

Thomas F. Ogle

Zoology Department
Washington State University
Pullman, Washington

Predator-Prey Relationships between Coyotes and White-tailed Deer

Introduction

A study was made to understand better the importance of coyote predation on white-tailed deer in northeastern Washington. It was directed toward answering these questions: 1) How important are deer to the over-all diet of the coyote? 2) What segment of the population is most often taken? 3) Under what conditions are deer vulnerable to predation?

Study Area

The study area occupies 800 square miles in the northwestern part of Stevens County, Washington (Fig. 1). The western half of the area is drained by the Columbia River, the eastern half by the Colville River. The Huckleberry Mountain Range forms the height of land, and has an average elevation of 4500 ft. Rainfall is light; the 10-year average for 1957-67 was 17.36 in. annually as compiled by the U.S. Weather Bureau in Colville.

The vegetation forms a complex mosaic which varies with respect to slope, elevation, and rainfall. Blue bunch wheatgrass (*Agropyron spicatum*) and bluegrass (*Poa* spp.) occur on dry sites. Ponderosa pine (*Pinus ponderosa*), larch (*Larix occidentalis*), douglas fir (*Pseudotsuga menziesii*), and grand fir (*Abies grandis*) occur with increasing moisture. Snowberry (*Symphoricarpos albus*), mountainspray (*Holodiscus discolor*), mallow ninebark (*Physocarpus malvaceus*), and huckleberry (*Vaccinium* spp.) are common understory species.

Materials and Methods

Importance of deer in the coyote diet was investigated by analyzing stomach and scat contents. Coyotes were trapped between June and September 1967, and February and June 1968. Contents of 31 stomachs were analyzed, and the volume occupied by each item was estimated. Only 12 coyotes showed items in their stomachs that could be classified as food; the remaining 19 were either empty or contained only bait. Percentage of frequency of occurrence and the aggregate percent volume (Martin *et al.*, 1946) were calculated. During the same period 102 coyote scats were analyzed. Scats were broken apart and the items identified. Hair, teeth, claws, and portions of skulls provided means for identification. Percent frequency of occurrence was calculated. A collection of small mammals was made on the study area which provided means of identifying hair and bones recovered from scats.

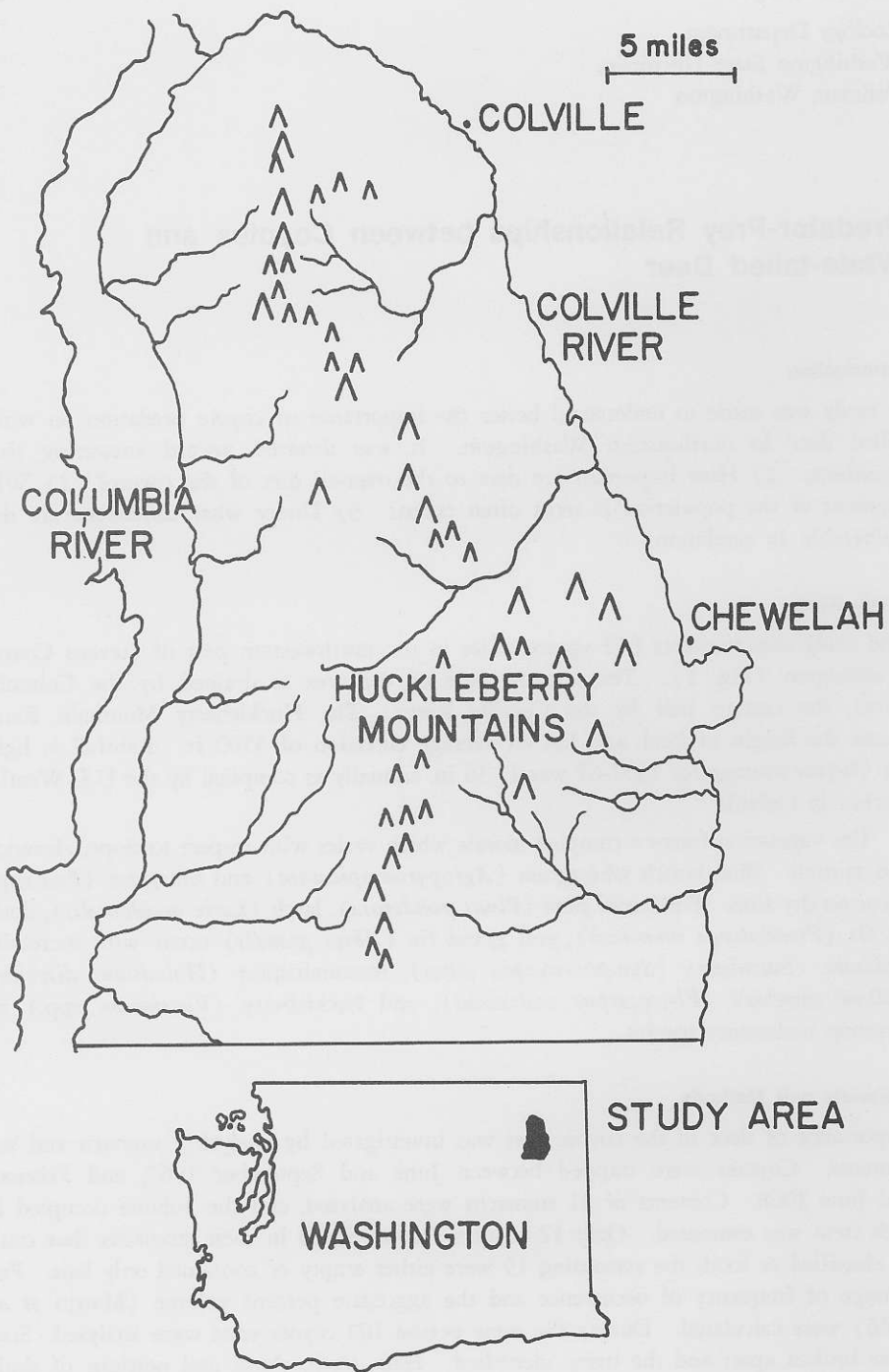


Figure 1. Study area in northeastern Washington.

Lower jaws from 43 deer found dead in the field were collected to study the age-classes most susceptible to mortality. Tooth wear was the sole criterion on which estimated age was based (Severinghaus, 1949). Eleven deer which were known to have died from causes other than predation were used to study feeding patterns of coyotes on carrion. This provided a means to distinguish deer killed by coyotes from those fed upon secondarily. Several coyote feeding characteristics were outstanding in freshly killed deer (dead from one month to less than 24 hrs.) found in the field that were never observed in deer known to have been fed upon as carrion. These characteristics are listed in order of constancy in Table 1. The patches of hide

TABLE 1. Criteria used to distinguish deer killed by coyotes from those fed on as carrion.

1) Large patches of hide leading to the carcass
2) Separation of vertebral column in the thoracolumbar region of adults and at the atlas of fawns
3) Nasal and maxillary bones chewed away
4) Ribs, vertebrae, and scapulae chewed ¹
5) Limbs widely scattered ¹

¹General characteristics of coyote feeding whether on coyote-killed deer or carrion.

are thought to result from biting and tearing action of attacking coyotes. This criterion is believed to be the most reliable in determining whether or not the animal was killed by coyotes. Observers have reported that deer under attack frequently have large areas of hide torn from the muscles of the belly and rump regions (local residents, pers. comm.; Cahalane, 1947; Cowan, 1947; Pimlott *et al.*, 1969). Patches of hide most often contained long, white hairs which indicate that they came from the rump or belly. Such patches were never found near deer that were known to have died from other causes, even though coyotes were known to have fed secondarily on the carcasses.

Results and Discussion

Importance of Deer to the Coyote Diet

Major sources of prey were rodents and deer; importance of each varied according to seasonal availability. From late winter to spring deer occurred most often in scats, and rodents were second. During this period porcupines and voles (*Microtus* spp.) made up the bulk of rodent occurrences. In late spring and summer rodents and deer reversed their importance in the diet; rodents became the primary food and deer were second (Fig. 2). Analysis of 12 coyote stomachs collected between May and September supports the finding from scat analysis that rodents were the primary food during this period (Table 2) but the sample size is too small to be conclusive. Rodents

TABLE 2. Analyses of food items in coyote stomachs from May to September.¹

Food Class	Percent Frequency Occurrence	Aggregate Percent Volume
Rodent	66.0	40.6
Deer	41.6	17.4
Insects	25.0	2.4
Plants	8.3	2.2

¹These data are based on the analyses of 12 stomachs.

SEASONAL DISTRIBUTION OF FOOD ITEMS FROM SCAT ANALYSIS EXPRESSED
IN PERCENT FREQUENCY OF OCCURRENCE

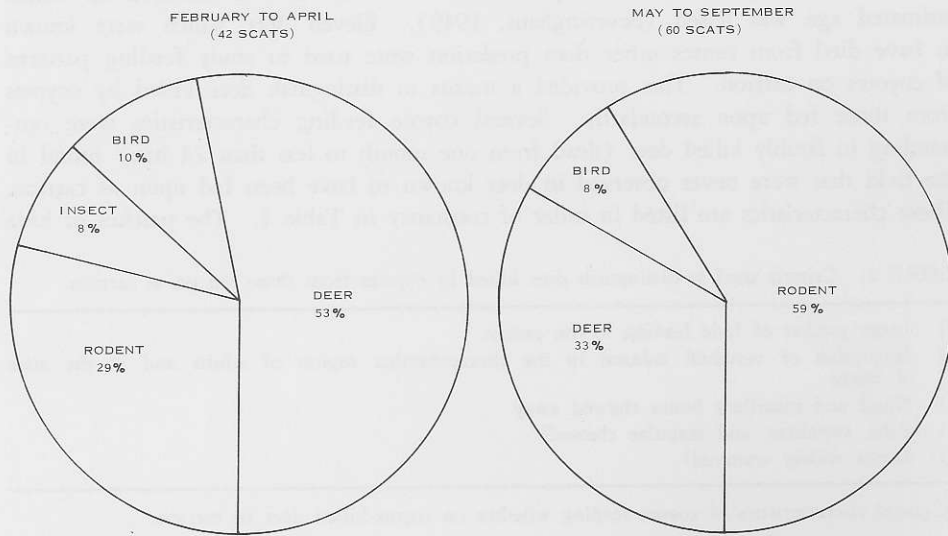


Figure 2. Seasonal distribution of food items from scat analysis expressed in percent frequency of occurrence.

first appeared as the primary food near the end of April when ground squirrels first became available. Fawns comprised 59 percent of the deer remains found in scats and stomachs of coyotes. Almost 80 percent of all rodents eaten were ground squirrels.

By mid-August ground squirrels began to estivate and were unavailable to coyotes. Thus, the availability of food in late August may be a limiting factor to the coyote population since the major summer source of prey becomes unavailable, and fawns are less susceptible to predation and accidents. Such a situation probably exerts a selective pressure against pups since they are more inexperienced and weaker. Emaciated pups in starving condition have been frequently sighted on the study area in early September and help substantiate this conclusion (local residents, pers. comm.).

Predation in Relation to Age of Deer

Age-classes most susceptible to mortality were determined from 43 deer believed to have died from natural causes (*i.e.*, environmental stresses, old age, or predation). These deer were found in the field between February and August. Male deer represented in the collection series had already lost their antlers indicating that they had died sometime after January, more than two months after the close of deer hunting season. This fact and the disparity between the number of mid-age and old-age classes represented suggest that mortality caused by hunting was minimal. Of the 43 carcasses studied, 19 fit the criteria for coyote-killed deer. Others showed characteristics of coyote feeding (Table 1) but probably died from causes other than predation.

Data in Table 3 show that deer under two and over six years of age are most susceptible to mortality factors, including predation. Deer between two and six years of age appear most secure from mortality. Sex ratios in all age-classes were essentially equal. Fawns and yearlings seemed to be most vulnerable to coyotes, perhaps because

TABLE 3. Age distribution of dead deer.

Age	Number of Deer ^a	Percent of Total
Fawn	19 (10) ^b	53.5 (68.5) ^c
Yearling	6 (3)	
2 to 5 years	3 (1)	6.9 (5.3)
6+ years	17 (5)	39.6 (26.2)

^a Sex ratios were equal in all age-classes.

^b Numbers in parentheses indicate coyote-killed deer.

^c Percent of total considered killed by coyotes.

they are inexperienced, weaker, and more dependent upon adults than deer in older age-classes. Almost 69 percent of dead deer considered coyote-kills were fawns or yearlings. Old deer, six-plus years old, comprised almost 40 percent of the dead deer but only 26 percent of coyote-killed deer. That coyotes may pay special attention to fawns is indicated by noting that 53 percent of dead fawns were considered coyote-killed whereas in the six-plus class only 29 percent were coyote-killed. More deer of all age-classes died from natural causes other than predation, suggesting that coyote predation was of a compensatory nature and not limiting to the deer population. The latter conclusion is further supported by the fact that the study area supports a general buck hunting season, a general doe season, and a late buck season.

This pattern of mortality has been described in a number of wild ungulate populations (Murie, 1944; Mech, 1966; Pimlott *et al.*, 1969), and even in the absence of canid predators (Murie, 1940; Pimlott, 1967; Houston, 1968).

Factors Which Contribute to Deer Predation

Most of the dead deer considered coyote kills were found in grassy fields where deer were known to congregate to feed in late winter. In reconstructing the chases it was noted that 65 percent of the dead deer were found on steep hillsides and that patches of hide were almost always uphill from the carcass which suggests a downhill chase. Murie (1940) stated that coyotes may systematically chase deer down slopes and catch them at the bottom. However, Rutter suggested that deer may select the roughest and most difficult terrain in escaping from wolves (Pimlott *et al.*, 1969). That one of these possibilities obtained on the study area is further supported by the following observation. Five coyote-killed deer were found in early spring on Rice Mountain. The mountain has steep slopes and talus slides on the east- and west-facing slopes; the north- and south-facing slopes are gentle with very little exposed rock. All of the dead deer were restricted to the former areas. Thus, it appears that deer are at a distinct disadvantage on steep slopes, and are highly vulnerable to coyotes in such situations. However, the possibility that deer attempt to escape coyotes by choosing rough terrain cannot be ruled out.

Deer in the old-age class may become vulnerable to predation due to a variety of degenerative changes associated with advancing age. This study provided only limited insight into one of these factors. One-third of the old deer exhibited necrotic jaws. Murie (1944) discussed this condition in detail and concluded that it may become a serious handicap to survival.

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Errata

Volume 40, no. 3, 91 (1966) *Podabrus marina* Fender should be *Phausis marina* Fender.
