information provided by local inhabitants and by coyote scat containing remnants of prey that are only present on the peninsula, such as hare (*Lepus californicus*) and wood rat (*Neotoma lepida*).

In the scat samples, we found three mammals that occur on the island (Lawlor, 1983); deer mouse (*Peromyscus maniculatus*), canyon mouse (*Peromyscus crinitus pallidissimus*), and Bailey's pocket mouse (*Chaetodipus baileyi*). The latter is only recently recorded on this island. *P. maniculatus* and *P. c. pallidissimus* are under protected status (Norma Oficial Mexicana, 2002). On the island, coyotes feed mainly on carcasses of great blue heron (*Ardea herodias*) which are present in abundant numbers.

Because coyote are an opportunistic species, we speculated that coyotes come to the island to scavenge birds, which possibly died at sea and were washed ashore. Our hypothesis is based on: (1) the most abundant species in scat were sea birds, (2) the island is not a nesting ground for any bird species, (3) complete carcasses were found on the shore, and easily scavenged, (4) on the Baja California coast, coyote frequency is 13 to 3 relative to the mainland and more than 69% of the scat contain marine items (Rose and Polis, 1998). (5) Marine inputs on the terrestrial system are related by a ratio of coastal perimeter to land area (Polis and Hurd, 1996). For San Luis Gonzaga Island, the ratio is large, and thus the island is a better place for scavengers than the coast of the peninsula. (6) Since winter–spring sea surface circulation has a clockwise direction (Beier, 1997; Lluch-Cota, 2000), material and

Table 1
 Frequency and percent of coyote food sources found in scat samples

Component	Frequency	% of frequency
<i>Birds (Total)</i>	194	48.87
Family Podicipedidae	4	1.01
<i>Pelecanus occidentalis</i>	9	2.27
<i>Phalacrocorax</i> sp.	16	4.03
Family Ardeidae	43	10.83
<i>Ardea herodias</i>	44	11.08
<i>Egretta tricolor</i>	6	1.51
Order Charadriiformes	3	0.76
<i>Calidris</i> sp.	1	0.25
Family Laridae	12	3.02
Birds no identified	56	14.11
<i>Fish (Total)</i>	87	21.91
Class Teleostei	87	21.91
<i>Crustaceans (Total)</i>	21	5.29
Order Decapoda	21	5.29
<i>Mammals (Total)</i>	14	3.53
<i>Lepus californicus</i>	2	0.50
<i>Neotoma lepida</i>	1	0.25
<i>Peromyscus maniculatus</i>	7	1.76
<i>Peromyscus crinitus</i> ^a	3	0.76
<i>Chaetodipus baileyi</i>	1	0.25
<i>Insects (Total)</i>	17	4.28
Tenebrionidae genus A	1	0.25
Tenebrionidae genus B	1	0.25
<i>Phlodes</i> sp.	10	2.52
Family Cincidelidae	2	0.50
Family Polyphagidae	1	0.25
Family Acrididae	2	0.50
<i>Reptiles (Total)</i>	3	0.76
Order Squamata A	1	0.25
Order Squamata B	1	0.25
Family Culebridae	1	0.25
<i>Arácnidos (Total)</i>	2	0.50
Order Araneida	1	0.25
Family Buthidae	1	0.25
<i>Plants (Total)</i>	59	14.86
<i>Opuntia cholla</i>	3	0.76
<i>Atripley barclayana</i>	4	1.01
<i>Salicornia</i> sp.	1	0.25
<i>Cucurbita palmata</i>	1	0.25
<i>Prosopis</i> sp.	1	0.25
Solanaceae	1	0.25
<i>Lycium</i> sp.	1	0.25
<i>Cryptantha maritima</i>	4	1.01

Table 1 (continued)

Component	Frequency	% of frequency
<i>Polygonum</i> sp.	1	0.25
<i>Boutelova aristoides</i>	1	0.25
<i>Aristida</i> sp.	1	0.25
<i>Sesivium portulacastrum</i>	2	0.50
<i>Suaeda taxifolia</i>	7	1.76
<i>Sargassum</i> sp.	1	0.25
Plants not identified	30	7.56
Total	397	100.00

^aEndemic subspecies under protected status by the Mexican government (Norma Oficial Mexicana, 2002).

dead birds from the Midriff Islands, which are important nesting sites, are washed to San Luis Gonzaga Island (Fig. 1), explaining why sea bird carcasses are so abundant and the single most important food in winter. We do not have data of the presence of coyotes during the summer–fall.

We believe coyotes respond to the increase of easily obtained food at this season. Since the number of insular mammal species, associated more with the interior of the island, is very low in the scat samples, we support the conclusion of Rose and Polis (1998) that coyotes have a preference for feeding along the coast.

The 1996 survey detected no positive or negative effect by El Niño Southern Oscillation (ENSO) that could not be interpreted as an increase or decrease in sea bird mortality. The results of our survey support the presumption that the island is used as a regular location for scavenging coyotes during the winter–spring season, a bonanza created by the clockwise sea surface circulation bringing dead seabirds from the Midriff Islands. Our survey shows that coyotes have very little impact at that season on endemic and protected mammals (Norma Oficial Mexicana, 2002) at this time of the year. A year-round study of the impact of coyotes on endemic species would contribute to a more satisfactory conclusion on conservation concerns.

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