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FOOD ITEM USE BY COYOTE SEX AND AGE CLASSES

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Food item use by coyotes was compared between sexes and among age classes at the Naval Petroleum Reserves, California. Item use did not differ significantly between males and females. Although leporid was the item most frequently used by all age classes, item use differed significantly between pups (< 1 year), yearlings (1 year), and adults (> 1 year), probably due to differential use of secondary items. Variation in item use among age classes could potentially bias results of coyote food habit studies.

INTRODUCTION

Coyotes (Canis latrans) are ecologically important predators in California due to their widespread distribution, abundance, and potential impacts on game populations and livestock. Coyote foraging patterns have been extensively investigated (Bekoff 1977), and several such investigations have been conducted in California (e.g., Ferrel et al. 1953, Hawthorne 1972, Bowyer et al. 1983, Cypher et al. 1994). Despite the number of investigations, food habit variation among sexes

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and age classes is rarely addressed. Such variation, if significant, potentially could bias foraging studies. As part of an investigation of coyote food habits in the southern San Joaquin Valley of California (Cypher et al. 1994), food item use was compared between sexes and among three age classes.

STUDY AREA

The investigation was conducted at the Naval Petroleum Reserves in California (NPRC), which is located 42 km southwest of Bakersfield in western Kern County, California. NPRC comprises approximately 31,392 ha and the primary land use is the production of petroleum products. NPRC encompasses a series of east-west oriented anticlinal ridges surrounded by gently sloping alluvial plains. The steep-sloped ridges are highly dissected by drainages. Elevations range from 88 to 473 m (Woodring et al. 1932). Climate is characterized by hot, dry summers and cool, wet winters with frequent fog. Annual precipitation averages approximately 12.5 cm and occurs primarily as rain falling between November and April (National Oceanic and Atmospheric Administration 1992).

The vegetation association is classified as either Lower Sonoran Grassland (Twisselman 1967), Valley Grassland (Heady 1977), or Valley Saltbush Scrub (Holland 1986). Herbaceous vegetation consists primarily of annual grasses and forbs dominated by red brome (<u>Bromus madritensis</u>), slender oats (<u>Avena barbata</u>), Arabian grass (<u>Schismus arabicus</u>), red-stemmed filaree (<u>Erodium cicutarium</u>), and peppergrass (<u>Lepidium</u> spp.). Common shrubs include desert saltbush (<u>Atriplex polycarpa</u>), bladderpod (<u>Isomeris arborea</u>), and cheesebush (<u>Hymenoclea salsola</u>). Common potential prey for coyotes include black-tailed jackrabbits (<u>Lepus californicus</u>), desert cottontails (<u>Sylvilagus audubonii</u>), San Joaquin kangaroo rats (<u>Dipodomys nitratoides</u>), and Heermann's kangaroo rats (<u>D.</u>

heermanni). Sheep (Ovis aries) are grazed on approximately half of NPRC each spring, and potentially are available to coyotes as either prey or carrion.

METHODS

Food item use by coyotes was determined by stomach content analysis. From 1985-1990, a coyote reduction program was conducted at NPRC in an effort to reduce predation on endangered San Joaquin kit foxes (Vulpes macrotis mutica cf. Mecure et al. 1994). This program resulted in the killing of 591 coyotes (Cypher and Scrivner 1992). Stomachs were collected from some carcasses and frozen. Stomachs were later thawed, and contents were rinsed in a strainer and spread on a tray for identification. Many items were entirely or partially intact permitting easy identification. For disassociated items, mammalian remains were identified by comparing teeth and skull fragments with reference specimens. Unknown hair was identified using macroscopic (e.g., length, texture, color, banding patterns) and microscopic (e.g., cuticular scale and medulla patterns) characteristics (Mayer 1952, Moore et al. 1974). Diagnostic parts of birds (skulls, bills, feet, and feathers), reptiles (skulls, scales), and insects (exoskeletons) were collected for comparison to known specimens. Fruit seeds were identified using seed keys (Young and Young 1992).

Frequency of occurrence of items in stomachs was determined by age class and sex. Age classes were defined as pups (< 1 year), yearlings (1 year), and adults (≥ 2 years). Coyote ages were determined by cementum annuli analysis (Matson's Laboratory, Milltown, MT 59851). Age information was available for 215 stomach samples. Among age classes, only adult sample sizes (52 male, 33 female) were adequate for comparison of food item use between sexes. Arrays of food item

occurrences were compared among age classes and between sexes using contingencey table analyses employing a X^2 statistic. For statistical analyses, items were grouped as follows: leporids, rodents, livestock, birds, insects, and other items. P-values $\leq$ 0.05 were considered significant.

<div align="center">RESULTS</div>

Leporids occurring in coyote stomachs consisted primarily of black-tailed jackrabbit and occasional occurrences of desert cottontail. The most commonly encountered rodents were kangaroo rat (Heermann's, and San Joaquin), pocket gopher (Thomomys bottae), and California ground squirrel (Spermophilus beecheyi). Other rodents included San Joaquin pocket mouse (Perognathus inornatus), San Joaquin antelope squirrel (Ammospermophilus nelsoni), deer mouse (Peromyscus maniculatus), and house mouse (Mus musculus). Livestock found in stomachs included sheep, pig (Sus scrofa), and cow (Bos taurus) or goat (Capra hircus). Most livestock consumed by coyotes at NPRC probably was in the form of carrion (Cypher et al. 1994). Identifiable bird remains included California quail (Lophortyx californicus), roadrunner (Geococcyx californianus), western meadowlark (Sturnella neglecta), and eggs. Insects consisted primarily of beetles (mostly Eleodes spp.), Jerusalem cricket (Gryllacrididae), and grasshopper (Acrididae), and also included occurrences of cockroach (Blattidae), wasp (Vespidae), and dragonfly (Odonata). Other items included mule deer (Odocoileus hemionus), long-tailed weasel (Mustela frenata), coyote, gopher snake (Pituophis melanoleucus), side-blotched lizard (Uta stansburiana), skink (Eumeces spp.), grape (Vitis spp.), pear or apple (Malus spp.), peach (Prunus persica), mulberry (Morus spp.), and refuse such as paper, cellophane,

rubber, and cloth.

Food item use by adult coyotes did not differ significantly between males and females ($\underline{X}^2$ = 3.39, 5 df, $\underline{P}$ = 0.64) (Table 1). Among coyote age classes (Table 2), proportional occurrence of items differed significantly between pups and yearlings ($\underline{X}^2$ = 12.54, 5 df, $\underline{P}$ = 0.03) and between pups and adults ($\underline{X}^2$ = 25.43, 5 df, $\underline{P}$ < 0.01). Item use differed between yearlings and adults at the 0.1 significance level ($\underline{X}^2$ = 10.21, 5 df, $\underline{P}$ =0.07). Leporid was the most frequently occurring item for all age classes. Therefore, differences in item use among age classes were primarily due to use of secondary items. The most frequently occurring secondary items included rodent for adults, livestock and rodent for yearlings, and insect for pups.

DISCUSSION

Although coyotes are sexually dimorphic (Bekoff 1977), food item use by males and females at NPRC was similar. Sexual dimorphism apparently is not sufficiently significant such that sex-specific foraging efficiency is optimized by differential food item use, as has been observed among some mustelids (e.g., fishers [Martes pennanti]; Kuehn 1989).

Differential item use among coyote age classes may have been a function of age-specific foraging experience. Yearlings are less experienced than adults. Livestock, particularly carrion, and birds may have been more easily obtained by yearlings. Pups are less experienced hunters than either yearlings or adults, and they frequently consumed insects. Insects constitute easy prey for coyote pups (Wells and Bekoff 1982), and high use of insects by pups also has been observed in northeastern California (Hawthorne 1972). Differential item use may

reduce resource competition among age classes.

Differential use of food items by coyote age classes potentially could bias coyote food habit investigations. A disproportionate number of samples from a particular age class could result in data that were less representative of actual food item use by all coyotes in a given area. Unfortunately, correcting for such bias may be difficult because the age structure of a given coyote population is usually unknown and the age of the animal from which a food habit sample is collected (particularly for fecal samples) also is usually unknown. However, food habit data will probably not be significantly biased as long as sampling methodology does not result in a disproportionate number of samples from a particular age class (e.g., collecting an inordinate number of fecal samples from around dens with pups).

ACKNOWLEDGEMENTS

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Table 1.   Comparison of food item use between male and female coyotes at the Naval Petroleum Reserves in California, 1985-90.

Item	Frequency of Occurrence (%)	
	Male (n = 52)	Female (n = 33)
Leporid	75.0	78.8
Rodent	11.5	24.2
Livestock	11.5	18.2
Bird	11.5	15.2
Insect	1.9	9.1
Other	11.5	21.2

Table 2.   Comparison of food item use among coyote age classes at the
             Naval Petroleum Reserves in California, 1985-90.

Item	Frequency of Occurrence (%)		
	Pup (n = 67)	Yearling (n = 59)	Adult (n = 89)
Leporid	62.7	57.6	76.4
Rodent	19.4	27.1	18.0
Livestock	17.9	27.1	13.5
Bird	14.9	20.3	13.5
Insect	41.8	11.9	4.5
Other	26.9	25.4	14.6