EFFECTS OF 1988 FIRES ON ECOLOGY OF COYOTES IN YELLOWSTONE NATIONAL PARK: BASELINE PRECEDING POSSIBLE WOLF RECOVERY

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Abstract

Fifteen healthy coyotes (Canis latrans) were captured from 25 September through 25 October 1989 in the Lamar Valley and Blacktail Plateau areas of the northern range of Yellowstone National Park. Six males and nine females weighed an average of 14.1 kg. Only three of the 15 captured were six months-old which suggests low population productivity. After six weeks of radio-tracking all 15 were in the general vicinity of capture. Initially, 7-8 appear to be alpha breeding adults. Pack size appears large and initial minimum counts averaged four adults per group. Pilot studies of direct visual observation and fixed-station radio-telemetry appear very promising. Sixty-five miles of scat-survey transects have been laid out and plans to capture 15 more coyotes at carcasses in specific areas are underway.

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 an 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 of coyote and quantify their ecological role preceding potential wolf (Canis lupus) restoration;

3. Quantify the effect of winter elk (Cervus elaphus) carrion availability and mule deer (Odocoileus hemionus) density on coyote population dynamics;

4. Describe coyote seasonal responses to movements of elk and mule deer (Odocoileus hemionus);

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;

7. Document predation of coyotes on ranch livestock by coyotes from Yellowstone, and on allotments on National Forests adjacent to the northern range;

8. Develop and test a social-class structured population model in comparison to sex- and age-structured approaches; and

9. Estimate parameters for, and develop an empirically-based energetic model that explains the variation in spatial location, movement, and reproductive success of coyotes based on various underlying themes (prey base, habitat, slope, aspect, etc.).

Methods

General Population Demography and Social Ecology

Adult coyotes will be captured with padded, offset leghold traps (Soft-catch, Woodstream, Inc.) with attached tranquilizer tabs (Balser 1965) and other injury-minimizing (and avoidance on non-target species) modifications developed by Crabtree (1988) who incurred no major injuries and no deaths in 121 captures of 112 individual coyotes. We will also capture coyotes with modified snares near carcasses during winter.

The sex, weight, estimated age, condition indices (Crabtree 1988), presence of scars and unique marks, and description of genitalia and mammae will be determined for each coyote. The vestigial first premolar will be extracted from an anaesthetized lower jaw for age analysis via cementum annuli examination. Each coyote will be ear-marked and fitted with a modified (Crabtree 1988) 3-year radio collar weighing 3% of body weight (collars include activity and mortality switches). Blood samples will be taken for serological analysis and DNA fingerprinting.

All baseline ecological data will be 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 will be canvassed to collect coyote feces. This will allow correlation of biological-season specific movements, habitat use, and behavior with foraging ecology and food habits.

Coyotes will be radio-tracked with a variety of techniques including a fixed-station null-peak system. Resident coyotes will be located every hour during 15 randomly chosen night sessions each biological season. Coyotes will be located only during active periods determined by infrequent 24-hour sessions conducted seasonally. Non-resident coyotes will be monitored approximately every other day at random hours. Individual residency times (Crabtree 1988) on the pre-selected core study area will be estimated to aid in the determination of social class, population social composition, and population density (Dennis et al. 1989). Coyotes will be assigned social status based on the classification criteria of Crabtree (1988) who studied a natural, unexploited population.

The above methods will allow for the estimation of emigration (dispersal), immigration, survival, mortality factors, territorial turnover, social class transition probabilities, and population productivity. Maximum-likelihood estimates of survival and mortality factors will be generated with program SURVIV (White 1984) and modified with the Kaplan-Meier staggered-entry models (Pollock 1989). This analysis will allow survival and mortality factors to be estimated and statistically tested by year, age class, social class, season, and sex. Litter size will be determined from den counts and occasional (if any) female carcasses. The proportion of females in the population that breed will be estimated from activity and movement data during whelping as verified by Crabtree (1988). A modified Markov transition/Leslie matrix model based on social-class specific mortality and fecundity will be constructed (Crabtree, unpublished manuscript) to estimate population growth rate and social-class transition probabilities.

Beginning in the second year of the study, pups will be hand captured at dens when 10-12 weeks old and either fitted with a newly-developed expandable radio-collar (Crabtree et al., unpublished manuscript) or intraperitoneal implants. This will allow 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) will be estimated with an adaptive kernel method (Worton 1989) using a recently developed computer program (Garton and Crabtree 1989, unpublished). For comparative purposes the minimum convex polygon (Mohr 1947) and harmonic mean (Dixon and Chapman 1980) methods will be calculated. Seasonal spatial overlap indices will be calculated based on volume overlap of animals' utilization distributions (program OVERLAP [Leban and Crabtree 1988]) and statistically tested with a non-parametric randomization procedure (Mielke et al. 1976).

<u>Specific methods for field-oriented objectives 1 through 7</u>

1. We will quantify the following coyote responses: survival, reproduction, changes in social status, territoriality, group size, food habits, prey consumption, seasonal home range shifts, and foraging activity and location. We will treat the territory or coyote social group as the sampling unit and conduct a "gradient analysis" (Ter Braak and Prentice 1988) in the form of a linear model. Extensive effort will be placed in capturing at least one (or both) alpha adult(s) in at least 12 territories located across a gradient of fire intensities and burn types (e.g., forest, shrubland, and sedge) with four of 12 territories located in unburned, "control" areas. We simply seek to explain the variation among territorial group response variables (dependent variables above) by measurement of habitat variables such as cover, burn characteristics, and prey abundances of each territory (independent variables).

2. We will utilize a modified mark-recapture method known as radioisotope feces-tagging that has much promise and has recently been implemented to directly estimate coyote population size and density (Crabtree 1988, Dennis et al. 1989). Captured coyotes are administered a tag that marks the feces. This averts recapture biases, eliminates the need for recapture of coyotes, and provides large sample sized and more precise estimates.

We propose a unique innovative approach to determine the ecological role of the coyote with emphasis on their impact on prey species. First, we will not only examine food habits from scat analysis but apply a method that estimates the actual fresh weight of prey ingested for each prey species (elk, mule deer, antelope (Antilocapra americana), microtines (Microtus spp.), etc.). Second, based on the bias-corrected estimate for fresh weight of prey consumed, the estimated defecation rate, and coyote population size, we can directly estimate the total biomass of each prey species consumed per coyote and the population total. Third, because we can collect a sample of scats for the interior core area of a territory with certainty that those scats are from the pack we can again, determine the effect of fire, available prey, group size, etc. on prey type consumed. Crabtree (1988) individually marked and identified the scats from 44 coyotes and verified that over 95% of the scats collected from inside the home-range core area are from the resident pack themselves.

3. We will estimate both the availability of elk carrion (and other ungulate carrion) and mule deer density and relate this to coyote population dynamics at 2 levels: the individual territory and the total coyote population (over time). Concurrent with the winter transects addressed in objective #6, we will conduct winter ground transects on the northern winter range in order to estimate the availability of carrion. Estimates of mule density will be gathered from other ongoing research efforts in the park.

Thus, as in objective #1, an individual territory's survival, reproduction, change in social status, territoriality, group size, food habits, prey consumption, seasonal home range shifts, and foraging activity and location will be related to, and tested for the availability estimates of carrion and mule deer (gradient analysis).

Additional estimates of other ungulate prey (e.g., antelope fawns) may also be addressed in the same manner as mule deer availability.

4. We will examine the following coyote responses to ungulate movements both to and from the winter range at both the territory and population level: diet shifts, changes in activity patterns, territorial behavior and carcass interactions (objective #6), home range shifts, and pack size. The radio-telemetry and winter observational data will be analyzed temporally with divisions centered on spring and fall ungulate migrations, coyote breeding and pair bonding, and alpha female parturition and weaning periods. Finally, paired comparison of responses will made between territorial and non-

territorial individuals.

5. Group or pack size will be determined by a combination of methods: visual sightings from ground and aerial observation during December through February when group cohesiveness is maximized, ratio estimate from marked feces (Crabtree et al. 1989), and most importantly vocalization monitoring and response playbacks in winter and summer.

6. Besides the nocturnal and crepuscular radio-tracking periods during the winter period we will conduct a supplemental study. This study will consist of two daytime tasks: an observation of scavenger interactions at carcasses and snow-transects. We will employ modified focal sampling procedures (Altmann 1977) and record behavioral information into a cassette tape recorder. We propose to observe carcass interactions at several locations in burned and unburned areas with marked territorial coyotes. The location of natural carcasses in relation to known territories will be recorded in three categories: territorial core area, territory periphery, and corridor between territories (outside). Data will be analyzed via a 3 x 2 ANOVA. Possible supplementation of carcasses to improve a balanced design and hopefully create carcass interactions at observational vantage points will be considered.

Concurrent with carcass transects (objective #3) we will record all predator tracks (Coyote, red fox (Vulpes vulpes), bobcat (Felis rufus), marten (Martes americana), cougar (Felis concolor), wolverine (Gulo gulo), etc.). Besides snow-track surveys, sightings, scats, and possible captures will be monitored to provide a baseline index to abundance before possible wolf presence.

7. There exists no valid method to ascertain actual coyote depredations unless the carcass is fresh. Some coyote predation can certainly be documented but a valid measure of predation rate is yet to be developed. We propose to make contact by letter, telephone, and personal visitation to local private ranches with livestock on private and National Forest land. Estimated dispersal rate and dispersal direction from Yellowstone coyotes will compared on a seasonal and yearly basis to the response by livestock owners other involved personnel (e.g., Montana Dept. of Fish and Game).

Results and Discussion

The project began in late June 1989 with the initial contact of research and ranger personnel. Various planning and consulting meetings occurred during the months of July and august. We also made several trips to the northern range to choose study areas and assess field logistics.

We began field work on 20 September in the Lamar Valley and Blacktail Plateau areas of northern Yellowstone. Starting 25 September we trapped for four consecutive weeks. Fifteen coyotes were captured (nine F, six M) in Lamar and Blacktail areas. Trap success was very high and averaged approximately 25 trap nights/coyote. In addition two badger (<u>Taxidea</u> <u>taxus</u>) and one red fox were captured. Coyotes averaged 14.1 kg and four larger males, thought to be alphas, averaged 17.3 kg. Three of the 15 captured were six month-old pups which may indicate low population productivity. Early indications suggest that seven-eight of the 15 captured may be alpha breeding adults. Based on tooth wear, the population seems to have an older age structure.

After six weeks of hand-held radio-tracking all 15 coyotes have stayed in close proximity to their initial location of capture indicating a resident status. However, it is not yet known if all 15 are territorial pack members. We also have systematically collected visual observations to ascertain social status and estimate pack size. Minimum pack size counts of seven groups were 3, 3, 4, 4, 4, 5, and 5. Numerous behavioral interactions and capture of prey items have been documented. Northern range coyotes appear well-suited to unbiased behavioral observation.

In November we set up approximately 65 miles of scat-survey transects. These transects were cleared of scats in order for spring collections to be represent winter food habits and population density. The number of scats found along transects averaged approximately three per mile. concurrent with transect selection and scat-clearing we took radio-fixed from a variety of locations to determine the best vantage points for fixed-station radio-telemetry of coyotes. Numerous vantage points were located on ridges and buttes along the boundaries of both the Lamar and Blacktail areas. We have begun construction of fixed-station tracking shelters.

We are now preparing for another capture session in December. Coyotes will be captured with leg snares adjacent to carcass bait stations. This method should be quite selective for capture of certain packs and pack members. Within two days after we placed a cow elk carcass at Blacktail Plateau at least 10 different coyotes either visited or fed on it. Intensive radio-tracking, visual observations, and snowtracking surveys concurrent with carcass surveys will begin in December.

Conclusions

Because the study was recently initiated and a sample size of 15 is small, no valid conclusions can be drawn at this time. However, it does appear that 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 appear to be physically among the largest coyotes in the western U.S. and may have pack sized approaching that of gray wolves.

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