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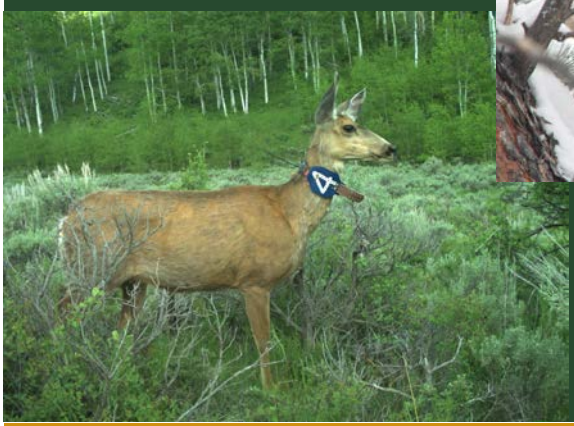
Wildlife Research Reports
MAMMALS – JULY 2019



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Wildlife Research Reports

July 2018 – June 2019

MAMMALS RESEARCH PROGRAM

Research Center, 317 West Prospect, Fort Collins, CO 80526

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COLORADO PARKS AND WILDLIFE
RESEARCH POLICY AND PLANNING BRANCH

EXECUTIVE SUMMARY

This Wildlife Research Report represents summaries (≤6 pages each with tables and figures) of wildlife research projects conducted by the Mammals Research Section of Colorado Parks and Wildlife (CPW) from July 2018 through June 2019. These research efforts represent long-term projects (4–10 years) in various stages of completion addressing applied questions to benefit the management and conservation of various mammal species in Colorado. In addition to the research summaries presented in this document, more technical and detailed versions of most projects (Annual Federal Aid Reports) and related scientific publications that have thus far been completed can be accessed on the CPW website at http://cpw.state.co.us/learn/Pages/ResearchMammalsPubs.aspx or from the project principal investigators listed at the beginning of each summary.

Current research projects address various aspects of wildlife management and ecology to enhance understanding and management of wildlife responses to habitat alterations, human-wildlife interactions, and investigating improved approaches for wildlife and habitat management. The Nongame Mammal Conservation Section addresses preliminary results of a recent project addressing influence of forest management practices on snowshoe hare density in Colorado. The Ungulate and Habitat Conservation Section includes 4 projects addressing mule deer/energy development interactions to inform future development planning, vegetation and animal responses to habitat treatments applied to mitigate energy development activity, evaluation of moose demographic parameters that will inform future moose management in Colorado, and a recent study to identify factors influencing elk calf recruitment. The Support Services Section describes the CPW library services to provide internal access of CPW publications and online support for wildlife and fisheries management related publications.

In addition to the ongoing project summaries described above, Appendix A includes 18 publication abstracts (<1 page summaries) completed by CPW mammals research staff since July 2018. These scientific publications provide results from recently completed CPW research projects and other outside collaborations with universities and wildlife management agencies. Topics addressed include mammal responses to beetle-killed forests in Colorado, lynx response to winter recreation, carnivore ecology and management (factors limiting mountain lion populations, lion movements and human interactions along the urban-wildland interface; evaluation of Colorado's 2-strike black bear management directive; assessment of garbage storage and social dynamics associated with black bear management along the urban-wildland interface), ungulate ecology and management (evaluating elk-livestock brucellosis transmission risk, applying acoustic technology to address mule deer foraging behavior, using GPS data to identify mule deer birth sites), remote camera sampling (application to estimate a low density bobcat population, and development of machine learning technology to enhance photo processing time), and genetics and disease research (interpretation of black bear telomere length, virus detection from fecal DNA, and mountain lion gene flow and genetic diversity).

We have benefitted from numerous collaborations that support these projects and the opportunity to work with and train wildlife technicians and graduate students that will likely continue their careers in wildlife management and ecology in the future. Research collaborators include the CPW Wildlife Commission, statewide CPW personnel, Federal Aid in Wildlife Restoration, Colorado State University, Idaho State University, University of Wisconsin-Madison, Montana State University, U.S. Bureau of Land Management, U.S. Forest Service, City of Boulder and Jefferson County Open Space, City of Durango, CPW big game auction-raffle grants, Species Conservation Trust Fund, GOCO YIP internship program, CPW Habitat Partnership Program, Safari Club International, Boone and Crocket Club, Colorado Mule Deer Association, The Mule Deer Foundation, Muley Fanatic Foundation, Wildlife Conservation Society, Summerlee Foundation, EnCana Corp., ExxonMobil/XTO Energy, Marathon Oil, Shell Exploration and Production, WPX Energy, and private land owners providing access to support field research projects.

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INFLUENCE OF FOREST MANAGEMENT ON SNOWSHOE HARE DENSITY IN LODGEPOLE AND SPRUCE-FIR SYSTEMS IN COLORADO

Colorado Parks and Wildlife

WILDLIFE RESEARCH PROJECT SUMMARY

Influence of forest management on snowshoe hare density in lodgepole and spruce-fir systems in Colorado

Period Covered: July 1, 2018 – June 30, 2019

Principal Investigators: Jake Ivan, Jake.Ivan@state.co.us; Eric Newkirk, Eric.Newkirk@state.co.us

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Understanding and monitoring snowshoe hare (*Lepus americanus*) density in Colorado is important because hares comprise 70% of the diet of the state-endangered, federally threatened Canada lynx (*Lynx canadensis*; U.S. Fish and Wildlife Service 2000, Ivan and Shenk 2016). Forest management is an important driver of snowshoe hare density, and all National Forests in Colorado are required to include management direction aimed at conservation of Canada lynx and snowshoe hare as per the Southern Rockies Lynx Amendment (SRLA; https://www.fs.usda.gov/detail/r2/landmanagement/planning/?cid= stelprdb5356865). At the same time, Forests in the Region are compelled to meet timber production and management response obligations. Such activities may depress snowshoe hare density, improve it, or have mixed effects dependent on the specific activity and the time elapsed since that activity was initiated. Here we describe a sampling scheme to assess impacts of common forest management techniques on snowshoe hare density in both lodgepole pine and spruce-fir systems in Colorado.

To select forest stands for sampling, we first used U. S. Forest Service (USFS) spatial data to delineate all spruce-fir and lodgepole pine stands (stratum 1) on USFS land in Colorado, and identified all of the management activities that have occurred in each stand over time. With consultation from the USFS Region 2 Lynx-Silviculture Team, we then grouped relevant forest management activities (stratum 2) into 4 broad categories: even-aged management, uneven-aged management, thinning, and unmanaged controls. We wanted to assess both the immediate and long-term impacts of management on hare densities. Therefore, when selecting stands for sampling, we took the additional step of binning the date of the most recent management activity into 2-decade intervals (i.e., 0-20, 20-40, and 40-60 years before 2018). We then selected a spatially balanced random sample of 5 stands within each combination of forest type × management activity × time interval. This design ensured that we sampled the complete gradient of time since implementation for each management activity of interest in each forest type of interest. There is no notion of "completion date" for unmanaged controls, so we simply sampled 10 randomly selected stands from this combination. Also, uneven-aged lodgepole pine treatments are rare, so we did not sample that combination, leaving a total of $n = 105$ stands sampled (Figure 1).

During summer 2018, we established $n = 50$ 1-m^2 permanent circular plots within each of the $n = 105$ stands selected for sampling. Plot locations within each stand were selected in a spatially balanced, random fashion. Technicians cleared and counted snowshoe hare pellets in each plot as they were established. These same plots were re-visited and re-counted during summer 2019. In addition to sampling the previously cleared plots from 2018, technicians were able to install plots at 2 more replicate sites for each combination of forest type × management activity × time interval, meaning that inference

from future years will be based on 7 stands within each combination, or n = 128 total stands (note that this total also reflects a handful of stands that were re-classified based field observations, along with new stands that were brought into the sample in 2019 to replace those that were reclassed).

Pellet information from cleared plots is more accurate than that from uncleared plots because uncleared plots usually include pellet accumulation across several years (Hodges and Mills 2008). The degree to which previous years are represented can depend on local weather conditions, site conditions at the plot, and variability in actual snowshoe hare density over previous winters. Data from cleared plots necessarily reflects hare activity from the previous 12 months, and tracks true density more closely. Therefore, we focused the current analysis on the 2019 data from previously cleared plots. For each forest type × management activity combination, we plotted mean pellet counts against "year since activity," then fit a curve (e.g., quadratic function) through the data (Figure 2).

Results from this preliminary analysis suggest that on average the highest snowshoe hare densities typically occur in unmanaged spruce-fir forests, and that unmanaged spruce-fir forests are estimated to have twice the relative hare density of unmanaged lodgepole pine forests. For both forest types, the fitted line suggests that even-aged management (e.g., clearcutting), immediately depresses relative hare density to near zero, but density rebounds and peaks 20-40 years after management before declining again 40-60 years after. Estimated peak hare densities after even-aged management in lodgepole systems tend to be higher than the control condition, but in spruce-fir systems estimated peak densities approach, but never match, the control condition. In both forest types, thinning (which often occurs 20-40 years after stands undergo even-aged management, especially in lodgepole), immediately depresses hare densities, but densities are estimated to slowly recover through time in nearly linear fashion, reaching their maximum 45-55 years after the treatment. As with the even-aged treatment, maximum hare density after thinning in lodgpole systems is estimated to be higher than the control condition, whereas in spruce-fir systems, the maximum hare density matches that of the control sites. Uneven-aged management of spruce-fir forests results in a similar snowshoe hare trajectory as that observed in thinned spruce-fir forests.

Note the two outliers on the right side of the even-aged lodgepole panel. These "high density" sites are represent even-aged lodgepole stands that happen to be surrounded by high quality spruce-fir forest on at least two sides. Thus, the high relative hare density observed at these sites may be due to the quality habitat in adjacent stands rather than by the quality of the sampled stands themselves. While we left them on the figure for transparency, we excluded them when fitting the curve as they appear to be true outliers. Also note that in some cases, 95% CIs are relatively large and overlap the control reference line in some panels. Thus, even though the fitted lines indicate the relationships discussed above, evidence for some of these patterns is moderate or weak. In future years, each panel will include cleared plot data from 6 additional sites, and each site will have data from multiple years (i.e., repeated measures). Both phenomena will greatly improve sample sizes, diminish the role of a few outlying data points, and tighten up our estimate, and corresponding inference, regarding the response of snowshoe hare density to forest management through time.

Literature Cited:

Hodges, K. E., and L. S. Mills. 2008. Designing fecal pellet surveys for snowshoe hares. Forest Ecology and Management 256:1918-1926.

Ivan, J. S., and T. M. Shenk. 2016. Winter diet and hunting success of Canada lynx in Colorado. The Journal of Wildlife Management 80:1049-1058.

U.S. Fish and Wildlife Service. 2000. Endangered and threatened wildlife and plants: determination of threatened status for the contiguous U. S. distinct population segment of the Canada lynx and related rule, final rule. Federal Register 65:16052–16086.

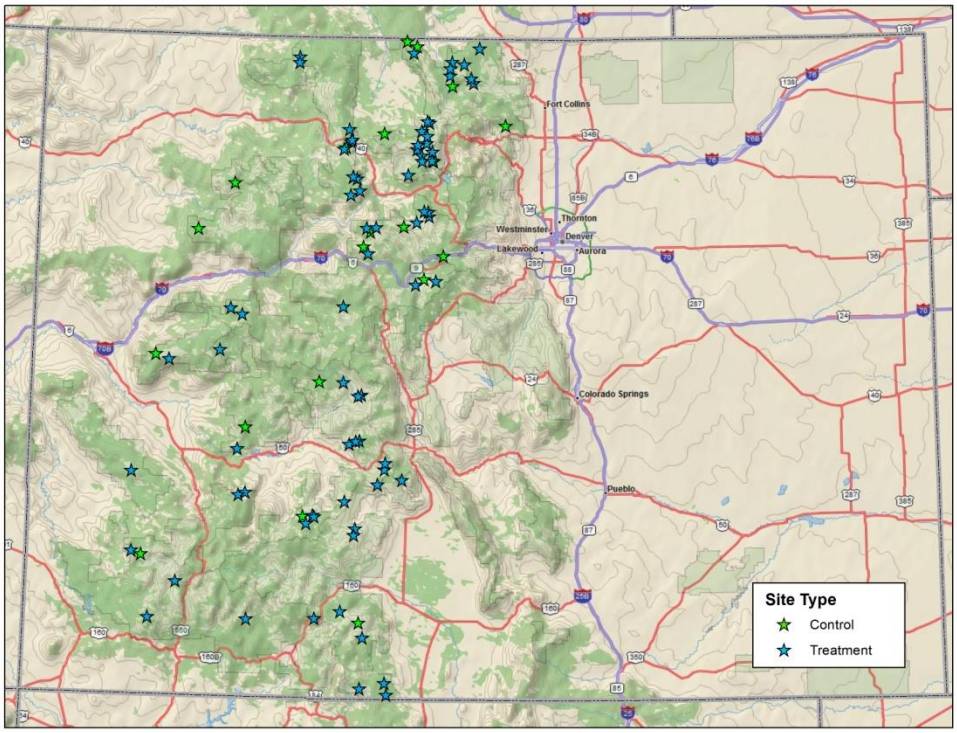

Figure 1. Location of all stands (n = 105) resampled for snowshoe hare pellets, June-September 2019.

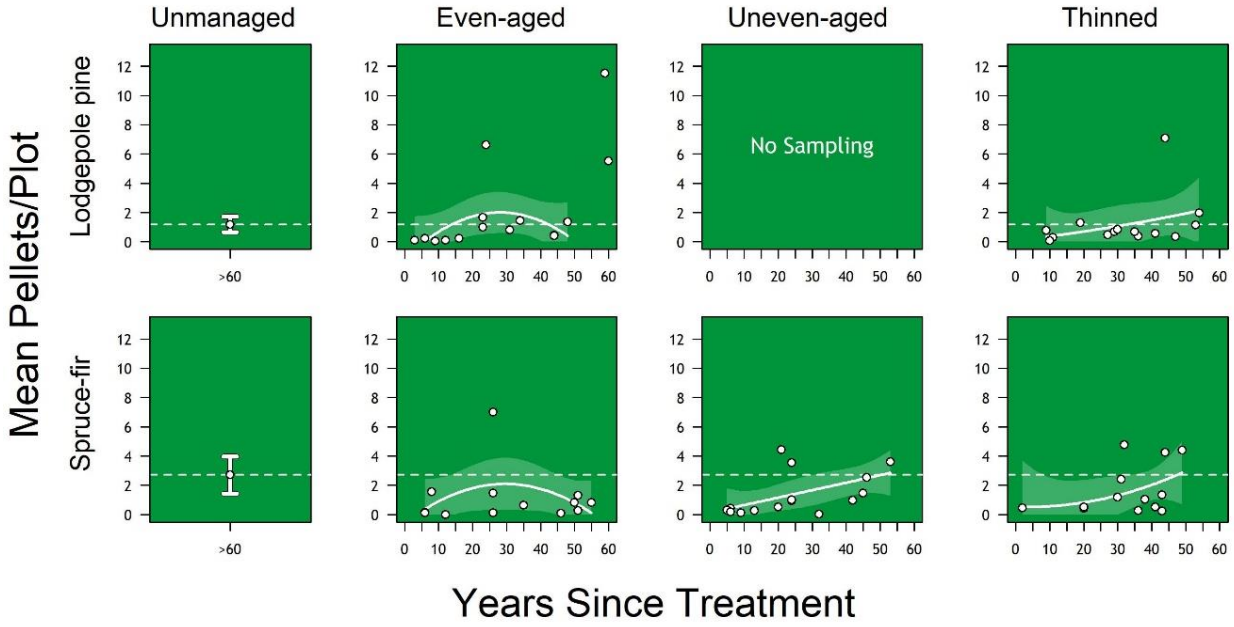

Figure 2. Fitted quadratic function (white line) and 95% CI (shaded polygon) relating pellet counts (i.e., relative snowshoe hare density) to time elapsed since treatment for each forest type × management activity combination. Dotted lines indicate the mean pellets/plot for the unmanaged controls for each forest type.