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NOTES

DIETS OF COYOTES NEAR THE BOUNDARY OF SAGUARO NATIONAL MONUMENT AND TUCSON, ARIZONA

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Suburban developments border the NW boundary of Saguaro National Monument East (SNM), a protected area for wildlife. Developments at this boundary have created an environment with potentially different sources of food for coyotes (*Canis latrans*). How coyotes use food resources at this boundary has not been described. Our objectives were to estimate and compare diets of coyotes living near suburban and rural areas of SNM to determine if suburban development influenced feeding patterns of coyotes in the Sonoran desert. To accomplish these objectives, we collected and analyzed coyote scats from an area of SNM that bordered a suburban landscape and compared them to scats from a rural area adjacent to SNM.

The 14 km² suburban area encompassed the NW corner of SNM. Housing density on adjacent residential lands was approximately 0.4 house/ha. The 12.5 km² rural area bordered the S boundary of SNM. Minimum airline distance between the two sites was 5.3 km. Topography and climate were similar in both areas. Similar sub-associations of Sonoran desert-scrub existed in both areas. Hunting, trapping, and livestock grazing were prohibited on the suburban site, but permitted on the rural site. Based on concurrent telemetry studies, we assumed that the ranges of coyotes between the two areas did not overlap (D.L. Bounds, pers. comm.).

From 1 December 1991 to 30 November 1992, we collected 667 scats from the suburban site and 449 scats from the rural site. We randomly selected washes, roads, and trails in each area and cleared all feces prior to collection dates, so only fresh scats were collected. We collected scats two times per week. We used criteria described by Murie (1954) and Danner and Dodd (1982) to

distinguish coyote scats from similar scats commonly found in the region: mountain lion (*Felis concolor*), bobcat (*Felis rufus*), and gray fox (*Urocyon cinereoargenteus*). We stored scats in paper bags, air-dried them for ≥ 14 days, pressurized (15 psi) each in an autoclave at 120°C for 30 min, and rinsed them through fine mesh nylon before analysis. We identified food items in each scat by comparison with known specimens of bones, teeth, and hair. Skull, teeth, and hair keys were used also when necessary (Moore et al., 1974; B. P. Glass, in litt.). Occasionally, scats were too moist and broken to be transported, particularly when the majority of them was prickly pear fruit or bread. We analyzed these scats in the field; any unknown material was retained and compared with reference material.

We pooled data on coyote foods over time and separated them by four behavioral periods: breeding (January and February), gestation (March and April), pup-rearing (May through August), and post reproductive (September through December). The post reproductive period included dispersal and the time when group fidelity was most evident. We differentiated among behavioral periods based on data by Drewek (1980), Laundre and Keller (1984), Andelt et al. (1987), and Persson and Hirth (1991). We determined if the frequency of foods in scats varied between sites and among seasons using Chi-square contingency tables (Zar, 1974).

We identified plant remnants in 57% of scats from the suburban area, annually. The frequency of plant material in scats from the suburban area was greater during pup-rearing (66%) and post-reproductive (68%) periods than during breeding (26%) and gestation (26%) periods ($\chi^2 = 88.3$, 3 d.f., $P < 0.0001$). Most differences in plant con-

TABLE 1—Percent occurrence of prey items identified in 667 coyote scats collected near a suburban interface of Saguaro National Monument and 449 coyote scats collected in a rural area adjacent to Saguaro National Monument, near Tucson, Arizona, December 1991 to November 1992. S = suburban, R = rural.

Food item	Site	Breeding Jan–Feb		Gestation Mar–Apr		Pup-rearing May–Aug		Post reprod. Sep–Dec		Annual	
		n	%	n	%	n	%	n	%	n	%
Mesquite pods	S	13	15	4	5	63	24	114	48	194	29
	R	7	14			41	22	125	73	173	39
Prickly pear fruit	S	1	1			80	31	27	11	108	16
	R					71	39	24	14	95	21
Other plants	S	22	26	15	18	65	25	59	25	161	24
	R	14	28	13	30	86	47	45	26	158	35
Rodent	S	18	21	21	25	77	30	74	31	190	28
	R	13	26	7	16	55	30	47	27	122	27
Lagomorph	S	22	26	26	31	58	22	39	16	145	22
	R	18	36	14	33	35	19	20	12	87	20
Mule deer	S	6	7	4	5	4	1	7	3	21	3
	R	8	16	13	30	10	5	11	6	42	9
Other mammals	S	6	7	5	6	2	1	10	4	23	3
	R	5	10	5	12	2	1	8	5	20	4
Dog food, bread, or human-related	S	26	31	32	38	91	35	82	35	231	35
	R					1	Tr*			1	Tr*
Miscellaneous	S	11	13	10	12	48	18	22	9	91	14
	R	17	34	8	19	27	15	18	10	70	16
No. of scat collected	S	85		85		260		237		667	
	R	50		43		184		172		449	

Tr* = <1%.

sumption were associated with the availability of mesquite pods (*Prosopis* sp.), prickly pear fruit (*Opuntia* sp.), graythorn berries (*Condalia* sp.), and Saguaro fruit (*Carnegea gigantea*) that ripened during pup-rearing and post-reproductive periods. Mammal remains, which were in 53% of scats from the suburban site annually, did not differ among behavioral periods ($\chi^2 = 4.9$, 3 *df.*, $P > 0.15$), occurring in 59% of scats during the breeding period, 61% during the gestation period, 52% during the pup-rearing period, and 49% during the post-reproductive period. Individually, lagomorph remains varied significantly among periods ($\chi^2 = 8.36$, 3 *df.*, $P < 0.05$; Table 1), whereas rodent remains did not vary among periods ($\chi^2 = 3.85$, 3 *df.*, $P > 0.20$; Table 1). We identified dog food or bread in 27% of scats from the suburban area, annually. We identified other food items associated with humans (i.e., fruits, vegetables, and table scraps) in 8% (annually) of scats from the suburban area. Human-related foods did not differ among behavioral periods ($\chi^2 = 1.6$, 3 *df.*, $P > 0.20$).

We identified plant remnants in 79% of rural

scats, annually. Like scats from the suburban area, plant remnants were in a greater percentage of rural scats during pup-rearing (89%) and post-reproductive (90%) periods than during breeding (40%) and gestation (37%) periods ($\chi^2 = 115.4$, 3 *df.*, $P < 0.0001$). Unlike scats from the suburban site, mammal remains, which were in 57% of the rural scats annually, varied among behavioral periods ($\chi^2 = 44.6$, 3 *df.*, $P < 0.0001$), occurring in 82% of scats during the breeding period, 91% during the gestation period, 52% during the pup-rearing period, and 46% during the post-reproductive period. Increased frequencies of lagomorph and deer remains during the breeding and gestation periods accounted for most of these differences (Table 1). We found one food item that was associated with humans (cantaloupe rind) in a scat from the rural site.

Plant material was in significantly more rural scats than suburban scats, annually ($\chi^2 = 59.66$, 1 *df.*, $P < 0.0001$). Differences were evident among all behavioral periods. Remains of mammals did not differ between sites, annually ($\chi^2 = 1.32$, 1 *df.*, $P > 0.20$). However, rural scats con-

tained mammal remains more frequently than suburban scats during the breeding ($\chi^2 = 7.70$, 1 *df.*, $P < 0.01$) and gestation periods ($\chi^2 = 12.01$, 1 *df.*, $P < 0.001$). Individually, rodent remains were in similar percentages of scats between sites, annually ($\chi^2 = 0.23$, 1 *df.*, $P > 0.20$; Table 1), as were lagomorph remains ($\chi^2 = 0.89$, 1 *df.*, $P > 0.20$).

During the year that we collected and analyzed scats, we estimated relative rodent abundance between sites to determine if coyotes preyed on rodents in proportion to availability. We set four 200-m trap lines (40 live traps/line) on each site in September 1991, and May and September 1992. All traps on the suburban site were placed inside SNM, <1 km from suburban interfaces. We trapped rodents concurrently on each site for three consecutive nights. We determined whether the relative abundance of rodents differed between sites by comparing trapping success rates using Chi-square contingency tables. Collectively, we trapped 681 (47% trapping success) rodents in the suburban area and 522 (36% trapping success) rodents in the rural area during the three trapping sessions. Annually, there were significantly more rodents on the suburban site ($\chi^2 = 36.0$, 1 *df.*, $P < 0.0001$). Heteromyids and cricetids comprised 98.7% and 99.8% of the species captured on the suburban and the rural sites, respectively.

The discrepancy between rodent consumption versus rodent availability provides preliminary evidence that suburban coyotes consumed human-related foods as partial substitutes for more natural foods. Although rodent abundance was 11% greater on the suburban site, rodent remains were identified in similar percentages of scats between sites, suggesting that availability of rodents was not correlated with use on one or both sites. Because coyotes are opportunistic predators (Nellis and Keith, 1976; Litvaitis and Shaw, 1980; Bowyer et al., 1983), substitution of foods is expected, particularly if one food is easier to procure than the other. In this case, human-related foods were probably easier to procure than rodents. Therefore, suburban coyotes must have decreased their predation on rodents, whereas rural coyotes must have preyed on rodents relative to their availability. This line of reasoning may also explain why coyotes on the suburban site consumed 22% fewer plants (annually) and 26% fewer mammals (during breeding and gestation periods) than coyotes on the rural site.

Although suburban coyotes substituted human-related foods for more natural foods, feeding patterns among behavioral periods remained similar between suburban and rural coyotes. These patterns were evident when both groups capitalized on mesquite, prickly pear, graythorn, and Saguaro as the fruits ripened and became available. Similar patterns in which coyotes capitalized on ripening fruits were noted by H. L. Short (in litt.) in the Santa Rita Experimental Range (75 km S of our suburban area), and in other locations of North America (MacCracken, 1984; Toweill and Anthony, 1988; Reichel, 1991).

In other suburban coyote studies, MacCracken (1982), Shargo (1988), and Atkinson and Shackleton (1991) showed that coyotes consumed human-related foods when these foods were available. Our study demonstrated that dog food, bread, and other items associated with humans were a major source of food for coyotes living at the suburban boundary of SNM. Suburban development influenced the feeding patterns of coyotes at this boundary by providing these alternate and supplemental sources of food.

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VARIATION IN THE DECIDUOUS DENTITION OF POCKET MICE
(HETEROMYIDAE: *PEROGNATHUS* AND *CHAETODIPUS*)

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Wood (1935) detailed some aspects of the heteromyid deciduous dentition, but this is one morphological aspect that has otherwise been neglected or ignored in descriptive or systematic studies of the group. Juvenile specimens with deciduous dentitions commonly are not available in collections. Milk teeth of a young pocket mouse are quickly lost or worn away, and the reproductive cycles of many species ensure only seasonal availability of juveniles. Scarcity of young animals in collections can be exaggerated by the seasonal biases that pervade systematic collections (Stangl and Jones, 1987), and by the age biases sometimes practiced by collectors (Dalquest et al., 1992).

In this study, we characterize the upper and lower deciduous premolars of pocket mice of the genera *Perognathus* and *Chaetodipus*, detail obvious evolutionary patterns or trends in dental evolution of the Perognathinae, and examine the potential utility of milk teeth as phylogenetic indicators. A survey of 2,862 skulls from 11 species of pocket mice located in the collections of Midwestern State University, Texas Tech University,

and Texas A&M University, produced 125 individuals which retained their deciduous premolars. Species and sample sizes examined are: *P. apache* ($n = 2$), *P. flavescens* ($n = 3$), *P. flavus* ($n = 23$), *P. parvus* ($n = 5$), *C. arenarius* ($n = 3$), *C. baileyi* ($n = 4$), *C. formosus* ($n = 4$), *C. hispidus* ($n = 39$), *C. intermedius* ($n = 4$), *C. nelsoni* ($n = 8$), and *C. penicillatus* ($n = 30$). Because deciduous premolars are commonly shed before excessive wear occurs, the teeth of most specimens were diagnostic for the full suite of occlusal characters.

Terminology for the structural features of the occlusal surface of deciduous premolars (Fig. 1) was adapted from previous studies (Wood, 1935; Wood and Wilson, 1936; Barnosky, 1986; Dalquest et al., 1992). Each specimen was scored according to the condition of development or presence/absence of each dental feature. These terms were originally applied by those workers to molars, and no inference of homology between features of molars and premolars is intended by adoption of this terminology.

Cladistic analyses (Hennig, 1965) were performed, using *Dipodomys ordii* ($n = 5$) as repre-