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William F. Andelt
Kansas State University, Garden State, Kansas

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William F. Andelt, Kansas State University, 1501 Fulton Terrace, Garden City, KS 67846

INTRODUCTION

During the past 2 decades, numerous research projects have been conducted to gain a better understanding of coyote (Canis latrans) behavior and ecology which could be used to reduce livestock losses to predators. This paper synthesizes some of these investigations to provide some insight into methods of reducing livestock losses to coyotes.

SOCIAL ORGANIZATION

The coyote has been described as a moderately social canid with the typical social unit being the mated pair (Fox 1975). However, recent research has shown that coyote social structure varies throughout its range. The majority of coyotes was found existing in relatively large groups (3-8 individuals) in unexploited areas of Wyoming (Camenzind 1978), Alberta (Bowen 1978, 1981), and Texas (Andelt 1982). Relatively smaller coyote groups generally have been shown/thought to exist in exploited areas (Chesness and Bremicker 1974, Hibler 1977, Althoff and Gipson 1981), suggesting that the reduction in group size was a result of human exploitation. However, Bekoff and Wells (1980) reported a low degree of coyote sociality in an unexploited area, Rocky Mountain National Park, Colorado.

Two general social types of coyotes, residents and transients, have been reported in several studies (Hibler 1977, Althoff 1978, Andelt and Gipson 1979x, Litvaitis and Shaw 1980, Bekoff and Wells 1981, Bowen 1981, Andelt 1982). Resident coyotes generally restricted their movements to relatively small home ranges (<10 squre miles, 26 km2) and usually associated with other coyotes while transients ranged over relatively larger areas (>10 square miles, 26 km2) and were usually found above. Resident coyotes composed 75 to 90% of the populations studied in Wyoming (Camenzind 1978), Alberta (Bowen 1981), and Texas (Andelt 1982). Resident adult coyotes occupied home range areas that varied geographically from approximately 2 to 10 square miles (5 to 20 km2) and appeared to be inversely related to coyote density (Andelt 1982).

Several studies (Gipson and Sealander 1972, Hibler 1977, Althoff 1978, Berg and Chesness 1978, Bowen 1978, Camenzind 1978, Andelt and Gipson 1979x, Andelt 1982, Messier and Barrette 1982) have reported or suggested that resident mated pairs and groups are highly territorial. This territorial behavior and data suggesting that only certain coyotes are responsible for depredations (Andelt and Gipson 1979b) can be used to more effectively limit predation on domestic livestock. The territorial behavior suggests that predation on domestic livestock can be curtailed by moving livestock to other pastures outside the territory of depredating coyotes to areas where non-killer coyotes are territorial; th4.0' practice may not be practical for some/many producers. The territorial behavior also suggests that those coyotes **occupying the area where depredations** are occurring are likely responsible for the losses. Trapping or otherwise removing afew coyotes within the territory (within 1 to 2 miles, 1.6 to 3.2 km, of the loss site) of these depredating coyotes should solve the depredations; this removal

technique has been successful in limiting livestock losses to coyotes (F. R. Henderson, personal communication).

HABITAT PREFERENCE

Andelt and Andelt (1981) reported that coyotes in an agricultural section of Nebraska preferred grass draws, woods, and pastures for nighttime hunting and travel while cultivated fields generally were avoided. Targeting **traps, snares,** and M44s in areas that are preferred by coyotes should increase the success of removing depredating coyotes.

PREDATORY BEHAVIOR

Fox (1969) and Lehner (1976) reported coyote predatory behaviors which include identifying, capturing, killing, and consuming prey are shaped through experience; inexperienced coyotes appear to kill mammalian prey by accident and consumption usually occurs only after the flesh has been exposed. However, Connolly et al. (1976) reported that prey-naive food-deprived coyotes fed on sheep immediately after killing them. If experience is required for some coyotes to associate prey with a food item, scavenging on livestock carcasses that are left on the range may enhance the coyote's ability to identify livestock as prey items. Allowing livestock carcasses to remain on the range may also enhance subsequent depredations by attracting coyotes to the area (Boggess et al. 1980).

Z'he relationship between coyote foraging ecology and social organization has been studied in Wyoming (Camenzind 1978, Bekoff and Wells 1980, 1981), Alberta (Bowen 1981) and Texas (Andelt 1982). Bowen (1981) found a direct relationship between coyote group size in winter and the percenhage deer in the diet while Andelt (1982) found no relationship between foraging ecology and coyote group size. Camenzind (1978) and Bekoff and Wells (1980, 1981) indicated that the advantage of larger coyote groups was in defending carrion from other coyotes during winter. If there is a direct relationship between coyote group size and consumption of large prey, human exploitation of coyote populations, which apparently reduces group size as noted above, may lead to a reduction in predation on domestic livestock.

BEHAVIORAL AND EVOLUTIONARY IMPLICATIONS OF PREDATOR CONTROL TECHNIQUES

Coyote predation of domestic livestock usually has been controlled through predator population reduction, removal of "killer coyotes," or preventative husbandry techniques. The behavioral and evolutionary implications of these control methods should be explored to provide a better understanding of the proximate and ultimate effects of these methods on subsequent coyote depredations.

Individual coyotes have been killed by hunting, trapping, M44s, and toxicants. Sport hunting and trapping of coyotes may proximately reduce depredations by removal of a portion of the population which should provide additional wild prey (if prey abundance or availability is limited) for the remaining coyotes and subsequently reduce their demand for livestock. However, sport hunting and trapping of coyotes likely selects for a behavioral phenotype which may be better adapted to avoid control measures targeted toward the removal of depredating coyotes. Removal of coyotes utilizing predator calling techniques likely will increase depredations by selecting against coyotes adapted to preying on rabbits

(Lepus spp., Sylvilagus spp.), particularly rabbits in distress. Perhaps, inventing/using predator calls that "bleat" like a lamb and shooting coyotes that are attracted to this distress call may reduce future depredations.

Till and Knowlton (1983) reported that sheep losses to coyotes was greatly curtailed following the removal of 2 adults and their pups or only the pups of coyotes responsible for the losses. If the tendency to kill domestic livestock is inherited or learned by the pups, destroying pups of depredating adults should have positive evolutionary implications for reducing future losses.

Producers that are not suffering livestock losses to coyotes may best avoid subsequent losses by not removing the non-killer coyotes that are occupying their rangeland (Boggess et al. 1980). Removal of the non=killer coyotes will create a territorial vacancy which may be filled by coyotes more prone to kill livestock.

Removal of coyotes with toxic drop baits or draw stations may reduce immediate depredations by decreasing population density, but the ultimate effect may be to select against carrion feeding coyotes and for coyotes more prone to killing live prey including livestock.

The use of toxic collars attached to sheep for predator control has positive proximate and ultimate implications. Removal of specific coyotes that kill sheep with this method should select against killer coyotes. However, problems with targeting, environmental effects of lost collars, and cost may curtail wide-spread application of this technique.

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