MONITORING SELECTED SPECIES OF MAMMALS IN GRAND TETON NATIONAL PARK IN 2000

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✦ ABSTRACT

Our objective is to establish a long-term monitoring project that will assess the abundance and densities of selected species of mammals at sites representing five defined vegetation types found in Grand Teton National Park. The term monitoring implies data collection over multiple years. Taking long term estimations of population composition before, during, and after biotic and abiotic changes provides needed information to assess the impacts of such changes and furnishes useful options for management decisions. This standardized monitoring plan will provide information on small and medium-sized mammals that will (1) assess species use of habitat, (2) monitor changes in species composition as a result of environmental change, such as precipitation and temperature, (3) produce predictive models of small and medium-sized mammal distribution based on vegetation type, and (4) analyze the impact of wolf colonization on the mammal (and plant) community.

✦ INTRODUCTION

Understanding abundance, distribution, habitat choice, and ecological interactions of mammalian species can promote management decisions that benefit overall ecosystem health. Monitoring programs that build an ecological model of the landscape, and assessing the trends in relation to biotic and abiotic changes, are essential to adaptive management, yet are seldom a standard part of management activities (Sinclair 1991; Noss and Cooperrider 1994; Lancia et al. 1996); Noss et al. 1996). Indeed, a conservation plan requires a long-term obligation to standardized ecological monitoring so that actions can be adjusted according to new information (Noss et al. 1996).

Over the long term, this standardized monitoring plan will provide information on small and medium-sized mammals that will (1) assess species use of habitat, (2) monitor changes in species composition as a result of environmental change, and (3) analyze the impact of wolf (*Canis lupus*) colonization on the mammal (and plant) community. The abundance and diversity of mammals can be greatly affected by a number of factors. These include plant productivity (Hunter and Price 1994; Krebs et al. 1995; Polis and Strong 1996), climate (Pinter 1996; Hoogland 1995; Post et al. 1999), natural disturbance (Pickett and White 1985), disease (Dobson and May 1986), environmental change (Lancia et al. 1996; Thompson et al. 1998), and changes in numbers of large predators (McLaren and Peterson 1994; Terborgh et al. 1999; Crooks and Soulé 1999; Crête 1999; Oksanen and Oksanen 2000).

✦ METHODS

This study is ongoing, and we will follow the same methods used in 1999 and 2000 vegetation types, follow the maps created by Debinski et al. (1996). In each habitat classification, they have

recorded their sampled sites by UTMs and described the route needed to arrive at each site. We sampled five different habitat types at the same altitude with two replicates in each habitat type. The habitats are: lodgepole pine (Pine), dry sage (M6), mixed grasses and forbs (M3), sedge/grass/willow damp meadow (M2), and sedge-grass swamp (M1).

We used standard capture-recapture techniques for small mammals (*e.g.* mice and voles, see Clark and Stromberg 1987) using folding Sherman traps that are 22.5 cm long and 7.5 by 7.5 cm wide. Bait was rolled oats that are coated with molasses.

We marked rodents with ear tags purchased from National Band and Tag (#1005 size 1). This method was tested in the Grand Teton National Park during 1999 and all tags were retained on captive mice and voles during a three-week trial. In the field, one vole was captured and marked with an ear-tag in 1999 as a juvenile, and that animal was recaptured in 2000 as an adult (with tag in place). During 1999, we also tested paint and dye for marking rodents, but both were less reliable and persisted on the animal for only a few days. Indeed, in some cases, rodents would lick at the paint until they had removed the fur from the section of body with paint. Furthermore, to paint or clip hair on a small rodent requires holding the animal for a much longer period of time than placing the ear tag. Time in the hand increases stress to the rodents, and in some cases they die while being held.

Marking with the small alloy ear-tags has been used on other rodents, and we also used it on the endangered black-footed ferrret (*Mustela nigripes*). It is safe for the animal, reliable for the researcher, and the tag is inconspicuous (even if a visitor should happen to see a mouse or vole in the field, which is highly unlikely). The tag would pose no threat to any carnivores eating a marked animal, as carnivores routinely eat bone fragments much larger than the tag. Ingested tags are passed through the carnivore gut and excreted in scat, or in the case of raptors, they are expelled in a pellet (pers. obs.).

We traped a site continuously until recaptures roughly equal new captures. For this reason, the sampled area is considered a closed population (Caughley 1977; Lancia et al. 1996; Thompson et al. 1998). Abundance can be calculated with several estimators, including program CAPTURE (White et al. 1982), Jolly Seber (Caughley 1977), a regression slope based on capture per unit effort (Caughley 1977), and an index of number of individuals captured per 1000 trap nights. Because this is only the second year, we are concentrating on the latter index for the preliminary data that follow. Number of trap-nights is adjusted for sprung traps via the technique of Beauvais and Buskirk (1999).

The standard grid size was 1 hectare with two replicate grids at a site. Traps within a grid were spaced every 10 meters (121 traps per 1 ha grid). The population size associated with a grid is a function of two known factors (grid area and perimeter) and two unknown factors (boundary strip-width and true animal density) (Otis et al. 1978). So, when sample size allows, data for each grid can be analyzed as a series of nested grids to address the issue of boundary strip-width and make the population estimate more accurate (Otis et al. 1978; Lancia et al. 1996).

Species not easily seen or trapped can be estimated via an index thought to be correlated with abundance (Lancia et al. 1996). For example, northern pocket gopher (*Thomomys talpoides*) were indexed by counting mounds within a 1 ha grid, and badgers (*Taxidae taxus*) by number of fresh digs (presence of fresh sub-soil on the mound that is not yet hardened by sun).

Observers counted all sign (tracks and scat) within transects 100 m long and 5 meters wide, until the entire one hectare grid was surveyed. This information was used as a measure of presence/absence. Presence/absence data can also be collected by snow-tracking in winter. This will be conducted on foot, and by flying for three mornings in February (following procedure in the permit for 2000).

We are in the process of collecting and genotyping feces, following the two techniques used by Kohn et al. (1999) to estimate marten and coyote population numbers. Genetic analysis involves molecular typing with hypervariable microsatellite markers (see Kohn et al. 1999). Genetic work is being be done at Aurora College in Denver, where Dr. Anna Goebel has a working laboratory and is presently extracting microsatellite markers from scat. Estimating population numbers is a very non-intrusive method of collecting reliable data (Kohn et al. 1999). Dr. Goebel is presently applying the technique with 55 coyote and 120 american marten scats that we collected walking approximately 200 kilometers of trails and stream beds in the 100 km^2 study area in Grand Teton National Park. Microsatellites are published for coyotes and pine marten.

We collected scat from trails and stream beds to ensure a higher capture probability, thereby strengthening the estimates (Karanth and Nichols 2000). While random sampling is advocated for estimates of rodents that are evenly distributed in a homogeneous vegetation type, the situation is different for carnivores covering heterogenous habitats and not using those habitats equally. Sampling from areas not likely frequented by the animal, will lower the number of "captures" and therefore lower precision. In the comparisons we seek, precision is of utmost importance (Karanth and Nichols 2000).

Tracking the impact of wolf colonization on small and medium-sized mammals over time in the Grand Teton National Park may be demonstrated with a time-series analysis, as was done when measuring the effects of sea otter (*Enhydra lutris*) reintroduction on selected species in that system (J. Estes, pers. com.). Time series analysis, and/or appropriate multivariate techniques, will allow examination of changes that occur as wolves enter the habitats we are sampling in the Grand Teton National Park.

We also have a proposal pending with Yellowstone National Park, (in cooperation with Doug Smith). If this proposal is approved, simultaneous sampling of small and medium-sized mammals in areas with wolves will allow a spatial control to compliment temporal analysis. Wolves already exist in Yellowstone National Park, in some areas at very high densities. If habitat types with wolves in Yellowstone National Park can be matched to any of the vegetation sites we are sampling in the Grand Teton National Park, we can directly compare mammal community and vegetation composition in areas with and without wolves over the next 2 or 3 years.

Over time, temperature changes, precipitation changes, natural prey cycles, and presence/absence of carnviores can be correlated to changes in the structure and abundance of the mammal community. Such correlational analyses may not show cause and effect, but it does allow induction to play a strong role in hypothesis formation to further understand the multiple factors that impact mammal communities.

✦ PRELIMINARY RESULTS AND DISCUSSION

In 2000, students from Tufts Veterinary School drew blood from mice and voles we captured in the Grand Teton National Park, testing for disease. No sign of Hanta virus or plague was detected. For detail, see report of Gillin et al.

For comparison to 1999, we will report number of unique individuals captured per 1000 trap-nights in 1999 and 2000. All grids trapped in 1999 were retrapped in 2000. In 1999, there was only one replicate in each of the five habitat types. In 2000, we added a second replicate.

In 1999, a dry sage plot (1M6—Two Ocean Lake Road) yielded a trapping success of 2.2% (Miller and Harlow 2000). Rodent composition was mainly deer mice (*Peromyscous maniculatus*), with an index of 11 individuals captured per 1000 trap-nights. When walking the one hectare plot in 1999, we found 15 fresh pocket gopher mounds, 8 badger holes, 60 piles of elk scat, 3 piles of deer scat, 1 moose scat, 1 bison scat, and 40 ant hills. We also captured 3 mountain voles (*Microtis montanus*) and 1 meadow vole (*M. pennsylvannicus*).

In 2000, the same plot yielded a capture success of 2%, with 10 individual deer mice captured per 1000 trap-nights. We also captured 1 meadow vole and 1 least chipmunk (*Tamias minimus*). When walking the plot in 2000, we found 23 fresh pocket gopher mounds, 5 badger holes, 73 piles of elk scat, 2 piles of deer scat, 1 moose scat, 1 coyote scat, and 83 ant hills.

At the second replicate of dry sage habitat (2M6—Pilgrim Creek), trapping success was 3% with 11 deer mice captured per 1000 trap-nights. We also captured 1 mountain vole. There were 170 fresh pocket gopher digs, 123 piles of elk scat, 16 ant hills, 2 piles of deer scat, 1 coyote scat and 1 raptor pellet.

On the lodgepole pine plot (1-Pine—Pacific Creek) in 1999, we mainly captured red-backed voles (*Clethrionomys gapperi*) and pine chipmunks (*Tamius amoenus*) with a trapping success of 4% (Miller and Harlow 2000). The index for red-backed

voles and pine chipmunks was 11 per 1000 trap-nights and 4 per 1000 trap-nights, respectively. When walking the plot to search for sign, we recorded the following data: 4 red squirrel (*Tamiasciurus hudsonicus*) middens, 13 large ungulate beds, 5 fresh pocket gopher mounds, 31 piles of elk scat, 8 piles of moose scat, 1 deer scat, 1 coyote scat, and 1 American marten scat. We also captured 2 long-tailed voles (*Microtis longicaudus*).

On the same plot in 2000, trapping success was 2 %. We captured 3 pine chipmunks, 3 least chipmunks, and 2 red-backed voles per 1000 trap-nights. Red-backed voles dropped from 11 captures per 1000 trap-nights in 1999 to 2 captures per 1000 trap-nights in 2000. We also captured a red squirrel and an american marten. When walking the plot, we found 85 piles of elk scat, 28 piles of moose scat, 3 ungulate beds, 3 piles of deer scat, 2 american marten scat, 1 porcupine scat, 1 coyote scat, 2 snowshoe hare scats, 3 bear scats, 1 bear bed, and 44 logs opened by bear.

On the second replicate of lodgepole pine (2-Pine—Grandview Road), trapping success was 3%. We captured 10 deer mice and 6 red-backed voles per 1000 trap-nights. We also captured 1 mountain vole, 1 pocket gopher, and 2 jumping mice (*Zapus princeps*). Unlike 1-Pine, we captured no chipmunks, although we did see 1 least chipmunk. We also saw one black bear *(Ursus americanus*) with a cub and 1 white-tailed deer (*Odocoileus virginianus*) on the plot.

The mixed grass/forb plot (1M3—Lozier Hill) had 4% trapping success in 1999. We captured 10 *Microtis* per 1000 trap-nights (4 *M. montanus* and 6 *M. pennsyvannicus* per 1000 trap-nights), and 11 deer mice per 1000 trap-nights. We also captured 3 pocket gophers, and 2 jumping mice. When walking the one hectare plot of mixed grasses and forbs, we recorded the following data: 462 fresh pocket gopher mounds, 283 mouse/vole holes, 101 vole runways, 2 vole nests, 134 piles of elk scat, 2 deer scat, 2 coyote scat, 1 elk bed, and 3 anthills.

On the same plot in 2000, trapping success was 3%, and we captured 11 deer mice and 3 *Microtis* per 1000 trap-nights (2 *M. pennsylvanicus* and 1 *M. montanus*). We also captured 1 pocket gopher. We counted 501 active pocket gopher mounds, 144 piles of elk scat, 3 moose scats, 12 deer scats, 1 ungulate bed, 1 coyote scat, and 6 anthills.

On the second replicate (2M3—Pacific Creek Elk Wallow) trapping success was 3% with 16 deer mouse per 1000 trap-nights. We counted 171 active gopher mounds, 44 elk scat, 1 deer scat, 16 ungulate beds, 1 bear dig. One black bear and her cub were seen walking just outside of the plot.

During 1999 in the sedge/grass/willow damp meadow (1M2—Christian Pond), trapping success was 8.8%. We captured 59 *Microtis* per 1000 trap-nights (50 *M. pennsylvanicus* and 9 *M. montanus*) per 1000 trap-nights. When walking the plot, we recorded the following data: 9 moose scats, 2 elk scats, 1 deer scat, 1 coyote scat, and 1 fox scat. The lack of scat may be misleading if one is looking across different habitat types, as the wetness of this grid will eliminate scat more rapidly than in drier areas. And, although there were few holes deeper than the length of a finger, there are a myriad of ways to get beneath patches of moss.

On the same plot in 2000, we had a trapping success of 8% with 42 *Microtis* per 1000 trap-nights (36 *M. pennsylvanicus* and 6 *M. montanus*). We found 7 elk scats, 1 moose scat, and 1 coyote scat.

The second replicate in 2000 (2M2—Grandview Road) was a 0.5 hectare grid. It showed a trapping success of 7% with 25 *Microtis* per 1000 trap-nights (16 *M. pennsylvanicus* and 10 *M. montanus*), and 8 jumping mice per 1000 trap-nights. When walking the grid we found 28 elk scats, 3 moose scats, and 1 bear scat.

During 1999, on a sedge-grass swamp plot (1M1—Grandview Road), trapping success was 7%. We captured 40 *Microtis pennsylvanicus* per 1000 trap-nights. When walking the 1 ha plot of grass-sedge swamp, we recorded the following data: 2 ungulate beds and 1 coyote scat.

On the same plot in 2000, trapping success was 18%, and we captured 91 *Microtis pennsylvanicus* per 1000 trap-nights. This more than doubled the trapping success and number of animals per 1000 trap-nights when compared to results of 1999. When walking the plot, we found 27 elk scats, 5 moose scats, 4 ungulate beds, 1 coyote scat, and 1 duck apparently killed by a coyote.

The second sedge-grass swamp (2M1—Cygnet Pond) was a 0.5 hectare plot, and it had a 12% trapping success. We captured 61 *Microtis* per 1000 trap-nights (41 *M. pennsylvanicus* and 20 *M. montanus*), and 5 jumping mice per 1000 trap-nights. When walking we found 6 elk scats, 1 moose scat, 2 ungulate beds, and 3 coyote scats.

We are presently analyzing genetic data from 55 coyote scats and 28 marten scats (Dr. Anna Goebel). We are also analyzing measurements of *M. pennsylvanicus* and *M. montanus* (with Alita Pinter) to assess the reliability of identifying these species in the field. These data will be forthcoming. Preliminarily, we have been able to check 19 *Microtis* trap-mortalities, using teeth as a control for the field measurements, and we correctly identified to species 18 of the 19 cases. Of these 19, 4 were adult *M. montanus* (2:2) and 6 were adult *M. pennsylvanicus* (2:4). The rest were juvenile *M. pennsylvanicus* (5:4), and the misclassified individual was a juvenile female.

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