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COYOTE INTERACTIONS WITH OTHER CARNIVORES

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Abstract: Coyotes (*Canis latrans*) occur sympatrically with several predators throughout their range. Habitat and food resources are similar, although the coyote typically utilizes a wider range of food items. Larger predators generally select larger prey, allowing predators of different sizes to coexist. Coyotes exhibit aggressive actions towards smaller predators, but in most cases they avoid contact with other predator species. Studies indicate that coyotes can exclude or displace foxes (*Vulpes vulpes*, *Urocyon* spp.), and an inverse relationship exists between abundance of coyotes and foxes. There is evidence suggesting that extensive reduction of coyote populations allows other predator populations to increase.

The coyote competes or coexists with several predators throughout its range. In Texas, the mountain lion (*Felis concolor*), bobcat (*Felis rufus*) and both red and grey foxes (*U. cinereoargenteus*) are predators that share resources with the coyote. Raccoons (*Procyon lotor*) and striped skunk (*Mephitis mephitis*) are 2 other small carnivores that are found in similar habitats and utilize the same foods. Research has identified the resources utilized by each of these species. However, dietary overlap alone does not imply competition is occurring. Studies of competition for resources, and the effects of such competition, are fewer and inherently more difficult to determine.

Food resources or prey availability is a major factor in determining an animal's use of an area or habitat. Numbers of predators and use of the same habitat and prey items can result in competition for resources. The purpose of this paper is to review current knowledge on: (1) resource use by, (2) interspecific relations between/among, and (3) population response to coyote control, in order to determine the impacts of coyotes on the carnivores listed above. Data included here illustrates how little has been done on interspecific relationships of predators in Texas or the Southwest.

Resource use

The coyote, mountain lion, bobcat, gray fox, raccoon, and striped skunk are found throughout the state. The red fox now ranges from the eastern part of the state to central Trans-Pecos region excluding south Texas (Davis and Schmidly 1994). These carnivores use similar habitats and can be found in close proximity to each other. However, each may

prefer specific habitat characteristics. Densities of each predator vary depending on area. Mountain lions prefer the dense cover found in the thick brush habitats of South Texas or the broken rough country characterized by rimrocks, boulder piles, cliffs and canyons of the Trans Pecos (McBride 1977). Foxes seem to prefer edges along brush and woodland areas where clearings have been created for pasture or cropland. They also do well around human habitations (Samuel and Nelson 1982). The raccoon prefers habitats with larger trees and are usually found close to water. However, they are a common predator in the brush habitats of South Texas and the semi-desert areas of West Texas (Davis and Schmidly 1994).

The prey items utilized by each carnivore are also similar, but the proportions are not similar. Prey items taken are related to size of the predator, habitat type, time of year, and abundance of prey. McBride (1977) analyzed mountain lion stomach contents and scats from the Trans Pecos and reported the major foods were deer (*Odocoileus* spp.), javelina (*Tayassu tajacu*), and porcupine (*Erethizon dorsatum*).

Leopold and Krausman (1986) documented the diets of mountain lions, bobcats, and coyotes in Big Bend National Park during 2 time periods. Their data indicate how 3 predators in the same area prefer certain prey items and how this can change when prey abundance changes (Table 1). A significant decline in the desert mule deer (*Odocoileus hemionus crooki*) population occurred during the second time period. Mountain lions increased the use of javelina when the deer population decreased.

Coyote and bobcat diets showed greater

Table 1. Average relative frequency of prey species in mountain lion, bobcat, and coyote scats for 2 time periods (1972-74 and 1980-81) in Big Bend National Park, Texas (after Leopold and Krausman 1986).

Prey	Mt. lion		Bobcat		Coyote	
	72-74	80-81	72-74	80-81	72-74	80-81
Deer	0.75	0.39	0.24	0.03	0.22	0.05
Javelina	0.15	0.38	0.06	0.02	0.10	0.02
Rodents	0.10	0.05	0.31	0.28	0.24	0.26
Rabbits	0.03	0.14	0.51	0.78	0.38	0.56
Birds, reptiles	0.04	0.03	0.14	0.18	0.17	0.22
Porcupine	0.07	0.01	-	-	-	-
Seeds, fruits	0.44	0.49	-	-	-	-

overlap. Rabbits and rodents were the primary items in bobcat diets. Deer were of secondary importance for both bobcats and coyotes, however when deer populations declined, bobcats and coyotes increased their use of rabbits. Coyote diets were most diverse and included seeds and fruits during the year. Leopold and Krausman (1986) suggested deer use decreased in the lion's diet because the deer population had declined. They speculated that because mountain lions were not preying as much on deer, less deer carrion was available for coyotes or bobcats.

Beasom and Moore (1977) studied the effects of a change in prey abundance on bobcat prey selection in South Texas. During one year 80% of the diet consisted of cotton rats (*Sigmodon hispidus*), cottontails (*Sylvilagus floridanus*), and white-tailed deer (*O. virginianus*). A total of 21 prey species was found in the diet. The following year there was an increase in cotton rat and cottontail populations. The diet changed to 96% cottonrats and cottontails, and only 6 different species of prey were recorded.

The diet of the fox changes during the year.

During winter, foods included 56% small mammals (cottontails, cotton rats, pocket gophers (*Geomys* spp.), pocket mice (*Perognathus* spp.), 23% insects (mostly grasshoppers [Acrididae]), and 21% birds. The late summer and fall diets included 30% persimmons and acorns, 26% insects, 16% small mammals, 14% birds, and 14% crayfish (Davis and Schmidly 1994).

Raccoons are considered to be 1 of the most omnivorous animals; their diet can include fruits, small mammals, birds, insects, carrion, garbage, grains, plant material, and most human foods (Sanderson 1987). Similar to raccoons, 78% of the striped skunk's diet consist of insects during different seasons of the year. The remainder of their diet may include small rodents, birds, reptiles, and vegetation (Davis and Schmidly 1994).

Interspecific interactions

Interspecific interactions can result in the death of a competing predator, or merely the exclusion of the subordinate species. Although aggressive

interactions occur, most predators avoid contact. To determine if a predator is being excluded by another, studies are conducted on the dietary overlap and habitat use during different weather conditions, seasons, or years.

Mountain lions, bobcats, and coyotes in central Idaho utilized different habitat and topographic characteristics during summer. Mountain lions and bobcats were associated with habitats providing stalking cover, whereas coyotes used open areas more frequently. The bobcat's inability to move through deep snow influenced use of areas in the winter. A greater degree of overlap of habitat and prey occurred during the winter as predators and prey moved to lower elevations

Dietary overlap in winter resulted in mountain lions killing 4 bobcats and 2 coyotes near feeding sites. These attacks involved mountain lions defending or usurping food caches (Koehler and Hornocker 1991) Boyd and O'Gara (1985) reported that mountain lions were a major cause of mortality for bobcats and coyotes. Five of 8 bobcats and 3 of 7 coyote deaths were attributed to mountain lions apparently protecting food caches. Analysis of mountain lion food habits have found trace amounts of coyote, bobcat, and fox present in stomach contents (Robinette et al. 1959, Krausman and Ables 1981).

It has long been believed that coyotes out-compete bobcats, resulting in reduced populations of bobcats. Major and Sherburne (1987), conducting research in Maine, indicated that coyotes and bobcats shared home ranges, habitat use, and diets, but there was no data to support interference competition. Coyote and bobcat diets and habitat use overlapped in Oregon, however there was little competition between the two because prey populations were high (Witmer and deCalesta 1986).

Litvaitis and Harrison (1989) studied bobcat-coyote relationships during a period of coyote expansion in Maine. Seasonal habitat use by coyotes varied more than bobcats, perhaps because of the greater variety of food items in coyote diets. They also indicate that bobcat food habits have changed since the arrival of coyotes to Maine.

Litvaitis and Harrison (1989) found that coyotes did not displace or exclude bobcats. They speculated that coyotes have reduced the carrying

capacity of bobcats by reducing prey availability and suggested that bobcat numbers will decline and stabilize at lower densities as a result of increasing coyote densities. They also report one incident of coyotes preying on a bobcat. Under the right circumstances it is not impossible for a coyote or group of coyotes to kill a bobcat.

Coyotes are believed to influence the distribution and abundance of red foxes (Sargeant 1982). Sargeant et al (1993) reported study areas that had increased coyote track counts had a corresponding decrease in fox track counts. Major and Sherburne (1987) reported simultaneous locations of coyotes, bobcats, and foxes that shared ranges maintained distances between individuals. Avoidance is believed to be the principal motive for this spatial segregation.

In areas where coyotes and red fox occur sympatrically, fox territories are located on the edges or outside of coyote territories. These data supported the conclusion of interference competition between foxes and coyotes (Major and Sherburne 1987). Schmidt (1986) suggested that red foxes are excluded or displaced from areas inhabited by coyotes. The fox seems to do well around human habitations because of the lower number of coyotes (Samuel and Nelson 1982)

Schmidt (1986) cited references indicating that coyotes kill red foxes, although he indicated that coyotes are an insignificant source of mortality. Sargeant and Allen (1989) reported on coyotes' antagonistic behavior towards foxes and identified instances of coyotes killing foxes. However, they also cited radio-telemetry studies that found no mortality of foxes in areas inhabited by coyotes

Population responses from coyote control

Although there have been studies conducted on the overlap of diets and habitat use between/among predators, there have been few studies designed to study the response of predators to removal of coyotes. If competition exists between coyotes and other predators, the reduction of coyotes should reduce competition and allow other predator populations to increase.

Toxicants, such as strychnine and compound 1080, were used in coyote control programs until their uses were banned in 1972. Compound 1080

was used extensively in western states (including Texas) as an effective and selective predicide for coyote management (Nunley 1977). Nunley (1977) and Schmidt (1986) indicated that coyote population trends decreased in western states with the initial use of compound 1080. Nunley (1977, 1978) reviewed United States Fish & Wildlife Service catch records from New Mexico to look at coyote control efforts on non-target species. He indicated that the use of Compound 1080, which increased substantially in 1950, resulted in a decrease in coyote numbers and a subsequent increase in bobcat, badger (*Taxidea taxus*), skunk, and fox numbers. This response was believed to be a result of reduced competition for food and not a reduction in predation by coyotes. Similar trends occurred in other western states, therefore Nunley (1978) deemed it unlikely that the population responses among other predators was caused by natural cycles in prey abundance.

Robinson (1961) and Linhart and Robinson (1972) reported on the densities of bobcat, skunk, badger, raccoon, and fox in areas under sustained coyote control. Trapper catch records in New Mexico, Colorado and Wyoming were used as an index to determine fluctuations in densities. Thus high densities of various carnivore species would be reflected by high catch records. They concluded that coyote control was having little effect on carnivore populations. Data from Wyoming showed that fewer coyotes were caught, but an increase in captures of bobcats, badgers, raccoons, and red fox were noted.

A year-round intensive coyote control program was conducted in Andrews County, Texas to study the population response of selected mammalian predators (Henke 1992). The relative abundance of bobcats, badgers, and gray fox increased on controlled areas after initiation of coyote removal. No change was detected in skunk populations.

Conclusions

Sympatric predators often share habitats and utilize similar foods depending on location, season, and prey availability. Decreases in prey abundance can result in increased competition and increase interspecific interactions. Differences in size allow similar predator species to coexist in the same area (Rosenzweig 1966). No studies have identified coyote predation as a cause for limiting or decreasing other predator populations. Studies do indicate that coyotes can and do exclude or displace

foxes, and there is an inverse relationship between abundance of coyotes and foxes. No studies show that coyotes exclude bobcats, raccoons, or skunks. There is evidence to indicate that extensive reduction of coyote populations allows other predators to increase. This response is probably related to the increase in food availability.

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