Effects of 1988 Fires on Ecology of Coyotes in Yellowstone National Park: Baseline Preceding Possible Wolf Recovery

Robert L. Crabtree ✦ Maurice G. Hornocker
Wildlife Research Institute
Moscow

✦ Introduction

The ecology of natural, unexploited coyote populations is, for the most part, unknown. Whether research is management-oriented or of evolutionary significance, the ecology of natural coyote populations must be understood in the absence of human exploitation. Yellowstone National Park should provide the ideal situation for such an investigation. Not since Adolph Murie's landmark study 50 years ago (Murie 1940) has a comprehensive, objective study of coyote ecology been undertaken in the Yellowstone ecosystem.

The objectives of this project are to:

1. assess effects of 1988 fires on coyote survival, reproduction, activities, pack and territorial dynamics,
2. estimate coyote population density and quantify their ecological role preceding potential wolf *(Canis lupus)* restoration,
3. quantify the effect of winter elk carrion availability and mule deer *(Odocoileus hemionus)* density on coyote population dynamics,
4. describe coyote seasonal responses to movements of elk and mule deer,
5. test if coyote pack size is related to prey size, territory size, size of litters, and pup survival,
6. describe interspecific interactions among scavengers, and
7. document predation on ranch livestock by coyotes from Yellowstone; and on allotments on National Forests adjacent to the northern range.

✦ Methods

General Social Ecology and Population Demography

Adult coyotes are captured with padded, offset leghold traps (Soft-catch, Woodstream, Inc.) with attached tranquilizer tabs (Balser 1965) and other injury-minimizing (and avoidance of non-target species) modifications developed by Crabtree (1988). The sex, weight, estimated age, condition indices (Crabtree 1988), presence of scars and unique marks,

and description of genitalia and mammae are determined for each coyote. The vestigial first premolar is extracted from an anaesthetized lower jaw for age analysis via cementum annuli examination. Each coyote is ear-marked and fitted with a modified (Crabtree 1988) 3.5-year radio collar weighing 3% of body weight. Blood samples are taken for serological analysis and DNA fingerprinting.

All baseline ecological data are collected according to 3 biological seasons: **whelping**, April to mid-June; **pup-rearing**, July through September; and **winter** (breeding), November through March. At the end of each biological season pre-defined transects are canvassed to collect coyote feces.

This allows correlation of biological-season specific movements, habitat use, and behavior with foraging ecology and food habits.

Resident coyotes are radio-tracked with a variety of techniques including a fixed-station null-peak system. Non-resident coyotes are monitored approximately every other day at random hours. Coyotes are assigned social status based on the classification criteria of Crabtree (1988) who studied a natural, unexploited population.

Litter size is determined from den counts and occasional (if any) female carcasses. The proportion of females in the population that breed is estimated from activity and movement data during whelping as verified by Crabtree (1988). Pups are hand captured at dens when 10-12 weeks old and surgically implanted with intraperitoneal implants. This allows estimates of early pup mortality, dispersal, and social interaction and transitions up to 2 years of age.

Coyote home ranges and utilization distributions (probability density functions) are estimated with an adaptive kernel method (Worton 1989). Seasonal spatial overlap indices are calculated based on volume overlap of animals' utilization distributions and statistically tested with a non-parametric randomization test.

✦ Results and Discussion

We began field work in fall 1989 in the Lamar Valley at Blacktail Plateau areas of northern Yellowstone. As of 1 November we have accomplished our first year goal of capturing 1 to 3 adults in all social groups in both study areas. Lamar Valley has 7 social groups or "packs", whereas Blacktail Plateau has 6. Including only the areas adjacent to, and either side of the paved highway there are 21 social groups from the west end of Blacktail Plateau to the east end of Lamar Valley.

Thirty-seven adult coyotes were captured (17 F, 20 M) in Lamar and Blacktail areas during fall/winter and spring trapping periods. Trap success was high and averaged approximately 50 trap nights/coyote. In addition 5 badger *(Taxidea taxus)* and 1 red fox were captured. Trapped coyotes averaged 13.0 kg; and 6 larger alpha males, averaged 17.0 kg. Three of 23 (13%) captured in the fall were 6 month-old pups which may indicate low population productivity. The age of adults (11+ months and older) ranged from 1 to 12 years and averaged 4 years. To our knowledge this is the oldest average age yet reported in any coyote study.

Adults captured in the spring averaged 11 kg (16% less than fall). One recapture was an alpha male that lost 31% (5.5 kg) body weight from October to May. The condition index of spring-captured coyotes was significantly less than that in the fall. In November we set up approximately 170 miles of scat-survey transects. We will begin scat analysis this spring. Seven of 17 (41%) radio-collared elk calves were killed by coyotes in the Lamar Valley area in the May to July period. This corresponds to the remains of 1 to 3 elk calves per den found during June in both study areas.

Social Organization

Of radio-collared adults, 10 appear to be alpha breeding males; 8 alpha breeding females; 10 associates or beta-adults; 4 loners, and 5 unknown. After 8 months of radio-tracking (over 5000 relocations), 31 of 35 adult and 11 of 12 pups have stayed in close proximity to their initial location of capture, indicating a resident status. Territorial packs were adjacent, non-overlapping, contiguous, and averaged 15 km^2.

We have systematically collected visual observations to ascertain social status and estimate pack size. Mean pack size (12 paks) was 4.2$\pm$ adults. Numerous behavioral interactions and capture of prey items have been documented. Northern range coyotes appear well-suited to unbiased behavioral observation.

Population Demographics

Based on visual capture-recapture and territory enumeration, population density of coyotes on the northern range appears to be very high. Preliminary estimates averaged 3.6 adult coyotes per km². On December 28 female #633 was killed by a radio-collared mountain lion at a lion-killed elk carcass at Druid Peak in Lamar Valley. In the past 2 winters, we have collected 8 records of mountain lion-killed coyotes. On July 20 female #650 was killed by a motor vehicle. These 2 mortalities equate to an approximate 90% annual adult survival rate. One of 13 pups died due to unknown causes 6-8 weeks after capture. Assuming a litter size of 6 at birth, pup mortality during the first 4 months of life was 33%. Reproductive failure rate among 12 territorial packs was 25%. These data result in an overall estimate of population productivity at 3 pups recruited per pack.

✦ Conclusions

The northern Yellowstone population has characteristics similar to the natural, unexploited population in south-central Washington studied by Crabtree (1988). Individuals in the northern Yellowstone population are older-aged and physically among the largest coyotes in the western U.S. and may have pack sizes approaching that of gray wolves.

✦ Summary

In 1989-1990, 37 healthy adult coyotes *(Canis latrans)* and 13, 8-12 week old pups were captured and radio-tagged in the Lamar Valley and Blacktail Plateau areas of the Northern Range of Yellowstone National Park. Twenty males and 17 females weighed an average of 13 kg. Only 3 of the 23 captured in the fall were 6 months-old which suggests low population productivity. Adults ranged in age from 1 to 11 years and averaged 4 years old. After 10 months of radio-tracking, 31 of 35 adults and 11 of 12 pups were in the general vicinity of capture. Two adults were killed (1 mountain lion *(Felis concolor)*, 1 road-kill) which equates to a 10% annual mortality rate. One of 13 pups died 6-8 weeks after capture, due to unknown causes. Initially, 10 appear to be alpha breeding males; 8 alpha breeding females; 10 associates or beta-adults; 4 loners, and 5 unknown. Average litter size at 10 weeks of age was 4.4 (31 pups/7 females). Population productivity the first breeding season was estimated at 3.0 pups recruited per territory. The reproductive failure rate among breeding groups was 25%. Thirteen pups were surgically implanted with intraperitoneal transmitters with a 28 month battery life. Recapture data suggest the surgery had minor affect on pups and 12 are still alive. Pack size (excluding pups) appears large and initial minimum counts ranged from 2 to 6 and averaged 4 adults per group. Over 5000 relocations have been collected from fixed-station radio-telemetry towers. Territory size is approximately 15 square kilometers. Initial density estimates are 1.4 coyotes per square mile. One hundred and seventy miles of scat-survey transects have been laid out and over 1500 scats have collected in three separate surveys. Coyotes killed as high as 40% of 1990 elk *(Cervus elaphus)* calves on the study areas.

We will continue radio telemetry, visual observations, and scat transects this winter and spring. We will begin intensive winter observations at carcasses in December.

✦ Literature Cited

Dalser, D.S. 1965. Tranquilizer tabs for capturing wild carnivores. J. Wildl. Manage. 45:641-649.

Crabtree, R.L. 1988. Social, spatial, and demographic characteristics of an unexploited coyote population. Ph.D. Thesis, University of Idaho, Moscow, ID. 79 pp.

_____, F.G. Burton, T.R. Garland, D.A. Cataldo, and W.H. Rickard 1989. Slow-release implants as individual markers for carnivores. J. Wildl. Manage. 53(4):949-954.

Dennis, B.D., R.L. Crabtree, and E.O. Garton. 1989. Statistical methods for closed population estimation using radioisotope tagging. J. Wildl. Manage.:(Accepted)

Murie, O.J. 1940. Ecology of the coyote in Yellowstone. Nat. Park. Serv. Fauna Ser. No. 4. 206 pp.

Worton, B.J. 1989. Kernel methods for estimating the utilization distribution in home-range studies. Ecology 70:164-168.