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# BEHAVIORAL EFFECTS OF REMOVAL OF COYOTE PUPS FROM DENS

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**ABSTRACT:** Predation by coyotes (*Canis latrans*) upon domestic sheep is a serious economic problem for some sheep producers in the United States. One of the few depredation control techniques that has been quantitatively analyzed is denning, the process of removing pups from the dens of depredating coyotes. The significance of coyote prey selection and territoriality are discussed with regard to the efficacy of denning and possible future depredation management strategies.

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## INTRODUCTION

Predation by coyotes (*Canis latrans*) continues to be a significant economic drain on individual sheep producers in the United States. Coyote predation typically accounts for the largest share of overall predation loss (Balsler 1974). The value of sheep killed by coyotes in the United States has been calculated at numerous times and by various methods; the latest survey that indicated that in 1990 coyotes killed over 300,000 sheep and lambs valued at over \$13.5 million (USDA 1991).

The USDA-APHIS-Animal Damage Control Program is directed toward alleviating these losses. The ADC Program presently employs depredation control methods focusing on "offending coyotes" or "offending populations." Coyote depredation control has been discussed by many authors (Young and Jackson 1951, U. S. Fish and Wildlife Service 1978, Wade 1982, Fall 1990), and although the effectiveness of predation control has been discussed in general terms (Cadieux 1983, Wagner 1988), few control methods have been quantitatively analyzed. Because of increased public concern (USDA 1990, General Accounting Office 1990), it is apparent that the need exists to evaluate current and perhaps new depredation control techniques.

One technique that has been critically evaluated is "denning," the practice of seeking out the dens of depredating coyotes and removing the young and/or adult coyotes. The purpose of this paper is to discuss the role of coyote prey selection and territoriality in the effectiveness of denning, experimental evidence that denning alters coyote prey selection, and some management implications.

## COYOTE PREY SELECTION

Coyotes produce one litter of pups a year, generally in April or May (Hamlett 1938). During this time period, domestic lambs are born on rangeland throughout the western United States. Traditionally, coyote predation levels on lambs are highest during the spring and early summer when coyote pups are still dependent upon adults (DeLorenzo and Howard 1976, Nass 1977, Tigner and Larson 1977).

Coyotes are opportunistic feeders and can meet their energy requirements by preying on mammals from rodent sized up to large ungulates (Nowak and Paradiso 1983). Several studies have shed some light on the relationship of coyotes and their food supply during the spring and summer period. Hamlin et al. (1984), determined that coyotes fed mainly on rodents, and the high rodent population buffered coyote predation rates upon mule deer (*Odocoileus hemionus*) fawns. Harrison and Harrison (1984) found that white-tailed deer (*Odocoileus virginianus*) fawns made up the bulk of

Coyotes' diets during the pup rearing season. In Yellowstone National Park, Wyoming, Crabtree (pers. comm.) reports elk (*Cervus elaphus*) calf remains as one of the most common items found at coyote dens, and he felt that coyotes may concentrate on these large sized prey items while provisioning pups. Stoddart (pers. comm.) has data which indicates natural prey abundance influenced coyote density, which in turn appeared to influence coyote predation rates upon domestic sheep. The general pattern seems to be that adult coyotes tend to prey upon the most energetically "efficient" food items available at this time of the year (Pyrah 1984).

Royama (1970) implied that adult predators may feed their young more "profitable" prey items than they consume themselves as a means of maximizing their hunting efficiency. It is possible that the most "profitable" prey available to coyotes in domestic sheep lambing areas are domestic lambs. Often the need to procure food for litters of pups results in large losses of domestic livestock (Young and Dobyns 1945). Adult coyotes may travel relatively great distances to obtain domestic lambs (Young and Jackson 1951, Lemm 1973), when less "profitable" (i.e. smaller and/or less abundant and/or more difficult to capture) food items are presumably found closer to their pups. Andelt and Gibson (1979) even suggest that coyotes preying on domestic livestock may shift home range areas closer to depredation sites during gestation and pup nursing periods. Throughout much of the western United States, domestic lambs are available for coyotes feeding pups, and adult coyotes may prey on lambs as a means of maximizing their hunting efficiency (Till and Knowlton 1983). The point at which adult coyotes "switch over" from typical prey of rodents and lagomorphs to domestic lambs during pup rearing probably depends on alternate prey type, abundance and availability, coyote density, and possibly social factors such as learned behavior. Some coyotes may have learned through mimicry of adults or through experience to recognize lambs as a "preferred" food source, and thus selectively seek out lambs when ecological conditions indicate these coyotes' diets should consist of other items. Extensive studies in sheep areas relating alternate prey abundance, coyote density, and domestic sheep depredation rates during the pup rearing season have not been conducted with the possible exception of Stoddart and Griffiths (in prep.). Provisioning pups by adult coyotes is a complex phenomenon that is not completely understood.

## COYOTE TERRITORIALITY

Coyote social systems, at least in unexploited areas, consist of resident, territorial pairs or groups interspersed with transient animals (Camenzind 1978, Bowen 1978, Andelt

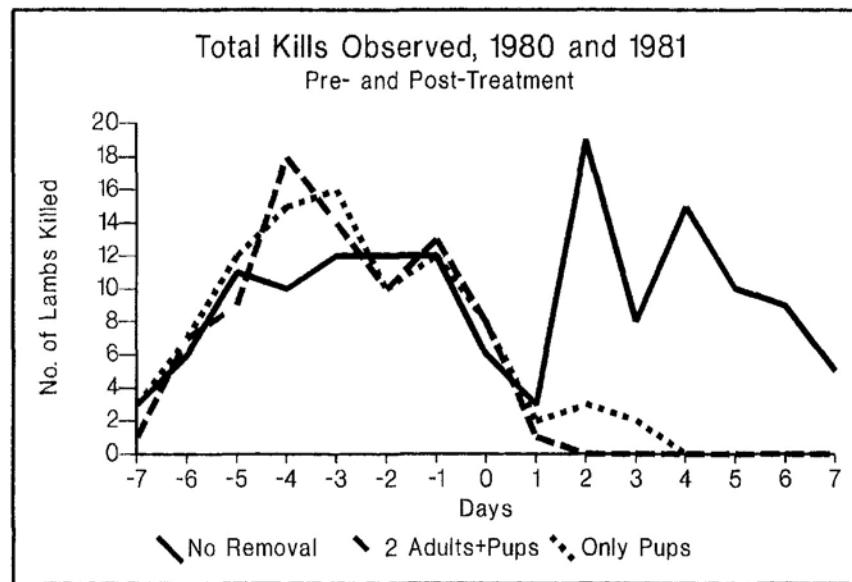


Figure 1. Domestic lamb losses before and after coyote removal strategies. (From Till and Knowlton 1983).

1985). Coyote home range and territoriality have been investigated in almost every habitat coyotes now occupy (e.g. Hibler 1977, Hilton, 1978, Bowen 1978, Bekoff and Wells 1986, Holzman et al. 1992).

Home range size may vary somewhat according to season (Laundre and Keller 1984, Crabtree 1989); however, most coyote movement appears to be that of transient or dispersing young animals rather than home range shifts of resident adults (Althoff 1978, Roy and Dorrance 1985). In unexploited populations, breeding adults may remain in the same home range for extended periods (Camenzind 1978, Gese et al. 1989). This phenomena may also occur in exploited populations (Althoff and Gibson 1981, F. T. Christensen, pers. comm.). Within a home range, den areas are thought to be traditional (Young and Dobyns 1945, Pyrah 1984), and spacing between dens of adjoining territories probably depends on many factors, including habitat quality and food base (Gier 1968, Althoff 1978). Camenzind (1978) found that coyote dens were often located near territorial boundaries, which he speculated may have been a function of available denning habitat.

Home range studies generally support the hypothesis that coyote territoriality is restricted to breeding groups. Knowlton et al. (1986) provided evidence that only territorial adult female coyotes produce pups. A territory may be a necessary prerequisite for coyotes to successfully reproduce (Windberg and Knowlton 1988), and the survival of pups may depend on maintenance and defense of the territory (Messiere and Barrette 1982). Wade (1978) maintains that reproductively active, and therefore territorial, coyotes may offer a greater threat to livestock than nomadic or transient coyotes because of the difference in survival strategies.

#### EXPERIMENTAL EVIDENCE ON COYOTE REMOVALS

Experienced depredation control personnel have linked domestic lamb losses with adult coyotes providing food for pups (Wade 1978). Anderson (1969) believed that predation should cease when pups are removed. Till and Knowlton

(1983) designed an experiment in which domestic sheep flocks suffering from coyote depredation were monitored before and after several predation control options were initiated. The option of removing no coyotes provided baseline information. Removal option of (1) offending adults and their litters of pups, and (2) removal of only the litters of offending adults, followed by monitoring of lamb losses, provided a measure of the efficacy of removing depredating adult coyotes and/or their pups. Results of this study indicate that removing only litters of pups was nearly as effective in stopping losses as removing the adults (Fig. 1). This suggests that when pups and their attendant energy demands are removed, adults no longer need to maximize their hunting efficiency and depredations upon lambs is often reduced or eliminated. Figure 2 represents a hypothetical model of what may have happened after removal of pups in this experiment.

#### MANAGEMENT IMPLICATIONS

Depredation control has been and will continue to be one of the most controversial issues in natural resource management (Wagner 1988). Future direction for the control of coyote depredations upon domestic sheep may involve more intensive management programs, and the need to define predation problems in biologic terms will become more important (Knowlton 1989). The behavioral shift caused by removing pups from adult coyotes that are killing domestic livestock has been established by Till and Knowlton (1983). More research is needed to verify the behavioral effects of removing coyote pups from depredating adults under a variety of ecological conditions. Several additional management alternatives based on this experimental result may warrant investigation. Simply removing coyote pups from depredating coyotes is quite possibly not feasible in some areas of coyote/domestic sheep conflict, the process requires a great deal of time and effort, and its utility may be limited in the future by societal pressures. The next logical step may be the development of a "preventative" mode of damage control in which the behavioral mechanism leading to depredations is excised. Without the pressure to feed litters of pups, coyotes

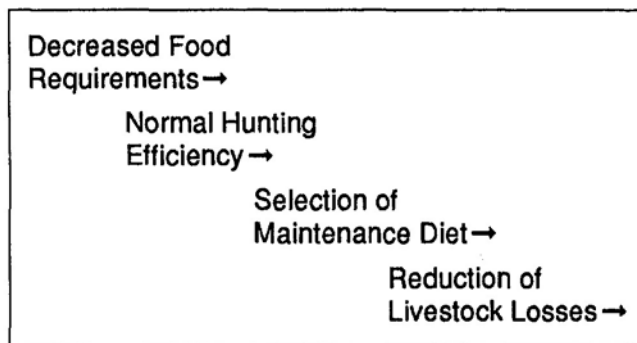


Figure 2. Hypothetical model of coyote foraging strategy in domestic livestock areas after pups are removed.

may in some situations select rodents, lagomorphs, or other alternate prey over domestic lambs (Crabtree 1989). Resident adult coyotes could be sterilized and released (Knowlton 1989), or a means to limit reproduction through the use of chemosterilants (Basler 1964) could be developed. Should these strategies be implemented, a critical factor would be the territorial behavior (or lack thereof) shown by adult coyotes which no longer have, nor are capable of, producing pups. Observations of penned coyotes indicates territorial behavior is still pronounced even among sterile coyotes (Knowlton pers. comm.). Field observations of "dry pairs," i.e. a male and a barren female coyote, acting aggressively toward an intruding dog and displaying such territorial behavior as howling and scent marking has been noted (Till unpubl. data, V. E. Dorn, pers. comm.). The mosaic of coyote territories in an area is disrupted by removing resident adult coyotes, which may cause constant social flux in the coyote population (Crabtree 1989), and a reservoir of transient coyotes exists to quickly occupy vacant territories (Windberg and Knowlton 1988). Boggess et al. (1980) suggested that it may be more practical to allow non-depredating coyotes to remain in livestock areas than contend with immigrating coyotes that may or may not cause damage.

Many unanswered questions remain about the social system and related coyote foraging strategies in exploited populations. Future research may include the establishment of a system in which sterile adult coyotes remained on territories, excluding other coyotes. Freed from the physiological demands of provisioning litters of pups, these coyotes should reduce or eliminate their consumption of domestic lambs. Because exploited coyote populations often overlap livestock producing areas, maintenance of such a system would no doubt require the work and cooperation of several entities. However, this could be an example of a more intensively managed predation problem which in limited areas may satisfy not only those concerned with livestock production but those who value coyotes for aesthetic reasons.

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