Investigating the Influence of Forest Disturbance on Grizzly Bear Habitat Ecology and Fitness in the Northern Continental Divide Ecosystem

Annual Progress Report 2024

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Investigating the Influence of Forest Disturbance on Grizzly Bear Habitat Ecology and Fitness in the Northern Continental Divide Ecosystem

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Degree: PhD Student – Fish and Wildlife Biology

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Overview

The Northern Continental Divide Ecosystem (NCDE) grizzly bear population of northwest Montana was listed as threatened in 1975 under the Endangered Species Act. Recovery objectives for this population have centered predominantly on limiting human-caused mortality and protecting habitat. Consequently, empirically informed habitat management has been an integral component of grizzly bear recovery in the NCDE and will remain a major component of future conservation and management efforts.

The NCDE has a long history of forest management and wildfire activity. Studies have demonstrated both positive and negative effects of timber harvest on grizzly bears. Grizzly bears are associated with forest edges and early successional forests (Munro et al. 2006, Stewart et al. 2013), which often have higher abundances of preferable forage (Mace and Jonkel 1986, Hamer and Herrero 1987a, Souliere et al. 2020). Forest management activities that reinstate early successional vegetation can thus have a positive effect on forage quality for grizzly bears (Nielsen et al. 2004b). However, roadbuilding and human access associated with timber harvest and silvicultural treatments can have a negative effect on grizzly bear habitat selection and survival (Kasworm and Manley 1990, Mace et al. 1996, 2012, Schwartz et al. 2010, Boulanger and Stenhouse 2014), potentially negating the positive effects of timber harvest and certain silvicultural treatments.

Wildfire disturbance is likely to have variable effects on grizzly bears. Post-fire, early successional vegetation provides high quality forage, and grizzly bears likely select these post-fire stands to take advantage of increases in graminoids, forbs, roots, ungulate prey, and fruiting shrubs that emerge post disturbance (Mace and Jonkel 1986, Hamer and Herrero 1987b, Best et al. 2024). On larger temporal scales, historical variation in spatial patterning of infrequent, predominantly stand-replacing fires in the NCDE, has contributed to heterogeneous landscape conditions (Hood et al. 2021). Such conditions likely benefit grizzly bears by providing various landscape features required for denning, access to foods, and security. However, more frequent,

larger, and high severity fires, projected to increase throughout the Rocky Mountains (Abatzoglou and Williams 2016), have the potential to lower plant diversity, disrupt tree regeneration, and alter species composition (Halofsky et al. 2020, Weeks et al. 2023). These changes in fire regimes and ecological consequences could alter historical landscape mosaic diversity and reduce wildfire benefits to grizzly bears.

Our objectives are to investigate the effects of harvested forests and fire disturbance on grizzly bears in the NCDE to understand conditions that improve or degrade grizzly bear habitat quality, with consequent impacts on fitness. Balancing grizzly bear conservation while managing forest disturbances is a complex and dynamic challenge for land managers. This proposed research will help address this challenge by providing information to assist managers in developing strategies that balance species conservation and forest management objectives.

Progress and Timeline

Progress summary: Milan Vinks (Ph.D. Student)

This project is in its second year. I defended my proposal in Spring 2024 and will be preparing for my comprehensive exams, which begin at the end of January 2025. I presented on components of my PhD research at the Montana Chapter of The Wildlife Society meeting in February 2024, and I plan to present preliminary results of my first PhD chapter at the Montana Chapter of The Wildlife Society meeting in March 2025. I attended the International Association for Bear Research and Management conference in Edmonton, AB, Canada in September 2024, where I was a co-author on three presentations. I have completed 12 coursework credits of the 20 coursework credits required by the University of Montana Wildlife Biology Program, and I will be completing an additional 4 credits Spring 2025. As part of my employment with Montana Fish, Wildlife and Parks (FWP), I have continued to capture and radiocollar grizzly bears for ongoing population trend research in the NCDE. New individuals will be integrated into analyses as the project progresses and data become available. In addition, I have contributed to three manuscripts in 2024 on grizzly bear management related topics.

My PhD research is investigating the effects of forest disturbance (focusing on timber harvest and fire) on the habitat ecology and fitness of grizzly bears in the NCDE. My research thus far has focused on my first PhD chapter, evaluating factors affecting grizzly bear selection or avoidance of harvested forests and fire disturbance. Below are the methods, initial summaries, and projected timeline of this initial chapter.

Chapter 1 objective: Effects of harvested forests and fire disturbance on grizzly bear habitat selection in the NCDE

Analytical approach

We conducted a three-stage analysis to quantify grizzly bear seasonal responses to forest disturbance within NCDE. In stage one, we modeled resource selection relative to landscape variables and forest disturbance variables (burn and harvest) to broadly examine if grizzly bears seasonally select or avoid forest disturbance patches. In stage two, we tested whether disturbance

severity could further explain seasonal patterns of grizzly bear selection or avoidance of forest disturbance patches by replacing the burn and harvest categories in our stage 1 analysis with five disturbance severity categories (moderate harvest, regenerative harvest, low severity burn, high severity burn, unburned residuals). In stage three, we tested whether spatial and temporal characteristics of disturbance patches (e.g., distance to disturbance patch perimeter, disturbance age) could explain seasonal patterns of fine-scale resource selection within disturbance patches. Ecologically relevant seasons for grizzly bears in this ecoregion have been described previously (Nielsen et al. 2004a, Kearney et al. 2019) and include spring months (hypophagia, den emergence - 14 June), summer months (mesophagia, 15 June - 14 August), and fall months (hyperphagia, 15 August – den entry).

In stage 1 and 2, we used point-based step selection functions (SSFs) (Thurfjell et al. 2014) to test for patterns in grizzly bear resource selection. We fit SSFs using conditional Poisson mixed models and included random coefficients at the individual bear-year level to account for highly individualistic grizzly bear behavior, differences in resource availability, difference in sample size, and correlated measurements taken on the same individual. In stage 3, we used a non-movement-based resource selection analysis (Manly et al. 2002) to test whether spatial and temporal characteristics of disturbance patches could explain seasonal patterns of fine-scale resource selection within forest disturbance patches. We modeled resource selection within disturbance patches using conditional Poisson mixed models and included random coefficients at the individual level. We fit our models using integrated nested Laplace approximation (INLA), a method for approximate Bayesian inference, using the R package R-INLA, version 24.2.9 (Rue et al. 2009). We shared preliminary model fits with FWP during spring and fall of 2024. We will continue to refine model fits and incorporate FWP feedback.

Data collection and processing

To identify wildfire and prescribed fire on public and private lands, we used burn perimeter polygons from the U.S. Geological Survey combined wildland fire datasets (Welty and Jeffries 2021), the U.S. Forest Service FACTS (Forest Activity Tracking System) database, and the Monitoring Trends in Burn Severity (MTBS) interagency program from 1984–2022. To identify timber harvests on public lands, we used perimeter polygons from the FACTS database and the Montana Department of Natural Resources and Conservation. To identify timber harvests on private lands (small proportion of the study area) we located areas with tree cover loss not attributed to other disturbances (e.g., fire) using the Global Forest Change dataset (Hansen et al. 2013).

After filtering GPS fixes to meet assumptions of our analysis, our stage 1 and 2 models included 70,057 used locations from 91 individuals (70F:21M) across 196 bear years. Our stage 3 models included 20,239 used locations from 43 individuals (30F:13M) across 84 bear years for within harvests and 47,837 used locations from 78 individuals (61F:17M) across 166 bear years for within burns.

This study was performed under the auspices of capture and handling protocols approved by the U.S. Fish and Wildlife Service (Endangered Species Permit Section [i] C and D of the grizzly bear 4[d] rule, 50 CFR17.40[b]) and the State of Montana (IACUC# FWP08-2023).

Timeline of activities for late 2024 through 2025:

- Dec 2024: Continue to refine model fit across all stages of analyses, incorporate FWP feedback, and compile preliminary results.

- TBD: Meeting with collaborators to discuss results.

- January-February 2025: Complete comprehensive exams.

- March 2025: Present preliminary results at the Montana Chapter of The Wildlife Society annual meeting.

- 2025: Work on manuscript compiling first components of this research and begin analyses to understand grizzly bear habitat quality in relation to forest disturbance.

Disclaimer

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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