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Re: Comments on Bridger-Teton Draft Assessment and Supplemental Information

These comments are submitted on behalf of the Yellowstone to Uintas Connection. We are a 501c3 organization working to ensure wildlife habitat and corridor integrity in the lands connecting the Greater Yellowstone Area to the northern and southern Rockies. We have an office here in Bondurant, Wyoming and our members have hiked, fished and climbed in the BTNF since the 1960s.

1. Road Density for Wildlife Security.

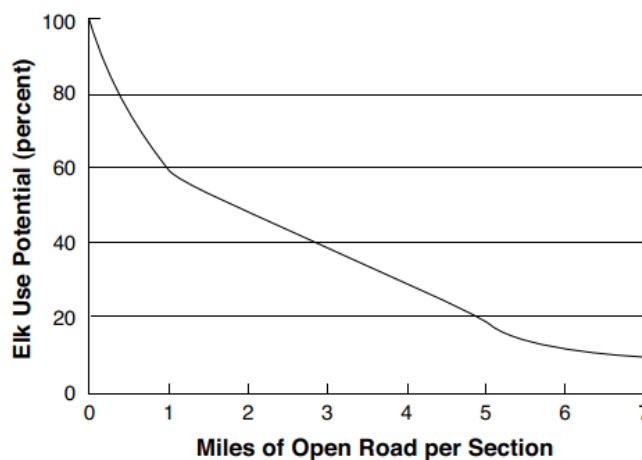
The Assessment has expressed a valid concern over climate change effects. We are concerned this will result in the Revised Forest Plan further weakening standards rather than imposing more strict limits on uses of the Forest to protect wildlife habitat. That fear was reinforced during the recent meeting in Bondurant when many people raised the topics of roads and heavy motorized recreation. The flood of off-road vehicle users coming from outside the area was a concern. The response was that the BTNF will rely on education, which has no history of success. Rentals are bringing people in who have no training or no experience with wildlife or quiet environments. There must be limits and these should be enforced. The BTNF has little enforcement staff, so limiting access and numbers is best achieved by closures at access points.

Similarly, the issue of road and trail density was raised. We commented that in Forests across our region, Forests are codifying user created or illegal trails and roads into the system. This is rewarding the malefactors who create these and offers no disincentive to future violations. Again, enforcement is critical and if the resources are not there for enforcement, route closures

and barriers must be implemented. This is especially important during these days of drought and extreme fire danger. Just yesterday I was watching the smoke plume rising above the Dollar Lake Fire as a flood of recreationists were being evacuated. Why do we risk the start of fires by allowing people in the forest during these extremely dry periods? Since people cause many fires, it would seem wise to put in place closures during these dry periods and just shut down use.

The Assessment used road density in its TCA tool, but it is not clear whether this included all roads and trails used by motor vehicles, including non-system roads and trails, temporary, or closed roads and trails that are trespassed. It appears from the Assessment that 40% of the roads/trails on the BTNF are illegal and user created. Even so, Figure 14 in the Assessment shows some heavily impacted areas. These need closer scrutiny and analysis with comparisons to the needs of wildlife for security. What is the road and trail density in miles/sq mile compared to that required for security for elk, grizzlies, and other species?

The Forest Service has publications that address this question. For example, Lyon (1983) is cited in GTR INT-303 as stating that “for areas intended to benefit elk summer range and retain high use, habitat effectiveness should be 70 percent or greater.” (Attachment A). This translates to about ½ mile per square mile as illustrated in Figure 1 of that report reproduced at right.¹



Another report by Forest Service researchers notes that (1) elk avoid areas near open roads, (2) mortality from hunting, both legal and illegal, increases as road density increases, and (3) in areas of higher road density, elk exhibit higher levels of stress and increased movement rates.² (Attachment B).

Using GPS location data for elk during the rifle and archery seasons it was recommended, “to create security areas on public lands during archery season, we recommend managing for areas with $\geq 13\%$ canopy cover that are $\geq 2,760$ m from motorized routes, and identifying and managing for areas of

¹ Christensen, A.G., Lyon, L.J., and Unsworth, J.W. 1993. Elk Management in the Northern Region: Considerations in Forest Plan Updates or Revisions. GTR INT 303.

² Rowland, M.M., Wisdom, M.J., Johnson, B.K., and Penninger, M.A. 2004. Effects of Roads on Elk: Implications for Management in Forested Ecosystems. In: Transactions of the 69th North American Wildlife and Natural Resources Conference.

high nutritional resources within these areas. During the rifle season, we recommend managing for areas with $\geq 9\%$ canopy cover that are $\geq 1,535$ m from motorized routes, and are at least 5,000 acres.”³
(Attachment C)

The Caribou NF Revised Forest Plan⁴, citing (Hillis et al 1991)⁵ described security areas as “non-linear blocks over .5 miles from an open route and at least 250 acres in size They also determined that there should be at least minimum of thirty percent 30 percent security in herds summer/fall range.”

These are examples of the type of analysis that are needed to determine the amount and location of security habitat for elk and grizzly bears along with other wildlife using the BTNF. That information should then be used in planning by setting road density standards.

2. Livestock Grazing Management

We have conducted [studies](#) on the Upper Green, Fisherman Creek, and Elk Ridge allotment complexes and found very high levels of utilization by livestock along with productivity greatly reduced below potential. Our measurements were made while the allotments were being used by about two-thirds of the permitted numbers. The Bridger-Teton Draft Assessment:⁵⁷ states, “East Zone allotments (primarily cattle) show an average utilization rate of only 12%, based on recent measurements...” This is a very large departure from what we measured by clipping grazed and ungrazed plots. By monitoring the places that cattle prefer according to the instructions in the Forest Service Handbook, in valleys and meadows along streams, we found 75% utilization. The Bridger Teton NF also clipped plots in the 2013 – 2014 period and found utilization several times higher than the 12% cited in the Draft Assessment. Those data were not used in the Assessment.

We also clipped plots in the vacant Elk Ridge allotments that had been rested for several years. We found production there at less than 25% of potential and the dominant species of grass, bluebunch wheatgrass, that should be present, was absent. We reviewed and [reported](#) on those studies to the BTNF. These reports are attached as Attachments D and E. We have proposed a quality control or data validation study to correct this situation, but this request has fallen on deaf ears.

³ Ranglack, D. Garrott, B., Rotella, J., Proffitt, K., Gude, J., and Canfield, J. 2016. Security areas for maintaining elk on publicly accessible lands during archery and rifle hunting seasons in southwestern Montana.

⁴ USDA Forest Service. 2003. FEIS for the Caribou National Forest Revised Forest Plan. Volume IV.

⁵ Hillis J.M., Thompson, M.J., Canfield, J.E., Lyon, L.J., Marcum, C.L., Dolan, P.M. McCleerey, D.W. 1991 Defining Elk Security: the Hillis Paradigm. Elk Vulnerability Symposium Montana State University Bozeman MT April 10-12 38-43.

One way to check the claim of 12% utilization is by looking at the amount of forage today's cattle use and your utilization measurements. Here, we are using the Upper Green allotments as an example. According to the Upper Green River Area Rangeland Project DEIS, there are 9,089 cow/calf pairs⁶ permitted to graze the Upper Green allotments 74,263 capable acres⁷.

If the 12% utilization found in your Draft Assessment were correct, then a cross check would be to determine the amount of forage that each acre would have to produce to achieve that 12% utilization and compare that to the potential and actual current production. We have done that in the following paragraph.

The permitted season is four months for 9,089 cow/calf pairs. In our review⁸ of forage consumption based on the current weights of cattle and calves, we found a cow/calf pair consumes 1,532 lbs air dry forage/month. (Attachment F). For 9,089 cow/calf pairs, then the total forage consumption during the four-month grazing season would be:

$$9,089 \text{ cow/calf prs} \times 4 \text{ months} \times 1,532 \text{ lb/month} = 55,697,392 \text{ lb per season}$$

At 12% utilization it would mean that there must be total forage available of:

$$55,697,392 \text{ lbs per season} / (74,263 \text{ capable acres} \times 0.12) = 6,250 \text{ lb forage/capable acre}^9$$

This level of production compares to that of an irrigated alfalfa field, not these dry sagebrush and forested areas. The [Ecological Site Descriptions](#) for the soil types found in the Upper Green ranged up to 1,800 lb/acre for upland sites, with current production measured at our plots being a fraction of that (<40%). It is important to recognize that not all forbs and grasses constitute forage as many are undesirable and little used or not used at all. It is also important to recognize that the grazing management here is the cause of this loss in production and the loss of bluebunch wheatgrass across these allotments.

We analyzed the monitoring by the Forest Service range staff and found they were measuring riparian utilization (stubble height) in dense willow areas little used by cattle, while ignoring the more sensitive open meadows. In addition, their sites were located at great distances from water or on ridges at higher elevations where little use occurs. The key upland species used by

⁶ USDA. 2016. Upper Green River Area Rangeland Project DEIS. Piv.

⁷ *Ibid.* P183.

⁸ Carter, J. 2016. Updating the Animal Unit Month. Yellowstone to Uintas Connection.

<https://app.box.com/s/zx4xjekrfuht2aq12soruw0qfil8hogk>

⁹ Even if only 2/3 of the permitted numbers were being grazed, the production needed to result in 12% utilization would be 2/3 of the 6,250 lb/acre, or 4,166 lb/acre, far in excess of the forage produced on the allotments.

the BTNF range staff to arrive at this low utilization claim is Idaho fescue, which is a short stature bunchgrass that is physically unable to be grazed by cattle to any significant degree. The attached paper shows most use by cattle occurs in areas close to water and on slopes less than 10%.¹⁰ (Attachment G) This is where monitoring should occur.

The lack of a validation study or QA/QC program leaves the conclusion that the reported 12% utilization is invalid and biased so as not to detect the actual use and therefore avoid the unpleasant political reality of reducing or shutting down livestock grazing as unsustainable. This means the Assessment itself is invalid.

3. Canada lynx Habitat

The Assessment:24 notes that lynx has not been documented in the BTNF since 2010. It then states that, *“The most important stressors and threats are climate change (habitat degradation and fragmentation, drought, increasing temperature, and diminishing snowpack); human-caused mortality; destruction, degradation, and fragmentation of riparian habitats; and insecticides.”* The Supplemental Assessment:147 describes the BTNF as “sink” habitat for lynx and then notes that the proposed rule for critical habitat identified 657,000 acres as proposed critical habitat rather than the current 2,731,000 acres. In doing so, the Supplemental Assessment cited Olson et al (2021) as the basis for that reduction in critical habitat.

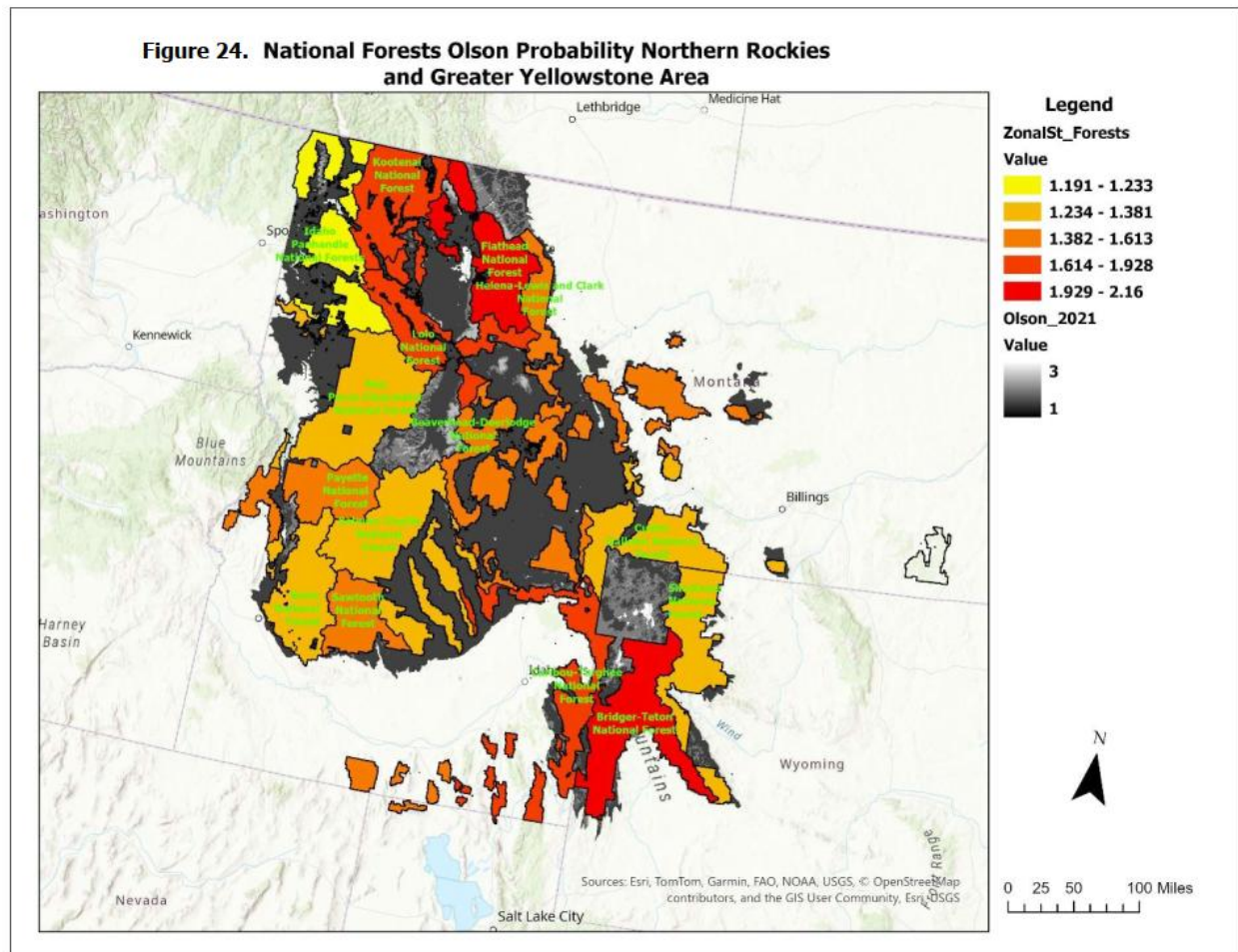
In our comments on the 2022 Lynx Species Status Assessment (Attachment H), the Draft Recovery Plan (Attachment I) and the Proposed Revision to Critical Habitat (Attachment J), we have reviewed the historical records of lynx occurrence, the heavy agency bias which discounts most historical observations, the factors that have been identified as affecting lynx occupancy, the characteristics of lynx habitat and home ranges, the explosion in roads, recreation, increases in surface disturbance that have occurred in the past few decades. These comprise an in-depth review, critique and analysis of lynx habitat requirements and agency issues. What we are not seeing is agencies actually analyzing these factors and explaining where lynx habitat has been compromised by human activities.

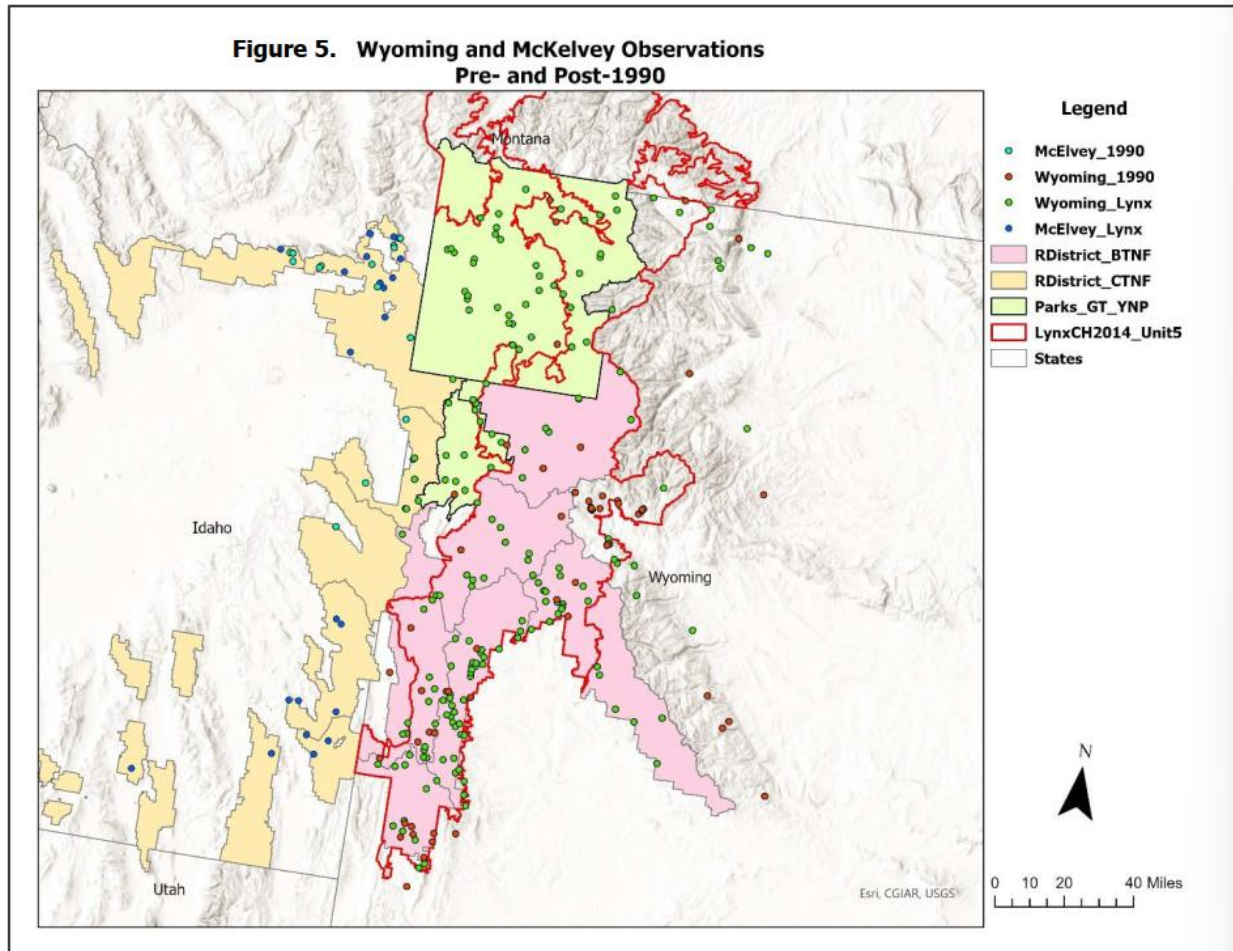
The Figures below are taken from our comments on the Proposed Revision to Critical Habitat (Attachment J). Olson et al (2021) modeled lynx habitat based on correlation of collared lynx locations to various forest and environmental factors, and while we disagree with some elements of that model, it does provide a good starting point for ranking management areas in their importance for lynx. In our comments on the Revised Designation of Critical Habitat, we used the Olson model to rank National Forests in the Northern Rockies by their lynx habitat

¹⁰ Pinchak, W.E., Smith, M.A., Hart, R.H., and Waggoner, J.W. 1991. Beef cattle distribution pattern on foothill range. *Journal of Range Management* 44(3):267-275.

probability as determined by Olson et al (2021). The map below (Figure 24 from those comments) shows the ranking of the National Forests, including the BTNF. As can be seen, the BTNF ranks in the top tier of habitat suitability along with the Flathead NF. Figure 5 below shows historical observations in the BTNF. These observations occurred across the entire BTNF. **Based on this, the entire BTNF should be managed for lynx habitat.**

Given the high habitat suitability of the BTNF based on the Olson (2021) model and historical observations, it is now incumbent on the BTNF to explain why, given this high suitability, no lynx have been observed here since 2010. This is what is needed to identify the causative factors leading to this decline and design corrective actions into the upcoming revised forest plan to restore habitats for lynx. **Lynx should be here, it is the job of this Assessment to determine in a quantitative analysis of lynx habitat requirements, forest structure, road density, timber harvest, prescribed fires, wildland fires, areas grazed by livestock, and other human uses why they are no longer being observed.**





In our comments on the 2022 Canada lynx Species Status Assessment (Attachment H) we reviewed the background documents and pointed out that the reason for lynx being listed as Threatened was due to lack of regulatory mechanisms to provide protections and that the situation has not changed with implementation of the Northern Rockies Lynx Management Direction incorporated into Forest Plans. Canada lynx were listed as a Threatened species under the Endangered Species Act (ESA). In December 1999, the Forest Service and Bureau of Land Management completed their “Biological Assessment of The Effects of National Forest Land and Resource Management Plans and Bureau of Land Management Land Use Plans on Canada Lynx” (Programmatic Lynx BA).¹¹ The Programmatic Lynx BA concluded that the current programmatic land management plans “*may affect, and are likely to adversely affect, the subject population of Canada lynx.*” The Lynx BA team recommended amending or revising

¹¹USDA Forest Service and DOI Bureau of Land Management.1999. Biological Assessment of the Effects of National Forest Land and Resource Management Plans and Bureau of Land Management Land Use Plans on Canada lynx.

Forest Plans to incorporate conservation measures that would reduce or eliminate the identified adverse effects on lynx. The Programmatic Lynx BA's determination means that Forest Plan implementation is a *"taking"* of lynx and makes Section 7 formal consultation on the land management plans (LMPs) mandatory, before actions are approved. The Lynx BA *"likely to adversely affect"* conclusion was based on the rationale that land use plans within the Northern Rockies have inadequacies, including:

- Aggressive fire suppression may limit the availability of foraging habitat.
- Allow levels of human access via forest roads that may risk incidental trapping, shooting, or access by competing carnivores.
- Weak in guidance for new or existing recreation developments.
- Allow mechanized and non-mechanized recreation that may pose a risk, by allowing compacted snow trails and plowed roads that facilitate competitors and predators.
- Weak direction for maintaining habitat connectivity.
- Weak in direction for coordinating management activities with adjacent ownerships to assure consistent management of lynx habitat across the landscape.
- Fail to provide monitoring of lynx, snowshoe hares, and their habitats, making the detection and assessment of adverse effects from other management activities difficult or impossible to attain.
- Forest management has resulted in a reduction of the area in which natural ecological processes were historically allowed to operate, thereby increasing the area potentially affected by known risk factors to lynx. The Plans have continued this trend. The Plans have also continued the process of fragmenting habitat and reducing its quality and quantity. Consequently, plans may risk adversely affecting lynx by potentially contributing to a reduction in the geographic range of the species.
- Plan revisions are needed to incorporate conservation measures included in the Canada Lynx Conservation Assessment and Strategy.¹²

The LCAS *"was developed to provide a consistent and effective approach to conserve Canada lynx on federal lands in the conterminous United States. The USDA Forest Service, USDI Bureau of Land Management, and USDI Fish and Wildlife Service initiated the Lynx Conservation Strategy Action Plan in spring of 1998."* The LCAS was published shortly after the Canada lynx was listed as Threatened under the ESA. Risk Factors from the LCAS (2000) include:

- Timber harvest and pre-commercial thinning that reduce denning or foraging habitat or convert habitat to less desirable tree species.
- Fire exclusion changing the vegetation mosaic maintained by natural disturbance processes.

¹²Ruediger et al. 2000. Canada Lynx Conservation Assessment and Strategy. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication #R1-00-53, Missoula, MT. 142 pp.

- Grazing by livestock that reduces forage for prey.
- Roads and winter recreation trails that facilitate access to historical lynx habitat by competitors.
- Incidental trapping and shooting.
- Predation.
- Being hit by vehicles.
- Obstructions to movement such as highways and private land developments.

In Attachment H we also reviewed habitat studies by noted lynx researchers. For example, the 1989 Brittell recommendations for lynx habitat defined a level of habitat connectivity for lynx, which included denning, travel, and stalking habitat as 66% of each square mile of lynx habitat, not an entire LAU of many square miles with no guidance as to where within that LAU habitat should be maintained.¹³

While clear-cuts and sparse forests may receive some lynx use, their suitability for lynx is significantly reduced for a significant amount of time. It has been shown not only that those clear-cuts and sparse forests are strongly avoided by lynx but that restoration of lynx habitat use in these logging areas to 50% of previous use takes 20 years in forest thinnings, and 34-40 years for selection cuts and clear-cuts. Also, all logging treatments are avoided by lynx for at least 10 years.¹⁴ Predictors for lynx reproductive success within occupied female home ranges were the connectivity of mature forest, intermediate (10 - 15%) amounts of young regenerating forest, young regenerating forest patches with low perimeter - area ratios, and the adjacency of mature forest to young regenerating types. Female lynx home ranges with greater than 50% mature forest and 10 - 15% young regenerating forest appear to be the optimum.¹⁵

More recent work has characterized habitat quality of Canada lynx at their "range periphery".

Our results indicated that the probability of a female producing kittens was most associated with the connectivity of mature, multistoried forests (composed of mostly spruce-fir). However, the variation among female lynx accounted for ≈62% of the total variation explained in litter production, suggesting substantial individual-level variation. Thus, managers can contribute to increased reproductive success of female Canada lynx by facilitating the development of mature forests but measuring that success will be

¹³ Brittell, J.D., R.J. Poelker, S.J. Sweeney, G.M. Koehler. 1989. Native cats of Washington. Washington Department of Wildlife, Olympia.

¹⁴ Holbrook, J.D., Squires, J.R., Bollenbacher, B., Graham, R., Olson, L.E., Hanvey, G., Jackson, S., Lawrence, R.L., 2018. Spatio-temporal responses of Canada lynx to silvicultural treatments within the Northern Rockies, U.S. For. Ecol. Manage. 422, 114–124.

¹⁵ Kosterman, M.K. 2014. Correlates of Canada Lynx Reproductive Success in Northwestern Montana. Graduate Student Theses, Dissertations, & Professional Papers. 4363. <https://scholarworks.umt.edu/etd/4363> Accessed on January 22, 2023.

*difficult given the individual variation. In core areas of high-quality females (i.e., produced kittens frequently), mature forest was 17% more abundant (i.e., ≈60% of the total core area), more connected, less clumpy, and exhibited 2.25-times larger patch sizes than the core areas of low-quality females. At the home-range extent, patterns were less pronounced while the abundance of mature forests remained high (≈50%) for high quality females. Additionally, we demonstrated that the relative density of snowshoe hares was ≥2.8 times higher in advanced regenerating forests compared to all other structural classes, including mature forest. Advanced regenerating forests accounted for ≈18–19% of the core area and home range of high-quality female lynx. Combined, our results suggest that a high-quality mosaic for female Canada lynx contains ≈50–60% mature forest and ≈18–19% advanced regenerating forest. Furthermore, we used Forest Inventory and Analysis data to characterize the approximate age distribution of advanced regeneration and mature forest, which was relevant for rotation schedules of forest silviculture. Results indicated that advanced regeneration was ≈20 to 80 years old while mature forest was ≈50 to ≥200 years old.*¹⁶

In addition, lynx spend a significant amount of time at the interface between mature and advanced regeneration forest. This is likely because advanced regeneration forest provides the most hares, but mature forest habitat makes these hares more accessible. This indicates that advanced regeneration forest subsidizes the occurrence of hares in adjacent mature forest where they are more accessible to lynx.¹⁷

All these factors continue to operate within the National Forests and BLM lands within and surrounding the GYA in spite of the Northern Rockies Lynx Management Direction and forest plan amendments. They are not being effectively addressed while degradation and fragmentation of habitat continues. Monitoring these activities is minimal to non-existent.

In our comments on the Draft Recovery Plan (I) we pointed out that the BTNF had snowshoe hare populations of sufficient size to support lynx based on actual surveys. We reviewed models by Olson et al (2021) and Beauvais et al (2001). Beauvais showed the entire BTNF had high suitability for Canada lynx. The Olson model also showed the majority of the BTNF was suitable for lynx with some areas of lower suitability needed for connections, basically the entire BTNF is lynx habitat.

¹⁶ Holbrook, J.D., Squires, J. R., Bollenbacher, B., Graham, R. O., Lucretia E., Hanvey, G., J, S., Lawrence, R.L., Savage, S. L. 2019. Management of forests and forest carnivores: Relating landscape mosaics to habitat quality of Canada lynx at their range periphery. *Forest Ecology and Management*. 437: 411-425.
<https://doi.org/10.1016/j.foreco.2019.01.011> Accessed on January 22, 2023.

¹⁷ Holbrook, J.D., Squires, J.S., Olson, L.E., Lawrence, R.L., Savage, S., 2017. Multi-scale habitat relationships of snowshoe hares (*Lepus americanus*) in the mixed conifer landscape of the Northern Rockies, USA: cross-scale effects of horizontal cover with implications for forest management. *Ecol. Evol.* 7, 125–144.

Finally, a lynx migration corridor was defined by the Forest Service in 2005.¹⁸ It passes through the area currently mapped as the project area for the East Rim WUI Fuels project. It was ignored in that analysis.

So, areas that burned, or have been logged, thinned or burnt with prescribed fire, roads and trail of all classes legal or illegal and these other factors need to be evaluated in an assessment and then explain the lack of lynx observations in recent years? This is a major failing.

Sincerely,



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August 24, 2025

¹⁸ Squires, J.R. and Oakleaf, R. 2005. Movements of a Male Canada Lynx Crossing the Greater Yellowstone Area, Including Highways. Northwest Science: 79(2&3):196 – 201.

ATTACHMENT A



United States
Department
of Agriculture

Forest Service

Intermountain
Research Station

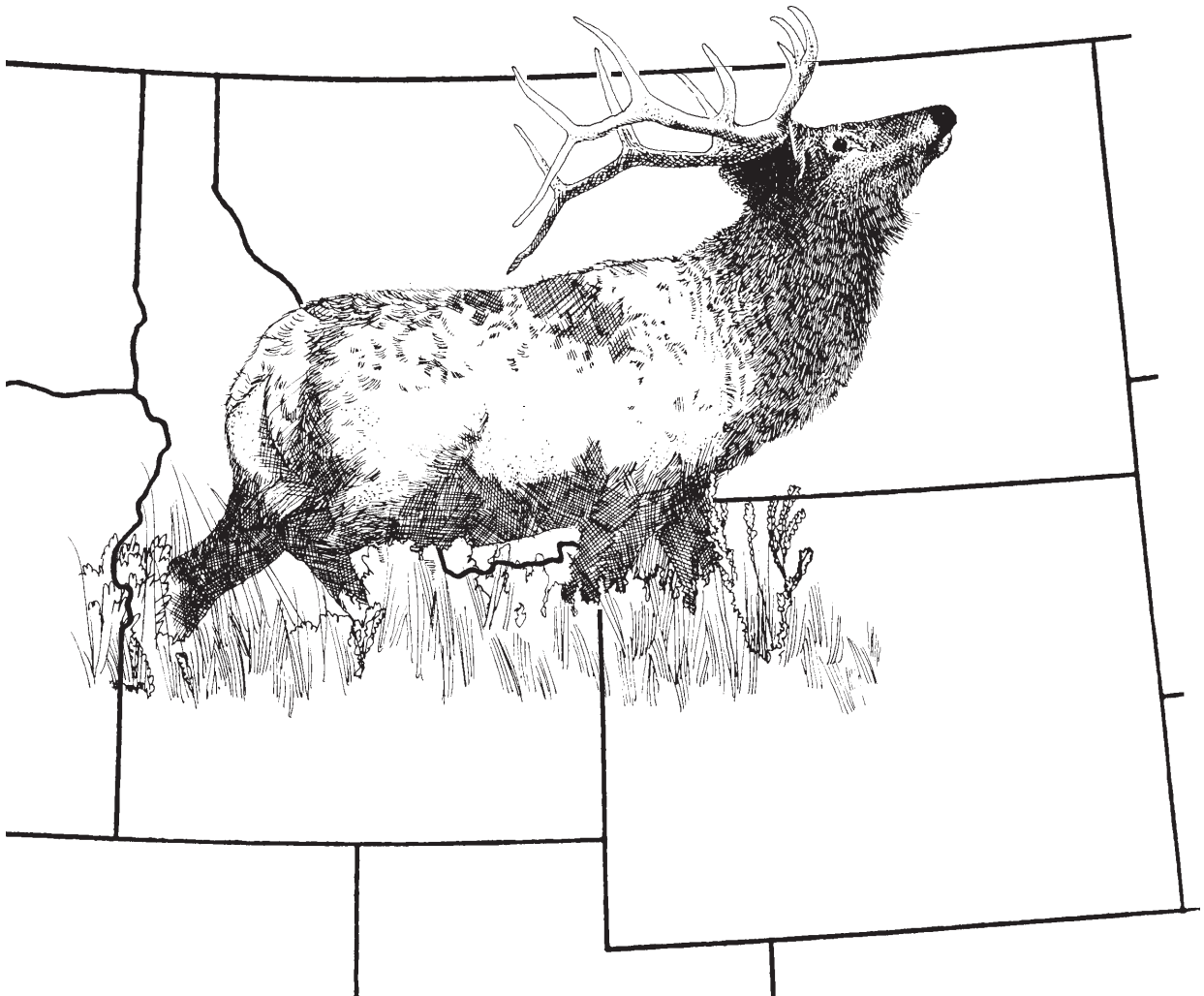
General Technical
Report INT-303

November 1993



Elk Management in the Northern Region: Considerations in Forest Plan Updates or Revisions

Alan G. Christensen
L. Jack Lyon
James W. Unsworth



THE AUTHORS

ALAN G. CHRISTENSEN is Northern Region Wildlife Program Leader and National Elk Initiative Coordinator in the Wildlife Branch, Northern Region, Forest Service, U.S. Department of Agriculture, Missoula, MT.

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Elk Management in the Northern Region: Considerations in Forest Plan Updates or Revisions

Alan G. Christensen
L. Jack Lyon
James W. Unsworth

INTRODUCTION

In the West, a large percentage of elk habitat is managed by the Forest Service, U.S. Department of Agriculture. Elk are a giant economic factor in Montana and Idaho, easily accounting for over \$100 million annually for hunting alone. This activity is especially important to many small, rural communities. At the same time, elk management can be controversial where it conflicts with other resource activities such as grazing, logging, and public access. As the habitat manager for this valuable resource, the Forest Service must develop management programs based on the best available information, work closely with State game managers, fully inform the public and disclose the effects of management actions, and embrace implementation of an ecological approach to elk management.

When the initial forest plans were developed in the early 1980's, there was no cohesive direction identifying a common set of elk management standards. As plans were written, generally recognized key pieces of elk management information were creatively modified by virtually every forest in an attempt to meet local needs. This often resulted in adjacent forests having startlingly different goals, objectives, standards, guidelines, and terminology.

In these forest plans, the approach to elk was usually narrow and focused. Because elk was a regional indicator species, managers established population targets, habitat standards, and monitoring goals. We recognize now that elk are part of a bigger picture and that elk habitat management must be placed within the context of ecosystem management, biodiversity, State management strategies and goals, and shifting public demand and interest that now embrace non-consumptive and consumptive interests.

This problem has been recognized and a solution proposed for the Northern Region of the Forest Service. Common terminology, a new perspective on elk vulnerability, and a better understanding of the application of habitat effectiveness have created the opportunity for forests to be more consistent and in tune with State management objectives. In the interest of better elk management, it is imperative State plans and forest

plans address the same issues. Elk vulnerability is the framework issue.

We present an initial overview under which individual forests can creatively address elk management and yet retain consistent and cohesive approaches within regional and State boundaries. Emphasis has been placed on process, content, and implementation of new information rather than on numerical standards, although these remain important for measuring success. Specific process guidance for biologists in the Northern Region of the Forest Service is provided in the appendix.

KEY COMPONENTS OF ELK MANAGEMENT

The relationship between National Forest lands and elk needs to be recognized for the following key components:

1. Habitat in which elk grow, reproduce, and exist as elements of biological diversity.
2. The basis upon which State management programs depend. While hunting mortality accounts for upward of 90 percent of elk mortality, the States depend on habitat availability and condition for their programs to exist.
3. Sites for the public to have the opportunity to hunt and view elk. Recreation is an important product of National Forest lands. In most areas, use of forests peaks during fall hunting seasons, but in other areas wildlife viewing is a year-around product. The setting needs to be considered along with other habitat issues.
4. Maintenance of elk as a part of the natural community and recognition of elk habitat in a landscape context and in response to natural processes.

These key components can be recognized and evaluated in the following three types of habitat considerations:

Habitat effectiveness: This is a measure to be applied to nonhunting, summer and fall habitat situations. It was developed from research related to the ability of

habitat to meet elk needs for growth and welfare requirements. It has been consistently misapplied as a measure of security during hunting season.

Elk vulnerability: This deals with security for elk during the hunting season. There is a rapidly expanding body of new information relating to this management concept that will be available for inclusion in forest plans as they are updated, revised, or amended.

Winter range: This has been a collective term referring to elk habitat during the nonsummer and fall, nonhunting season. However, during some years elk will move to winter habitat during the fall hunting season and, in most situations, become vulnerable. In updates, revisions, or amendments we must recognize and deal with this possibility as well as deal with traditional considerations.

HABITAT EFFECTIVENESS

Summer range includes the habitat used by elk from about late green-up (May) until they move to winter ranges, but prior to the hunting season. Summer range is the complete matrix upon which elk herds depend for growth, reproduction, and thrift. Management focus is on maintaining the ability of the habitat to meet elk needs for forage, water, seclusion, and special features (such as licks and moist areas). Forest Service lands that support summer range are the basis for State elk management; specifically, if habitat is degraded or poorly managed, the elk population will be degraded and, thus, directly influence State elk population management programs.

Habitat effectiveness is defined as the percentage of available habitat that is usable by elk outside the hunting season (Lyon and Christensen 1992). This is the measure of success in meeting elk needs on summer range. Based on years of research from various sites in Montana and Idaho, relatively sophisticated technologies exist for calculating habitat effectiveness. In forest plan revisions, updates, and amendments, this term should be used as a measure of summer range ability to support elk. Sources of information for habitat effectiveness and the major factors that influence it are included in Irwin and Peek (1979), Leege (1984), Lyon (1983, 1987), Lyon and others (1985), Thomas and others (1979), and Wisdom and others (1986). (See the References section at the end of this publication.)

Considerations for Forest Plans Related to Habitat Effectiveness

The following list is not inclusive but does cover the main issues managers need to consider.

1. **Roads**—density (miles per square mile), construction standards, seasons of use, method of closure.

2. **Special features**—wet sites, riparian habitat, licks, movement corridors.

3. **Cover**—extent, shape, size, connectiveness.

4. **Scale of analysis**—site specific, herd unit, habitat analysis unit.

5. **Spatial relationships**—intermingled ownerships, adjacent administrative units, district or forest “averaging.”

6. **Domestic livestock**—forage and spatial competition.

Recommendations

Roads—Roads are undoubtedly the most significant consideration on elk summer range.

1. Use figure 1 (Lyon 1983) road model for determining habitat effectiveness related to roads. Avoid classifying roads as primitive and downgrading their effect unless they really are.

2. Discuss methods of closure. For elk, physical closure with “trashing” is desirable for year-long closure. Area closures are needed where terrain features and cover characteristics do not favor closure with gates or barriers. Honor systems of closure have been only moderately successful, at best.

3. Discuss construction standards. Where roads will be system roads, strive for construction and design features that lay lightly on the land. Identify temporary roads where they are an option. Avoid “tie through” systems where possible. Strive for minimum miles of new construction in summer range. Identify logging technology that reduces road construction. Avoid key habitat features when locating roads.

4. Any motorized vehicle use on roads will reduce habitat effectiveness. Recognize and deal with all forms of motorized vehicles and all uses, including administrative use.

5. Levels of habitat effectiveness:

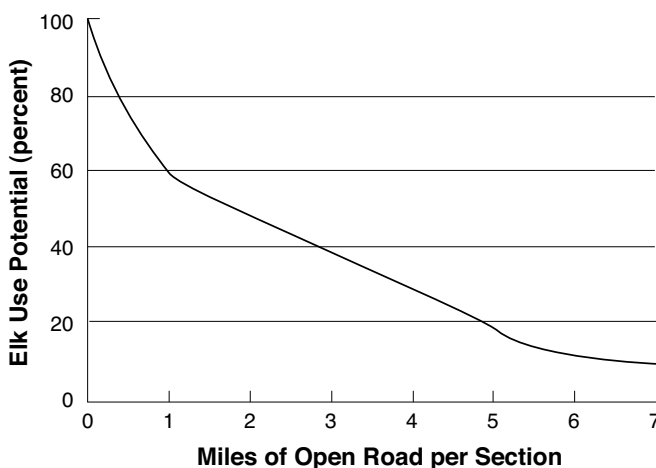


Figure 1—Habitat effectiveness for elk determined by road density (Lyon 1983).

a. For areas intended to benefit elk summer range and retain high use, habitat effectiveness should be 70 percent or greater.

b. For areas where elk are one of the primary resource considerations habitat effectiveness should be 50 percent or greater.

c. Areas where habitat effectiveness is retained at lower than 50 percent must be recognized as making only minor contributions to elk management goals. If habitat effectiveness is not important, don't fake it. Just admit up front that elk are not a consideration.

d. Reducing habitat effectiveness should never be considered as a means of controlling elk populations. A population over target is not a Forest Service habitat problem. Remember that in most situations, populations can be reduced through hunting.

Special Features—Wet drainage heads, saddles, riparian habitats, shadowed draws with cool air movement, and wet meadows are some examples of special features. In many areas these features support a disproportionate level of elk use and contribute significantly to overall elk use of a larger area. Generally, these sites are highly desirable for forage, water, temperature regulation, movement, or a combination. Such sites should be recognized and protected in prescriptions that deal with elk summer range. Logging activities, road locations, and siting of structures or activities should all be evaluated. Avoid damaging these features where elk are a benefiting resource (Lyon and others 1985).

Cover—Early guidelines greatly emphasized analysis of cover, specifically thermal and hiding cover (Thomas and others 1979). Today, detailed analyses of hiding and thermal habitat components are not considered as essential except in habitats with high natural levels of openings or where conifer cover is at a premium. Some approaches have created the classification "optimal cover" (Wisdom and others 1986) as an aid in analyzing cover from aerial photographs. Another approach, where stand analysis data are available, is provided by the HIDE2 hiding cover computer model (Lyon 1987).

While we still need to recognize the importance of maintaining cover blocks and movement corridors, a more meaningful approach to cover analysis includes maintenance of security, landscape management of coniferous cover, and monitoring elk use with radio telemetry or other means. Recognition that summer cover blocks are also fall hunting season security areas is an important coordinating consideration.

Cover unit size, patterns on a landscape basis, connectiveness with other cover, the amount of cover available to elk, and known use patterns by elk should be considered in prescriptions.

Scale of Analysis—Early guidelines tended to be project specific in scale; often 3,000 to 10,000 acres

was recommended. However, while road locations, special features, and the location of cover or cutting units still need project-level analysis, such analysis also needs to recognize the project in a broader context of herd units (where known), habitat analysis units, or other meaningful, larger scale perspectives. Herd units need to be identified in cooperation with State biologists. Consideration of project-level effects may necessitate analysis in light of influences on adjacent herd units, adjacent forests, or even adjacent States over landscape units from 30,000 to 150,000 acres.

Another consideration in establishing factors for scales of analysis are known movement patterns. If your management of summer range may influence elk in terms of their movement to adjacent fall or winter ranges, the scale of analysis should be appropriate.

Spatial Relationships—This criterion has to do with habitat features, values, or project analyses that have a relationship to intermingled ownerships, concurrent and adjacent activities, or adjacent features that are significant to your concerns for elk habitat.

When elk habitat crosses intermingled ownerships, activities that reduce habitat effectiveness on intermingled lands require the Forest Service to decide how they will be dealt with in prescriptions. Adjacent and concurrent activities beyond Forest Service control, such as logging and grazing on private land, should be recognized in prescriptions, and courses of action for the Forest Service should be identified. Federal managers need to coordinate with State biologists on these activities.

Internally controlled activities that affect elk summer range should also be recognized. An example is the relationship of herd units or analysis areas to each other and, collectively, to forest elk habitat. Each individual unit should have an identified role for elk and a level of habitat effectiveness. In this way, the whole area or forest can achieve an expected level. It is undesirable to play off one unit against another. For example, recognizing high habitat effectiveness values in adjacent wilderness areas should not be a justification for excessive reductions in habitat effectiveness in managed areas, even if some average level for the forest is met.

Significant reductions in habitat effectiveness in areas identified as benefiting elk cannot be recovered at a pace equal to our ability to move activities around a forest. In addition, patterns of recreational activity related to elk can be significantly affected by this type of management.

Domestic Livestock—Current perspective is that cattle on elk summer range are not as significant a conflict as formerly thought and probably only warrant analysis where local understanding indicates a problem may exist. Elk appear to avoid areas where cattle

are present if other options exist. Where no other options exist, elk will tolerate some cattle use.

Major points of conflict are wet sites and gentle terrain with succulent vegetation. Season-long cattle occupation of these types of sites undoubtedly reduces their value to elk.

Forests where cattle are a concern need to work with State biologists on standards and guidelines for cattle and elk relationships.

Of equal concern is the perception that elk herd expansion is causing cattle use reductions on National Forests. In developing management guidance, forests should address this issue and strive to gather habitat use data that will help clarify this situation.

Summary for Summer Range

1. Habitat effectiveness is the method of measurement.
2. The presence and motorized use of roads is the major impact on elk habitat effectiveness.
3. Detailed cover: forage analysis is important only when cover is at a premium.
4. Landscape levels of analysis are necessary.
5. Recognition of adjacent activities, intermingled ownerships, and cumulative effects is needed in plan revisions and updates.
6. Analysis of elk and domestic livestock conflicts is probably warranted where it is considered a problem locally.
7. Forests should set standards for habitat effectiveness that are congruous with goals for a prescriptive unit. Specific prescriptive guidelines should reflect the level of habitat effectiveness desired.
8. Close coordination with State biologists and recognition of identified State management goals for elk are necessary in all aspects of summer range management.
9. Forests should recognize traditional uses of elk as well as burgeoning nonconsumptive interest in elk.

ELK VULNERABILITY ANALYSIS

The primary source of elk mortality is hunting. While the State manages hunters, the Forest Service management of access and cover are extremely influential in affecting the ability of hunters to kill elk. Therefore, it is important that in forest plan revisions or updates, prescriptive guidance is identified for elk vulnerability analysis. This procedure applies during the hunting season and is not to be confused with habitat effectiveness. Vulnerability is a separate issue that forests need to recognize in elk management and write into prescriptions. Vulnerability results from an extremely complex relationship involving access, cover, topography, hunter density, and weather. A great deal of intercorrelation among these factors

exists, and a great deal of cooperation between agencies will be necessary to achieve the goals of elk vulnerability management.

The measure of success for elk vulnerability is the level of compatibility between Forest Service and State management plans. Often, this will be the number of bulls per hundred cows surviving the hunting season or some expression of the quality of the recreation experience provided.

Considerations for Forest Plans Related to Elk Vulnerability

The following list is not inclusive but does include the main issues managers need to consider:

1. *Roads*—season of use, density.
2. *Security areas*—distance from roads, size, cover characteristics, closures (area), topographic characteristics.
3. *Cover management*—description, connectiveness, scale, terrain relationships.
4. *Mortality models*—demonstrated predictors of elk mortality based on habitat quality, hunter density, or other factors.

Recommendations

Roads—As with habitat effectiveness, access to and use of roads appear to be the most significant factors in vulnerability analysis.

Two studies in Idaho have demonstrated direct relationships between levels of road access and bull mortality (Leptich and Zager 1991; Unsworth and Kuck 1991). In Montana, Youmans (1991) implicated “road densities as the key factor in increased elk vulnerability.”

Concerning open roads during hunting season, forests should develop criteria that meet State management goals for elk. Information on the relationship between roads and elk vulnerability is so new that specific criteria are scarce. However, the studies in northern Idaho provide initial guidance. Unsworth and Kuck (1991) found bull survival more than doubled in situations comparing road densities in excess of 4 miles per section with densities under 0.5 mile per section. In a different study area, Leptich and Zager (1991) reported bull mortalities of 62, 45, and 31 percent in study areas with 4.5, 2.6, and 1.0 miles of open road per section. In both these studies, cover during the hunting season was not considered limiting.

1. In areas with heavy cover, road management can be extremely influential in meeting desirable post-season bull:cow ratios.
2. Where heavy cover is not available, reduced open road densities contribute to maintaining some level of quality hunting opportunity through the season and to meeting postseason bull:cow ratios. In areas of

more open cover and, perhaps, gentler terrain, roads speed up the harvest of available bulls and make bulls more vulnerable throughout the season. Increased emphasis should be placed on security where poor cover conditions exist.

3. Even primitive roads that see little summer use are often used extensively during the hunting season. Area closures with open routes designated will most likely provide better security than individual closures. Area closures should address all motorized vehicles including all-terrain vehicles.

Security Areas—Security is the result of a combination of factors that allow elk to remain in a specific area while under stress from hunting. In Forest Service management, such areas are defined by cover blocks and road management. Specifically, these are areas of coniferous cover large enough and far enough away from open roads to provide security. There have been efforts on the Lolo and Deerlodge National Forests to develop criteria for managing security. The “Hillis paradigm” (Hillis and others 1991) provides these criteria and, with careful consideration, may be appropriate for other forests to use as a general guide. Briefly, this model identifies the size (250 or more acres), shape (nonlinear), and distance from open roads (over 0.5 mile) for security areas as well as how much of the area (over 30 percent) should be dedicated to security.

In discussions with biologists in Idaho and Montana, there appears to be a gradient from west to east regarding the significance of cover in this equation. In northern Idaho, it appears that open road density, hunter numbers, and topographic roughness are the major considerations (Unsworth and others 1993). Cover is so ubiquitous that security can be controlled with road management alone. As you move east into Montana and over the Continental Divide, cover considerations become more important because cover is less abundant and less contiguous. It is extremely important for forest biologists to work with their State counterparts in developing criteria for security areas, including their size, extent, distance from roads, and vegetative characteristics. Data from radio telemetry studies are the best source for developing such criteria.

Cover Management—This criterion is directed mostly at the more naturally open elk habitat in central and southwestern Montana and southern Idaho where care must be taken to recognize and retain adequate coniferous cover. In developing this criterion, a landscape-level perspective is absolutely necessary. Size, location on the landscape, connectiveness with other cover, and vegetative composition are important considerations (Hillis and others 1991). Data from Montana hunting seasons suggest that elk are less selective about the specific vegetative characteristics of coniferous cover and more responsive to size of units, connectiveness with adjacent units, and the scale of

cover on the landscape (Lyon and Canfield 1991). A strong relationship exists between maintaining cover for summer range habitat effectiveness and maintaining the same cover for security during fall hunting. Where coniferous cover may be a limiting factor, it will be important to develop long-term perspectives (rotation length) on cover management that address condition, quantity, location, and configuration.

Mortality Models—Models that link habitat, hunter density, and elk mortality can provide guidelines to coordinating habitat condition and State management objectives. Unsworth and others (1993) have developed a model for northern Idaho that predicts bull elk hunting season mortality using open road density, circular standard deviation of aspect, and hunter intensity (density for the length of the season). This model virtually requires a computerized Geographic Information System for calculating the aspect variable. But the effect can be estimated based on the fact that greater topographic relief reduces elk vulnerability. The more moderate the topography (fig. 2), the more impact road density and hunter density have. If we assume average topography and around 10 hunter days per section spread over a 26-day season, the probability of mortality for a bull elk is 60 percent greater in an area with 1 mile of road per section than in an unroaded area. Likewise, 2 miles of road per section will more than double the mortality probability, and at higher road densities bulls usually do not survive the hunting season.

Using a different measure of hunting intensity, Vales and others (1991) and Vales (1993) presented data from northeastern Oregon indicating that the ratio of hunters to available elk can also provide an estimate of probable mortality; basically, there is a consistent increase in harvest rate as the number of hunters per elk increases (fig. 3). These data are important because they indicate that excessive hunting pressure can, in the end, overwhelm all other provisions of elk vulnerability management.

Summary for Elk Vulnerability

1. Roads appear to be the single most important variable that the Forest Service manages. Roads not only directly affect elk mortality but also affect hunter opportunity by accelerating bull mortality. Forests must work closely with State biologists to identify acceptable levels and locations of motorized access to meet postseason bull:cow ratios and maintain optimum hunter opportunity.

2. Security area definition is variable across the region. Some forests have developed criteria. It is essential that cooperation and coordination with State biologists be used to formulate criteria.

3. Elk vulnerability analysis, a new concept, will be further defined. Hunter density and opportunity

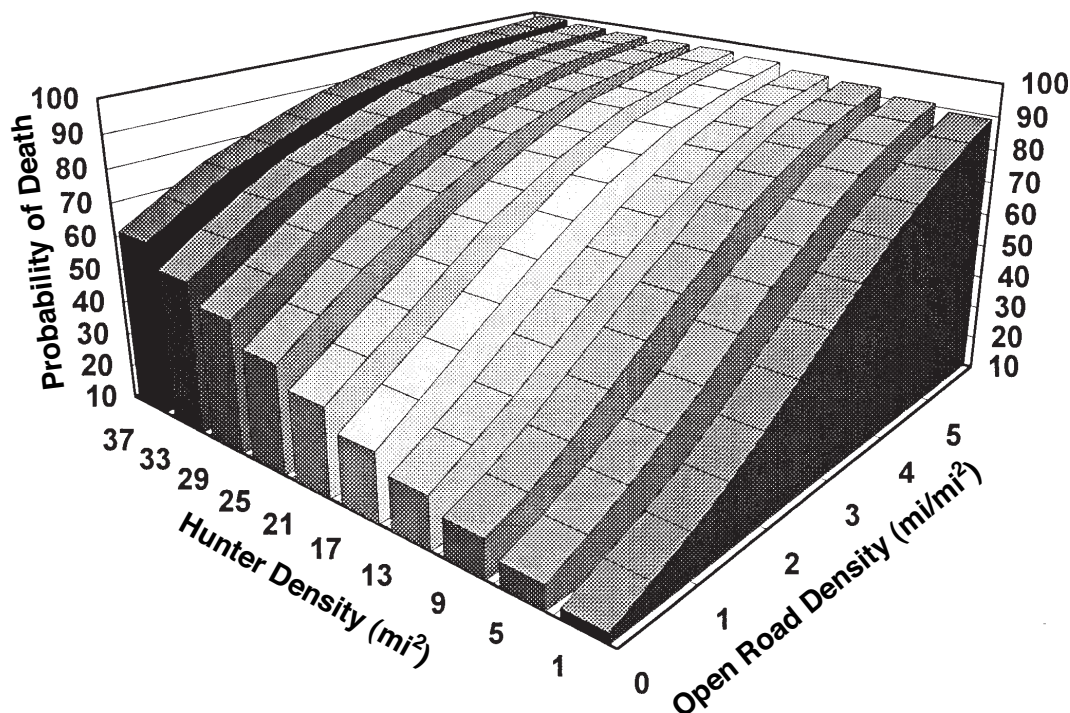


Figure 2—Elk vulnerability influenced by hunter density and road density (Unsworth and others 1993).

afforded by State regulations are also major components. It is essential that forest biologists and planners and their State counterparts communicate and coordinate extensively on this topic as forest standards and guidelines are developed.

4. Recently available mortality models can establish numerical standards for elk mortality. Local data bases may exist to help tailor mortality models to specific geographic areas. Numerical standards for elk mortality can be established through coordination with State biologists.

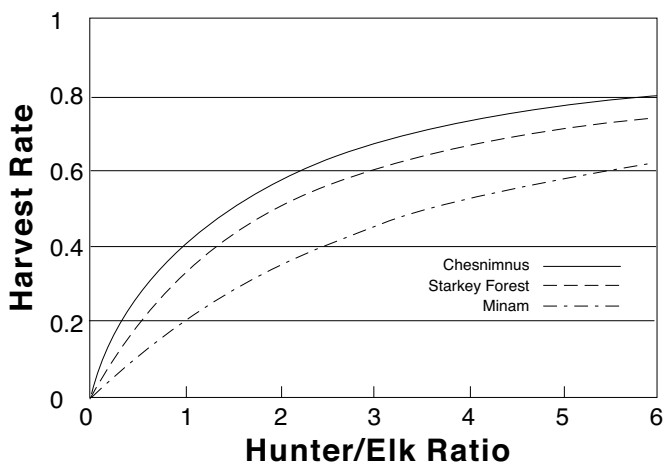


Figure 3—Elk vulnerability influenced by hunter to elk ratio (Vales 1993).

WINTER RANGE

Management of winter range remains the single most site-specific consideration for elk habitat. Each winter range is unique in some way. In this section, we briefly address the traditional considerations that already appear in the majority of forest plans. We again mention, however, that winter range should be evaluated as a part of the vulnerability assessment where appropriate to do so.

Traditionally, winter ranges for elk have been viewed as geographic sites on which animals concentrate seasonally because of snow depths. Heavy utilization of available plants, and animal die-off in severe winters, have been commonly recorded. For many years, the primary objective of management was to improve, or at least prevent deterioration of, existing vegetation.

In recent years, our understanding of animal physiology on winter ranges has modified this view. Forage is important, but in severe weather many animals substitute an energy-conservation strategy for forage intake. Thus, management of winter range to improve thermal cover and prevent harassment may be as important as anything done to change forage quantity or quality.

Considerations for Forest Plans Related to Winter Range

The following list is not inclusive but does include the main issues managers need to consider:

1. *Forage quantity and quality*—methods for improvement.
2. *Thermal cover*—energy conservation considerations.
3. *Roads and other disturbances*—energy conservation considerations.
4. *Livestock management*—forage allocation management.

Recommendations

Forage Quantity and Quality—In the majority of situations, actually modifying forage quantity or quality on the winter range is a difficult management challenge. Encroaching vegetation can sometimes be removed mechanically or with fire, and large or decadent shrubs can be burned to produce resprouting.

Thermal Cover—Some winter ranges lack thermal cover, which does not mean thermal cover serves no purpose where it is available. Where behavior patterns have been recorded, elk select resting and feeding sites based on control of energy transfer rather than forage availability. We recommend selective retention of larger trees where possible.

Roads and Other Disturbances—Disturbance and harassment result in tremendous energy costs to wintering animals. Selective road closures and restrictions on recreational use have proved effective in reducing these costs.

Livestock Management—Appropriate management of domestic livestock can, in some cases, be an important consideration in management of elk winter ranges. Local range specialists should be consulted about grazing techniques designed to leave adequate winter forage for elk.

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APPENDIX: COORDINATING FOREST PLANS WITH STATE STRATEGIC PLANS

By Alan G. Christensen

The significance of managing the elk resources of the forests in the Northern Region has been well documented. Guidance for amendments, updates, or revisions of forest plans has been promulgated in the elk chapter in the Northern Region's handbook titled "Our Approach," and in a working paper sent to all the Region's forests in July 1992 (File 2600, dated July 2, 1992).

This appendix will largely focus on procedures recommended for coordinating the States' strategic elk plans with forest plans. This is not a recommendation for decision. Rather, it represents a method to identify where decisions are needed and what the specifics of the decision may be. It necessitates a close working relationship between the forest and district wildlife biologists and their State counterparts. It requires some time to work with maps, landscape perspective, and an exchange of resource information between Forest Service and State biologists. It is a dynamic process that will change as more information becomes available, as agency priorities shift, or as public demands change. We are fortunate to have a wealth of management information available, an identified plan with which to begin framing the decision space, and expanding populations of elk.

Step 1

Assemble all available information on elk and elk habitat for the forest. This will include maps, habitat-related information (for example roads, cover status), hunter-related statistics that the State has, elk population information, harvest and management information, the State strategic plan, and any related elk studies or data pertaining to your forest.

Step 2

In cooperation with State biologists, map the boundaries of proposed State elk management units on the forest maps. This is the initial point for coordination. Recognition of what the elk management unit boundaries mean in terms of biological, administrative, or management options is an important early perspective that is needed at the landscape level. The State elk management units are largely based on hunting district boundaries and may be drawn for biological reasons or administrative convenience.

- Look for boundary locations that don't "fit the landscape" and may create biological problems in the future analysis.
- Look for ownership patterns that will dictate management options (for example, checkerboard ownership).

- Look for administrative boundaries that may dictate management options (for example, wilderness, roadless, State or county boundaries).

Step 3

Within elk management units, you will need to further subdivide elk habitat so that eventually a ground-level project perspective can be developed. Some units have established habitat analysis units or other, smaller units that define an area of importance to elk but are still quite large, perhaps as big as a hunting district or several major watersheds. This habitat analysis unit or equivalent may represent all seasonal ranges for several herds, cross some administrative lines, include private lands, and still be at a scale difficult to implement at the project level. Defining habitat analysis units can be facilitated by known elk use from radio telemetry, or patterns of historical management by the State, or some negotiated reasoning between the State and forest biologists. In many instances, habitat analysis units have not been mapped yet. In the further subdividing of elk management units, areas of particular importance will begin to emerge that will highlight ownership pattern problems, area-specific management emphasis by the State or forests (for example, a roadless hunting area contained within an area scheduled for future harvest), and priorities for information gathering.

At this level of mapping, you can begin to compare some of the goals stated in the State strategic plan with those in the forest plan regarding management area allocations, standards and guidelines, and areas where plans may be in harmony or conflict.

Step 4

You will need a final mapping level that will facilitate project-level analysis and that represents herd units (where data are available). This level will recognize known core areas, seasonal ranges, movements, and patterns of use. If data are unavailable to base these units on, then State and forest biologists should agree on mapping units that can be used for project-level analysis. These units will probably encompass third-order drainages and be specific enough to be used in meaningful Habitat Effectiveness and Vulnerability analysis at the project level. These units will "nest" within the larger habitat analysis units, which in turn will "nest" within elk management units.

At this level, specific coordination will occur regarding road access, security cover management, and hunter opportunity. Aggregation of the herd units and the data related to them should be the basis for evaluating

where and to what extent forest plans and State strategic plans are in harmony or conflict.

Uses of the Stepdown Process

Without this stepdown process, it will be extremely difficult to identify and prioritize management decisions that will need to be addressed by amendment, update, or revision. It will allow forests to focus in on key areas, to identify strengths or weaknesses of existing plans, and to specify the alternatives that may be needed in future plan changes. It will provide a forestwide perspective that will facilitate an incremental approach to planning or an ecosystem approach. It will identify the key elements that must be addressed (for example, ownership patterns, management allocations, population factors) and the

agency or entity that has the management authority and responsibility.

This process will also identify important needs and the agency responsible. For example, if road access or the status of security is the issue, then the Forest Service will need to develop the pertinent data. If bull mortality rates or adjacent private land depredation is a concern, then the State will lead. If ownership patterns emerge, land exchanges may be identified as a solution to long-term management needs.

In this stepdown process, a geographical framework for elk management will be established that identifies site-specific considerations. A landscape perspective can emerge where site-specific decisions can be framed to achieve a larger, overall goal that can be fully developed and implemented through the planning and decision process.

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National Forests provide a major proportion of the habitats in which elk grow, reproduce, and exist as elements of biological diversity. Forests also provide the basis upon which State management programs depend and provide sites for the public to hunt, view, and otherwise enjoy the elk resource. Individual National Forests can creatively address elk management through habitat effectiveness and elk vulnerability, and yet retain more consistent and cohesive approaches within regional and State boundaries. Emphasis in this report has been placed on process, content, and implementation of new information rather than on numerical standards

KEYWORDS: habitat effectiveness, elk vulnerability, forest planning



ATTACHMENT B

Effects of Roads on Elk: Implications for Management in Forested Ecosystems

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The effects of roads on both habitat and population responses of elk (*Cervus elaphus*) have been of keen interest to foresters and ungulate biologists for the last half century. Increased timber harvest in national forests, beginning in the 1960s, led to a proliferation of road networks in forested ecosystems inhabited by elk (Hieb 1976, Lyon and Christensen 2002). Among disturbances to elk habitat, roads have been viewed as a major factor influencing distributions of elk across the landscape (Leege 1984, Lyon 1984, Lyon et al. 1985, Roloff 1998, Lyon and Christensen 2002, Wertz et al. 2004). Evidence from a variety of studies, such as those conducted at the Starkey Experimental Forest and Range (Starkey) in northeastern Oregon, has corroborated this view (Lyon 1983, 1984; Witmer and deCalesta 1985; Cole et al. 1997; Johnson et al. 2000; Rowland et al. 2000; Ager et al. 2003).

Early studies of elk were among the first to address effects of roads on wildlife, establishing a precedent for subsequent research on a wide range of terrestrial and aquatic species. These early elk-roads studies included those

reported in a symposium on the topic in 1975 (Hieb 1976), the seminal studies of Jack Lyon in Montana and northern Idaho (Lyon 1979, 1983, 1984), the Montana Cooperative Elk-Logging Study (Lyon et al. 1985), and work by Perry and Overly (1977) in Washington and by Rost and Bailey (1979) in Colorado.

As research and analysis techniques have become more sophisticated, particularly with the advent of geographic information systems (GIS) and high-resolution remote imagery, the study of effects of roads on terrestrial and aquatic communities has evolved into a unique discipline of "road ecology" (Forman et al. 2003). Road effects are far more pervasive than originally believed and include such disparate consequences as population and habitat fragmentation, accelerated rates of soil erosion, and invasion of exotic plants along roadways. Indeed, "in public wildlands management, road systems are the largest human investment and the feature most damaging to the environment" (Gucinski et al. 2001:7). Summaries of the effects of roads on wildlife habitats and biological systems in general have been compiled by Forman and Alexander (1998), Trombulak and Frissell (2000), Gucinski et al. (2001), Forman et al. (2003) and Gaines et al. (2003).

Well-designed research that furthers our understanding of road effects and road management on key species, such as elk, and their habitats is critical for enhancing the long-term functioning of ecosystems impacted by the vast network of roads in North America. Moreover, addressing effects of roads on elk and elk habitat often is mandated on public land, e. g., through standards and guidelines developed for national forests.

Our goals in this paper are three-fold: (1) to describe current knowledge about effects of roads on elk, emphasizing results of research conducted at Starkey, (2) to describe an example in which a distance-band approach, rather than the traditional road density method, was used to evaluate habitat effectiveness (HE) for elk in relation to roads, and (3) to discuss the broader implications of road-related policies and land management with regard to elk.

Effects of Roads on Elk in Forested Ecosystems—What Do We Know?

Effects of roads on elk can be divided into two broad categories: indirect effects on habitats occupied by elk and direct effects on individual elk and their populations. Effects of roads in forested ecosystems in general have been well summarized (Gucinski et al. 2001, Gaines et al. 2003). With regard to elk habitat,

the primary effect of roads may be habitat fragmentation; heavily roaded areas may contain few patches of forest cover large enough to function effectively as habitat for elk, especially where elk are hunted (Leege 1984, Rowland et al. 2000). The total loss of elk habitat from road construction is unknown; a rough estimate of 5 acres per linear mile (1.4 ha/km) of road is often applied (Forman et al. 2003). Across the United States, the area occupied by public roads and associated corridors is estimated to be 27 million acres (10.9 million ha); these numbers do not include private roads or unofficial roads on public land (Forman et al. 2003). Roads may also exert more subtle influences on habitat; for example, they may facilitate the spread of exotic vegetation (Gelbard and Belnap 2003), which may subsequently reduce quality and abundance of forage available to elk. Gaines et al. (2003) listed five road-associated factors in relation to elk: hunting, poaching, collisions, displacement or avoidance, and disturbance at a specific site.

The direct impacts of roads and associated traffic on elk, in addition to outright mortality from collisions with motorized vehicles, can be summarized as follows.

1. *Elk avoid areas near open roads.* A plethora of studies have demonstrated an increasing frequency of elk occurrence or indices of elk use, such as pellet groups, at greater distances from open roads (defined here as any road where motorized vehicles are allowed). This response varies in relation to traffic rates (Wisdom 1998, Johnson et al. 2000, Ager et al. 2003), the extent of forest canopy cover adjacent to roads (Perry and Overly 1977, Lyon 1979, Wisdom 1998, Wisdom et al. 2004b), topography (Perry and Overly 1977, Edge and Marcum 1991), and type of road (e. g., improved versus primitive; Perry and Overly 1977, Lyon 1979, Witmer and deCalesta 1985, Marcum and Edge 1991, Rowland et al. 2000, Lyon and Christensen 2002, Benkobi et al. 2004), which also correlates with traffic rates. Responses may also differ between sexes, with bull elk demonstrating a stronger avoidance of areas close to roads than do cow elk (Marcum and Edge 1991). Shifts in distribution of elk away from roads may occur across a range of temporal and spatial scales. For example, elk at Starkey were generally farther from open roads during daytime but moved closer to roads during nighttime (Wisdom 1998, Ager et al. 2003). This pattern was also observed in South Dakota (Millspaugh 1999). In addition, both daily movements and size of home ranges of elk may decrease when open road density

decreases. These reductions could lead to energetic benefits that translate into increased fat reserves or productivity (Cole et al. 1997). On a larger scale, entire ranges can be abandoned if disturbance from traffic on roads and the associated habitat loss and fragmentation exceed some threshold level. The ultimate effect of displacement of elk, by motorized traffic as well as other disturbances, is a temporary or permanent reduction in effective habitat for elk. Concomitant with loss of effective habitat are reduced local and regional populations (Forman et al. 2003).

2. *Elk vulnerability to mortality from hunter harvest, both legal and illegal, increases as open road density increases.* Many factors affect elk vulnerability to hunter harvest, but the evidence is compelling that survival rates of elk are reduced in areas with higher road density (Leege 1984, Leptich and Zager 1991, Unsworth et al. 1993, Gratson and Whitman 2000a, Weber et al. 2000, Hayes et al. 2002, McCorquodale et al. 2003). Closing roads offers more security to elk and may decrease hunter densities (fewer hunters may be willing to hunt without vehicle access). Also, poaching losses may decrease when roads are closed (Cole et al. 1997).
3. *In areas of higher road density, elk exhibit higher levels of stress and increased movement rates.* Higher levels of physiological indicators of stress, such as fecal glucocorticoids, have been observed in elk exposed to increased road density and traffic on roads (Millspaugh et al. 2001). In addition, the energetic costs of moving away from disturbance associated with roads may be substantial (Cole et al. 1997). Research to estimate such costs to elk in relation to recreational use on roads is underway at Starkey (Wisdom et al. 2004a). Conversely, elk may conserve energy by traveling on closed roads to avoid woody debris and downfall (Lyon and Christensen 2002).

Knowledge has been gained not only about elk response to roads, but also about modeling of this relationship. Results from research at Starkey suggested that a road-effects model based on distance bands provides a more spatially explicit and biologically meaningful tool than a traditional model based on road density (Rowland et al. 2000). This analysis, based on more than 100,000 radiolocations of cow elk during spring and summer, found no relation between numbers of elk locations and HE scores based on open road density in 15 elk

analysis units. (We define habitat effectiveness as the "percentage of available habitat that is usable by elk outside the hunting season" [Lyon and Christensen 1992:4].) However, elk preference increased strongly (as measured by selection ratios) as distance to open roads increased. Such distance-to-roads analyses are readily accomplished using widely available spatial data layers in a GIS.

Despite the wealth of information about how roads and motorized traffic affect elk and their habitats, gaps in our knowledge remain. For example, although we know that elk response to roads generally varies depending on the level and type of motorized traffic, we have little knowledge about the precise levels of such disturbance that elicit a response and the duration of that response. Research at Starkey has demonstrated threshold rates of traffic above which a response by elk is elicited but below which open roads are functionally equivalent to closed roads (A. A. Ager, personal communication 2003; Wisdom et al. 2004b). Measurements of traffic rates and elk response to these rates are needed in other locations to better understand these thresholds. Though more costly to obtain than maps of roads, information about traffic rates can be used to improve management of roads in elk habitat in ways that are both cost-effective and beneficial to elk. Further research also is needed to better understand the interaction of roads, topography and forest cover in affecting elk distributions, primarily in relation to providing security for elk.

Also needed is a better understanding of the effectiveness of road closures; examples abound about the lack of effectiveness of closures on public land, especially when few resources are made available for enforcement (Havlick 2002, Wertz et al. 2004). More than half of 802 road closures inventoried on national forests in Idaho, Montana, Washington and Wyoming were found to be ineffective, even after accounting for administrative use (Havlick 2002). In Idaho, elk mortality was positively correlated to densities of both closed roads and open roads, suggesting that road closures were ineffective in reducing mortality from hunting (Hayes et al. 2002). Systematically collected data on use by all motorized vehicles, including off-highway vehicles, of closed roads would benefit management of elk and other resources (e. g., soils) affected by vehicle traffic on roads. And last, HE models for elk, including the roads variable, need further validation. Beyond the Starkey research (Rowland et al. 2000) and a few other studies (e. g., Roloff et al. 2001, Benkobi et al. 2004), such validation has not been conducted, especially of the most commonly applied models (Wisdom et al. 1986, Thomas et al. 1988). Given the continued widespread use of elk HE models in

land-use planning on national forests and on other land occupied by elk, such validation is a critical research need.

A final cautionary note: much of what has been learned about elk and roads to date has resulted from field studies that had no experimental component and, thus, no sound basis from which to infer cause-effect relations. Experimental studies underway at Starkey—in which road densities and traffic rates are manipulated according to strict sampling protocols and distributions of elk are closely monitored—will greatly enhance our understanding of elk response to roads (Wisdom et al. 2004b).

Current Management Approaches to Elk-Roads Issues

In light of the deleterious effects of roads on elk as described above, both ungulate biologists and land managers have developed methods to address their respective concerns. During the 1970s and 1980s, biologists created a suite of models, based on empirical data, to predict effects of land management activities on habitat effectiveness for elk (e. g., Lyon 1979, 1983; Thomas et al. 1979, 1988; Leege 1984; Wisdom et al. 1986). All of these models incorporated a road-density component. In addition to the more general elk HE models, specific habitat guidelines related to roads were written. For example, guidelines developed in Montana specified that elk security areas be located more than 0.5 mile (0.8 km) from open roads (Hillis et al. 1991). Elk habitat models that include a roads component also have been used to evaluate the suitability of sites for restoration of elk populations (Didier and Porter 1999). Further, ungulate biologists have constructed resource selection models that include a roads variable to predict spatial distributions of elk (Cooper and Millspaugh 1999, Johnson et al. 2000).

Land managers, in turn, have incorporated concerns about elk and roads into formal planning processes through the application of standards and guidelines. How management agencies address elk-roads issues varies widely, however, both within and across agencies. For example, elk are designated as a management indicator species (MIS) within some national forests but not others. This designation, or lack thereof, subsequently affects how elk habitat is addressed in forest planning and environmental assessment.

Forest plans for many national forests contain specific standards and guidelines for elk HE, using one or more of the various elk HE models that have been developed. For example, the forest plan for the Wallowa-Whitman National

Forest in northeastern Oregon provides direction to maintain HE at greater than 0.5 during timber sale planning in management area 1 (MA1; timber production emphasis), but only, "where this can be done without reducing timber harvest volumes" (U. S. Department of Agriculture, Forest Service 1990b:4–57). (Habitat effectiveness scores range from 0 to 1.0 in most HE models.) Furthermore, the plan assumes that, in the long-term, elk HE will be maintained at 0.62 in MA1. Open road density in this management area is targeted not to exceed 2.5 miles per square mile (1.6 km/km²) in general but no more than 1.5 miles per square mile (0.9 km/km²) in selected elk summer and winter ranges. In the adjacent Umatilla National Forest, elk HE is projected to range between 0.67 and 0.70, and open road density from 2.0 to 2.2 miles per square mile (1.2–1.4 km/km²), forest-wide during the five decades beyond 1990 (U. S. Department of Agriculture, Forest Service 1990a). In addition, the standard for elk HE on big game winter range is 0.70 (U. S. Department of Agriculture, Forest Service 1990a). Generally, if habitat for elk is identified as an issue for a proposed management activity, such as timber restoration, or if elk have been identified as a MIS, evaluation of elk habitat is mandated during the environmental assessment process. Such evaluation commonly entails the application of an elk HE model to the affected area under the various alternatives, with the results incorporated into an effects analysis for evaluation of alternatives.

A more recently developed approach incorporates evaluations of habitat effectiveness for elk into the initial stages of forest planning, rather than using HE models to evaluate effects of single management activities, such as timber harvests (Bettinger et al. 1999). This approach incorporates elk HE into the objective function of a mathematical forest-planning model. Various scenarios can be simulated, with maximization of elk HE scores, timber output, or both. Likewise, Roloff et al. (1999) developed a decision support system that allows evaluation of effects of various management strategies on habitat for elk and other wildlife within the context of forest planning models.

Applying a Distance-Band Model of Elk-Road Effects in Forest Planning: A Case Example

A method to evaluate effects of roads on elk using a distance-band approach has been suggested both by Roloff (1998) and by Rowland et al. (2000), as described above. Based on radiolocations of elk at Starkey, Rowland et al.

(2000) found no relation between number of elk locations and HE based on open road densities. By contrast, the authors found a strong, linear increase in selection ratios of elk as distance to roads increased. For this analysis, elk locations were assigned to 109-yard- (100-m-) wide bands away from open roads. Roloff (1998) also developed a road-effects module in which habitat adjacent to roads was buffered into distance bands in a GIS. Habitat effectiveness in the bands was adjusted according to level of security cover, as well as road use or road type. Regardless of the exact approach selected, ongoing planning efforts within national forests and other land that provide habitat for elk may benefit from consideration of a revised, spatially explicit road-effects variable.

The mechanics of calculating HE related to roads (HE_R) using distance bands are similar to those for another variable in elk HE models—the size and spacing of cover and forage (HE_S). Both variables involve buffering outwards from linear features—either roads, for HE_R , or the cover and forage edges, for HE_S —to create distance bands. Each band is assigned a weight, with lower weights corresponding to lower HE. A weighted average is then calculated, based on the proportion of the analysis area in each of the bands and the weight of the appropriate band (see Hitchcock and Ager 1992). The sum of these products yields the final HE value, which cannot exceed 1.0.

To examine how the method of calculation (i. e., the traditional road-density method versus distance bands) might affect HE_R for elk, we applied both methods in an evaluation of the effects of a timber sale in the Wallowa-Whitman National Forest in northeastern Oregon. The Dark Meadow Restoration Project was proposed to restore and enhance ecosystems within the project area, through thinning, prescribed fire and mechanical fuels-reduction treatments over the next 10 to 15 years (U. S. Department of Agriculture, Forest Service 2003). Project goals include reductions in fuel loading, promotion of old-growth habitat, improvement in big game habitat and initiation of tree regeneration. Under the two action alternatives of the project, open road density will be lower than that under the no action (existing condition) alternative (Table 1, Figure 1).

The Dark Meadow Restoration Project encompasses 17,700 acres (7,169 ha) of the Blue Mountains and is completely contained within the Starkey Game Management Unit. The elk population in this unit is estimated to be at the objective (5,300) set by Oregon Department of Fish and Wildlife. The area functions primarily as summer range for elk, with smaller portions used as

Table 1. Comparison of two methods for modeling effects of roads on elk habitat effectiveness (HE) under three alternatives in the Dark Meadow Restoration Project, Wallowa-Whitman National Forest, northeastern Oregon.

Variable	"No action" alternative ^a	Alternative 1	Alternative 2
Total miles (km) of open roads in analysis area ^b	138.1 (222.2)	114.2 (183.7)	106.5 (171.4)
Open road density in miles per square mile (km/km ²)	4.99 (3.09)	4.13 (2.56)	3.85 (2.39)
HE _R -ORD ^c	0.20	0.28	0.31
HE _R -DB ^c	0.17	0.19	0.20
HE _C ^d	0.60	0.59	0.61
HE _S ^e	0.84	0.79	0.80
Total HE (ORD method) ^f	0.47	0.51	0.52
Total HE (DB method)	0.45	0.46	0.47

^aThis alternative is the existing condition.

^bOpen roads include any road available to motorized traffic; these are roads officially designated as open as well as closed roads that have no promulgation.

^cHabitat effectiveness for roads (HE_R) based on open road densities (ORD); HE_R-DB uses distance bands (DB) to calculate HE_R.

^dHabitat effectiveness as related to cover quality.

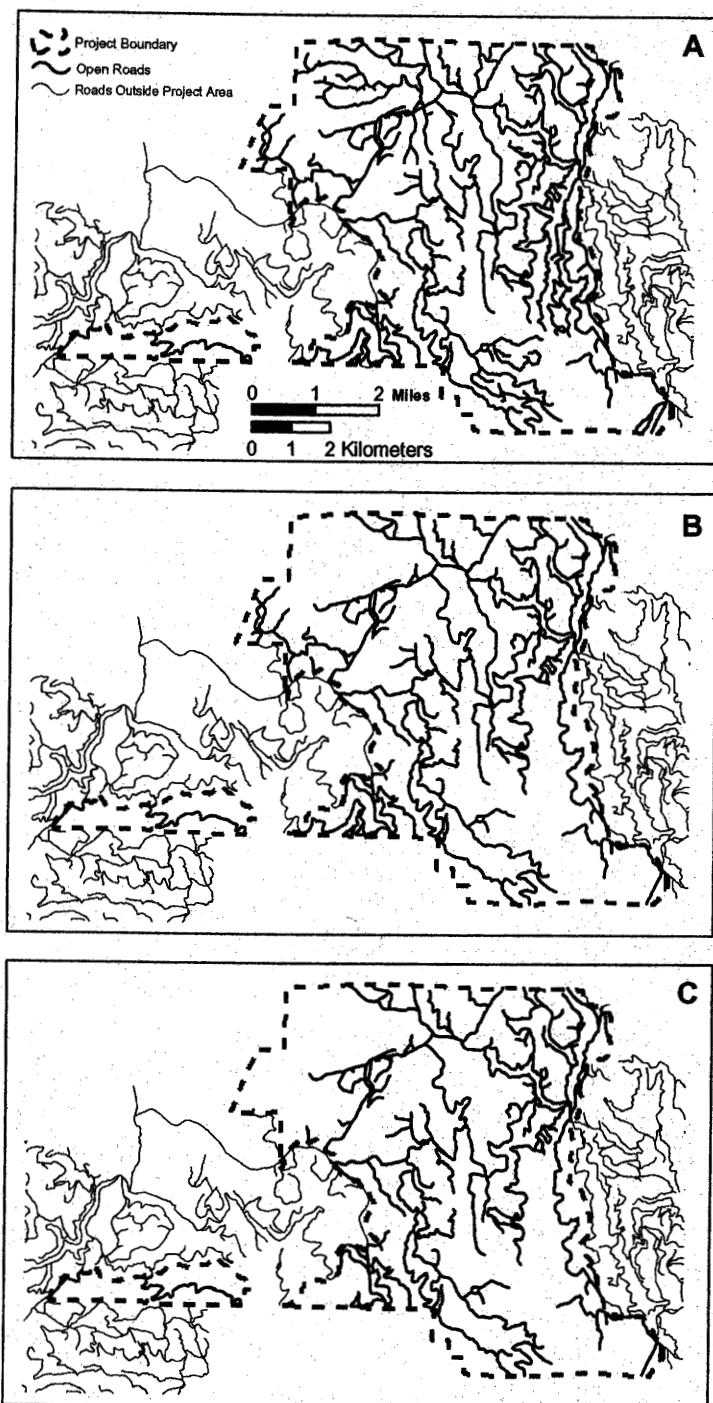
^eHabitat effectiveness as related to size and spacing of cover and forage areas.

^fTotal habitat effectiveness, which is the geometric mean of HE_R, HE_C, HE_S and HE_F. HE_F (habitat effectiveness as related to forage quality and quantity) was not derived empirically for this analysis; rather, a default value of 0.5 was input for this variable.

transitional or winter range. Lack of elk security habitat was identified as a key issue in planning for the Dark Meadow Restoration Project; thus, roads were a primary consideration in the crafting of alternatives (U. S. Department of Agriculture, Forest Service 2003).

To calculate HE_R for elk in Dark Meadow Restoration Project, all roads open to motorized vehicles were counted. No traffic rate data were available; thus, roads were not weighted according to level of use. We defined open roads as those officially designated as open as well as closed roads for which no promulgation was planned. Promulgated road closures are those for which the Code of Federal Regulations is applied; such closures are legal and enforceable. In the Wallowa-Whitman National Forest Plan, closed roads were assumed to be physically impassable to full-sized vehicles and also assumed to be seldom traveled by off-highway vehicles (U. S. Department of Agriculture, Forest Service 1990b). Roads designated as closed but not promulgated, however, are often traveled by off-highway vehicles (Havlick 2002).

Figure 1. Open roads under three alternatives of the Dark Meadow Restoration Project, Wallowa-Whitman National Forest, northeastern Oregon: the “no action” alternative (A); Alternative 1 (B); and Alternative 2 (C). Open roads were defined as any road available to motorized traffic, including roads officially designated as open and closed roads that have no promulgation.



The HE_R variable based on open road densities (ORD)(hereafter referred to as HE_R -ORD) was then calculated with the equations of Hitchcock and Ager (1992) for the existing condition and the two action alternatives (Table 1). To calculate HE_R based on distance bands (HE_R -DB), all open roads were buffered in a GIS. The analysis area was partitioned into five bands, each 394 yards (360 m) wide, with the sixth band containing any area greater than 1,969 yards (1,800 m) from an open road. This distance (i. e., 1,969 yards) is equivalent to that at which elk response to open roads diminished markedly at Starkey (Rowland et al. 2000). Each band was assigned a weight, reflecting a linear increase in elk selection ratios as distance from open roads increased at Starkey: band 1 was 0.17, band 2 was 0.33, band 3 was 0.50, band 4 was 0.67, band 5 was 0.83 and band 6 was 1.0. HE_R -DB was then calculated as a weighted average, with the proportion of the analysis area in each band multiplied by the appropriate weight. Finally, we calculated total HE for the analysis area, based on the four variables of the elk HE model, with only HE_R differing between the two calculations (Table 1).

Open road density in the Dark Meadow Restoration Project area was relatively high under all three alternatives, and HE_R -DB was consistently lower than HE_R -ORD (Table 1). However, this difference was more pronounced with lower open road densities; under the no action alternative, HE_R -DB was only 15 percent less than HE_R -ORD, but, under the two action alternatives, this difference increased to at least 32 percent (Table 1). Compared to the no action alternative, the density of open roads declined 17 and 23 percent, respectively, under alternatives 1 and 2. Concomitant with this decline in road density were increases in HE_R -ORD of 40 and 55 percent for the two action alternatives, respectively; however, HE_R -DB increased only 12 and 18 percent (Table 1). These results suggest that the spatial arrangement of remaining open roads was such that the amount of effective habitat for elk improved only marginally (Figure 1). Thus, HE_R -ORD may overestimate habitat effectiveness for elk under certain conditions.

Because total HE is the geometric mean of all four input variables, differences in total HE between the two methods were not as substantial as were those for HE_R alone (Table 1). Among the four variables used to calculate HE, all of which are equally weighted in computing the mean, values for HE_R were substantially lower than those of the other three variables (Table 1). Thus, in the Dark Meadow Restoration Project, the relatively high open road densities were

largely responsible for the low total HE scores. These scores exceeded only slightly the recommended standard of 0.5 for total HE in timber planning on the Wallowa-Whitman National Forest and only when HE_R -ORD was used for the roads variable (Table 1). By contrast, when HE_R -DB was used, total HE was below the standard for all alternatives (Table 1).

We did not alter band weights, or back buffer them, based on the level of security cover in each band (see Roloff 1998). This additional refinement may be warranted in situations where cover quality varies widely across the analysis area, or is predicted to vary under proposed management alternatives. In addition, band weights could be adjusted by accounting for topographic relief, such that areas providing topographic barriers to human disturbance would have weights adjusted upward, or by traffic rates, if such data were available.

Implications for Management and Policy Involving Elk-Roads Issues

Road management inevitably involves tradeoffs between the benefits of increased access that roads provide versus the ecological and economic costs associated with roads (Gucinski et al. 2001, Forman et al. 2003). Because the U. S. Department of Agriculture, Forest Service manages about 10 percent of the public road system in the United States (Forman et al. 2003), road-management decisions made by that agency strongly influence current road systems. U. S. Department of Agriculture, Forest Service policy regarding road closures and construction continues to engender controversy, exemplified by the multiyear debate over the national roadless rule. The rule, first published in the Federal Register in January 2001 (U. S. Office of the Federal Register 2001), has been challenged by at least nine lawsuits in federal district courts. Decisions about roads, including construction, reconstruction, closure, obliteration or decommissioning, are complex because they affect a multitude of resources, not just wildlife. All resource values in a watershed must be evaluated when making decisions about roads; these may include human safety (e. g., access to combat wildfires), soils, recreation, commercial timber harvest and restoration activities. In addition, decisions about roads are closely tied to available funding. Expenses are involved both in constructing, maintaining and decommissioning roads and in enforcing road closures (Forman et al. 2003). Complicating the issue of evaluating effects of roads is that roads in forested ecosystems currently are not well inventoried (Gucinski et al. 2001).

The potential implications of road-related policies for elk management are diverse and complex. Benefits of road closures may include:

- decreased energy expenditure by elk, a result of less frequent disturbance by motorized vehicles, with potential improvements in animal performance
- increases in total amount of effective habitat for elk in the area affected by the closures
- increased hunting opportunities on public land, when roads are closed on public land adjacent to comparatively less-roaded private land, thereby enticing elk to remain on public land rather than moving to private land where hunting may not be allowed or is prohibitively expensive (Wertz et al. 2004)
- decreased damage to crops and haystacks from elk on private land, due to lessened disturbance from traffic on public land, which in turn causes elk to remain on public land longer during the fall and winter seasons
- improvements in diet quality when elk are able to forage undisturbed in areas previously avoided due to excessive motorized traffic; these changes may translate into improvements in animal fitness and population performance
- increased hunter satisfaction, defined as either the ability to hunt in a roadless area or the access to roads and the use of all-terrain vehicles on closed roads or other off-highway sites (Gratson and Whitman 2000b)
- decreased vulnerability of elk during hunting seasons, due to fewer hunters willing to hunt without a vehicle or able to access the area.

Road closures alone may not be effective in eliminating effects of roads and traffic on elk because of inadequate enforcement. For this reason, the U. S. Department of Agriculture, Forest Service may promulgate road closures in addition to designating roads as closed, as in the Dark Meadow Restoration Project discussed above. Careful assessment of how roads are being used, rather than their official status, is important to credibly evaluate effects of roads on elk and other wildlife. Likewise, judicious closing of certain road segments, particularly road spurs (Forman et al. 2003), may retain or create blocks of habitat that serve as security areas for elk while allowing sufficient road access for other management needs. Spatially explicit models and tools are currently available to aid in evaluating among road closure alternatives.

Elk continue to exert tremendous impact on local economies, through their status as a premier game species, and on forested ecosystems, through their role as abundant, widespread large herbivores. Given the indisputable effect of roads on distribution of elk, roads and their management will undoubtedly remain, as stated by Lyon and Christensen (2002:566), "central to elk management on public and private lands."

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**Transactions
of the
Sixty-ninth North American Wildlife
and Natural Resources Conference**

Conference Theme:
*Resource Stewardship in the 21st Century:
A Voyage of Rediscovery*

*March 16 to 20, 2004
DoubleTree Hotel and Spokane City Center
Spokane, Washington*

Edited by
Jennifer Rahm

Published by the
Wildlife Management Institute
Washington, DC
2004

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ATTACHMENT C

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Security areas for maintaining elk on publicly accessible lands during archery and rifle hunting seasons in southwestern Montana

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Security areas for maintaining elk on publicly accessible lands during archery and rifle hunting seasons in southwestern Montana



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Executive Summary

Fall elk habitat management on public lands has focused on providing security areas that allow for reasonable elk survival and hunter opportunity. The management focus of maintaining or improving security areas, combined with conservative harvest regulations, may explain why some elk populations have increased in the western United States. However, in areas that include both publicly accessible and inaccessible lands, elk may alter their space use patterns during the hunting season by increasing use of areas that restrict public hunting access rather than utilizing security areas on adjacent public lands. We used GPS location data from 325 adult female elk in 9 populations to determine resource selection during the archery and rifle hunting seasons in southwest Montana. We found that for the covariates over which managers have some control, in order of the strength of selection, elk selected for areas that were not known to be publically accessible for hunting, had higher time-integrated NDVI, higher canopy cover, were further from motorized routes, and had lower hunter effort during the archery season. During the rifle season, in order of the strength of selection, elk selected for areas that were not known to be publically accessible for hunting, further from motorized routes, had higher canopy cover, and higher hunter effort. Interactions among several of these influential covariates revealed dependencies in elk resource selection patterns. Further, cross-population analyses revealed increased elk avoidance of motorized routes with increasing hunter effort during the both hunting seasons. In order to create security areas on public lands during archery season, we recommend managing for areas with $\geq 13\%$ canopy cover that are $\geq 2,760$ m from motorized routes, and identifying and managing for areas of high nutritional resources within these areas. During the rifle season, we recommend managing for areas with $\geq 9\%$ canopy cover that are $\geq 1,535$ m from motorized

routes, and are at least 5,000 acres. Lastly, given increased elk avoidance of motorized routes with higher hunter effort, we recommend that to maintain elk on public lands managers consider increasing the amount of security habitat in areas that receive high hunter effort, or hunting seasons that limit hunter effort in areas of high motorized route densities.

Background

In 2013, biologists from the United States Forest Service (USFS) and Montana Fish, Wildlife and Parks (MFWP) developed collaborative recommendations for elk habitat management on the Custer, Gallatin, Helena, and Lewis and Clark National Forests and identified the need to better understand fall elk distributions and resource selection (MFWP and USFS 2013). Many of the Forest Plans in this area are in the process of being revised, so there is an important opportunity to provide science-based recommendations for formulating standards and guidelines for elk habitat management into the future. MFWP elk population management focuses on maintaining numbers above population viability thresholds, protecting certain sex and age classes from over-harvest, providing public hunting opportunity, and attempting to balance elk distribution across public and private lands. The USFS strives to complement MFWP's efforts through management of elk habitat on USFS lands (MFWP and USFS 2013). As such, both agencies share the management goal of maintaining elk on public lands and work together to design habitat management recommendations to achieve this goal.

Historically, forest management focused primarily on road building and timber management. The cooperative elk-logging studies of the 1970s and 1980s provided some of the first insights into the effects of these activities on elk distributions and developed the concept of managing public lands to include secure areas for elk (Lyon et al. 1985). While specific recommendations were not made, it was recognized that logging activity and the associated roads caused displacement of elk from areas of traditional elk use. Thus, it was recommended that timber harvests should be designed to minimize the number of routes and the duration of logging activity (Lyon et al. 1985).

In the early 1990's, biologists from both agencies recognized that a new management paradigm was needed, leading to the Elk Vulnerability Symposium in Bozeman, Montana in April 1991, hosted by the Montana Chapter of the Wildlife Society. It was here that the concept of security areas for elk was first formalized (Hillis et al. 1991). Hillis et al. (1991) analyzed data collected from radio-collared elk (bulls and cows) during the rifle hunting season in relatively continuous conifer forests in western Montana (Lyon and Canfield 1991). They recommended managing for at least 30% of a valid analysis area in forest blocks of similar canopy cover structure, which were at least 250 acres in size, and at least 0.5 mile from the nearest motorized route. The objective of managing for security areas was to provide reasonable levels of bull elk survival and hunter opportunity during the rifle hunting season. The authors cautioned that the numerical parameters they reported for block size and distance to the nearest motorized route should not be considered an exact 'recipe' to be followed in all situations, but that the concepts (size, distance, and percent of a valid analysis area) could be tailored to an area based on local knowledge. As such, a variety of security definitions, some including specific requirements for minimum forest cover, have been used in developing travel management plans and for evaluating project level effects on elk (Christensen et al. 1993). In areas where forest cover is less contiguous than western Montana, where the Hillis paradigm was generated, the importance of forest cover for security areas has been questioned, but not formally examined.

Extrapolations of Hillis et al. (1991) security area parameters to less densely forested habitats, mixed ownership regions, archery hunting seasons, and female elk survivorship may not be valid, and therefore may not be useful to managers in some areas. In areas that include a matrix of publicly accessible and inaccessible lands, elk may decrease their use of security areas on public lands and increase their use of areas that restrict public hunter access during the hunting season (Burcham et al. 1999, Conner et al. 2001, Hayes et al. 2002, Proffitt et al. 2010, 2013). Additionally, in many areas, hunting seasons are designed to decrease the number of elk, and as such are focused on increasing the harvest of adult female elk rather than providing for bull elk survival. However, if female elk are not available to public hunters in sufficient numbers due to a distribution shift from publicly accessible to inaccessible lands, then harvest is not an effective tool to reduce adult female survival and overall elk population growth. Elk distribution shifts from publicly accessible to inaccessible lands, whether the result of short-term changes in hunting pressure (Millspaugh et al. 2000, Proffitt et al. 2010) or long-term behavioral adaptations (Boyce 1991), is a major challenge to wildlife and land managers as they attempt to maintain elk populations at socially acceptable levels while also meeting public demand for hunting opportunities (Haggerty and Travis 2006).

The timing and degree of changes in elk distributions during hunting season are not consistent across populations, with some populations showing little to no change in distribution across publicly accessible and inaccessible lands during the hunting season, or even increasing use of publicly accessible areas during the hunting seasons (Figure 1). This may be the result of a functional response in resource selection (Myserud and Ims 1998, Mabelle et al. 2012), where the strength of selection for or against a particular resource is dependent on the availability of that resource. Each elk population's annual range is comprised of different proportions of publicly accessible lands with different levels of hunter pressure. Thus, differences in the strength of selection for or against various habitat attributes may be related to these differences in hunter access and hunter pressure (e.g., elk may respond more strongly to motorized routes in areas with greater hunter pressure). Additionally, the effects of the archery and rifle season on elk distributions vary across populations and likely correlate with different degrees of hunting pressure. Some elk populations begin redistribution during the archery season (Conner et al. 2001, Vieira et al. 2003, Proffitt et al. 2013), whereas others do not respond until during the rifle season (Millspaugh et al. 2000, Johnson et al. 2004, Proffitt et al. 2013), if at all. Differences in hunter pressure during rifle and archery seasons, as well as differences in topography and elk migratory behavior have been suggested to explain the differences in selection among populations (Conner et al. 2001, Proffitt et al. 2013), and better understanding of these differences in selection is a priority identified in the collaborative elk habitat management recommendations (MFWP and USFS 2013).

While most research and management has focused on the impacts of rifle hunting on elk, archery hunting has been increasing in popularity, with a 98% increase in archery license sales in Montana since 1985 (Montana Fish, Wildlife and Parks, unpublished data). As such, it is important to examine elk responses to archery hunting. Archery hunting has the potential to lead to reduced pregnancy rates and delayed conception in elk (Davidson et al. 2012). Nutritional condition of female elk during the late-summer and rut is also related to pregnancy rates and conception (Noyes et al. 2004, Cook et al. 2013). It is therefore possible that human disturbance associated with archery hunting may shift elk distributions away from areas of high nutritional resources, potentially impacting elk population dynamics further than would be expected through archery hunting mortality alone.

Here, we used fine-scale location data collected during 2005–2014 to assess female elk resource selection during the archery and rifle hunting seasons in 9 elk herds in southwestern Montana. We also examined potential functional responses in elk resource selection by comparing the standardized coefficient estimates from population-specific models along gradients of accessible:inaccessible lands and mean hunter pressure to determine if the relative availability of publicly accessible land or population-specific hunter pressure influence the direction and/or strength of elk resource selection during the hunting seasons. Finally, we evaluated the traditional paradigm of elk security areas (Hillis et al. 1991) against security area metrics derived from our top resource selection function models for archery and rifle hunting seasons.

Methods

Study Area

The study area included the annual ranges of 9 elk populations in southwestern Montana (Figure 2). Climate in these ranges is characterized by short, cool summers and long, cold winters. Vegetation types across these ranges included a mix of montane forest (e.g., aspen [*Populus tremuloides*], Douglas fir [*Pseudotsuga menziesii*], lodgepole pine [*Pinus contorta*]), open sage-grassland (e.g., big sagebrush [*Artemisia tridentata*], blue-bunch wheatgrass [*Pseudoroegneria spicata*], Idaho fescue [*Festuca idahoensis*]), and upland grasslands, meadows, and unvegetated areas, but the relative proportions of these habitat types varied among the populations. All elk ranges included a mix of public lands that are generally accessible to public hunters, primarily managed by the United States Forest Service or Bureau of Land Management, privately owned lands that are accessible to hunters through a State of Montana hunter access program, and privately owned lands with unknown but likely varying degrees of restrictions on public hunting access. Elevation, motorized route densities, and indices of nutritional resources varied among the populations' ranges (Table 1). Mule deer (*Odocoileus hemionus*), white tail deer (*Odocoileus virginianus*), bighorn sheep (*Ovis canadensis*), and moose (*Alces alces*) also occupy the elk ranges. Wolves (*Canis lupus*), mountain lions (*Puma concolor*), black bears (*Ursus americanus*), and coyotes (*Canis latrans*) are the elk predators in the system, and grizzly bears (*Ursus arctos*) are also found in the ranges in the eastern portion of the study area. For full descriptions of the elk habitats for these populations, see Gude et al. (2006), White et al. (2012), Proffitt et al. (2013, 2014).

Data Collection

During 2005–2014, we captured and radiocollared adult female elk from 9 populations in southwestern Montana on their winter ranges using helicopter net-gunning or chemical immobilization. Elk populations were selected for capture and radiocollaring as part of several different projects related to carnivore-elk interactions, elk brucellosis, or elk survival investigations. Collar functionality differed among populations and years, and all collars contained GPS receivers that collected 12–48 locations per day for a minimum of 1-year. Because our goal in this project was to synthesize data collected across a large spatial scale, we pooled data from these 9 elk populations to create a regional elk location dataset, as well as used the individual population datasets.

Data Analysis

We developed separate archery- and rifle-season resource selection functions using a used-available framework (Johnson 1980, Manly et al. 2007). Archery and rifle seasons for each

year were defined by the Montana Fish, Wildlife, and Parks hunting season dates (Appendix S1). We treated locations collected from the GPS collars as the used sample. We randomly selected 4 locations per individual per day to reduce spatial autocorrelation in the data (Hansteen et al. 1997). In order to maintain equal sampling effort for all individuals, we only used data from the first year each individual was collared. We defined population-specific annual ranges by randomly selecting 1 location per day per individual to reduce spatial autocorrelation among the locations, and then building 99% kernel density estimator (KDE) contours. We randomly generated available points at a 1:5 used:available ratio within the population-specific annual range (Northrup et al. 2013).

We evaluated 9 covariates describing elk resource selection based on a review of previous elk studies and current metrics used for elk habitat management (Lyon 1979, Hillis et al. 1991, Christensen et al. 1993, Pettoirelli et al. 2011, Proffitt et al. 2011, McCorquodale 2013, Ranglack et al. In Review). To represent roads and other motorized routes, we included distance to motorized routes. In this case, only routes that were open to public motorized use during the hunting season were included. All other routes (private, administrative or closed routes) were excluded. To represent general landscape characteristics, we included 4 landscape attributes: canopy cover, slope, elevation and solar radiation. Hunting pressure was represented using 2 covariates: accessible for public hunting (hunter access) and hunter effort. Hunter access was a binary covariate contrasting lands that were freely and publically accessible with private lands with some level of restriction to public access. For this analysis, public lands that permitted hunting and private lands enrolled in the State of Montana's Block Management hunter access program were considered publicly accessible, and all other lands were considered lands that may have restricted public hunter access. Hunter effort was estimated annually per hunting district using the Montana Fish, Wildlife and Parks harvest survey program, and we created an index of hunter pressure for each hunting district as hunter days/km² (based on the area of the whole hunting district regardless of hunter access), which we used for both the archery and rifle seasons. During the archery season (Appendix S1), we included a remotely sensed metric of greenness derived from the Normalized Difference Vegetation Index (NDVI), time integrated NDVI, to represent effects of nutritional resources on selection. Time integrated NDVI represents the net primary production during the growing season (Jonsson and Eklundh 2002, White et al. 2009), and is an important factor influencing summer elk resource selection in this area (Ranglack et al. 2016). During the rifle season we included snow water equivalent (SWE) as a covariate representing effects of snowpack on selection. We generated SWE values based on the max SWE value from SNOWDAS (National Operational Hydrologic Remote Sensing Center 2004) for each pixel during each of six 6-day periods during the rifle season which we called 'hunt period'. These hunt periods were unique for each year. Full details on covariate development are included in Appendix S2.

Although resource selection analyses are typically conducted at the resolution of the available covariate data, animals may perceive and select resource attributes at different spatial scales (Anderson et al. 2005, Laforge et al. 2015, DeVoe et al. 2015), therefore, we considered each continuous covariate over 6 different spatial scales (30, 100, 250, 500, 750, 1000 m; Table 2). Additionally, because the relationship between selection and covariates might be nonlinear, we evaluated multiple functional forms (linear, quadratic, pseudothreshold) for each continuous covariate. This allowed us to fit either straight lines or curves to the data, depending on which received more support. We evaluated spatial scale and functional forms for each covariate in an

exploratory analysis, unless the most appropriate functional form could be identified *a priori* from existing literature (Table 2).

We screened all continuous covariates for multi-collinearity using Pearson correlation coefficients. Any covariates that were found to be collinear ($r \geq |0.7|$) with one another were not included in the same model. First, we examined all possible univariate models in an exploratory analysis to determine the most explanatory functional form(s) and spatial scale(s) for each covariate. We considered covariates from all the models within 5 AIC_c units of the top model and advanced only these covariates to the next step. Then, we combined the top covariate forms and scales in all possible combinations to determine the overall best-supported model for elk resource selection during the hunting seasons. We also included interactions between hunter access and distance to motorized routes, hunter access and canopy cover, distance to motorized routes and canopy cover, distance to motorized routes and time integrated NDVI/SWE (archery/rifle), and distance to motorized routes and hunter effort. We developed separate models for the archery and rifle seasons.

We pooled data from all herds and fit models using a conditional logistic regression model, conditioned on ‘herd-year’ (unique for each population by year combination) for the archery season to allow for the annually varying time integrated NDVI values and ‘herd-hunt period’ (unique for each population and hunt period combination) for the rifle season to allow for the 6-day variation in SWE. We chose this modeling framework to ensure that the available points for each stratum were evaluated against the used points for that stratum, since there were time varying covariates, a different set of instrumented individuals for each year, and different available choice sets for each population.

To determine if the strength of selection for covariates differed across herds with different levels of hunter effort and hunter access, we then fit population-specific models and explored the functional response between the distance to motorized routes, canopy cover, hunter effort, and hunter access standardized coefficient estimates along gradients of accessible:inaccessible lands and hunter pressure, as these varied among populations. Population-specific models were fit using the same model structure as that found in the top pooled model. As our dependent variables (standardized model coefficient estimates) were estimates with associated standard errors instead of measured values, each estimate was weighted by the inverse of the variance (Marin-Martinez and Sanchez-Meca 2009), such that estimates that were estimated with greater precision were given more weight than those that were estimated with less precision. We identified functional responses as significant if the 95% confidence intervals on the slope of the estimated regression lines did not overlap 0.

To compare results of our top models with the traditional security area paradigm, we evaluated the relative support from the data for our resulting top models and models representing the traditional security area paradigm (Hillis et al. 1991, Christensen et al. 1993). To do so, we examined plots from our top models depicting how relative resource selection changes as canopy cover and distance to motorized routes increase across the range of available values for publicly accessible elk during each season while holding all other covariates at their means. From those, we identified the values of canopy cover and distance to motorized routes where relative resource selection begins to reach a pseudothreshold, which we arbitrarily defined as having a relative slope of 0.5 (slope = range of Y values / (2 * range of X values)). These cutoff values were considered to be analogous to the dense forest canopy cover (e.g. $\geq 40\%$) and ≥ 0.5 mile distance to motorized route thresholds commonly used in the traditional security area paradigm (Hillis et al. 1991, Christensen et al. 1993). To test the influence of block size on elk selection of

areas with canopy cover and distance from motorized routes attributes considered indicative of security areas, we varied the block size of our security area definitions to include areas ≥ 0 acres (no size requirement), 250 acres, ≥ 500 acres, $\geq 1,000$ acres, $\geq 2,000$ acres, and $\geq 5,000$ acres. To determine the importance of the canopy cover component of traditional security areas, we evaluated models representing traditional security areas with a range of canopy cover values (≥ 0 , 10, 20, 30, 40, 50, 60, 70%), while holding the distance to route (≥ 0.5 miles) and size of the block (≥ 250 acres) constant.

To compare traditional security areas with those identified in our analyses, we extracted values for both used and available points from our new security metrics and the traditional paradigm with varying canopy cover metrics. We then fit our top model for each season, replacing the canopy cover and distance to motorized routes covariates with either the traditional security area paradigm with varying canopy cover or our new security area values. This resulted in a total of 8 traditional security area metrics and 6 security area metrics derived from our analyses for each season. We compared these models using AIC_c to determine which combination of canopy cover, distance to motorized routes, and block size covariates was most supported by the data, where models with ΔAIC_c values from 0-2 were considered equally supported, 2-10 showed less support, and values >10 were not supported.

Lastly, to determine if the proportion of security areas within a population home range influenced the extent to which the population redistributed from publicly accessible to inaccessible lands through the course of the fall hunting seasons, we examined a potential relationship between elk redistribution and the proportion of the annual range qualified as a security area, using linear regression. We quantified redistribution as the difference between the proportion of used locations on publicly accessible lands in August and the proportion of used locations on publicly accessible lands during the rifle season for each population. The proportion of the population annual range defined as a security area was based only on the publicly accessible portion of the annual range, and was calculated based on the security area metrics from our top archery and rifle models, as well as using the Hillis et al. (1991) security area definition.

Results

We used a total of 57,282 archery season and 47,602 rifle season elk locations collected from 325 individual elk in our analyses. Of the elk locations, 61.9% and 52.5% occurred on publicly accessible lands during the archery and rifle seasons respectively. Mean elevation of the elk locations was 6,903 ft (SD = 1,519) and 6,578 ft (SD = 1,378) during the archery and rifle seasons, respectively. Mean distance to motorized routes of the elk locations was 1.61 miles (SD = 1.85) and 1.28 miles (SD = 1.31) during the archery and rifle seasons respectively. Mean time integrated NDVI of the elk locations during the archery season was 52.6 (SD = 11.6). Mean SWE of the elk locations during the rifle season was 1.09 in. (SD = 1.13). The mean slope of the elk locations was 14.3 degrees (SD = 9.4) and 14.1 degrees (SD = 8.9) during the archery and rifle seasons respectively. The mean canopy cover of the elk locations was 27.7% (SD = 25.2) and 19.6% (SD = 23.2) for the archery and rifle seasons respectively. Information on what was available for each population's annual range can be found in table 1.

Archery season elk resource selection

Using the pooled regional dataset, the full archery season model was the most supported model of elk resource selection during the archery hunting season, with the next best model

having a $\Delta AIC_c = 80.4$. In general, elk were more likely to use areas that were not known to be publicly accessible. Regardless of accessibility, elk were less likely to use hunting districts with higher hunter effort. Further, elk were more likely to use areas as distance to motorized routes, canopy cover, time integrated NDVI, and solar radiation increased, though distance to motorized routes and canopy cover quickly reached a pseudothreshold at ≥ 1.71 miles and $\geq 13\%$ respectively for publicly accessible lands, after which further increases in distance to motorized routes and canopy cover resulted in only small increases in elk resource selection. Elk were also more likely to use moderate slopes (Fig. 3, Table 3). All interactions improved model fit. Model results indicated that at high NDVI values, there was little difference in elk selection for areas near *versus* far from motorized routes, but at low NDVI values, elk were more likely to use areas far from motorized routes. Elk also were less likely to use areas with higher hunter effort if they were closer to motorized routes, but elk showed little response to increases in hunter effort far from motorized routes. Additionally, the difference in strength of selection for areas with high and low canopy cover were greater on publicly accessible lands than on lands that are not known to be publicly accessible. This same pattern was also found for the difference in the strength of selection for areas near and far from motorized routes (Fig. 4, Table 3, Appendix S4).

Rifle season elk resource selection

Using the pooled regional dataset, the full model was the most supported model of elk resource selection during the rifle hunting season, with the next best model having a $\Delta AIC_c = 36.6$. Similar to the archery hunting season model, elk were more likely to use areas that were not known to be publicly accessible during the rifle season. Regardless of accessibility, elk were more likely to use areas as distance to motorized routes, canopy cover, hunter effort, and solar radiation increased, and less likely to use areas as elevation and SWE increased. Elk responses to distance to motorized routes, canopy cover, and hunter effort quickly reached pseudothresholds at ≥ 0.95 miles, $\geq 9\%$, and ≥ 3.44 hunter days/mile² respectively for publicly accessible lands, after which further increases in distance to motorized routes, canopy cover, and hunter effort resulting in only small increases in elk resource selection. Elk also were more likely to use moderate slopes (Fig. 5, Table 3). All of the interactions improved model fit. Elk showed a stronger response to increases in SWE when far from motorized routes than when near motorized routes. Elk showed stronger selection for areas further from motorized routes as hunter effort increased, while they showed little response to increases in hunter effort when near motorized routes. Similar to the archery season, the difference in strength of selection for areas with high and low canopy cover were greater on publicly accessible lands than on lands that are not known to be publicly accessible. However, contrary to the archery season results, the difference in the strength of selection for areas near and far from motorized routes was greater in areas not publicly accessible (Fig. 6, Table 3, Appendix S4).

Functional Response

We detected no changes in the strength of selection for areas that had higher canopy cover, were not publicly accessible, or had lower hunter effort with increases in the ratio of accessible:inaccessible lands and hunter effort during the archery and rifle seasons (Table 4, Appendix S3). However, elk were significantly ($p \leq 0.05$) more likely to use areas further from motorized routes as mean hunter effort in the annual range increased during both the archery (Fig. 7a) and rifle seasons (Fig. 7b). This response was very similar during the rifle season and the archery season (Table 4).

Security Areas

Based on the top model from the archery season, we identified areas with $\geq 13\%$ canopy cover (1,000 m spatial scale) and ≥ 1.71 miles from a motorized route as security areas for elk during the archery season. The model including these two parameters, without a defined minimum block size (≥ 0 acres), received the most support, with the next best model having a $\Delta AIC_c = 88.9$ (Table 5). All of the new security area metrics arising from our most supported archery season model were more strongly supported than all of the traditional security area metrics. Of the traditional security area metrics with a minimum block size of 250 acres at least 0.5 miles from a motorized route, $\geq 10\%$ canopy cover was the most supported (Table 5).

Based on the top model from the rifle season, we identified areas with $\geq 9\%$ canopy cover (1,000 m spatial scale) and ≥ 0.95 miles from a motorized route as security areas for elk during the rifle season. The model including these two parameters with a minimum block sizes of 5,000 acres received the most support, with the next best model having a $\Delta AIC_c = 24.7$ (Table 5). Again, all of the new security area metrics derived from our most supported rifle season model were more strongly supported than all the traditional security area metrics. Of the traditional security area metrics with a minimum block size of 250 acres at least 0.5 miles from a motorized route, $\geq 0\%$ canopy cover (i.e., no canopy cover threshold) was the most supported (Table 5). Maps comparing the top archery and rifle security metrics with the traditional security area paradigm can be found in Appendix S5.

No relationships were found between the amount of elk redistribution from accessible to inaccessible lands and the proportion of the annual range in any of the security area metrics (Figure 8).

Discussion

Overall, our results suggest that elk habitat management during the hunting seasons should focus on accessibility of lands for public hunting, motorized routes, and canopy cover. These covariates all had significant effects on female elk resource selection during the archery and rifle seasons and are under some degree of management control. Additionally, nutritional resources are important drivers of female elk resource selection during the archery hunting season and should be considered in elk archery hunting season habitat management strategies. Depending on population size objectives (increase or decrease elk population size) managers can attempt to manipulate each of these factors to make elk more or less vulnerable to harvest. However, managers should also consider that increases in hunter effort or motorized routes may encourage elk to select for areas that restrict public hunter access. We also recommend that new security area metrics derived from our most supported models be considered for southwest Montana (Table 5). Because these metrics are predictive of female elk resource selection, they may encourage elk to remain on publicly accessible lands throughout the hunting seasons thereby enabling sufficient harvest to affect population size and providing season long public land hunter opportunities.

Our modeling of elk resource selection during the archery and rifle hunting seasons suggests that, in general, female elk have similar resource selection patterns in both seasons, as suggested in the collaborative elk habitat management recommendations (MFWP and USFS 2013), particularly in relation to covariates over which managers have some level of control (distance to motorized routes, canopy cover, and hunter access). Lands that were not known to be publicly accessible to hunters were preferred to publicly accessible lands during both seasons.

Thus, we recommend that managers work closely with private landowners to increase public hunting opportunity on private lands. Additionally, the results of our functional response analysis suggest that high hunter effort during the archery season increases elk avoidance of areas near motorized routes (Fig. 7a) in a similar manner to elk responses during the rifle season (Fig. 7b). In order to maintain elk distribution on publicly accessible lands, we recommend managers consider wildlife related motorized travel closure dates that include both archery and rifle season in areas of high hunter effort, or hunting seasons that limit hunter effort in areas of high motorized route densities, similar to what was described in the collaborative elk habitat management recommendations (MFWP and USFS 2013).

The increase in elk selection for areas farther from motorized routes with increases in hunter effort (Fig. 7) helps to explain the documented shift in elk movements during archery hunting seasons that occur in some areas (Conner et al. 2001, Vieira et al. 2003, Proffitt et al. 2013). Contrary to Vieira et al. (2003), who found that hunter effort during the archery season did not influence elk movement to private lands, we found that hunter effort influenced elk resource selection during the archery season, as elk generally avoided areas of high hunter effort, with this response being even stronger in areas near motorized routes. In our study sites, this selection pattern also involves elk selecting for lands not known to be publicly accessible, which had one of the strongest effects on elk resource selection during the archery season. Security for elk on publicly accessible lands has traditionally been regarded as areas away from motorized routes with high canopy cover that can maintain elk even during periods of hunting stress (Lyon 1979, 1983, Hillis et al. 1991). We found that hunter access had a stronger influence on elk resource selection in both hunting seasons than either distance to motorized routes and/or canopy cover (Table 3).

The influence of late-summer nutrition on ungulate population dynamics and resource selection has been well documented (Cook et al. 2004, 2013, Monteith et al. 2014, Ranglack et al. In Review), but the potential effects of nutrition on archery season elk distributions have not been previously evaluated. Using data from these same study areas, Ranglack et al. (In Review) found that during July and August, female elk were much more likely to be found in areas of high nutritional resources (as represented by time-integrated NDVI). Additionally, motorized routes had a relatively small influence on female elk resource selection during July and August (Ranglack et al. In Review). Using standardized coefficient estimates to compare summer and archery season effects in the same 9 elk herds, female elk avoidance of motorized routes nearly doubles during the archery season, while selection for areas with higher time integrated NDVI values decreased by nearly half. Our results suggest that during the archery hunting season, female elk still seek out areas of high nutritional value even when they are near motorized routes (Figure 4), but this selection for areas of high nutritional value has been reduced, likely due to the increased avoidance of motorized routes or selection for the other covariates that we documented as influential. If elk are attempting to select for areas of high nutritional value throughout the archery hunting season but are unable to do so due to other influences on archery season resource selection, archery hunter pressure may affect elk access to these areas of high nutritional value, and therefore compromise nutritional status at a critical time of year (Noyes et al. 2004, Davidson et al. 2012). This suggests that archery hunting has the potential to affect fall nutritional condition of female elk, and potentially pregnancy rates and body fat levels of elk entering the winter season. We recommend that this topic needs more investigation, and that managers may need to consider including motorized route closures, earlier closure dates during travel planning, and limits on hunter numbers during the archery season in areas of high

nutritional value for elk if maintaining elk access to nutritional resources is part of the management intention. Additional work is also needed to better understand the relationship between NDVI and forage plant communities, and provide recommendations for vegetation management aimed at quantifying and/or improving elk nutritional resources.

During the rifle season, similar to the archery season, elk avoided areas near motorized routes. This response was stronger than during the archery season, indicating that the impact of motorized routes on elk resource selection continues to increase from summer (Ranglack et al. In Review) to archery to rifle seasons. While not unexpected given the vast literature on road effects on ungulates (see McCorquodale 2013 for review), these differences suggest that elk response to motorized routes varies seasonally and is strongly related to the risks associated with hunting seasons. We identified different thresholds in our most supported models; during the archery season we found that elk selected for areas ≥ 1.71 miles from the nearest motorized route, while this distance decreases during the rifle season to ≥ 0.95 miles. This may indicate that while the overall influence of motorized routes on elk resource selection during the archery season is lower than during the rifle season, the spatial scale of effects during archery season is larger. This may be because archery hunters are more apt to hike further away from motorized routes in pursuit of elk. In contrast, rifle hunters have a stronger, but more limited area of influence around motorized routes. The impact of motorized routes on elk resource selection during the hunting seasons is further supported by the functional response depicting increasing selection for areas further from motorized routes with higher hunter effort (Figure 7). Given the increasing popularity of archery hunting, the different impacts of archery and rifle hunters should be incorporated into management designed to maintain elk on public lands by extending motorized route closures such that they include the archery season, as suggested in the collaborative elk habitat management recommendations (MFWP and USFS 2013). Additionally, due to the larger spatial influence of motorized routes during the archery season, some motorized routes may warrant closure during the archery season only and can be re-opened during the rifle hunting season. These archery only closures could be used to protect nutritionally valuable areas.

The traditional security paradigm of managing for blocks of unfragmented forest cover away from motorized routes (Lyon 1979, 1983, Hillis et al. 1991) has been widely accepted. Our results suggest that similar security paradigms could be applied to southwestern Montana in efforts to encourage female elk to utilize public lands. During the archery season, our analysis suggests that areas with $\geq 13\%$ canopy cover (1,000 m scale) that are ≥ 1.71 miles from the nearest motorized route may be perceived by female elk as secure, regardless of block size. During the rifle season, areas with $\geq 9\%$ canopy cover, that are ≥ 0.95 miles from the nearest motorized route, with a block size of $\geq 5,000$ acres may be perceived by female elk as secure. This, along with our analysis of the traditional paradigm with varying levels of canopy cover (Table 5), suggests that the often used 40% canopy cover threshold for security areas is too stringent, and that the influence of motorized routes is more important than canopy cover to female elk resource selection, as suggested in the collaborative elk habitat management recommendations (MFWP and USFS 2013). Indeed, our models show that while some level of canopy cover is preferred over open areas, the influence of canopy cover on elk resource selection reaches pseudothresholds at relatively low values for both hunting season (Figures 3 and 5). While having patches of dense forest cover may be valuable for elk as hiding cover in the face of disturbance, security areas need not contain 100% hiding cover (hiding cover proxy is $\geq 40\%$ canopy cover, MFWP and USFS 2013). We found that for the archery season no minimum block size requirement was supported by our data, while the largest minimum block

size we tested (5,000 acres) was supported during the rifle season. This pattern perhaps reflects the generally higher hunter pressure during the rifle season than the archery season, leading to a need for large security areas.

While it may be beneficial to increase the proportion of security areas within population annual ranges if the goal is to reduce hunting stress on elk, we found no relationship between the proportion of security areas within the annual range and the amount of redistribution that occurs in these elk populations (Figure 8). This highlights that even when security areas are available on publicly accessible lands, elk may still choose to redistribute to lands that are not known to be publicly accessible (MFWP and USFS 2013). This may be due to learned behaviors that are passed from one generation to the next (Boyce 1991), or due to additional security from hunting risk on lands not known to be publicly accessible than is found in security areas on publicly accessible land. In any case, it highlights the importance of wildlife and land management agencies working collaboratively with private landowners in managing elk habitat.

Overall, we saw very similar patterns of resource selection during the archery and rifle hunting seasons in terms of direction of selection for the different covariates. However, the direction of selection for hunter effort changed from the archery to rifle season (Table 3). During the archery season, when elk are not limited by snow and the effect of motorized routes is weaker, elk are more likely to use areas with lower hunter effort. However, during the rifle season, elk are more limited in the habitats that are available to them. Hunters may in turn respond to these more tightly defined elk resource selection patterns, making it appear that elk are more likely to be found in areas of high hunter effort when in reality hunter effort may be higher where elk are more likely to be present.

Finally, our results confirm many of the collaborative elk habitat management recommendations for elk habitat management (MFWP and USFS 2013). Similar to Hillis et al. (1991), we caution users that the numerical guidelines may not be valid in all cases and that strict application of the results should be avoided. Extrapolation of these results beyond the study area may or may not be appropriate as results generated in one area may perform extremely poorly when applied in areas that are geographically distant or dissimilar ecologically (Ranglack et al. In Review). However, managers could use this information as a guide for developing hunting season management strategies directed at both hunters and habitat. We recommend a collaborative management strategy that may include adjustments to both the habitat features described above, as well as overall hunter pressure through changes in hunting season structures and working with private landowners to increase public hunter access.

Recommendations:

- 1) We recommend that current fall elk habitat management based on managing motorized route density and providing security areas for elk during the rifle season (Hillis et al. 1991, Christensen et al. 1993) should be expanded to also include the archery season. We found elk responses to hunting risk during the archery season were similar to elk responses during the rifle season.
- 2) We recommend that managers consider the influence of nutritional resources on elk distributions during the archery season. Managers can use time integrated NDVI as an assessment tool to identify areas of optimal nutrition (i.e., values ≥ 66 , free access at http://phenology.cr.usgs.gov/get_data_250w.php). This product is available to FWP staff through the FWP mapper system.

- 3) We recommend that managers assess the balance between hunter pressure and motorized routes in their area and consider wildlife related travel closure dates during both archery and rifle hunting season in areas of high hunter pressure (≥ 12.75 hunter days/mile²), or hunting seasons that limit hunter pressure in areas of high motorized route densities.
- 4) We recommend that managers work closely with private landowners to increase public accessibility on private lands if management goals are to maintain a distribution of elk across both public and private lands throughout the hunting seasons.
- 5) We recommend that security areas be defined as having $\geq 13\%$ canopy cover that are ≥ 1.71 miles from a motorized route during the archery season, with no minimum block size requirement, and as having $\geq 9\%$ canopy cover that are ≥ 0.95 miles from a motorized route, that are at least 5,000 acres during the rifle season.

Acknowledgements

This project was developed with assistance from Montana Fish, Wildlife and Parks staff (Q. Kujala, A. Grove, N. DeCesare) and United States Forest Service staff (E. Tomasik), and funded by Montana Fish, Wildlife and Parks and the United States Forest Service. We thank the many field biologists and aircraft pilots that captured and radiocollared elk during 2005–2014 including J. Cunningham, M. Duffy, J. Grigg, K. Hamlin, B. Jimenez, C. Jourdonnais, M. Hebblewhite, M. Ross, J. Shamhart, M. Shelton, and R. Swisher. The data used in this project were collected by a variety of biologists, faculty and graduate students at Montana Fish, Wildlife and Parks, Montana State University, University of Montana, and MPG Ranch. C. Butler, M. Kohl, B. Lowry, and P. Mahoney provided valuable input in preparing this manuscript. Animal capture and radio-collaring was conducted under appropriate IACUC research permits.

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Table 1. The mean and standard deviation (in parentheses where applicable) of landscape attributes and annual precipitation at 9 elk population annual ranges within the southwestern Montana study area.

Population	Elevation (ft)	Distance to Motorized Routes (miles)	Canopy Cover (%)	Time Integrated NDVI	Proportion Publicly Accessible	Hunter Effort (days/mile ²)
Bitterroot	6,289	1.03	26.4	48.3	0.77	19.4
East Fork	(1,079)	(1.16)	(25.7)	(11.4)		(10.8)
Bitterroot	6,257	1.24	35.8	45.1	0.96	4.92
West Fork	(899)	(1.37)	(23.4)	(8.8)		(0.60)
Blacktail	7,218	1.14	14.9	51.0	0.82	12.6
	(866)	(1.02)	(22.6)	(13.0)		(6.55)
Dome	7,972	3.96	26.2	53.0	0.19	5.10
Mountain	(925)	(3.37)	(24.1)	(9.6)		(10.8)
Madison	7,457	1.85	26.0	52.1	0.62	15.0
Valley	(1,168)	(1.77)	(25.9)	(12.6)		(7.82)
Paradise	7,198	2.12	25.0	47.3	0.45	21.3
Valley	(1,391)	(1.91)	(24.1)	(11.9)		(8.03)
Pioneers	7,034	1.04	25.8	44.8	0.75	15.3
	(938)	(0.97)	(28.9)	(13.1)		(6.94)
Sage Creek	7,142	1.50	10.6	50.4	0.81	10.7
	(741)	(1.38)	(19.7)	(12.9)		(3.55)
Sapphires	4,764	0.55	25.2	40.2	0.56	15.1
	(1,119)	(0.62)	(25.6)	(12.2)		(3.29)

Notes: The values presented above are based on the minimum spatial scale available for each of the covariates.

Table 2. The covariates included in analysis of female elk archery season and rifle season resource selection in southwest Montana, with the spatial scales (in meters) and the functional forms (linear, pseudothreshold, quadratic) or data type (binary) that were evaluated for each covariate.

Covariate	Functional Form(s)	Spatial Scale(s)	Season(s)
Access	Binary	30 m	Both
Canopy Cover	Pseudothreshold	30, 100, 250, 500, 750, 1000 m	Both
Distance to Motorized Routes	Pseudothreshold	30 m	Both
Elevation	Quadratic	30, 100, 250, 500, 750, 1000 m	Both
Hunter Effort	Linear, Pseudothreshold	Hunting Unit	Both
Slope	Quadratic	30, 100, 250, 500, 750, 1000 m	Both
Snow Water Equivalent	Linear, Pseudothreshold	1000 m	Rifle Only
Solar Radiation	Quadratic	30, 100, 250, 500, 750, 1000 m	Both
Time Integrated NDVI	Pseudothreshold	250, 500, 750, 1000 m	Archery only

Table 3. The functional form, spatial scale, standardized coefficient estimates and 95% confidence intervals (in parentheses) for the top regional model of archery season and rifle season female elk resource selection in southwest Montana.

Covariate	Archery		Rifle	
	Functional Form and Spatial Scale	Coeff. Estimate (CI)	Functional Form and Spatial Scale	Coeff. Estimate (CI)
Access	Binary; 30 m	-0.75 (-0.78, -0.72)	Binary; 30 m	-0.93 (-0.96, -0.91)
Canopy Cover	Pseudothreshold; 1,000 m	0.55 (0.51, 0.60)	Pseudothreshold; 1,000 m	0.41 (0.37, 0.44)
Distance to Motorized Routes	Pseudothreshold; 30 m	0.43 (0.40, 0.47)	Pseudothreshold; 30 m	0.73 (0.68, 0.78)
Elevation	Quadratic; 30 m	-0.62 (-0.65, -0.59); 0.87 (0.84, 0.90)	Quadratic; 1,000 m	-1.14 (-1.19, -1.09); 0.34 (0.31, 0.38)
Hunter Effort	Linear; Hunting unit	-0.32 (-0.35, -0.30)	Pseudothreshold; Hunting unit	0.19 (0.16, 0.21)
Slope	Quadratic; 1,000 m	0.70 (0.67, 0.72); -0.51 (-0.55, -0.47)	Quadratic; 1,000 m	1.11 (1.07, 1.15); -1.06 (-1.11, -1.02)
Snow Water Equivalent	-	-	Linear; 1,000 m	-0.26 (-0.30, -0.23)
Solar Radiation	Quadratic; 1,000 m	0.55 (0.53, 0.58); 0.02 (0.00, 0.05)	Quadratic; 1,000 m	0.66 (0.62, 0.71); -0.34 (-0.37, -0.30)
Time Integrated NDVI	Pseudothreshold; 250 m	0.63 (0.61, 0.66)	-	-
Canopy Cover *	-	1.28 (1.20, 1.36)	-	0.39 (0.34, 0.45)
Access	-	0.25 (0.21, 0.30)	-	-0.46 (-0.52, -0.39)
Distance to Route *	-	-0.42 (-0.51, -0.32)	-	-0.29 (-0.38, -0.20)
Canopy Cover	-	0.95 (0.91, 1.00)	-	1.15 (1.11, 1.19)
Distance to Route *	-	-0.63 (-0.69, -0.58)	-	-
NDVI	-	-	-	-0.47 (-0.50, -0.43)
Distance to Route *	-	-	-	-
SWE	-	-	-	-

Notes: The second value presented for quadratic covariates represents the squared term.

Table 4. The estimated regression slope (and standard error) examining potential functional responses between the standardized coefficient estimates from the population specific models for hunter access, canopy cover, distance to motorized routes, and hunter effort along gradients of accessible:inaccessible and mean hunter effort for the population annual ranges. Values with confidence intervals that do not overlap 0 are bolded.

Covariate	Archery		Rifle	
	Accessible: Inaccessible	Mean Hunter Effort	Accessible: Inaccessible	Mean Hunter Effort
Hunter Access	1.23 (1.06)	0.02 (0.10)	-0.02 (1.03)	-0.10 (0.10)
Canopy Cover	0.79 (0.82)	0.11 (0.07)	0.42 (1.00)	0.11 (0.10)
Distance to Motorized Routes	1.06 (0.68)	0.19 (0.07)	0.81 (0.75)	0.20 (0.09)
Hunter Effort	-1.09 (0.56)	-0.01 (0.08)	-0.06 (0.94)	0.06 (0.10)

Table 5. The results of a comparison of the traditional security habitat paradigm based on ≥ 0.5 miles from a motorized route, ≥ 250 acre block size, and canopy cover varying from $\geq 0 - 70\%$ in increments of 10% and secure area definitions based on results of the top ranked model and 6 different minimum block sizes ($\geq 0, 250, 500, 1,000, 2,000$, and $5,000 \text{ km}^2$) for each hunting season. During the archery season, the top model defined secure areas based on $\geq 13\%$ canopy cover (1,000 m spatial scale), ≥ 1.71 miles from a motorized route, and various block sizes. During the rifle season, the top model defined secure areas based on $\geq 9\%$ canopy cover (1,000 m spatial scale), ≥ 0.95 miles from a motorized route, and various block sizes.

Model Rank	Archery		Rifle	
	Model	ΔAIC_c	Model	ΔAIC_c
1	Archery - ≥ 0 acres	0.0	Rifle - $\geq 5,000$ acres	0.0
2	Archery - ≥ 250 acres	88.9	Rifle - ≥ 0 acres	24.7
3	Archery - ≥ 500 acres	94.0	Rifle - ≥ 500 acres	66.3
4	Archery - $\geq 1,000$ acres	138.2	Rifle - ≥ 250 areas	90.4
5	Archery - $\geq 2,000$ acres	167.0	Rifle - $\geq 1,000$ acres	105.0
6	Archery - $\geq 5,000$ acres	229.7	Rifle - $\geq 2,000$ acres	151.6
7	Traditional - $\geq 10\%$ Canopy	482.2	Traditional - $\geq 0\%$ Canopy	266.3
8	Traditional - $\geq 0\%$ Canopy	781.7	Traditional - $\geq 10\%$ Canopy	1327.1
9	Traditional - $\geq 20\%$ Canopy	1088.0	Traditional - $\geq 20\%$ Canopy	1699.7
10	Traditional - $\geq 30\%$ Canopy	1208.4	Traditional - $\geq 30\%$ Canopy	1767.2
11	Traditional - $\geq 40\%$ Canopy	1407.5	Traditional - $\geq 40\%$ Canopy	1988.1
12	Traditional - $\geq 50\%$ Canopy	1843.8	Traditional - $\geq 50\%$ Canopy	2491.7
13	Traditional - $\geq 60\%$ Canopy	2049.3	Traditional - $\geq 70\%$ Canopy	3214.8
14	Traditional - $\geq 70\%$ Canopy	2691.1	Traditional - $\geq 60\%$ Canopy	3229.7

Figure 1. Distribution shifts in the 9 Montana elk populations that were included in this study. The x-axis represents 4 different time periods: summer (July and August), archery season, rifle season, and winter (Jan – March). The y-axis is the proportion of used points that are on publicly accessible lands. Populations are labeled as follows: BT = Blacktail, DM = Dome Mountain, EF = Bitterroot East Fork, MV = Madison Valley, PI = Pioneers, PV = Paradise Valley, SA = Sapphires, SC = Sage Creek, and WF = Bitterroot West Fork.



Figure 2. The study area included 9 elk population annual ranges in southwest Montana.

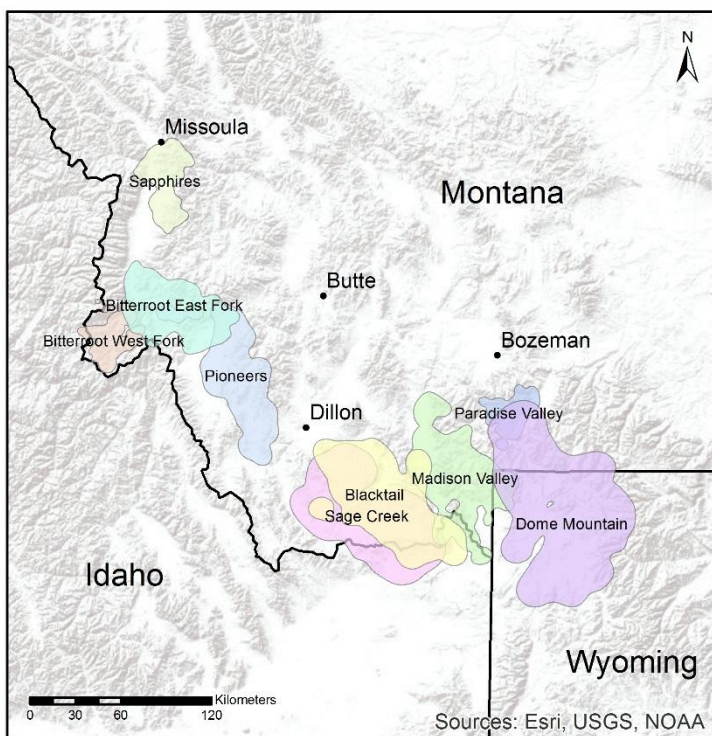


Figure 3. Plots of the main effects for the covariates included in the top archery season model, presented on the original, non-standardized scale. The plots present the coefficient estimate (line) and 95% confidence interval (shaded) for areas that allow or do not allow public hunter access across the available range for each covariate, with the other variables held at their mean value. The y-axis is analogous to the log-odds of selection.

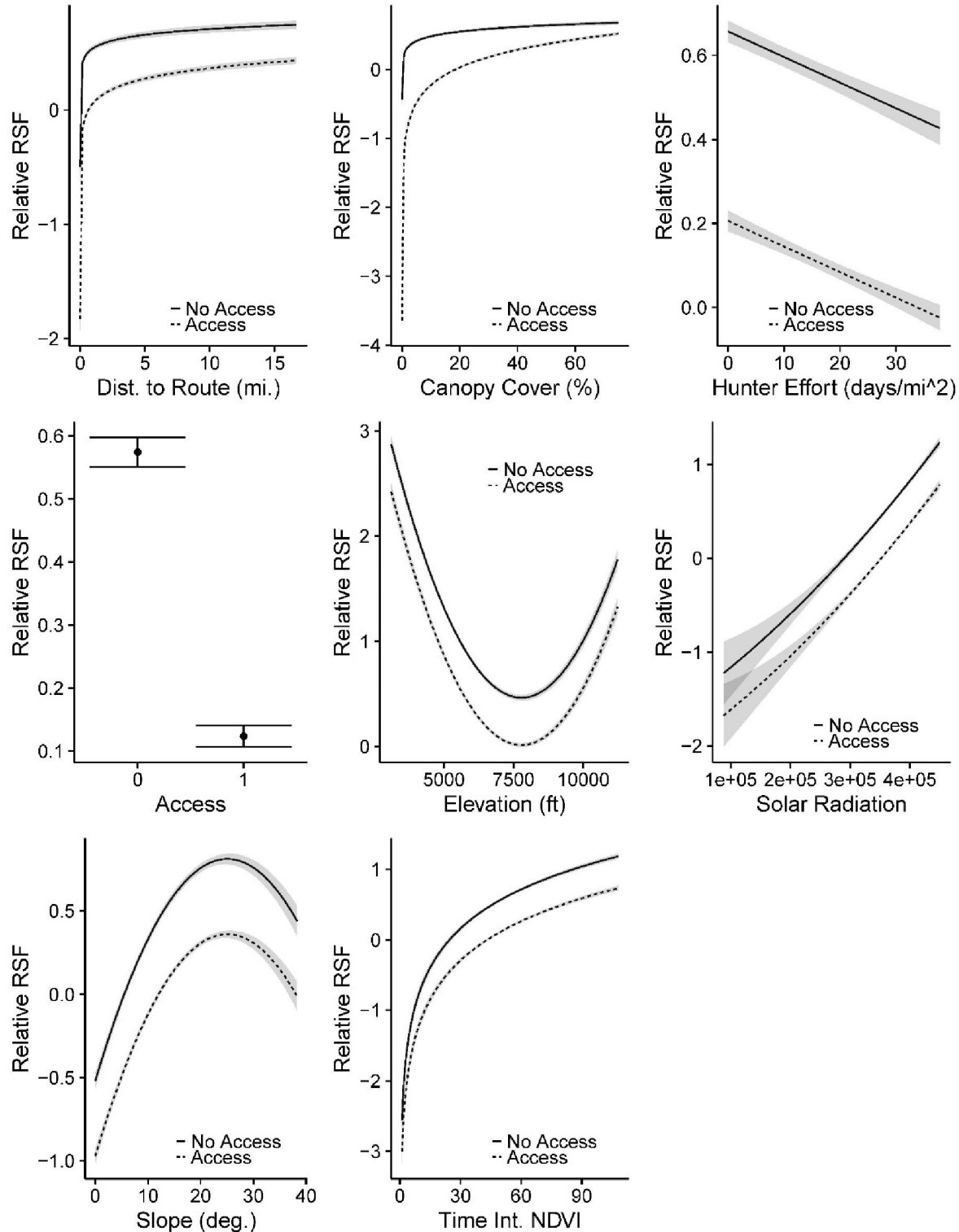


Figure 4. Plots of the interactions included in the top archery season model, presented on the original, non-standardized scale. Each row presents one interaction, with one of the interacting variables presented on the x-axis while the other is presented using two lines on the plot, one for a low value (1st quartile) and one for a high value (3rd quartile) of that covariate. The specific ‘high’ and ‘low’ values used are available in Appendix S4. The plots present the coefficient estimate (line) and 95% confidence interval (shaded) across the available range for each covariate, with the other variables held at their mean value. The y-axis is analogous to the log-odds of selection.

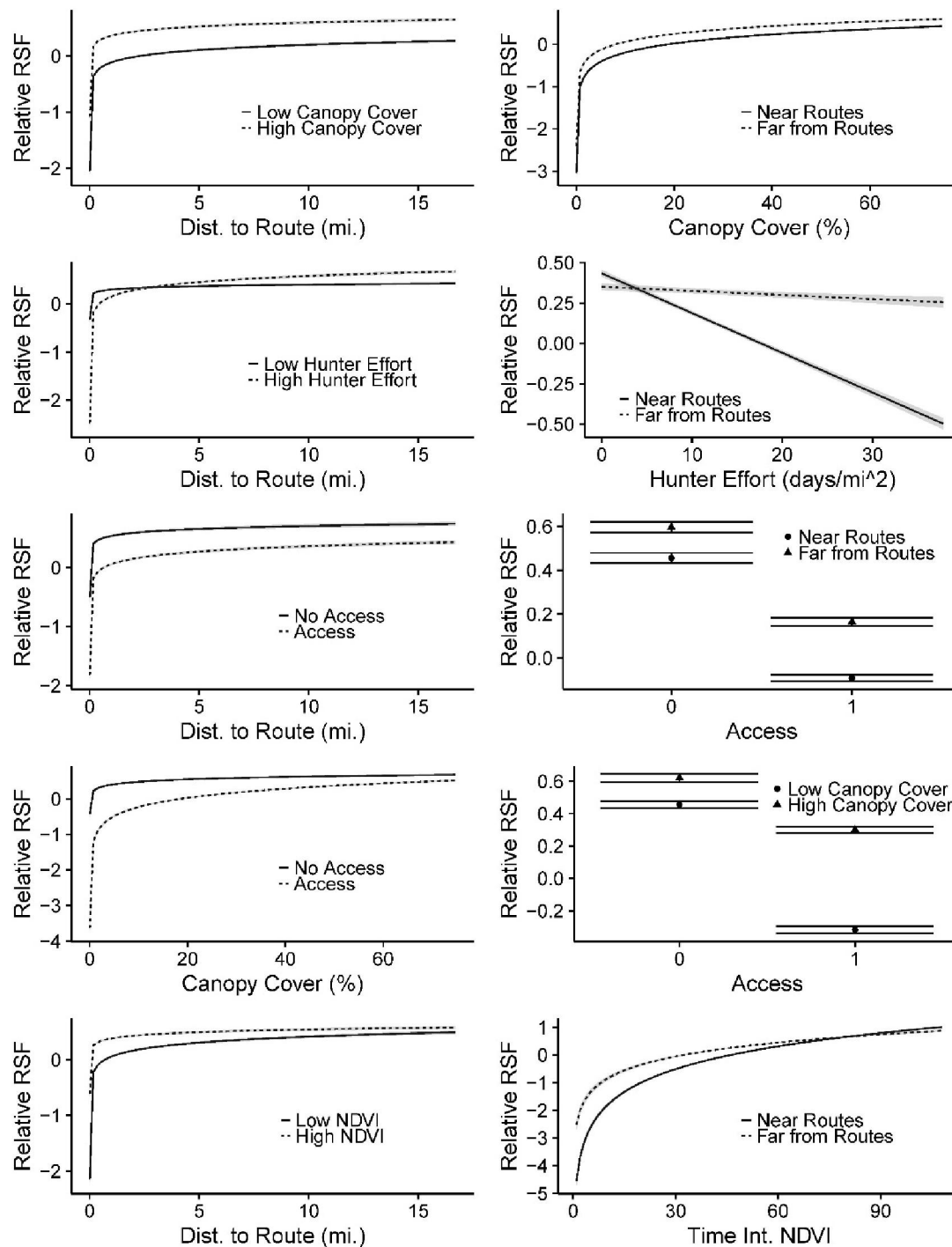


Figure 5. Plots of the main effects for the covariates included in the top rifle season model, presented on the original, non-standardized scale. The plots present the coefficient estimate (line) and 95% confidence interval (shaded) for areas that allow or do not allow public hunter access across the available range for each covariate, with the other variables held at their mean value. The y-axis is analogous to the log-odds of selection.

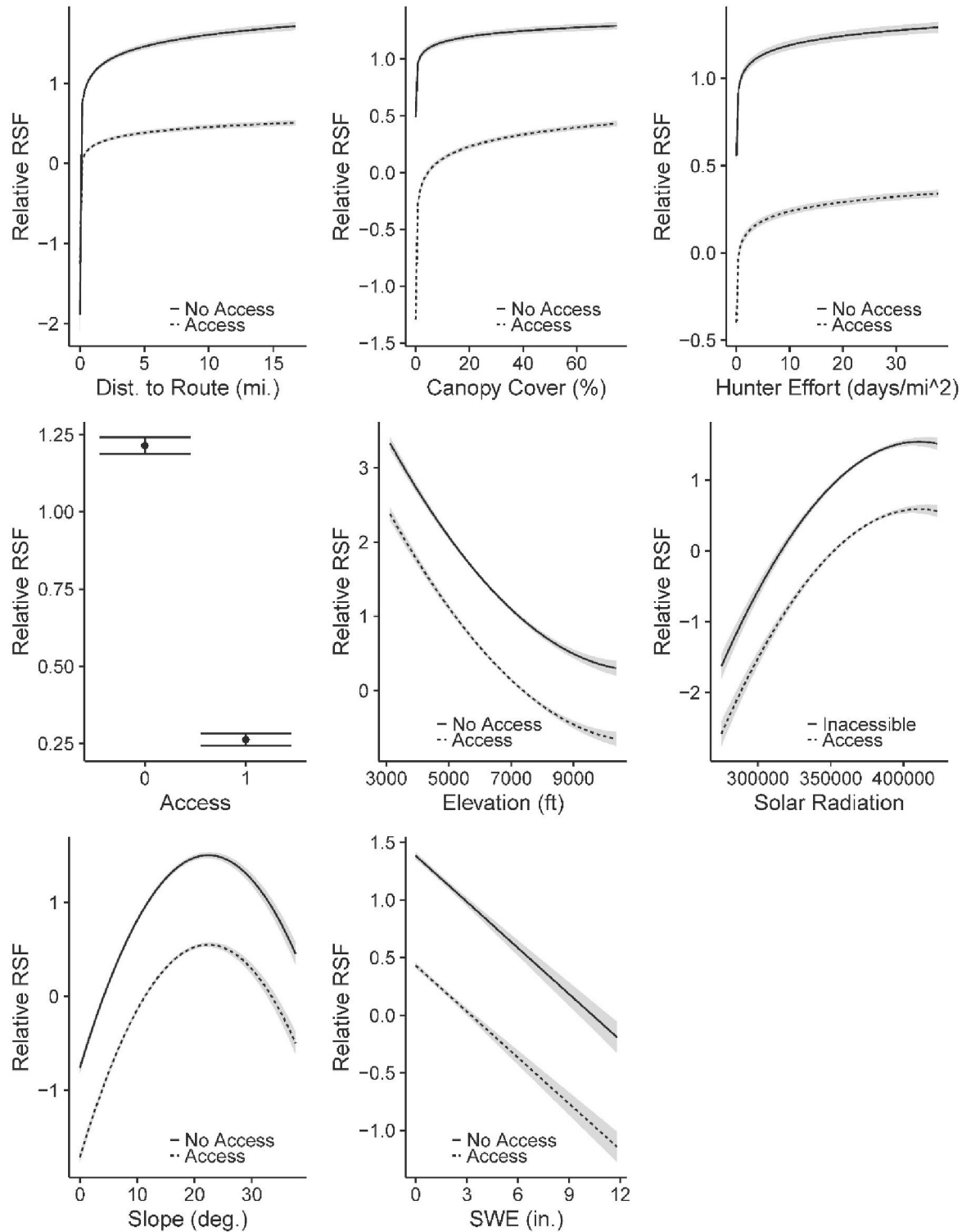


Figure 6. Plots of the interactions included in the top rifle season model, presented on the original, non-standardized scale. Each row presents one interaction, with one of the interacting variables presented on the x-axis while the other is presented using two lines on the plot, one for a low value (1st quartile) and one for a high value (3rd quartile) of that covariate. The specific ‘high’ and ‘low’ values used are available in Appendix S4. The plots present the coefficient estimate (line) and 95% confidence interval (shaded) across the available range for each covariate, with the other variables held at their mean value. The y-axis is analogous to the log-odds of selection.

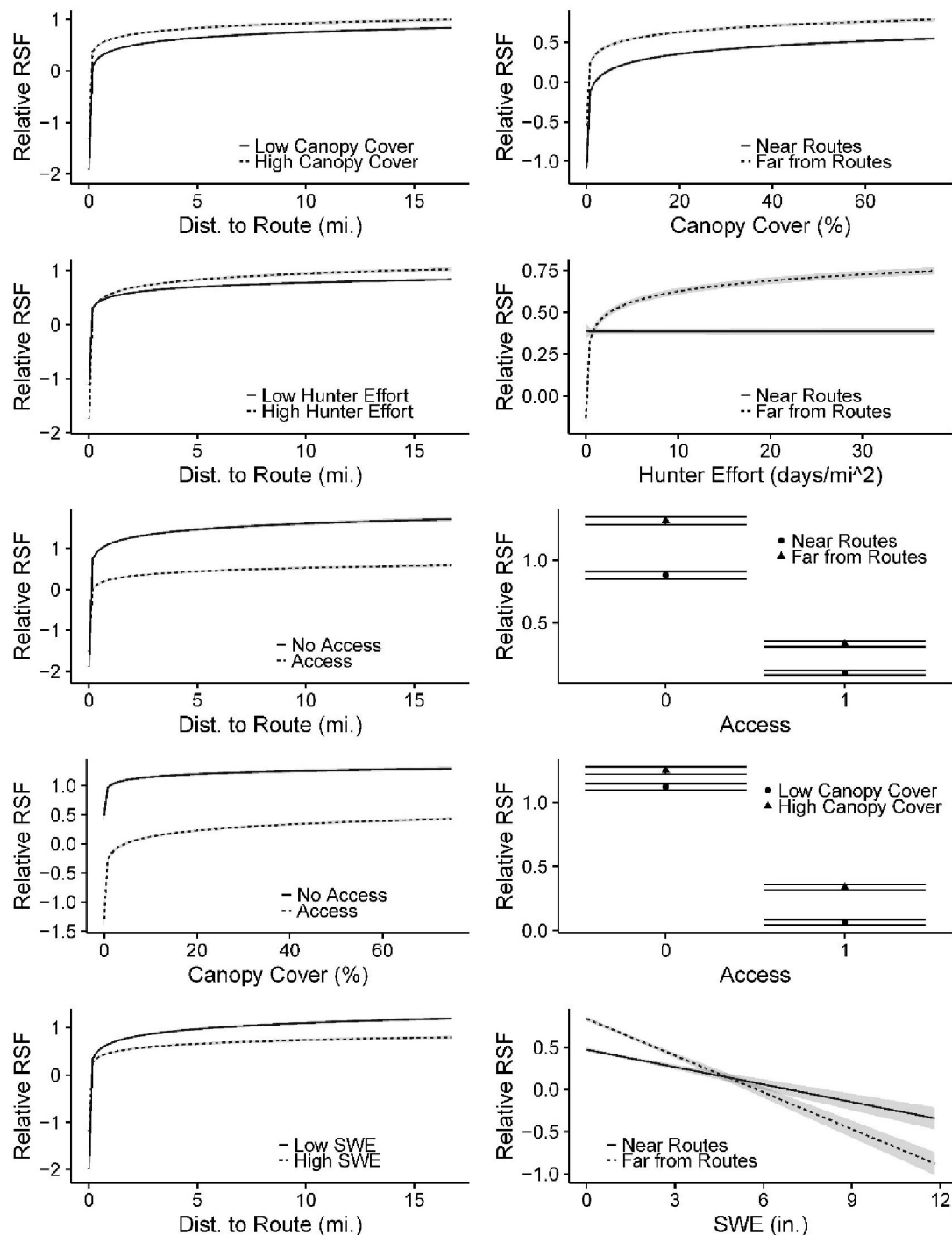


Figure 7. The relationship between the estimated effect of distance to motorized routes on the y-axis and mean hunter effort (days/km²) on the x-axis for the archery (Panel A) and rifle (Panel B) seasons. The standardized estimated coefficient from each population, and standard error, is presented with the results of the generalized least squares model designated by the dashed line. See Figure 1 for population abbreviations.

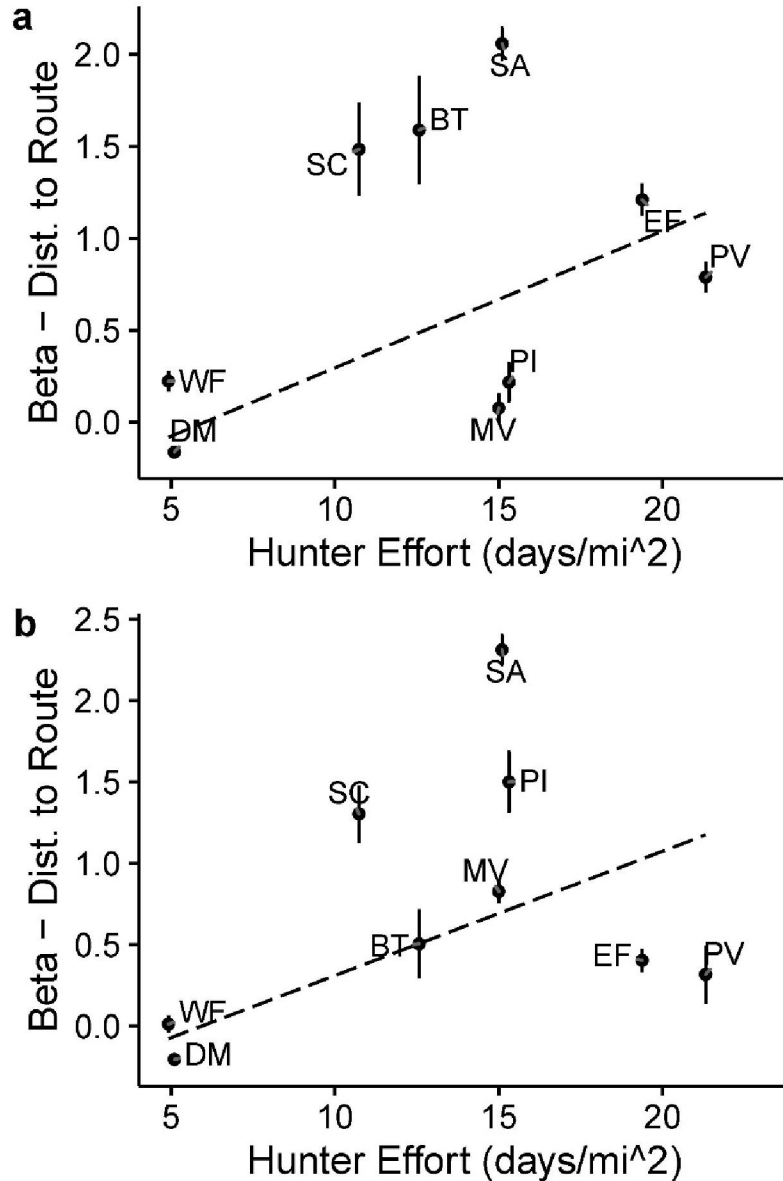
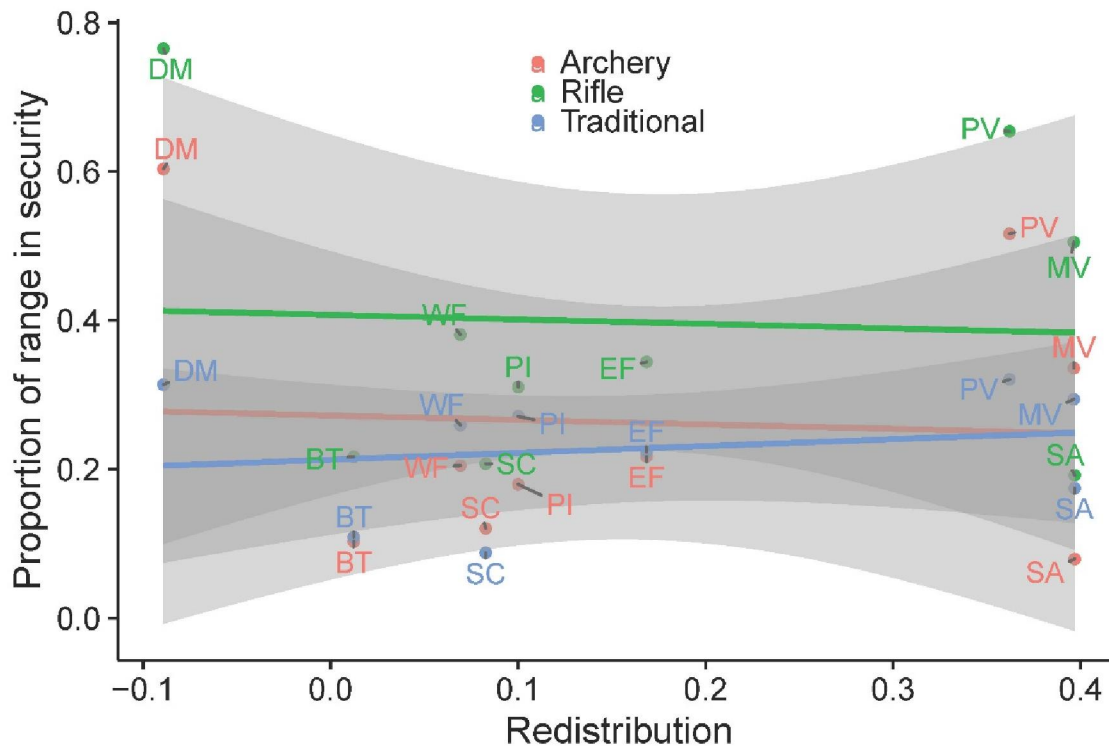


Figure 8. A comparison of the proportion of each population's annual range that is 'secure' based on the top archery (on $\geq 13\%$ canopy cover [1,000 m spatial scale], ≥ 1.71 miles from a motorized route) and rifle ($\geq 9\%$ canopy cover [1,000 m spatial scale], ≥ 0.95 miles from a motorized route, and $\geq 5,000$ acres) security area metrics and the traditional security area metric ($\geq 40\%$ canopy cover [30 m spatial scale], ≥ 0.5 miles from a motorized route, and ≥ 250 acres). These are based only the publicly accessible portion of each population's annual range. The amount of redistribution from publicly accessible to inaccessible lands for each population is also presented. Redistribution was defined as the change in proportion of locations on publicly accessible lands from August to rifle season. Population abbreviations same as Figure 1. For maps of the different security definitions for each population, see Appendix S5.



APPENDIX S1. The start and end dates for the archery and rifle hunting seasons for each of the years of the study, as defined by Montana Fish, Wildlife, and Parks harvest regulations.

Year	Archery		Rifle	
	Start	End	Start	End
2005	9/3/2005	10/16/2005	10/23/2005	11/27/2005
2006	9/2/2006	10/15/2006	10/22/2006	11/26/2006
2007	9/1/2007	10/14/2007	10/21/2007	11/25/2007
2008	9/6/2008	10/19/2008	10/26/2008	11/30/2008
2009	9/5/2009	10/18/2009	10/25/2009	11/29/2009
2010	9/4/2010	10/17/2010	10/23/2010	11/28/2010
2011	9/3/2011	10/16/2011	10/22/2011	11/27/2011
2012	9/1/2012	10/14/2012	10/20/2012	11/25/2012
2013	9/7/2013	10/20/2013	10/26/2013	12/1/2013
2014	9/6/2014	10/19/2014	10/25/2014	11/30/2014

APPENDIX S2. Covariate development and details

What follows is a breakdown of each covariate with details as to why they were selected, how they were generated, and the spatial scales and functional forms considered for each.

Access – access – This covariate was used represent the differences in lands that are accessible to public hunters (public lands that permit hunting and private lands that are accessible to public hunters through a State hunter access program) and lands that are inaccessible to public hunters (public lands where hunting is not permitted and private lands with varying degrees of restrictions on public hunting access). This covariate was developed as a binary accessible/inaccessible (1/0) at the 30 x 30 m scale. Functional forms were not considered as this was a binary covariate.

Canopy cover – cc11 – This layer was obtained from the National Landcover Database at 30 x 30 m resolution. Larger grain sizes represent a moving window average of percent canopy cover with the search window radius equal to the designated grain size. Canopy cover may have several different impacts on elk, as lower canopy covers may represent areas that provide feeding opportunities, while high cover may provide hiding cover (Lyon 1979, Johnson et al. 2000, Ager et al. 2003). This covariate was evaluated only for the pseudothreshold functional form.

Distance to open routes – d2rd - This covariate was developed at 30 x 30 m resolution using the Euclidean Distance tool in ArcGIS 10.2. Only routes that were open to the public during the hunting seasons were used for this analysis (MFWP and USFS 2013). Distance to motorized routes is included as a covariate as it also represents the potential impact of roads on elk (Rowland et al. 2000, Ager et al. 2003). This covariate was only evaluated for the pseudothreshold functional form, as there is no reason to expect selection for/against an intermediate value. Larger spatial scales were not evaluated.

Elevation – elev – Elevation is a key component of the physical landscape that has dramatic influences on water availability and vegetation and is often used in resource selection modeling. This layer was obtained at 30 x 30 m resolution. Larger spatial scales represent the moving window average elevation with a search radius equal to that of the designated spatial scale. This covariate was only evaluated for the quadratic functional form (Ranglack et al. 2014. In Review).

Hunter effort – effort – An index of hunter effort was created for each hunt district. Total hunter effort was estimated for each hunt district as part of the Montana Fish, Wildlife and Parks harvest survey program, without respect to archery and rifle seasons. As the hunt districts are of varying size, effort was standardized for each hunt district by dividing by the area of the hunt district, resulting in an estimate of hunter days/km². This was converted to a raster at 30 x 30 m resolution, but the values only varied by hunt district, thus larger spatial scales were not considered. This covariate varied annually.

Slope – slp – Slope has various impacts on the landscape that can influence elk responses to different areas. Steep slopes may present barriers to travel and foraging, and may also be drier, impacting the vegetation types that are found there. There may also be differing risks of predation with slope, as mountain lions often hunt on steeper slopes that allow them to ambush their prey more easily (Logan and Irwin 1985, Husseman et al. 2003),

but steep slopes may offer protection from wolf predation (Laporte et al. 2010). Slope was generated at 30 x 30 m resolution based on the digital elevation model for the area using the Slope tool in ArcGIS 10.2. The larger spatial scales were calculated using a moving window average with a search radius equal to that of the spatial scale. The resulting rasters contained extremely small values, thus they were multiplied by 1000 to allow for easy extraction in integer form. This covariate was only evaluated for the quadratic functional form (Ranglack et al. 2014. In Review).

Snow Water Equivalent – swe - Snow accumulation is strongly associated with the ecology and behavior of animals in cold climates, as snow can reduce access to forage patches (Craighead et al. 1973, Bruggeman 2006) and increase energy expenditure for thermoregulation, travel, and search for food (Parker et al. 1984, Telfer and Kelsall 1984). We used snow water equivalent (SWE) data from the Snow Data Assimilation System (SNODAS) Data Products at the National Snow and Ice Data Center (http://nsidc.org/data/docs/noaa/g02158_snodas_snow_cover_model/). As snow accumulations are unlikely to impact elk resource selection during the earlier archery season, SWE was only included for the rifle analysis. We generated SWE rasters based on the max SWE value for each pixel during each of six 6-day periods during the rifle season which we called ‘hunt period’. These hunt periods were unique for each year. As the data is only available at the 1,000 m scale, no other spatial scales were evaluated. Both the linear and pseudothreshold functional forms were evaluated. This covariate varied every 6 days during the annual rifle seasons.

Solar radiation – sr – Solar radiation in this study is used as a surrogate for aspect. The amount of solar radiation received by an area can impact the water balance and thus the vegetation types that are found in the area (Fu and Rich 2002). This was generated at 30 x 30 m using the Area Solar Radiation tool in ArGIS 10.2. Inputs were the elevation DEM and the time frame of July 1 – August 31, 2009, as that represented the desired months of the year and roughly the mid-point of the study. All other options were set to their defaults. The larger spatial scales were calculated using a moving window average with a search radius equal to that of the spatial scale. The resulting rasters contained extremely large values, thus they were divided by 1000 to allow for extraction. This covariate was only evaluated for the quadratic functional form (Ranglack et al. 2014. In Review).

Time Integrated NDVI – tin – Time-integrated NDVI is the daily (interpolated) integration of NDVI values above the start of season NDVI baseline for the entirety of the growing season. It therefore represents the net primary production during the growing season for each pixel (Jonsson and Eklundh 2002, White et al. 2009). As such, the influence of forest canopy on forage available to ungulates (Borowik et al. 2013) is mediated, as the value is simply the entire area under the NDVI curve from the start of the growing season to the end. This was downloaded for each year in a pre-processed format from http://phenology.cr.usgs.gov/get_data_250w.php at 250 m resolution, with the larger spatial scales calculated using a moving window average with a search radius equal to that of the spatial scale. This covariate was only evaluated for the pseudothreshold functional form during the archer season (Ranglack et al. 2014. In Review). This covariate varied annually.

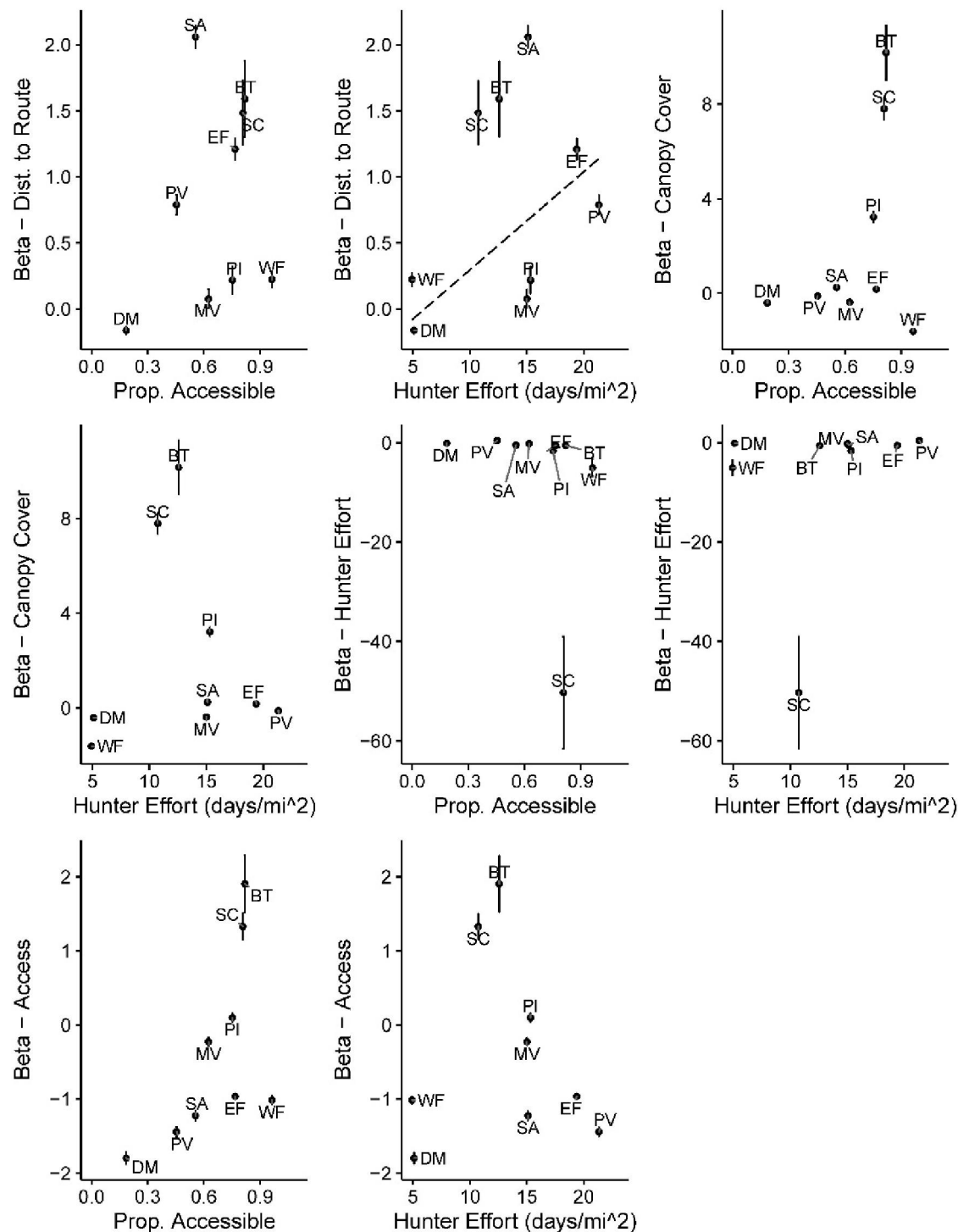
Traditional paradigm – hillis – The Hillis paradigm (Hillis et al. 1991) is often used for defining security areas for elk, and is a combination of distance to routes ≥ 0.5 miles, and size of the security block (≥ 250 acres). We tested several different levels of minimum canopy cover ($\geq 0, 10, 20, 30, 40, 50, 60, 70\%$). The raster was generated at 30 x 30 m resolution as a binary secure/unsecure (1/0). This covariate was only considered in a post-hoc comparison of the traditional paradigm versus new paradigms of security habitat based on our top model results.

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Appendix S3. Examining potential functional responses.



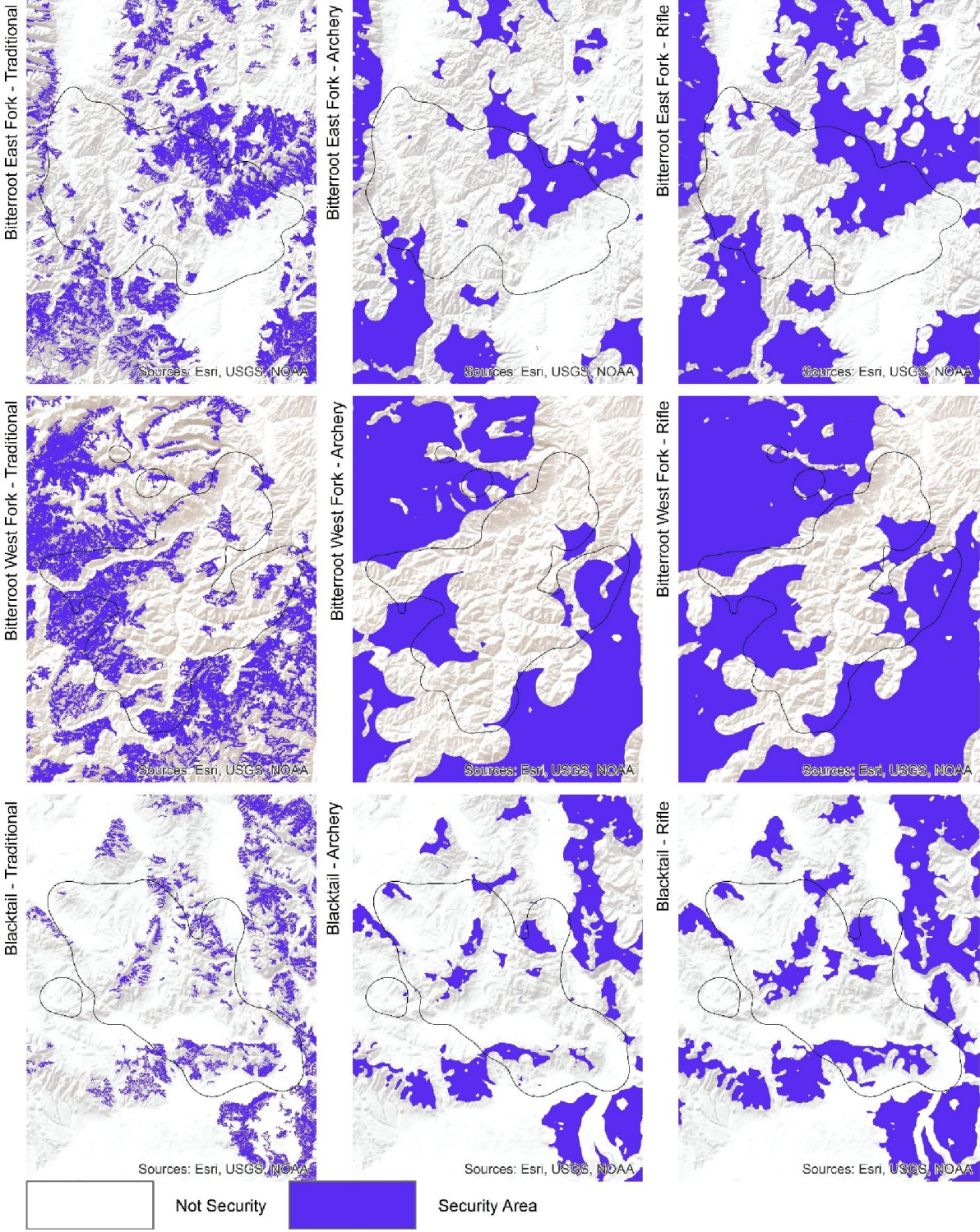
Examining the potential for a functional response between the estimated effect of distance to motorized routes, canopy cover, hunter access, and hunter effort on the y-axis and proportion of annual range that is publicly accessible and mean hunter effort (days/km²) on the x-axis for the archery season. The points represent the standardized coefficient estimate from each population, along with the associated standard error. Any significant ($p \leq 0.05$) relationships are represented by a dashed line. See Figure 1 for population abbreviations.

Appendix S4. ‘Low’ and ‘high’ values used in Figures 4 and 6, which correspond to the 1st and 3rd quantiles from the pooled data, presented for both the archery and rifle seasons.

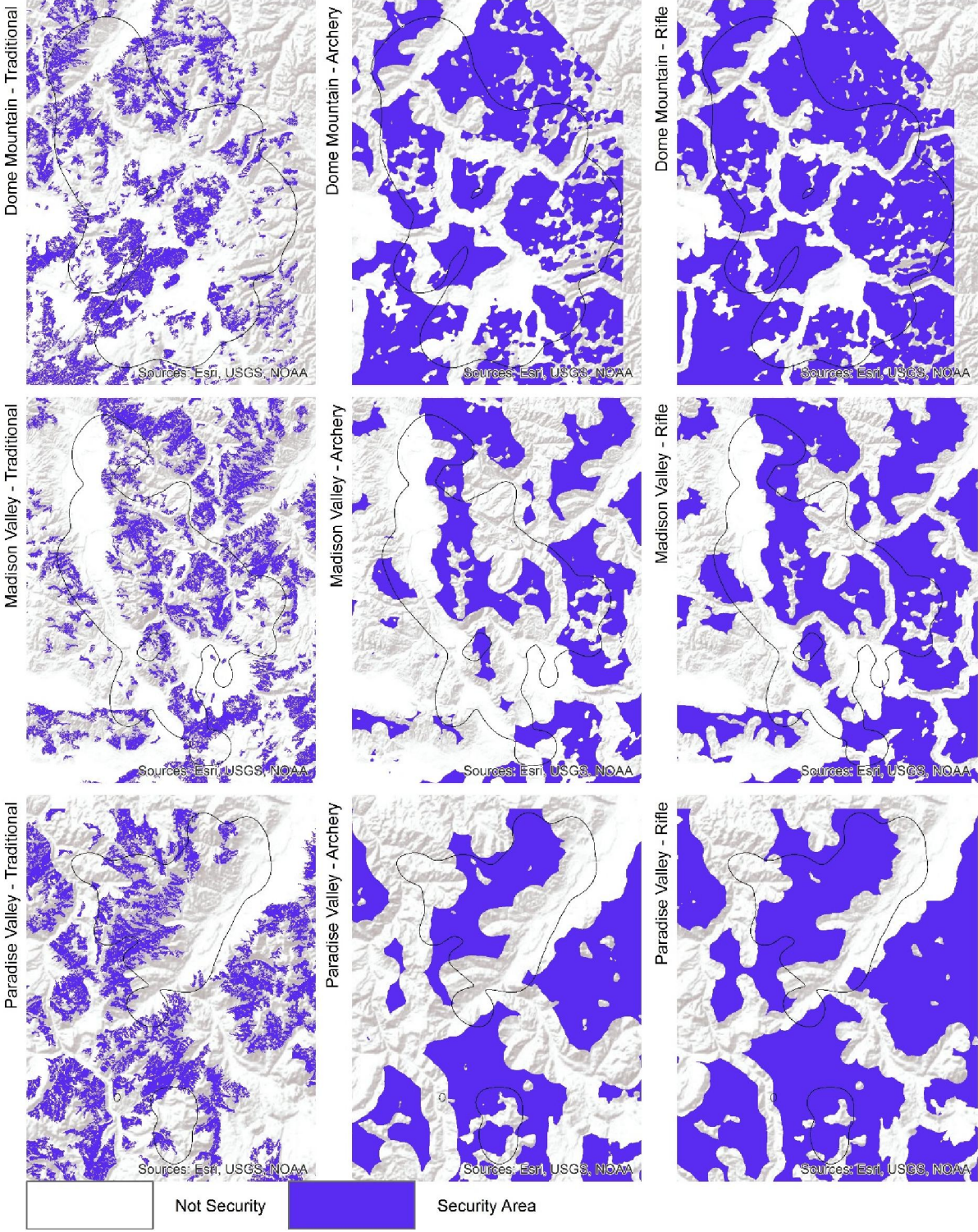
Covariate	Archery		Rifle	
	Low	High	Low	High
Distance to motorized route (miles)	0.32	2.20	0.32	2.09
Canopy Cover (%)	7.85	41.66	6.87	40.67
Hunter Effort (hunter days/mile ²)	7.61	20.0	7.61	20.7
Time Integrated NDVI	42	60	-	-
SWE (in.)	-	-	0.20	1.93

Appendix S5. Maps comparing the traditional security areas with the top security area metrics from the top archery and rifle season models for each population used in the analysis. Traditional security areas are defined as areas of at least 250 acres, that have at least 40% canopy cover (30 m scale), and are at least 0.5 miles from the nearest motorized route. Archery security areas have at least 13% canopy cover (1,000 m scale) and are at least 1.71 miles from the nearest motorized route, with no block size requirement. Rifle security areas are defined as areas of at least 5,000 acres, that have at least 9% canopy cover (1,000 m scale), and are at least 0.95 miles from the nearest motorized route. Security areas based on all of the definitions are shown in blue, with each row representing one population and each column representing a different security definition. Population annual ranges are designated by the black line, as defined by a 99% KDE.

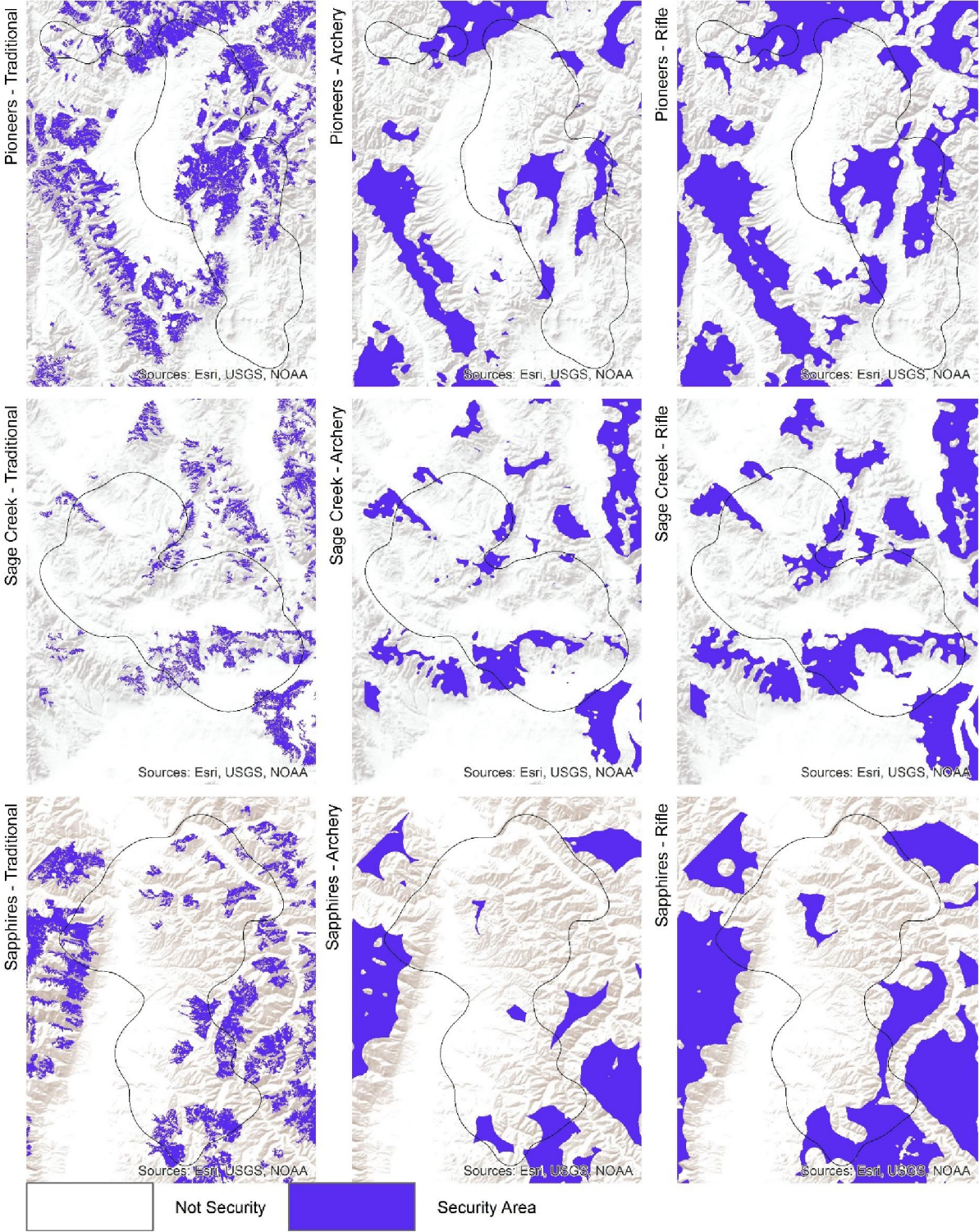
Security Metric Comparison



Security Metric Comparison



Security Metric Comparison



ATTACHMENT D

June 9, 2023

Chad Hudson, Forest Supervisor
Bridger-Teton National Forest
340 N. Cache
P.O. Box 1888
Jackson, WY 83001



Re: Upper Green Study - Utilization v Retention - BTNF 2013/2014

VIA Email

Dear Mr. Hudson:

We previously submitted our report, [Surveys of Upper Green, Fisherman Creek, and Elk Ridge Allotment Complexes dated April 13, 2023](#) (April 13 Report) to you. A zoom meeting was held on April 21, 2013 to discuss the report. Randall Griebel, Kevin Khung, Jonathan Ratner, and John Carter participated. Following the discussion, Randall provided some reports and [data](#) prepared by the Bridger Teton NF. Randall was going to circulate our report to Gary Hayward, Mike Henn, and Albert Sommers, and discuss addressing the report and our proposal to do a simple joint effort of data validation in the summer of 2023.

The data Randall provided consisted of spreadsheets from a 2013 and 2014 study conducted by the Bridger Teton NF to compare utilization and retention based on caged plots (ungrazed) and grazed plots. This was similar to the methodology we employed in our study. We have analyzed that data and compared it to our study results, finding similar outcomes.

We have not heard back from your office regarding our request to do a validation study this summer and at this time, the livestock are near the entry date into the allotments unless delayed due to range ready conditions. In addition, the recent ruling in the Upper Green case remanded the decision back to the BTNF to address certain issues. We have three requests:

1. That you respond to our request for the validation study in a timely manner so this season is not lost.
2. That you incorporate our report cited above along with the analysis contained in this letter report into your process to arrive at a new Decision on the Upper Green issues remanded to the BTNF.
3. Finally, that you inform us as to the nature and timing of the process and public input opportunities you will be using to address the Upper Green remand.

Before presenting the results of our analysis of the data provided by Randall Griebel, we would like to outline a few of the results from our April 13 Report for ease of comparison with this current analysis.

Summary of WWP and Y2U April 12, 2023 Report Results:

- Plots clipped and weighed in the Elk Ridge Complex were producing less than 25% of potential after five years rest. Bluebunch wheatgrass was absent. According to the Ecological Site Descriptions, it should comprise a significant portion of forage production. Bluebunch wheatgrass is a strong decreaser species which is often eliminated from the system by livestock grazing.
- Our ungrazed plots in the Upper Green allotment found that most areas were producing less than 40% of potential. Bluebunch wheatgrass was absent even though it should have been a major component.
- Our measurement of paired plots in the Upper Green allotment found 73.1% upland utilization and 75.5% riparian utilization. This is much greater than the utilization standard provided in the Upper Green ROD or the 25% recommended by range science.
- The SCCD, Forest Service and Permittee (SCCD) joint monitoring in 2020 found an average of 9% utilization using stubble height of Idaho fescue, an increaser, as a key species. We calculated that forage production would need to be greater than 5,000 lb/acre to result in this low level of utilization based on the stocking rate.
- The SCCD green line results in 2020 averaged 11.7" for ungrazed sedges and 9.4" for grazed sedges which is approximately 8% utilization. Data was collected in dense willow stands where the sedges are protected from grazing.
- Greenline stubble heights are not representative of utilization in the adjacent riparian zone.
- The lowered production in these allotments is due to lack of rest, turning in a month earlier than actual range ready time of mid- to late July, underestimating the forage consumption of cattle, and continued unsustainable stocking rates.
- Incorporating range science, representative, and accurate monitoring into management would result in a major reduction in season and numbers. We estimated that would be 31% of the current stocking rate.
- We proposed a data validation study to compare methods, key areas, and determine forage production and are awaiting a response from the BTNF.

Bridger Teton National Forest Retention Plots from 2013 and 2014: A map of the BTNF study locations is provided in Figures 1 and 2. We consolidated the 2013 and 2014 BTNF data and performed some analysis. The Tables below provide a summary of our analysis with Table 1 (summary), Table 2 (site description and location), Table 3 (sample weights for each site), Table 4 (utilization and retention calculations from the raw data), Table 5 (utilization and retention values while removing sites with negative or zero values) and

Table 6 (production compared to ecological site potentials). Mesic sites are riparian meadow sites. Upland sites were in sagebrush and shrubby cinquefoil areas. Key species were sedges in the riparian areas and Idaho fescue in uplands. Non-key species included forbs, non-key grasses, and non-native plants.

Table 1 shows that utilization ranged from 45% to 59.4% with utilization on the non-key species being the highest. This indicates that the key species being used are less sensitive to grazing or less desirable to livestock. It also shows that retention levels do not meet the herbaceous retention objective of 70% specified in the Upper Green FEIS. At a key species utilization of 51.4% (which is near the 50% criteria used by the BTNF), retention is less than 50% for the key species and 55% for all species combined.

In 2013, the BTNF used a Robel Pole to measure average vegetation height. In the mesic (riparian areas), the ungrazed average height was 2.6 inches with a grazed average height of 1.4 inches. One upland site was measured at 2.1 inches ungrazed average height and 0.8 inches grazed average height. These are significantly less than the Sage grouse grass height objectives provided in the Upper Green FEIS which are > 7 inches in uplands and > 4 inches in herbaceous riparian and meadow habitat.

The 2013 – 2014 BTNF data illustrates what we also found, that use of the height-weight curves (utilization gauge) for Idaho fescue grossly underestimates utilization when compared to actual clipping and weighing using the Paired Plot Method. The SCCD has used a method/key species combination that appears unable to accurately reflect utilization and retention. Greenline monitoring conducted by SCCD in locations with protection by willows showed little utilization in 2020. Our study found 75% utilization and therefore 25% retention in riparian areas not protected by willows. The insensitivity of the method, key species selected, and locations negate the Adaptive Management process touted in the Upper Green ROD.

The data from the 2013 and 2014 BT retention study also found significant utilization in riparian areas that have less than 30% willow cover/protection (utilization ranged from 43.1 to 73%). (Table 1).

Table 1. Summary Averages of Utilization and Retention across Habitats

Site type	Key Species Retention	Key Species Utilization	Non-Key Species Retention	Non-Key Species Utilization	All Species Retention	All Species Utilization
Mesic Site Average	51.7%	48.3%	27.0%	73.0%	56.9%	43.1%
Upland Site Average	44.7%	55.3%	52.0%	48.0%	52.6%	47.4%
Overall Average	48.6%	51.4%	40.6%	59.4%	55.0%	45.0%

The Supplemental Wildlife Specialist Report (2016) by Kerry Murphy also analyzed this data and used it to evaluate herbaceous retention for amphibians.¹ The analysis compared key species utilization from the paired (clipped and weighed) plots to the 70 percent herbaceous retention needs of amphibians. Regression relationships were developed for both mesic areas (riparian with sparse willows) and uplands, comparing the key species utilization to herbaceous retention. The results included 2 of 11 mesic plots where key forage use was negative and one where it was zero, indicating that the randomly selected plots were subject to error. These were excluded from the regressions. The Paired Plot method requires that the grazed plots be selected to be similar to the caged plot and marked prior to grazing so this type of error can be minimized.²

Based on the regression relationships the analysis concluded that retention could be estimated as 100% minus the key forage use. This relationship was then used to determine retention in several allotments' riparian zones using the key species stubble heights data provided from the Upper Green monitoring program, resulting in herbaceous retention ranging from 92% to 35%, depending on the allotment. We have reviewed the [2013 Field Monitoring for the Upper Green River Cattle Allotment](#) to see if plots were clipped. These data were all based on stubble heights of sedges and in uplands, Idaho fescue.

As we determined in our 2022 Paired Plots, the greenline stubble heights are measured in areas with dense willow cover, not in mesic areas with sparse willow cover, and thereby

¹ Murphy, Kerry. 2016. Upper Green River Area Rangeland Project. Supplemental Wildlife Specialist Report: Federally listed species, Sensitive amphibians, Management indicator amphibians. Jackson Ranger District, Bridger-Teton National Forest.

² USDA and DOI. 1999. Utilization Studies and Residual Measurements. Interagency Technical Reference 1734-3.

https://www.blm.gov/sites/default/files/documents/files/Library_BLMTechnicalReference1734-03.pdf

understate utilization by measuring these stubble heights in areas little used by livestock. Similarly, the BTNF monitoring is using stubble height of Idaho fescue and a utilization gauge to determine utilization in uplands. Because Idaho fescue is a grazing-tolerant increaser grass, it was found to grossly understate upland utilization. Neither of these can be used to determine herbaceous retention.

The Specialist Report assumed “that adequate function and retention in riparian zones also indicated desired conditions in uplands and in shoreline aquatic communities were also met—requires verification in the project area through field studies.” [Emphasis added]. Our prior report provides evidence that the current key species monitoring in the Upper Green allotment grossly understates utilization and thereby any estimate of herbaceous retention is grossly overstated.

The Specialist Report then cited a Forest Service research study by Clary and Webster (1989) which related a 6” stubble height in the riparian zone to Utilization of 24 – 32% and a 4” stubble height to a utilization rate of 37 – 44%. Our 2022 study found that greenline stubble heights do not represent the stubble heights in the adjacent mesic, or riparian meadows. For example, the average greenline stubble height was 4.8” and 17.7% utilization while the adjacent riparian meadow transects averaged 3.3” and 31% utilization (without accounting for trampling). Meanwhile, our paired plots for riparian areas averaged 75.5% utilization. While Clary and Webster’s recommendations for 24 – 32% utilization comport with the best science, they are not being achieved and are retention levels are not meeting the recommendation of the Boreal Toad Recovery Team and Advisory Group to limit herbaceous utilization to no more than 30% of current season’s growth.

The Specialist Report made this assumption. “I assumed that achieving 70% total herbaceous retention in moist meadow-sparse willow riparian areas would provide for at a similar or greater level of retention in dry riparian (silver sage and shrubby cinquefoil), dense willow, and upland habitats dominated by herbaceous vegetation. Given the opportunity, cattle spend a disproportionate amount of time (up to 30 times higher) in riparian habitats as compared to adjacent, xeric uplands (Clary and Webster 1989). This assumption will require verification if any of the grazing alternatives are implemented.” [Emphasis added].

We summarized the 2013 Field Monitoring Data for the Upper Green River Cattle Allotment into a [spreadsheet](#) in order to determine average utilization for mesic and upland area. Key species were sedges in mesic areas and Idaho fescue in uplands. In the mesic areas, utilization on sedges averaged 10.8%. In uplands, utilization on Idaho fescue averaged 15.5%. As shown in Table 1, when the BTNF personnel clipped paired plots, directly measuring utilization, the utilization levels were much greater. These compare directly with our April 13 report results in which key species utilization levels measured by stubble

height were small in comparison to the paired plots. The key species are a proxy for an actual measurement of utilization by clipping and weighing standard grazed and ungrazed plots (paired plots).

In addition, we mapped the BTNF retention study sites and overlaid them on the Ecological Sites that are available in the Upper Green allotments. Three ecological sites were identified within which the retention study paired plots were collected. These included: (1) [Coarse Upland \(Foothills And Mountains West\)](#), (2) [Loamy \(Foothills And Mountains West\)](#), and (3) [Subirrigated \(High Mountains\)](#). Table 6 summarizes the production found in the BTNF Retention Study compared to the Ecological Site potential herbaceous production. These sites were taken as mapped but should be field verified. The resulting production for mesic sites averaged 597 lb/acre and 40.1% of potential. Production in the uplands averaged 270 lb/acre and 17.3% of potential. These values are much less than those claimed to exist in the analysis in the Upper Green FEIS.

In our April 13 report and transmittal letter, we requested these deficiencies be addressed. The current monitoring protocol is clearly unable to accurately measure actual use and retention for comparison to the BTNF required standards and objectives. We also determined that current production of herbaceous vegetation is a fraction of potential as did the BTNF retention study. Current forage capacity and stocking rates should be determined in conjunction with providing rest and later turn in. This can be accomplished in a true joint monitoring and management effort involving the Forest Service, Sublette County Conservation District, Permittees, WWP, and Y2U that will:

1. Select key areas in upland and riparian areas that meet the advice in the Forest Service guidance and research we have cited. It will include areas grazed first, that is, riparian areas lacking significant willow protection and upland areas that are in valleys, on slopes less than 7% and no more than 366 meters from the nearest water source. These would then be compared to the nearest SCCD monitoring sites.
2. Place cages in these areas, at current SCCD sites, and establish paired plots.
3. At each site, measure the key species, Idaho fescue, along upland transects; sedges along transects in riparian meadows; and green line stubble heights. Include trampling in the measures.
4. Compare the results from the different methods and locations.
5. Determine the stocking rate on capable areas using the Paired Plot production data and visiting pastures with turn-in after July and clip the vegetation. Inspection of the 2022 AOI indicates six pastures could be available if the schedule remains the same.
6. Initiate this in the summer of 2023.

We also included in our April 13 Report some of the Forest Service guidance on participation by the public in monitoring and grazing management. The Forest Service

Handbook FSH 2209.10 Chapter 10 describes public involvement:

- "Involve the permittee and interested publics in management of the range allotments." (Par. 11.3).
- "Obtain ID team, interested publics, and permittee assistance in securing the necessary inventory and monitoring information and establish criteria for determining allowable use levels." (Par. 12.2).
- "The interdisciplinary (ID) team, the permittee, and interested publics should assist in the rangeland inventory and analysis and in the preparation of environmental documents." (Par. 13).
- "Public participation should be a key element of the NFMA process as well as the NEPA process. Close consultation, cooperation, and coordination with grazing permittees is essential to help them understand the differences between existing and desired vegetation on their allotment and in identifying possible practices that will achieve desired future conditions for vegetation as well as the permittees livestock operation. Other interested parties should be involved as well to identify possible practices that will be responsive to potential concerns or issues they may express. Not only is public participation good business from the standpoint of identifying opportunities and possible practices to achieve desired conditions and reduce controversy later in the planning process, but it is a requirement of law.... Furthermore, in FLPMA's declaration of policy, Congress specifically requires the Secretary of Agriculture to consider the views of the general public, and to allow for adequate third-party participation exercising his discretionary authority. (43 USC (1701(a) (5)))." (Par. 15.7).
- "Benchmark areas should be selected and/or approved by the most experienced and qualified personnel available and agreed upon or coordinated with permittees and in some cases other interested agencies, individuals or groups." (1993 FSH 2209.21 Chapter 40 Par. 40.41).

At this time, we have not received a response from the BTNF regarding implementation of our proposal. We received a May 10, 2023 email invitation from Gary Hayward³ to a May 19, 2023 meeting for "presenters" or "interested parties" to attend a "short information sharing session". We provided our Report to the Forest Service on April 13, 2023 and met with Kevin Khung and Randall Griebel via Zoom on April 21 to discuss our Report and recommendations which included setting a meeting with Albert Sommers (Upper Green Grazing Association), Mike Henn (Sublette County Conservation District) and Gary Hayward (Range Specialist BTNF) in order to develop and carry out a data validation study at up to three locations this summer. Our report was provided a month before the meeting on May 19 and we did not get an invite as a presenter. Our prior experience with this annual meeting was it was very brief and our attempt to discuss issues was cut off and the meeting ended after about 15 minutes. This is hardly worth a drive to Pinedale.

³ Email from Gary Hayward dated May 10, 2023.

When we mentioned that there was no mention of our study being addressed in the meeting, we were told in an email received from Randall Griebel⁴ that, “The purpose of the meeting is to get through these topics and provide folks the results of the Forest’s monitoring effort – not go over other entities monitoring results that can range from “maybe usable information to not-useful-at-all” because the methods, site selections, and interpretation are not representative of the actual conditions in the allotment, as one example.”

This statement by Mr. Griebel is an exact description of what we find with the SCCD monitoring. We disagree with his interpretation of the meeting purpose as Jonathan Ratner⁵ pointed out in his email response to Randall. In that email, he cited the Upper Green ROD, which states:

“Monitoring and Adaptive Management – An Open Process: The overall intent of adaptive management for this project is to proactively manage livestock grazing consistent with meeting other resource objectives, using all available tools. This includes an intent to avoid the need for drastic consequences unless other tools and management options have not met desired outcomes. To address this intent, I will provide a forum for new information, current monitoring results sharing, and other information to be presented and considered so that solutions to issues can be considered in a collaborative, proactive way. The forum would consist of at least one annual meeting which would be open to collaborators and include, at a minimum, the following agenda items.”

This situation should be corrected to open the process to the public with sufficient time to prepare. Due to conflicts and short notice, we were not able to attend the May 19 meeting. However, we expect the BTNF to arrange a meeting with Albert Sommers, (Grazing Association President), Michael Henn (Sublette Conservation District), Gary Hayward (BTNF Range Specialist), Randall Griebel (Forest Ecologist), and ourselves to go over our data and reports and develop a plan to carry out a monitoring validation study in the summer of 2023 as we have outlined herein.

⁴ Email from Randall Griebel dated May 10, 2023.

⁵ Jonathan Ratner email dated May 10, 2023.

Sincerely,

A handwritten signature in blue ink that reads "John G. Carter". The signature is written in a cursive style with a large, stylized 'J'.

John Carter, Ecologist
Yellowstone to Uintas Connection
PO Box 464
Bondurant, WY 82922

A handwritten signature in blue ink that reads "Jonathan Ratner". The signature is written in a cursive style with a large, stylized 'J'.

Jonathan Ratner, Utah and Wyoming Director
Western Watersheds Project
PO Box 171
Bondurant, WY 82922

Figure 1. Bridger Teton NF Retention Study Site Locations

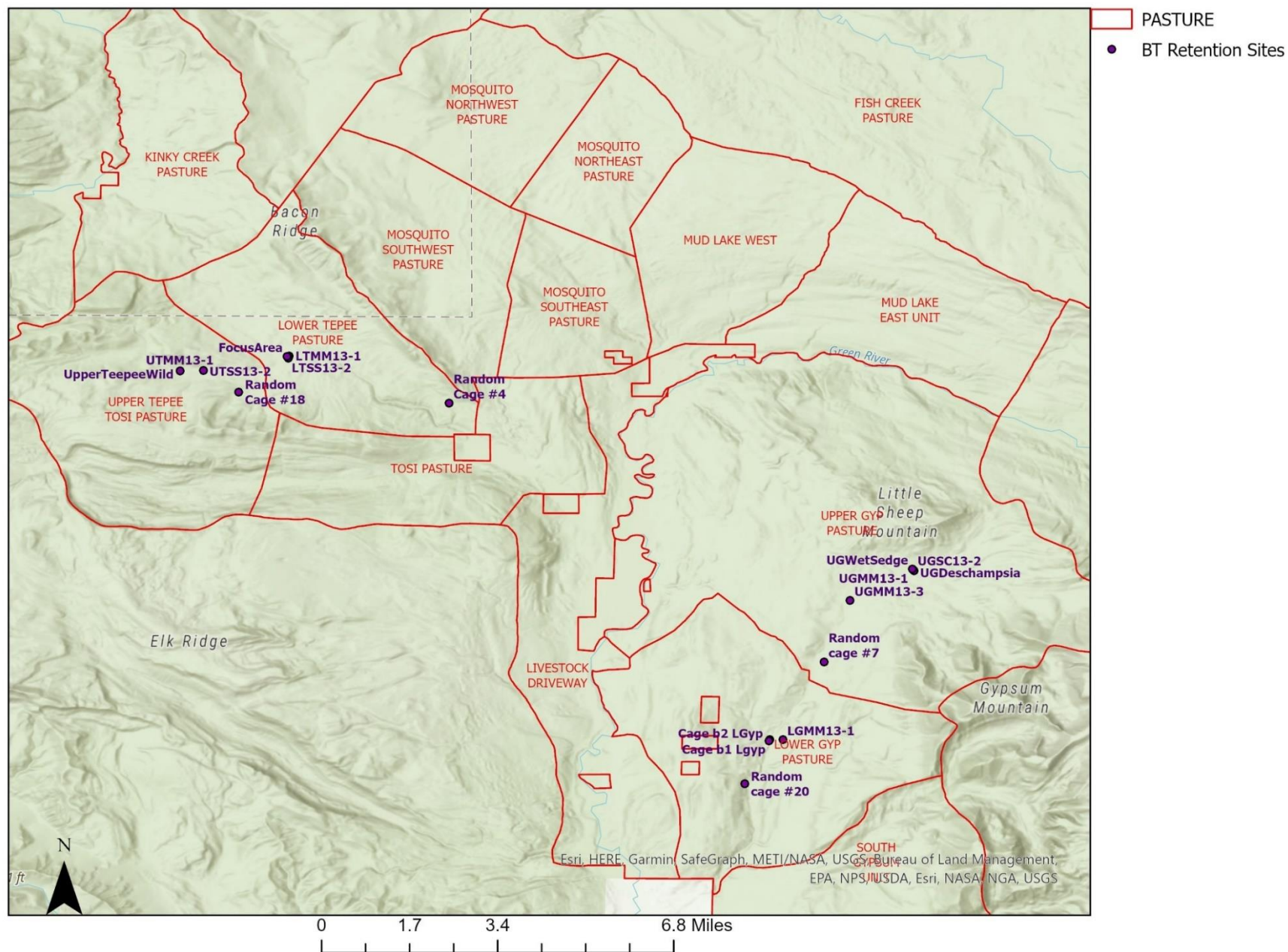


Figure 2. Bridger Teton NF Retention Study Sites Overlain on Ecological Sites

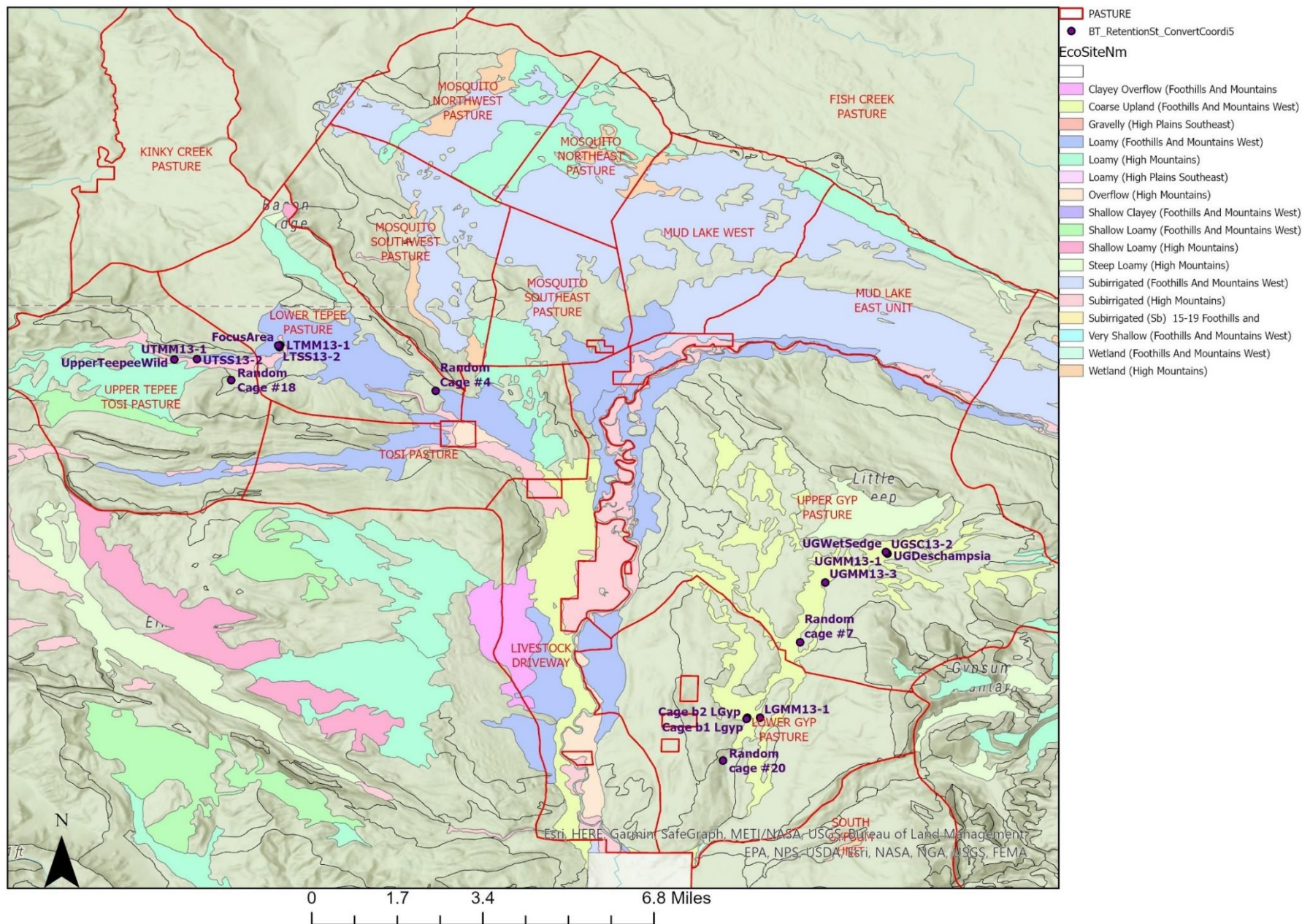


Table 2. Site Descriptions and Locations

Year	Pasture	Site ID	Site type	Easting	Northing	Elevation
2013	Lower Gypsum	LGMM13-1	Mesic Meadow	583564	4790190	8233
2013	Upper Gypsum	UGMM13-1	Mesic Meadow	586439	4795507	8950
2013	Upper Gypsum	UGMM13-3	Mesic Meadow	585033	4794531	8733
2013	Upper Teepee	UTMM13-1	Mesic Meadow	569784	4801473	8921
2013	Lower Teepee	LTMM13-1	Mesic Meadow	572253	4801959	8775
2014	Lower Gypsum	Cage b1 LGyp	Mesic Meadow	0583268	4790186	8212
2014	Lower Gypsum	Cage b2 LGyp	Mesic Meadow	0583245	4790149	8097
2014	Upper Gypsum*	UGDeschampsia	Mesic Meadow	0586470	4795470	8944
2014	Upper Gypsum*	UGWetSedge	Mesic Meadow	0586432	4795517	8925
2014	TosiTeepeeRed lower	FocusArea	Mesic Meadow	0572202	4801940	8775
2014	Upper Teepee	UpperTeepeeWild	Mesic Meadow	569784	4801473	SeeLastYr
2014	Upper Teepee	Random Cage #18	Mountain Big Sage	0571121	4800826	7172?
2013	Upper Gypsum	UGSC13-2	Shrubby Cinquefoil	586453	4795496	8961
2014	LGyp Random	Random cage #20	Shrubby cinquefoil	582716.45	4788812	
2013	Upper Teepee	UTSS13-2	Silver Sage	570316	4801491	8894
2013	Lower Teepee	LTSS13-2	Silver Sage	572228	4801893	8769
2014	Upper Teepee	UpperTeepeeNonWild	Silver Sage	570316	4081491	SeeLastYr
2014	UGyp Random	Random cage #7	SilverSage/Shrubby Cinquefoil	584470	4792615.8	
2014	TosiTeepeeRed lower	Random Cage #4	SilverSage/Shrubby Cinquefoil	0575885	4800540	8111?

Reproduced from the original spreadsheet unedited and sorted by mesic or upland type across years

Table 3. Summary of Sample Weights for Key, Non-Key, and All Species Grazed and Ungrazed

Year	Site ID	Site type	Key Species Cage, g	Key Species Grazed, g	Non-Key Sp Cage, g	Non-Key Sp Grazed, g	All Species Cage, g	All Species Grazed, g
2013	LGMM13-1	Mesic Meadow	18.7	11.5	0.8	2.8	19.1	12.9
2013	UGMM13-1	Mesic Meadow	7.6	4.8	5.5	1.7	10.4	5.7
2013	UGMM13-3	Mesic Meadow	7.2	7.7	10.1	2	12.3	8.9
2013	UTMM13-1	Mesic Meadow	9	4.8	7	2.6	12.5	6.1
2013	LTMM13-1	Mesic Meadow	7.6	4.4	3.8	6.7	9.5	7.8
2014	Cage b1 Lgyp	Mesic Meadow	13.75	10.8	1.65	0.45	15.4	11.25
2014	Cage b2 LGyp	Mesic Meadow	13.05	5	0.6	1.6	13.65	6.6
2014	UGDeschampsia	Mesic Meadow	12.25	2.8	0.8	1.5	13.05	4.3
2014	UGWetSedge	Mesic Meadow	31.3	19.1	0	0.05	31.3	19.15
2014	FocusArea	Mesic Meadow	35.85	10.15	0	0	35.85	10.15
2014	UpperTeepeeWild	Mesic Meadow	7.75	12.3	3.5	0.7	11.25	12.65
2014	Random Cage #18	Mountain Big Sage	8.5	2.4	1.85	2.95	10.35	5.35
2013	UGSC13-2	Shrubby Cinquefoil	3.2	5.1	6.9	2.8	6.7	6.5
2014	Random cage #20	Shrubby cinquefoil	0.75	0.25	2	1.25	2.75	1.5
2013	UTSS13-2	Silver Sage	2.7	2.3	18.2	6.1	11.8	5.3
2013	LTSS13-2	Silver Sage	3	1	2.7	2.9	4.5	2.4
2014	UpperTeepeeNonWild	Silver Sage	3.8	2.55	6.25	2.55	10.05	5.1
2014	Random cage #7	SilverSage/Shrubby Cinquefoil	4.55	0.4	4.45	2.85	9	3.25
2014	Random Cage #4	SilverSage/Shrubby Cinquefoil	3.15	1.8	1.35	0.95	8.4	2.75

Values summarized from BT Spreadsheets. Non-key values are forbs, non-natives, and invasives combined

Table 4. Utilization and Retention for Key, Non-Key and All Species Grazed and Ungrazed Unfiltered

Year	Site ID	Site type	Key Sp Retention	Key Sp Utilization	Non-Key Sp Retention	Non-Key Sp Utilization	All Sp Retention	All Sp Utilization
2013	LGMM13-1	Mesic Meadow	61.5%	38.5%	350.0%	-250.0%	67.5%	32.5%
2013	UGMM13-1	Mesic Meadow	63.2%	36.8%	30.9%	69.1%	54.8%	45.2%
2013	UGMM13-3	Mesic Meadow	106.9%	-6.9%	19.8%	80.2%	72.4%	27.6%
2013	UTMM13-1	Mesic Meadow	53.3%	46.7%	37.1%	62.9%	48.8%	51.2%
2013	LTMM13-1	Mesic Meadow	57.9%	42.1%	176.3%	-76.3%	82.1%	17.9%
2014	Cage b1 Lgyp	Mesic Meadow	78.5%	21.5%	27.3%	72.7%	73.1%	26.9%
2014	Cage b2 LGyp	Mesic Meadow	38.3%	61.7%	266.7%	-166.7%	48.4%	51.6%
2014	UGDeschampsia	Mesic Meadow	22.9%	77.1%	187.5%	-87.5%	33.0%	67.0%
2014	UGWetSedge	Mesic Meadow	61.0%	39.0%	#DIV/0!	#DIV/0!	61.2%	38.8%
2014	FocusArea	Mesic Meadow	28.3%	71.7%	#DIV/0!	#DIV/0!	28.3%	71.7%
2014	UpperTeepeeWild	Mesic Meadow	158.7%	-58.7%	20.0%	80.0%	112.4%	-12.4%
2014	Random Cage #18	Mountain Big Sage	28.2%	71.8%	159.5%	-59.5%	51.7%	48.3%
2013	UGSC13-2	Shrubby Cinquefoil	159.4%	-59.4%	40.6%	59.4%	97.0%	3.0%
2014	Random cage #20	Shrubby cinquefoil	33.3%	66.7%	62.5%	37.5%	54.5%	45.5%
2013	UTSS13-2	Silver Sage	85.2%	14.8%	33.5%	66.5%	44.9%	55.1%
2013	LTSS13-2	Silver Sage	33.3%	66.7%	107.4%	-7.4%	53.3%	46.7%
2014	UpperTeepeeNonWild	Silver Sage	67.1%	32.9%	40.8%	59.2%	50.7%	49.3%
2014	Random cage #7	SilverSage/Shrubby Cinquefoil	8.8%	91.2%	64.0%	36.0%	36.1%	63.9%
2014	Random Cage #4	SilverSage/Shrubby Cinquefoil	57.1%	42.9%	70.4%	29.6%	32.7%	67.3%

Table 5. Utilization and Retention for Key, Non-Key and All Species Grazed and Ungrazed

Year	Site ID	Site type	Key Sp Retention	Key Sp Utilization	Non-Key Sp Retention	Non-Key Sp Utilization	All Sp Retention	All Sp Utilization
2013	LGMM13-1	Mesic Meadow	61.5%	38.5%			67.5%	32.5%
2013	UGMM13-1	Mesic Meadow	63.2%	36.8%	30.9%	69.1%	54.8%	45.2%
2013	UGMM13-3	Mesic Meadow			19.8%	80.2%	72.4%	27.6%
2013	UTMM13-1	Mesic Meadow	53.3%	46.7%	37.1%	62.9%	48.8%	51.2%
2013	LTMM13-1	Mesic Meadow	57.9%	42.1%			82.1%	17.9%
2014	Cage b1 Lgyp	Mesic Meadow	78.5%	21.5%	27.3%	72.7%	73.1%	26.9%
2014	Cage b2 LGyp	Mesic Meadow	38.3%	61.7%			48.4%	51.6%
2014	UGDeschampsia	Mesic Meadow	22.9%	77.1%			33.0%	67.0%
2014	UGWetSedge	Mesic Meadow	61.0%	39.0%			61.2%	38.8%
2014	FocusArea	Mesic Meadow	28.3%	71.7%			28.3%	71.7%
2014	UpperTeepeeWild	Mesic Meadow			20.0%	80.0%		
2014	Random Cage #18	Mountain Big Sage	28.2%	71.8%			51.7%	48.3%
2013	UGSC13-2	Shrubby Cinquefoil			40.6%	59.4%	97.0%	3.0%
2014	Random cage #20	Shrubby cinquefoil	33.3%	66.7%	62.5%	37.5%	54.5%	45.5%
2013	UTSS13-2	Silver Sage	85.2%	14.8%	33.5%	66.5%	44.9%	55.1%
2013	LTSS13-2	Silver Sage	33.3%	66.7%			53.3%	46.7%
2014	UpperTeepeeNonWild	Silver Sage	67.1%	32.9%	40.8%	59.2%	50.7%	49.3%
2014	Random cage #7	SilverSage/Shrubby Cinquefoil	8.8%	91.2%	64.0%	36.0%	36.1%	63.9%
2014	Random Cage #4	SilverSage/Shrubby Cinquefoil	57.1%	42.9%	70.4%	29.6%	32.7%	67.3%
		Mesic Site Average	51.7%	48.3%	27.0%	73.0%	56.9%	43.1%
		Upland Site Average	44.7%	55.3%	52.0%	48.0%	52.6%	47.4%
		Overall Average	48.6%	51.4%	40.6%	59.4%	55.0%	45.0%

Utilization and Retention are calculated from Table 3 omitting zero and negative values.

Table 6. Bridger Teton Retention Study Production Compared to Ecological Site Potentials

Year	Site ID	Site type	Ecological Site Name	Normal Yr Ecosite Herbaceous Production lb/acre	Caged Plots Herbaceous Production lb/acre	Caged Plots Percent of Potential Production
2013	LGMM13-1	Mesic Meadow	Coarse Upland	1200	681	56.8
2013	UGMM13-1	Mesic Meadow	Coarse Upland	1200	371	30.9
2013	UGMM13-3	Mesic Meadow	Coarse Upland	1200	439	36.6
2013	UTMM13-1	Mesic Meadow	Subirrigated	4250	446	10.5
2013	LTMM13-1	Mesic Meadow	Subirrigated	4250	339	8.0
2014	Cage b1 Lgyp	Mesic Meadow	Coarse Upland	1200	549	45.8
2014	Cage b2 LGyp	Mesic Meadow	Coarse Upland	1200	487	40.6
2014	UGDeschampsia	Mesic Meadow	Coarse Upland	1200	465	38.8
2014	UGWetSedge	Mesic Meadow	Coarse Upland	1200	1116	93
2014	FocusArea	Mesic Meadow	Loamy	1800	1278	71
2014	UpperTeepeeWild	Mesic Meadow	Subirrigated	4250	401	9.4
2014	Random Cage #18	Mountain Big Sage	NA		369	NA
2013	UGSC13-2	Shrubby Cinquefoil	Coarse Upland	1200	239	19.9
2014	Random cage #20	Shrubby cinquefoil	NA		98	NA
2013	UTSS13-2	Silver Sage	Loamy	1800	421	23.3
2013	LTSS13-2	Silver Sage	Loamy	1800	160	8.8
2014	UpperTeepeeNonWild	Silver Sage	NA		358	NA
2014	Random cage #7	SilverSage/Shrubby Cinquefoil	NA		321	NA
2014	Random Cage #4	SilverSage/Shrubby Cinquefoil	NA		300	NA
		Mesic Site Average			597	40.1
		Upland Site Average			270	17.3

ATTACHMENT E

April 13, 2023

Chad Hudson, Forest Supervisor
Bridger-Teton National Forest
340 N. Cache
P.O. Box 1888
Jackson, WY 83001



Gregory Brooks, District Ranger
Big Piney Ranger District
10418 South US Highway 189
Big Piney, WY 83113

Ivan Geroy, District Ranger
Pinedale Ranger District
Bridger-Teton National Forest
29 East Fremont Lake Rd.
P.O. Box 220
Pinedale, WY 82941

Re: Upper Green Monitoring Report VIA email

Dear Chad, Greg, and Ivan:

As we noted in our letters leading up to the permit to use utilization cages and do a study on the Fisherman Creek and Upper Green allotments in 2022, we have prepared the attached report in accordance with our commitment. We outlined this commitment in our January 3 and March 17, 2022 letters to the previous Forest Supervisor, Patricia O'Connor, District Rangers Gregory Brooks and Ivan Geroy. The study was designed to inform BTNF monitoring and grazing management. The letters are included in Exhibit 6 of the report.

Prior to livestock entry into the pastures, we placed utilization cages for later measurement and comparison of the quantitative Paired Plot method to height-weight or stubble height estimates. Following livestock leaving the pastures, the plots were clipped to determine the amount of herbaceous vegetation in the ungrazed caged plot compared to the two grazed plots. Green line stubble heights as well as stubble heights along transects in the riparian AIZ between the caged and grazed plots were measured. Comparing the outcomes of these different approaches is intended as a way of validating the current monitoring as carried out by the BTNF, SCCD and Permittees.

Our results demonstrate that the Upper Green and Fisherman Creek allotments are overstocked based on our measures of average upland and riparian utilization using Paired Plots at 73.1 percent and 75.5 percent respectively. These far exceed the 50 percent utilization

or allowable use standard required by the BTNF. They do not meet herbaceous retention needs for wildlife and are nearly triple what range science studies recommend. We note that the stocking rate as represented in the 2022 Annual Operating Instructions for the Upper Green allotments was approximately two-thirds of permitted numbers.

Herbaceous and grass production was lower than potential at all sites, with most in Poor Condition, producing less than 25% of potential. The dominance by increaser species and loss of sensitive native bunchgrasses in uplands is consistent with the characterization of degraded systems in the Ecological Site Descriptions that NRCS uses to characterize plant communities. The loss of production is due to improper range management, overstocking, and inaccurate monitoring. This also affects wildlife such as elk and other big game, as well as grizzly bears that also rely on herbaceous vegetation and prey species that also rely on plants. In the vacant Elk Ridge allotments, after five years with no livestock, production remains low at less than 20% of potential and most sites remain visibly degraded.

Measurement of stubble heights on the key species, Idaho fescue, underestimates utilization when the herbaceous community is quantitatively assessed by the Paired Plot method. The SCCD and Forest Service measurements have underestimated utilization by a large amount. For example, in the 2020 SCCD Cooperative Monitoring Report average utilization was 9 percent using the key species, Idaho fescue. Compare this to the >70 percent results we find using the Paired Plot method. The residual heights do not meet the needs for sage grouse nesting or brood-rearing areas. Upland monitoring locations used by SCCD do not appear to meet Forest Service guidelines to monitor those areas grazed first or sensitive areas for wildlife.

Green line stubble heights were greater than those found on transects within the adjacent riparian area or AIZ that is important to migrant birds, amphibians, small mammals, and sage grouse. Some locations failed to meet the green line stubble height standard while most adjacent riparian AIZ transects would not meet the standard if it were applied to them. SCCD green line monitoring locations are in areas with protection by willows and result in no sites exceeding standards, while adjacent unprotected riparian and meadow areas are degraded.

Capacity calculations reveal a basic problem with SCCD monitoring. At the 9 percent utilization found in 2020, the 74,263 capable acres would need to produce over 5,000 lbs/acre of forage to support the 5,800 cow/calf pairs currently grazing. This ranges from 1.5 to 4.4 times what the ESDs for uplands estimate as potential production. Then, when the current Fair/Poor condition found in the allotments is considered, they are producing less than half of potential, most producing less than 25 percent of potential. Our capacity determination using the recommended range science results in 1,811 cow/calf pairs (31% of current rate) should be allowed to graze.

What needs to happen: What is needed at this point is to revamp the current monitoring protocol and also determine current forage capacity and stocking rates along with providing

rest and later turn in. This can be accomplished in a true joint monitoring and management effort involving the Forest Service, SCCD, Permittees, WWP and Y2U that will:

1. Select key areas in upland and riparian areas that meet the advice in the Forest Service guidance and research we have cited. It will include areas grazed first, that is, riparian areas lacking significant willow protection and upland areas that are in valleys, on slopes less than 7% and no more than 366 meters from the nearest water source. These would then be compared to the nearest SCCD monitoring sites.
2. Place cages in these areas, at current SCCD sites, and establish paired plots.
3. Measure the key species, Idaho fescue, along upland transects. Measure sedges along transects in riparian meadows (AIZ). Measure green line stubble heights at each riparian location. Include trampling in the measures.
4. Compare the results from the different methods and locations.
5. Determine the stocking rate on capable areas using the Paired Plot production data and visiting pastures with turn-in after July and clip the vegetation. Inspection of the 2022 AOI indicates six pastures are available if the schedule remains the same.
6. Initiate this in the summer of 2023.

We look forward to engaging in a true monitoring and management protocol with you this summer. Please respond with your suggestion as to how we can implement this program in time to prepare for the summer of 2023. I advise we have a phone discussion by zoom between the four of us early next week and prior to our release of the report or your sharing it with staff.

Sincerely,



John Carter, Ecologist
Yellowstone to Uintas Connection
PO Box 464
Bondurant, Wy 82922



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Western Watersheds Project
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Surveys of Upper Green, Fisherman Creek, and Elk Ridge Allotment Complexes



Western Watersheds Project and Yellowstone to Uintas Connection

Prepared By:

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April 13, 2023

Introduction and Summary

This report summarizes visits and data collection on the Upper Green and Elk Ridge Allotment Complexes and the adjacent Fisherman Creek Allotment during 2021 and 2022. The Upper Green and Fisherman Creek allotments have been continuously grazed while the Elk Ridge Complex was vacated from livestock grazing at the end of the 2016 season. Herein we document conditions at photo points and data collection including forage production and utilization. Chronologically, these include:

- Elk Ridge Photo Points – July 7, 2021
- Upper Green Photo Points – July 12, 2021
- Elk Ridge Production Plots – September 14, 2021
- Upper Green and Fisherman Creek Forage (Herbaceous) Production and Utilization Measures – Following cattle exit, summer, 2022.

Elk Ridge Photo Points – July 7, 2021

The photo points, maps and observations are included in Exhibit 1. These were taken along our travel route through the Lime Creek, Elk Ridge, and Tosi Creek allotments. Points were selected as topography and vegetation types varied along the route. They are indicative of the generally degraded and early seral conditions found. Observations representing five years rest from livestock grazing included:

- Low aspen recruitment and sparse understory.
- Significant bare soil with erosion paths and soil pedestaling.
- Idaho fescue in low vigor and short stature, although some litter generation by seed stalks was found. Idaho fescue is an increaser species, i.e. tolerant of grazing, according to the Ecological Site Descriptions (ESDs) discussed later in this report.
- Herbaceous vegetative cover was sparse and of low productivity.
- Upland cover for migrant birds, small mammals and sage grouse was low stature and sparse.
- Forbs were dominated by species of low desirability to cattle.
- Slopes were subject to accelerated erosion.
- North facing slopes had better cover and production than other areas.
- Bluebunch wheatgrass was nearly absent with a few specimens of low vigor, although the ESDs indicate it should be a dominant bunchgrass. It is a species sensitive to livestock grazing pressure and decreases with over grazing and lack of rest.

It is important to keep in mind that these conditions represent five years of rest from livestock grazing. That has been inadequate to restore the plant community. Upland vegetation and cover even in this rested state have not recovered to the point where there is adequate herbaceous cover for small mammals, migrant birds, or sage grouse.

Upper Green Photo Points – July 12, 2021

The photo points, maps and observations are included in Exhibit 2. These were taken in conjunction with a site/monitoring visit with the Bridger Teton NF (BTNF), Sublette County Conservation District (SCCD), and Permittees. The locations were in the Upper Teepee Pasture, Mosquito SE Pasture, and one location in the Fisherman Creek allotment, Pasture 2 at the end of the grazing season. Observations included:

- Upper Green Teepee Creek location (SCCD site TP-23) was located near a ridge top upslope from water. The herbaceous community was dominated by forbs low in desirability as forage.
- Teepee Creek suffered from scoured banks, bank alteration, and was becoming incised with a head cut observed where the creek emerged from a willow stand.
- The uplands on the lower slopes between Teepee Creek and the SCCD site had significant bare soil while the ridgetop location had nearly 100% ground cover.
- Mosquito Pastures appeared low in production and where grazed, little residual cover remained.
- Wagon Creek in the Mosquito SE Pasture was recovering within the exclosure, while the area outside the exclosure remained degraded with bare and sluffing banks, and short residual vegetation. The stream was heavily impacted by sediment.
- An aspen stand in the Mosquito SE Pasture had a barren understory, low recruitment with heavy browsing of shoots.
- The post grazing visit to Pasture 2 of Fisherman Creek revealed that the riparian stubble height was reduced to about 1.5 inches.

The observations of these areas show the effects of overstocking and lack of rest. Standards and monitoring have failed to provide residual cover and vegetation for wildlife, stream bank protection, and aspen recruitment.

Elk Ridge Production Plots – September 14, 2021

On September 14, 2021, 8 plots were established in the mapped ecological sites in the Elk Ridge Allotments. The ArcMap Random Point Generator function was used to generate points within the Elk Ridge allotments. Monitoring points were selected which occurred within areas that had been mapped for soil ecological sites. Eight locations were chosen that occurred within the Shallow Loamy Foothills, Clayey Overflow, and Loamy High Mountain ESDs. At the designated point, a 100-foot tape was strung in one of the cardinal directions that kept the transect within the vegetation type present. Four 9.6 sq. ft. plots were clipped for grasses and forbs at 25-foot intervals along the tape. These samples were air dried and weighed to obtain production data. Maximum and average heights of Idaho fescue (key species) were collected on ten plants at each site. The average weight of the four plots at each site was determined and compared to the production for the ecological site during an average year. Range condition

was determined as either poor, fair, good, or excellent based on the percent of current herbaceous production compared to potential.¹ The site map, data tables, and photos are provided in Exhibit 3. A summary of production and range conditions found is provided in Table 1.

Table 1. Summary of Forage Production and Range Condition – Elk Ridge

Site No	Ecological Site	Site Avg Grass and Forb Production lb/acre	Potential Grass and Forb Production (From ESD) Average Year lb/acre	Current Production as a Percent of Expected/Range Condition
14	Shallow loamy foothills	121	1050	12/Poor
57	Clayey overflow	174	2125	8/Poor
61	Clayey overflow	366	2125	17/Poor
67	Loamy High Mountain	90	2250	4/Poor
72	Loamy High Mountain	166	2250	7/Poor
79	Loamy High Mountain	111	2250	5/Poor
98	Loamy High Mountain	218	2250	10/Poor
145	Loamy High Mountain	108	2250	5/Poor

- Average production of grasses and forbs ranged from 90 to 366 lb/acre air dry.
- All sites were below 20% of expected production.
- Six of 8 sites were below the Forest Service capability criterion of 200 lb/acre forage production.
- All sites were in poor condition.
- Idaho fescue maximum leaf length ranged from 5 – 12” with an average of 6.3”.
- Forbs were of generally low desirability as forage for cattle and were a small percent of total herbaceous vegetation.

Fisherman Creek Range Ready Survey - 2021

On June 21, 2021 an inspection of upland locations in the Fisherman Creek allotment Pasture 1 was conducted. (Exhibit 4). Three locations were surveyed to ascertain the readiness of the key species, Idaho fescue. A few flowering heads were beginning to emerge from the boot stage at two of the locations with none at a third location. The plants were generally of low stature and low vigor. A review of the growth stages and timing from the range literature indicated that range readiness would occur most likely in July. These locations were at elevations lower than those in the Upper Green allotments, and thereby would be ready earlier. Grazing should not

¹ Holechek, J.L., Pieper, R.D., and Herbel, C.H. 2004. Range Management: Principles and Practices. Fifth Edition. Prentice Hall, Upper Saddle River, NJ. Chapter 7, p107.

begin in the Upper Green or Fisherman Creek until seeds are ripe which is late July or early August.

Upper Green and Fisherman Creek Monitoring - 2022

This work was undertaken following a long process of requesting permission to place utilization cages in the Upper Green and Fisherman Creek allotments to address public concerns over conditions within the allotments. These concerns included:

- Whether the current monitoring program is capturing the actual conditions on the allotments and the need for a quality control or validation effort,
- Whether the key species, Idaho fescue is under-representing actual utilization,
- Whether green line stubble heights represent utilization in the Aquatic Influence Zone,
- Suitability of the monitoring locations used by SCCD and the BTNF, and
- Use of Wyethia and other forbs as key species.²

These and other concerns were described in a series of letters to the Bridger – Teton NF Supervisor, Pinedale, and Big Piney District Rangers. All the concerns other than suitability of Wyethia as a key species were addressed as laid out in the correspondence and subsequent permit.

Methods: Utilization cages (32" x 40" footprint) were placed at 13 locations (6 riparian and 7 upland) within the Upper Green and Fisherman Creek allotments. Cages were placed prior to cattle entry into the pasture and clipped following cattle exit from the pastures. Methods used were the Paired Plot and Stubble Height/Height-Weight from the Interagency Technical Reference.³ For Paired Plots, two grazed plots were located 100' from the cage within the same vegetation type. For the Height-Weight method, in upland areas, Idaho fescue average heights (grazed and ungrazed) were recorded along the transects. At a subset of the sites, the amount of Idaho fescue trampled was recorded to estimate the effect of trampling on loss of plant availability to grazers (Holechek et al 2004). In riparian areas, green line stubble height on sedges was recorded in addition to stubble heights along the transects. We also measured ungrazed stubble heights either in cages, protected by willows, or in one instance where grazing pressure was low enough, we measured ungrazed sedges along the transects. Samples from the Paired Plots were air dried and weighed with utilization calculated based on the difference. For upland and riparian locations where stubble heights were measured, the data were transformed to utilization percent using height weight curves⁴ or a utilization gage. Site location coordinates are provided in Table 2. A map of the sample sites is provided in Figure 1.

² Wyethia is not addressed in this report as it is applicable to the Wyoming Range but was part of our discussion on selection of key species.

³ USDA and DOI. 1999. Utilization Studies and Residual Measurements. Interagency Technical Reference 1734-3.

https://www.blm.gov/sites/default/files/documents/files/Library_BLMTechnicalReference1734-03.pdf

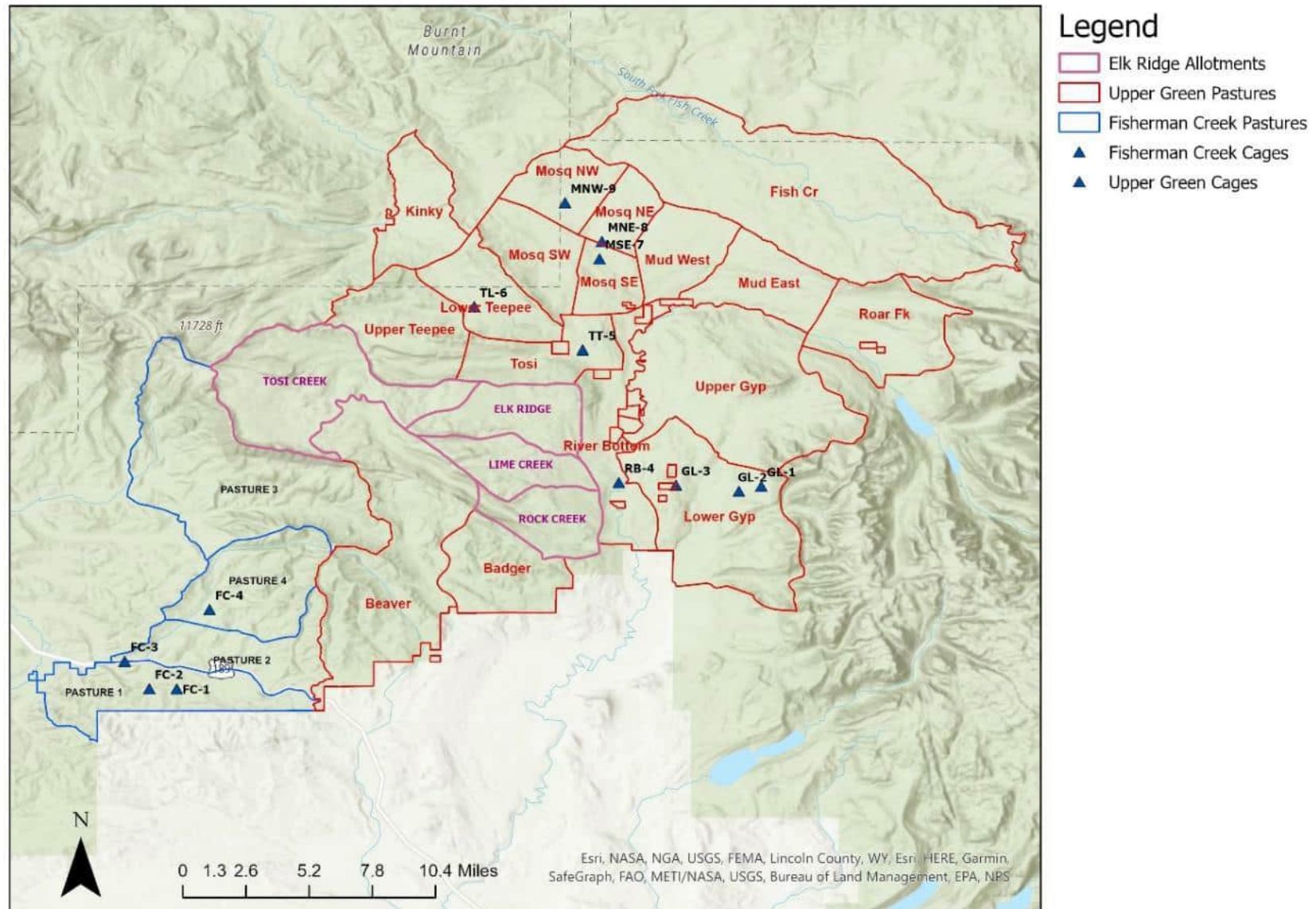
⁴ Kinney, J.W. and Clary, W.P. 1994. A Photographic Utilization Guide for Key Riparian Graminoids. USDA Forest Service, Intermountain Research Station. INT-GTR-308.

Field data and photographs for sample locations are included in Exhibit 5. Correspondence with the Forest Supervisor and District Rangers regarding the need for monitoring validation are provided in Exhibit 6.

Table 2. Sample Locations and Descriptions

Site No	Pasture	Latitude	Longitude
Riparian Sites			
FC-1	Fisherman Creek Pasture 1	43.139259	-110.285318
FC-2	Fisherman Creek Pasture 1	43.139362	-110.301638
FC-3	Fisherman Creek Pasture 2	43.155714	-110.316313
GL-2	Lower Gypsum Pasture	43.256666	-109.950904
MNE-8	Mosquito NE Pasture	43.40498	-110.032404
MNW-9	Mosquito NW Pasture	43.427988	-110.054333
Upland Sites			
FC-4	Fisherman Creek Pasture 4	43.18639	-110.265797
GL-1	Lower Gypsum Pasture	43.259586	-109.937601
GL-3	Lower Gypsum Pasture	43.260259	-109.988381
MSE-7	Mosquito SE Pasture	43.394659	-110.033826
RB-4	River Bottom Pasture	43.261809	-110.022374
TL-6	Lower Teepee Pasture	43.36621	-110.10833
TT-5	Tosi Pasture	43.340669	-110.043837

Figure 1
Upper Green and Fisherman Creek Allotment
Plot Locations



Upland Height-Weight Utilization Results: Height-Weight utilization gage results for upland locations are provided in Table 3. The ungrazed average height of Idaho fescue ranged from 3.4 to 5.6 inches with an average of 4.6 inches. The average Idaho fescue height on the grazed transects ranged from 1.9 to 3.3 inches with an overall average of 2.5 inches. These averages for the grazed transects included ungrazed plants present on the transect. When the effect of trampling of individual plants was considered, the height of Idaho fescue along the grazed transects ranged from 1.1 to 3.1 inches with an average height of 1.8 inches. Using these numbers and a utilization gage, utilization ranged from 5 to 38 percent with an average of 16.1 percent. When trampling flattened plants to the soil surface and resulted in the plant being unavailable for grazing (stubble height = 0), utilization gage readings ranged from 8 to 63 percent with an average of 35.1 percent.

Riparian Stubble Height Results: Stubble heights and utilization results for the riparian sites are provided in Table 4. The ungrazed stubble height ranged from 5 inches to 7.6 inches with an average of 6.8 inches. The AIZ transect stubble height ranged from 1.6 inches to 4.7 inches with an average of 3.3 inches. The green line stubble height averaged 4.8 inches. The green line average height was greater than the transect (AIZ) average height. Utilization on the AIZ transects ranged from 18 to 48 percent with an average of 31.0 percent. Utilization along the green line ranged from 1 to 45 percent with an average of 17.7 percent compared to 31.0 percent on the transects. Trampling was only considered in one location (GL-2) resulting in a reduction of the grazed stubble height from 4.2 inches to 3.2 inches. For the two transects that included the effects of trampling, average utilization was higher at 37 percent as compared to the transects at that location which had 18 and 28 percent utilization when trampling effects were not incorporated.

Paired Plot Utilization Results: Production and utilization results from the Paired Plots for both upland and riparian areas are provided in Table 5. Utilization in riparian areas ranged from 55.4 percent to 92.6 percent with an average of 75.5 percent. In upland areas, utilization on the total herbaceous vegetation ranged from 49.3 percent to 90.8 percent and averaged 73.1 percent. Utilization on upland grasses ranged from 54.5 percent to 91.0 percent and averaged 70.9 percent. Utilization on grasses closely tracked utilization for all species combined. Overall average riparian utilization was 75.5 percent compared to the average from the height-weight method for the AIZ transects of 31.0 percent, or green line of 17.7 percent. In uplands, paired plot overall utilization was 73.1 percent with grass utilization of 70.9 percent compared to the height-weight results of 16.1 percent on Idaho fescue without considering trampling, or 35.1 percent if trampling is accounted for.

Production Comparison to Ecological Site Descriptions: NRCS Ecological Sites were mapped from the NRCS Wyoming Soil Survey.⁵ Climate data indicated that 2022 was a normal

⁵ NRCS. 2020. SSURGO database. <https://nrcs.app.box.com/v/soils>

precipitation year.⁶ Figure 2 is a map showing the ecological sites for the Upper Green allotments. No ecological sites were found for the locations in the Fisherman Creek allotment. Table 6 provides the production for a normal year at the historical climax plant community compared to the production found in the caged plots. Five of six sites with ESDs were in Poor or Fair Condition based on expected production. One site was in Excellent Condition based on production expected.

Sites TT-5 and TL-6 were in the Loamy Foothills and Mountains West Ecological Site. These are in Poor to Fair condition with Idaho fescue, an increaser, being the dominant grass. According to the ESD, the absence of cool-season grasses such as bluebunch wheatgrass, a decreaser, indicates a deteriorated state: *“As this site deteriorates because of a combination of frequent and severe grazing, species such as mountain big sagebrush, buckwheat, and yarrow will increase. Less palatable grasses such as Letterman needlegrass, Idaho fescue, rhizomatous wheatgrass, and Sandberg bluegrass also increase. Kentucky bluegrass often invades. Cool-season grasses such as bluebunch wheatgrass, blue wildrye, mountain brome, Columbia needlegrass, and spike fescue will decrease in frequency and production.”*

Sites MNW-9, MNW-8, and MNE-7 were mapped as Subirrigated Foothills and Mountains Southeast Ecological Site. The ESD describes it as: *“this site deteriorates from frequent and severe grazing, grasses such as basin wildrye and tufted hairgrass will decrease in frequency and production. Western wheatgrass tends to increase. Under continued frequent and severe defoliation, the plant community will eventually become sod-bound. Over the long-term this sod will ultimately become broken with areas of bare ground developing and species such as Kentucky bluegrass and annuals invading.”* MSE-7 occurred in a sagebrush site, so this ESD may not be applicable. Sites MNE-8 and MNW-9 appear to fit the ESD and are in a degraded state. See Figure 3 of site MNE-8. Here you can see a head cut and channel migrating through this sub-irrigated site as the ESD predicts. If not allowed to heal, this can continue downcutting and dewatering the site leading to a change to more xeric conditions and plant community.

Sites RB-4 was mapped as a Coarse Upland Foothills and Mountains West Ecological Site. The ESD describes it as: *“As this site deteriorates because of a combination of frequent and severe grazing, species such as Idaho fescue, mountain big sagebrush and snowberry will increase. Cheatgrass often invades with ground disturbance and fire, especially on south and west facing slopes. Cool-season grasses such as bluebunch wheatgrass, Columbia needlegrass, spike fescue, and woody plants such as bitterbrush will decrease in frequency and production.”* The site lacked evidence of species such as bluebunch wheatgrass or bitterbrush and is in a degraded state.

⁶ NOAA. 2022. Coop Water Year 2022 for Western and Central Wyoming.
<https://www.weather.gov/riw/coopwateryear2022>

The Annual Operating Instructions for the Fisherman Creek allotment were reviewed for stubble height and utilization criteria.⁷ Utilization limits are 50% on riparian key species and 40% on upland key species. There were no green line stubble height criteria. The Annual Operating Instructions for the Upper Green allotment specified utilization will not exceed 50% in upland and riparian areas and green line stubble heights of 4 and 6 inches shall be maintained as identified in the 2019 ROD.⁸ In this case, only South Gypsum Creek in the Lower Gypsum Pasture was to have 6" green line stubble height with all other streams to meet 4" green line stubble height.⁹

Based on the upland Idaho fescue stubble height measurements along the transects, none violated any utilization standard, reflecting what the SCCD monitoring finds. When trampling was considered, FC-4 violated the Fisherman Creek upland utilization standard of 40%, however the presence of smooth brome in the cage biased this result. GL-1 violated the upland standard for the Upper Green allotments. The riparian green line stubble height of 4 inches was not met on MNE-8 while the green line standard of 6 inches was not met on GL-2.

The Paired Plot utilization data showed that the upland utilization standard of 40% and the riparian utilization standard of 50% for riparian areas in the Fisherman Creek allotment were not met at all sites. The Upper Green allotments utilization standards of 50% for both riparian and upland areas was not met at any site other than at site TT-5, where it was 49.3% on total herbaceous vegetation, but violated the standard for grass utilization. All other upland and riparian sites in the Upper Green allotments exceeded the standard based on the Paired Plots. These large differences amplify the lack of ability of key species stubble height monitoring to reflect the actual amount of material removed. It is an indicator that underestimates grazing pressure and utilization determinations for the overall plant communities.

⁷ Bridger Teton National Forest. Annual Operating Instructions 2022 Fisherman Creek Allotment #2012. Big Piney Ranger District.

https://www.fs.usda.gov/detail/btnf/landmanagement/resourcemanagement/?cid=fsbdev3_063635

⁸ Bridger Teton National Forest. Annual Operating Instructions 2022. Pinedale Ranger District. Same link.

⁹ Bridger Teton National Forest. 2019. Record of Decision Upper Green River Area Rangeland Project. Pinedale Ranger District. <https://www.fs.usda.gov/project/?project=3049>

Figure 2
Upper Green Plot Locations and Ecological Sites

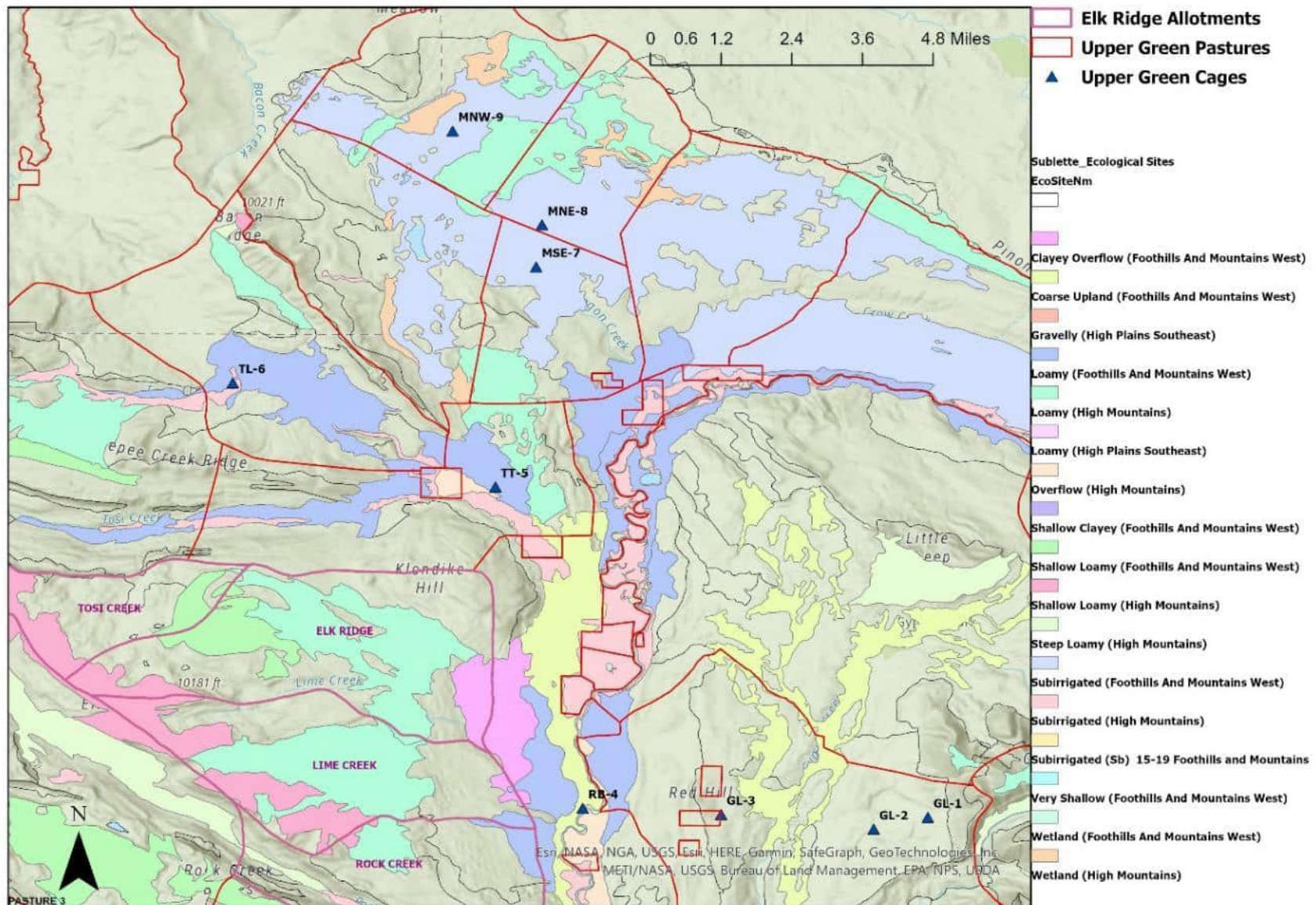




Figure 3. Mosquito Lakes NE Site MNE-8, September 8, 2022. Photos of hummocks, hoof shear, and head cut occurring in this sub-irrigated meadow.

Table 3. Upland Stubble Height and Utilization for Idaho fescue

Upland Site No	Transect	Average Ungrazed Height inches	Transect Average Height inches	Utilization %	Transect Average with Trampling inches	Utilization with Trampling %
FC - 4	East	3.8	2.5	7	1.1	57
FC - 4	West	4.7	2.5	15	1.1	63
MSE-7	North	4.7	2.5	15	1.7	45
MSE-7	South	4.9	2.9	9	2.0	36
TT-5	North	3.4	2.6	5	2.1	8
TT-5	South	4.4	2.4	15	2.2	17
TL-6	North	4.4	2.2	17	-	
TL-6	South	4.7	2.4	15	-	
RB-4	North	5.6	2.4	14	2.1	21
RB-4	South	4.8	1.9	38	1.6	49
GL-1	East	4.1	1.9	25	1.3	51
GL-1	West	5.0	2.2	35	1.4	55
GL-3	North	4.8	3.3	7	3.1	8
GL-3	South	5.4	3.0	8	2.4	11
Averages		4.6	2.5	16.1	1.8	35.1

Blue highlight indicates the site exceeds the standard.

Table 4. Riparian Stubble Height and Utilization on Sedges

Riparian Site No	Transect	Average Ungrazed Height inches	Transect Average Height inches	Utilization %	Transect Average Height with Trampling inches	Transect Utilization with Trampling %
FC-1	Down	7.0	3.3	31		
FC-1	Up	7.0	3.8	25		
FC-1	Green line	7.0	6.9	1		
FC-2	Down	7.3	4.2	22		
FC-2	Up	7.3	3.2	37		
FC-2	Green line	7.3	5.7	8		
FC-3	Down	5	1.6	48		
FC-3	Up	5	2.2	35		
FC-3	Green line	5	3.1	19		
MNE-8	Down	7.3	3.1	38		
MNE-8	Up	7.3	3.2	36		
MNE-8	Green line	7.3	2.6	45		
MNW-9	Down	6.8	3.8	24		
MNW-9	Up	6.8	3.3	30		
MNW-9	Green line	6.8	6.5	3		
GL-2	Down	7.5	4.7	18	3.4	35
GL-2	Up	7.0	3.6	28	2.9	39
GL-2	Green line	7.6	3.7	30		
Average Ungrazed		6.8				
Transect Averages			3.3	31.0	3.2	37.0
Green line Average			4.8	17.7		

Blue highlight indicates the site exceeds the standard. Site FC-3 contained mixed grasses, rushes, and sedges, so utilization was estimated on the combination using the height-weight curves.

Table 5. Production and Utilization from Paired Plots

Site No	Cage Total Herbaceous ¹⁰ Production air dry Lb/acre	Cage Grass Production lb/acre	Grazed Plot Herbaceous Residual lb/acre	Grazed Plot Grass Residual lb/acre	Utilization on Herbaceous Residual %	Utilization Grasses Only %
Riparian						
FC - 1	2017.7		899.9		55.4	
FC - 2	2809.7		570.8		79.7	
FC - 3	2748.2		203.9		92.6	
GL - 2	878.3		378.7		56.9	
MNE - 8	1164.2		183.4		84.3	
MNW - 9	2842.1		460.7		83.8	
Averages	2076.7		449.6		75.5	
Upland						
FC - 4	1926.0	1864.5	220.1	168.3	88.6	91.0
GL - 1	752.1	419.7	274.1	112.2	63.6	73.3
GL - 3	843.8	785.5	339.9	322.6	59.7	58.9
MSE - 7	881.5	591.3	80.9	60.4	90.8	89.8
RB - 4	454.3	375.5	49.6	39.9	89.1	89.4
TL - 6	746.7	154.3	101.4	70.1	86.4	54.5
TT - 5	304.3	262.2	154.3	105.7	49.3	59.7
Averages	663.8	431.4	166.7	118.5	73.1	70.9

Blue highlight indicates the site exceeds the standard.

¹⁰ Herbaceous applies to all grasslike plants and forbs in the plots.

Table 6. Production in Caged Plots Compared to NRCS Ecological Site Production

Site No.	ESD	Normal Year Herbaceous Production	Normal Year Grass Production	Site Herbaceous Production (lb/acre) and Percent of Potential	Site Grass Production (lb/acre) and Percent of Potential	Range Condition Herbaceous/ Grasses
TT-5	Loamy Foothills and Mountains West R043BY222WY	1800	1500	304.3/16.9%	262.2/17.5%	Poor/Poor
TL-6	“	1800	1500	746.7/41.4%	154.3/10.2%	Fair/Poor
MNW-9	Subirrigated (Foothills and Mountains Southeast) R049XA174WY	3600	3200	2842.1/78.9%		Excellent
MNE-8	“	3600	3200	1164.2/32.3%		Fair
MSE-7	“	3600	3200	881.5/24.5%	591.3/18.4%	Poor/Poor
RB-4	Coarse Upland (Foothills And Mountains West) R043BY208WY	1200	960	454.3/24.4%	375.5/39.1%	Poor/Fair

Observations on Monitoring by the Sublette County Conservation District: We reviewed the 2019¹¹ and 2020¹² Cooperative Monitoring Reports to understand the monitoring protocols undertaken by the SCCD, BTNF, and Permittees (SCCD from here) and the results obtained. No violations of green line stubble heights or upland utilization standards were found.

When we averaged the non-wetland sedge heights from the 2020 SCCD monitoring report, the average ungrazed height was 11.8 inches and the average grazed height was 9.2 inches. These are greater than the average 6.8 inch ungrazed height and the 4.8 green line height we found. (Table 4). There were no riparian utilization calculations in the 2020 SCCD report, but our paired plot determination for riparian utilization averaged 75.5%. We compared the 2020 SCCD Idaho fescue utilization to our paired plot measures based on clipping and weighing grazed and ungrazed (caged) plots. The SCCD average was 9% across all upland sites. This was on the order of the 16.1% we found using the same method. However, when we incorporated the effect of trampling, this increased from 16.1% to 35.1%. Paired plot results averaged 73.1% utilization compared to the 2020 SCCD average of 9%.

These differences may be explained by a number of factors. In the uplands, Idaho fescue is used as a key species and its height-weight characteristics are used to determine utilization. As noted in the ESD for uplands in a degraded state, Idaho fescue increases, indicating grazing tolerance. It also has fine leaves and a low growth habit, making it less desirable/available, especially when compared to larger bunchgrasses such as bluebunch wheatgrass which should be present on these upland sites. In order to reach 50% utilization on a utilization gage, a 6" Idaho fescue plant would need to be grazed to 5/8".¹³ Grazed Idaho fescue plant heights averaged 2.5 inches on our transects and if trampling effects were included, the average was 1.8 inches. The 2020 SCCD grazed plant average was 2.6 inches which is close to our average of 2.5 without considering trampling effects. Another factor affecting utilization results can relate to site location. Are sites selected at significant distances from water? On ridges?

During the 2021 monitoring effort with the SCCD, we visited Site TP-23. We noted that the site being monitored was near a ridgetop with ground cover near 100%. (Figure 5). When we walked back down the hill, as we got closer to the stream, ground cover was reduced. (Figure 6). District Ranger Hoelscher agreed this was the case as he walked along with us. At this point, the stream and riparian area were showing bare soil, hoof shear, bank sluffing, and the stream was incised and impacted by sediment in the reach lacking willows.

¹¹ Sublette County Conservation District. Upper Green River 2019 Cooperative Monitoring Report. Prepared for the Upper Green River Cattlemen's Association.

¹² Sublette County Conservation District. Upper Green River 2020 Cooperative Monitoring Report. Prepared for the Upper Green River Cattlemen's Association.

¹³ Ratner, J. 2021. Power Point Presentation.

<https://app.box.com/file/813925693097?s=ootb4tf9eblexz16f5a18oz57j1w7zw>



Figure 5. SCCD Site TP-23 July 12, 2021. Upper photo showing position high on ridge above Teepee Creek. Lower photo of ground cover at near 100%.



Figure 6. SCCD Site TP-23 July 12, 2021. Upper left photo showing bare soil in riparian to upland transition (AIZ). Lower left photo of Teepee Creek showing hoof shear, scouring, and sluffing of banks. Upper right is a photo of a head cut at the point where Teepee Creek emerges from a willow carr, where willows stabilize the banks.

Forest Service research decades ago determined the order in which cattle grazed particular areas; *“Ravine bottoms were usually grazed first. Next in order were openings in timber stands on gentle slopes, areas near water, areas along fences and ridgetops, salt grounds, accessible openings in timber stands on steeper slopes, areas under large trees, and finally areas covered by tree thickets.”*¹⁴ In another study, *“cattle dispersion was constrained by the spatial distribution of water and slope. Across 3 seasons, 77% of observed use was within 366 meters of water. Approximately 65% of the land area was beyond 723 meters from water and sustained only 12% of observed use. Cattle concentrated use (79%) on slopes less than 7%. Consequently 35% of the area, on or surrounded by slopes > 10%, received only 7% of observed use. Loamy, grazable woodland and wetland sub-irrigated range sites were most preferred and accounted for over 65% of observed use while occupying less than 35% of the land area”*¹⁵

In a letter to Forest Supervisor Patricia O'Connor regarding monitoring, we provided some preliminary analysis showing the distance of SCCD upland monitoring locations from water in the Mud Lakes pastures. (Exhibit 6). Distances were much greater than the 366 meters derived from the Pinchak (1991) paper which was based on research in Wyoming. The Forest Service Rangeland Analysis and Management Training Guide describes selection of key areas as: *“Key areas are usually five acres or more and are selected as sites where prescribed use will occur first. Also included are sites where use must be closely monitored because of management plan requirements, such as riparian areas or areas where threatened, endangered, or sensitive species may occur.”*¹⁶

The Forest Service Handbook defines a Critical Area as *“A portion of rangeland which has a critical issue related to it, such as a threatened or endangered or sensitive species, a high use recreation area, a key wildlife habitat, or water quality limited reach. The area serves as a monitoring and evaluation site for the critical issue.”* (FSH 2209.21 Zero Code 05-Definitions).

The current monitoring locations do not meet these criteria due to the upland sites being located at great distance from water or being placed on ridges which avoids monitoring the valley bottoms or riparian areas (Aquatic Influence Zones) used first as the Training Guide describes. While the SCCD monitors green line stubble height on sedges, it does not monitor riparian areas or these AIZs which are located between the green line and uplands. These areas are critical to amphibians, migrant birds, and small mammals, some of which are sensitive species.

The SCCD and BTNF riparian monitoring locations were mapped using coordinates we obtained from the Cooperative Monitoring Reports for 2019 and 2020. Some of the points did

¹⁴ Hormay, op. cit.

¹⁵ Pinchak, W.E., Smith, M.A., Hart, R.H., and Waggoner, J.W. 1991. Beef cattle distribution patterns on foothill range. *Journal of Range Management*, 44(3):267-275.

¹⁶ USDA Forest Service. 1996. *Rangeland Analysis and Management Training Guide*. Rocky Mountain Region, Denver, Co.

not map in riparian areas for unknown reasons. But for those that did we found the majority to be in riparian areas with significant willow cover. This is problematic in that many of the forage plants are unavailable for livestock due to the dense shrub cover, so utilization estimates or stubble height measures can be misleading. In our measurements, we treated sedges beneath willow canopy as protected and their average heights were similar to those in our cages or the ungrazed sedges we found along one set of transects. Essentially, the SCCD riparian monitoring is occurring in areas least used by cattle and less sensitive to damage by livestock due to the dense willow cover. See photo of site SCCD site GYP-11 in Figure 7 showing Forest Service personnel measuring riparian stubble heights. Note there is no stream bank alteration in the portion seen in the photograph.

The Upper Green River 2020 Cooperative Monitoring Report lists the participants for each site monitored.¹⁷ The participants included BTNF, SCCD, and Permittees. No members of the public were involved. Our experience in 2021 was not a "cooperative" monitoring effort that involved the public. It was predetermined by the BTNF, SCCD and Permittees.

The Forest Service Handbook FSH 2209.10 Chapter 10 describes public involvement. It is supposed to:

- "Involve the permittee and interested publics in management of the range allotment." (Par. 11.3).
- "Obtain ID team, interested publics, and permittee assistance in securing the necessary inventory and monitoring information and establish criteria for determining allowable use levels." (Par. 12.2).
- "The interdisciplinary (ID) team, the permittee, and interested publics should assist in the rangeland inventory and analysis and in the preparation of environmental documents." (Par. 13).
- "Public participation should be a key element of the NFMA process as well as the NEPA process. Close consultation, cooperation, and coordination with grazing permittees is essential to help them understand the differences between existing and desired vegetation on their allotment and in identifying possible practices that will achieve desired future conditions for vegetation as well as the permittees livestock operation. Other interested parties should be involved as well to identify possible practices that will be responsive to potential concerns or issues they may express. Not only is public participation good business from the standpoint of identifying opportunities and possible practices to achieve desired conditions and reduce controversy later in the planning process, but it is a requirement of law.... Furthermore, in FLPMA's declaration of policy, Congress specifically requires the Secretary of Agriculture to consider the views of the general public, and to allow for adequate third-party participation exercising his discretionary authority. (43 USC (1701(a) (5)))." (Par. 15.7).

¹⁷ Sublette County Conservation District. 2020. Upper Green River 2020 Cooperative Monitoring Report. Prepared for Upper Green River Cattlemen's Association.

- "Benchmark areas should be selected and/or approved by the most experienced and qualified personnel available and agreed upon or coordinated with permittees and in some cases other interested agencies, individuals or groups." (1993 FSH 2209.21 Chapter 40 Par. 40.41).

Our experience with the 2021 Joint Monitoring was that the monitoring sites and methods were established without public participation. Only the SCCD, BTNF, and Permittees appear to have had any meaningful input to the process, site selection or monitoring methodology. The sites do not represent those most sensitive areas such as the riparian zones or uplands where grazing occurs first and do not fit the requirements of the Forest Service Rangeland Analysis and Management Training Guide or research referenced above. This monitoring program now requires revisiting in view of the conflicting results between SCCD and this current report.



Figure 7. Forest Service personnel monitoring stubble heights (or looking for a lost golf ball) at Gypsum Creek site GYP-11 in 2022. Note the dense willows and absence of streambank damage. Sites such as this appear protected from livestock impacts to a significant degree.

Discussion

Summary of Findings: We have summarized our observations and data from a number of field visits to the Elk Ridge Complex, Fisherman Creek, and Upper Green allotments. The damage is evident, and we have documented it with data and photographs. Meanwhile, the agencies and permittees have monitored these same areas and found no issues with overuse. The SCCD reports do not delve into analysis of their site selection process, or the ecological implications of their data collection. No observations are made of streambank damage, head cutting, sedimentation, or lack of cover in the riparian areas without willow canopy. See the example of Wagon Creek in Figure 8 showing severe bank alteration and sedimentation.

The Upper Green allotment complex contains streams inhabited by Yellowstone cutthroat trout and Colorado River cutthroat trout. These are BTNF Management Indicator Species. The Upper Green FEIS (FEIS)¹⁸ notes that invasions by brook trout are causing population declines. This increases the need to have protections for the streams so that banks are not altered, sediment loads are reduced, and habitat is fully functional so these native fish can have a better chance to compete and persist. Livestock grazing is clearly affecting the streams by increasing the sediment loads and inducing high mortality to fish eggs and larvae. Monitoring of spawning habitats for Colorado River cutthroat trout by Western Watersheds Project in 2004 included streams in the project area.¹⁹ Tepee Creek, Wagon Creek, Tosi Creek, Gypsum Creek, North Beaver Creek, Packer Creek, Rock Creek, and Miner Creek all were experiencing levels of substrate sediment fines that result in high mortality of egg to larvae and therefore, low survival to emergence.

We observed that in the Elk Ridge Complex, after five years of complete rest from livestock grazing, aspen recruitment is poor with sparse understory; uplands remain low in production and cover for small mammals, migrant birds, and amphibians; bare soil and accelerated erosion were present in uplands and on slopes; bluebunch wheatgrass, a dominant bunchgrass sensitive to defoliation was near absent. A site visit for joint monitoring with the SCCD, BTNF and Permittees to the Upper Green allotments in 2021 revealed that sampling was biased towards areas with less use by livestock, while sensitive stream and riparian areas were suffering hoof shear, bare soil, head cutting, and bank scour. In September 2021, we assessed production and condition within the Elk Ridge Allotment Complex. All sites were in poor condition based on herbaceous production as they were producing less than 20% of the Ecological Site potential. A range readiness visit to the Fisherman Creek allotment Pasture 1 on June 12, 2021 revealed Idaho fescue of low stature and low vigor with few flowering stalks emerging from the boot stage. Range readiness would not occur until July or early August. This indicates that livestock

¹⁸ USDA Forest Service. 2017. Upper Green River Area Rangeland Project Final Environmental Impact Statement. Bridger-Teton National Forest.

¹⁹WWP. 2004. McNeil Sediment Core Sampling of 18 Critical Colorado River Cutthroat Trout Spawning Streams. Wyoming Range, Upper Green River and Wind River Range – 2004.

are turning in nearly a month earlier than they should. The Upper Green allotments are at higher elevations and would not be ready until even later in the summer.

Our data collection and analysis of the Upper Green and Fisherman Creek allotments during the 2022 grazing season showed that required or allowable utilization limits of 50 percent (40 percent for Fisherman Creek uplands) are not met with average upland and riparian utilization using Paired Plots at 73.1 percent and 75.5 percent respectively. These rates far exceeded the limits set in the AOIs. We found that green line stubble height averaged 4.8 inches as opposed to 3.3 inches on the transects in riparian meadows away from the green line. Green line utilization of 17.7 percent was less than that on the transects, which averaged 26.6 percent. When trampling effects were considered, utilization was higher.

In the uplands, height weight determinations on Idaho fescue showed an average ungrazed height of 4.6 inches and average transect height of 2.5 inches. The effect of trampling (pressing the plants flat to the ground) resulted in an average height of 1.8 inches. Corresponding utilization rates were 16.1 percent and 35.1 percent. Measures of stubble height failed to accurately depict overall utilization as measured by the Paired Plots. The 2020 SCCD report found only 9% utilization at their upland sites in 2020 using their height weight measures.

Research in Utah evaluated BLM key species height weight monitoring as compared to Paired Plots and found similar results in which the agency found light use while Paired Plots method documented heavy use in both riparian and upland areas.²⁰ BLM, in order to address the impaired riparian conditions, implemented a four-pasture deferred rotation system and added upland water troughs. A long-term study established in the allotment that was implemented prior to and after the management change showed that the deferred rotation grazing system and upland water did not reduce livestock utilization or bank alteration in the riparian areas, while upland use remained high and increased following the installation of the water troughs.²¹

These grazing system changes, if implemented here would not compensate for the overstocking and overuse occurring in the Upper Green and Fisherman Creek allotments. It is important to also note that our measurements occurred while current stocking levels reflected in the 2022 Upper Green Annual Operating Instructions are approximately 2/3 of permitted use.

²⁰ Catlin, J., Carter, J., Jones, A. 2011. Range management in the face of climate change. In Monaco, T.A. et al. comps. 2011. Proceedings – Threats to Shrubland Ecosystem Integrity; 2010 May 18-20; Logan, UT. Natural Resources and Environmental Issues, Volume XVII. S.J. and Jessie E. Quinney Natural Resources Research Library, Logan Utah, USA. <https://app.box.com/s/1a47e1d19816fd843968>

²¹ Carter, J., Catlin, J., Hurwitz, N., Jones, A., and Ratner, J. 2017. Upland Water and Deferred Rotation Effects on Cattle Use in Riparian and Upland Areas. *Rangelands* 39:112-118. <https://app.box.com/s/k5a1uu81qmnafarmhlqdku54ib5ft808>



Figure 8. Upper left photo of Wagon Creek in grazed portion of the creek. Hoof shear, bank sloughing, riparian vegetation cropped close to the ground, and streambed filled with sediment characterize this reach. The lower right photo is within the riparian exclosure showing good cover in the riparian area and banks healing.



Utilization, Herbaceous Retention and Rest: The allowable use levels implemented in these allotments are excessive and do not provide the needed cover and habitat for migrant birds, amphibians, small mammals, or sage grouse. Streams and adjacent riparian areas lack protection. There is a lack of planned rest to allow recovery of plant community vigor and production following grazing. Don DeLong, wildlife biologist for the Bridger Teton NF has done detailed studies of the value of herbaceous vegetation retention to support watershed function and wildlife habitat.^{22 23} He provided comparable percent herbaceous retention levels for percent key forage utilization levels. The 50 percent allowable use level does not provide the 80 percent herbaceous retention needed for amphibians.²⁴ That report also addressed buffer zones and levels of protection needed, including 100 foot, 200 yards, 1/3 mile, and 1 1/2 mile riparian/wetland/upland buffers to provide adequate habitat for amphibians. Table 2 of that report describes the various factors impacting their habitat. The DeLong (2021)²⁵ Power Point relates utilization, Forest Plan objectives and retention to the needs of many species. Also see Exhibit 7 by DeLong which is a Summary Basis for Building Wildlife Habitat – Needs & Protections into Forage Utilization Limits.

The allowable use or utilization and stubble height standards for Upper Green (note Fisherman Creek lacks stubble height requirements) do not provide the retention needed for wildlife. As Delong notes, 30 percent utilization is more appropriate in providing the retention needed. Excerpts from a review of Utilization, Rest and Grazing Systems by Dr. Carter are provided here.²⁶ These support a 25 percent utilization standard.

Long standing research has recommended that 25 percent of forage be allocated to livestock, 25 percent to wildlife and 50 percent to watershed protection.²⁷ The paper also noted that the NRCS has adopted guidelines for reduction in capacity for distance to water and slope with

²² DeLong, D. 2015. Literature Review and Analysis of Scientific Information for the Conservation Assessment for Columbia Spotted Frogs and Boreal Toads on the Bridger-Teton National Forest. Reference Document Version 3.0. Bridger-Teton National Forest. 698p.

<https://app.box.com/s/fiatx8jmndlm27q8ewrjgwqbb262imll>

²³ DeLong, D. 2016. Upper Green Allotment Management Planning EIS Supplemental Wildlife Specialist Report Migratory Birds. Bridger-Teton National Forest. 183p.

<https://app.box.com/s/jpzfwzh9vjlzj5i7887dnhlc1ixv30w>

²⁴ DeLong, D. 2015. Summary Basis for Building Wildlife Habitat-Needs & Protection into Forage Utilization Limits. West Zone Wildlife Biologist, Bridger-Teton National Forest. 8 p.

<https://app.box.com/s/nexfkktm2zfd0leqt748vgqqg4wzt38x>

²⁵ DeLong, D. 2021. Forest Plan Direction & Other Wildlife. PowerPoint. 115p.

<https://app.box.com/s/vuptjmujedgrk1n5xan5z08xk7pzc2zn>

²⁶ Carter, J. 2013. Utilization, Rest and Grazing Systems – A Review. Yellowstone to Uintas Connection.

<https://app.box.com/file/22619911223?s=ngw6723dx52quxw2rd8u>

²⁷ Galt, D., Molinar, F., Navarro, J., Joseph, J., and Holechek, J. 2000. Grazing capacity and stocking rate. Rangelands 22(6):7 - 11.

areas more distant or upslope having reduced use and therefore reduced capacity.²⁸ Early turn in of livestock and lack of adequate rest can reduce plant vigor and therefore, productivity. In a 1953 paper, 25 – 30 percent use of all forage species by livestock was recommended because routinely stocking at higher levels would result in overgrazing in half the years.²⁹ Even at these use levels complete de-stocking would be needed in 2 or 3 out of ten years. This is because plant production is related to precipitation and is lower during lower precipitation years, including drought. During these lower precipitation years, not only is production lower, but the ability of plants to recover from grazing is lessened. The BTNF has implemented 50 percent utilization and higher in the Upper Green allotments while leading range scientists have documented for decades that 30 percent or less is needed to sustain the plants. Holechek et al (2004) provide that *“use of harvest coefficients higher than 25% invariably leads to land degradation...”*.

In our experience, over-utilization and lack of required rest are common across BLM and Forest Service managed lands in the west. Agencies refer to deferment as “rest”, but areas are still grazed each year. Forest Service researchers originally developed guidance for rest-rotation grazing based on intensive field studies.³⁰ They stated, *“While the idea of incorporating rest in grazing management is not new, the concept of longer rest periods than have heretofore been recommended, at least for mountain bunchgrass ranges, and of closer correlation of resting and grazing with plant growth requirements, is new.”* Some points of interest from the study were that, even with the rest-rotation system, some areas were more heavily used than others, regrowth was minimal on clipped plants after the seed-in-milk phase and clipping during active growth reduced total herbage yield during that year. A single season of clipping reduced basal area of forbs and grasses the next year. Four consecutive seasons of clipping at the seed-in-milk phase reduced basal area of Idaho fescue 80 percent. Four years’ rest after four years’ clipping resulted in little or no recovery of Idaho fescue. They also found that cool-season grasses such as Idaho fescue varied in production by a factor of three due to changes in annual precipitation, while the beginning of growth varied by up to a month with similar variations on time to flowering and seed ripening. Based on this research, the basic principle was to require adequate years of rest to allow the native plants to recover their vigor before again being grazed. They also recommended that it is important to include adequate monitoring of each grazed unit or pasture to determine if these rest periods are sufficient to maintain or restore production.

Native cool-season perennial bunchgrasses can be very sensitive to defoliation and growing season use. Regarding bluebunch wheatgrass, *“Effects of growing season defoliation injury are well documented: basal area, stem numbers and both root and forage yields are reduced and mortality can be*

²⁸ USDA Natural Resources Conservation Service. 2003. National Range and Pasture Handbook Chapter 5 Management of Grazing Lands. Tables 3 - 12 and 3 - 13.

https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1043064.pdf Accessed on 6/15/2021.

²⁹ Hutchings, S.S., and G. Stewart. 1953. Increasing forage yields and sheep production on Intermountain winter ranges. U.S. Department of Agriculture Circular 925. 63p.

³⁰ Hormay, A. L. and M. W. Talbot. 1961. Rest-rotation Grazing – A New Management System for Perennial Bunchgrass Ranges. USDA Forest Service Production Research Report No. 51.

high. ... Defoliation to very short stubble heights during the boot stage has been reported to essentially eliminate plants within as few as three years. ... Vigor recovery has been found to require most of a decade, even with complete protection from grazing.”³¹ The author went on to describe experiments in which a single clipping of the grass during the growing season resulted in 43 percent less herbage and 95 percent fewer flower stalks the following year when compared to unclipped plants. Under a deferred rotation system in eastern Oregon, it was reported that bluebunch wheatgrass could not be maintained at 30 – 40 percent use in the boot stage (early June). A one-time removal of 50 percent of the shoot system during active growth may require six years’ rest even in an area with 17” precipitation. *“The belief that range improvement will occur after one or two years of rest following a single season of more than ‘light’ use during the growing season is erroneous.”* Idaho fescue of moderately low vigor required 3 years of rest for recovery and plants of bluebunch wheatgrass and Idaho fescue in very low vigor may require 8 years and 6 years of rest, respectively, for recovery.³² We see evidence of this in the Elk Ridge Complex after five years of rest in which bluebunch wheatgrass has not recovered, production has not recovered, and Idaho fescue remains in low vigor. Rest is not part of the management of the pastures in the Upper Green and Fisherman Creek allotments.

The Forest Service determined the order in which cattle grazed particular areas; *“Ravine bottoms were usually grazed first. Next in order were openings in timber stands on gentle slopes, areas near water, areas along fences and ridgetops, salt grounds, accessible openings in timber stands on steeper slopes, areas under large trees, and finally areas covered by tree thickets.”*³³ In another study, *“cattle dispersion was constrained by the spatial distribution of water and slope. Across 3 seasons, 77% of observed use was within 366 meters of water. Approximately 65% of the land area was beyond 723 meters from water and sustained only 12% of observed use. Cattle concentrated use (79%) on slopes less than 7%. Consequently 35% of the area, on or surrounded by slopes > 10%, received only 7% of observed use. Loamy, grazable woodland and wetland sub-irrigated range sites were most preferred and accounted for over 65% of observed use while occupying less than 35% of the land area.”*³⁴

We mapped SCCD monitoring locations in the Mosquito Lakes pastures and estimated the distance to water compared to the 366 meters in which most use occurred in the Pinchak et al (1991) study. Table 7 and Figure 9 provide a summary of the distances and maps of the locations. The SCCD Cooperative Monitoring needs to be revamped to focus on the areas in valleys and near water that are used first as the cited research has shown and Forest Service guidance cited above has stated. The public must be involved in developing the monitoring plan.

³¹ Anderson, Loren D. 1991. Bluebunch wheatgrass defoliation, effects and recovery – A Review. BLM Technical Bulletin 91-2, Bureau of Land Management, Idaho State Office.

³² Mueggler, W.F. 1975. Rate and pattern of vigor recovery in Idaho fescue and Bluebunch wheatgrass. *Journal of Range Management* 28(3):198-204.

³³ Hormay, op. cit.

³⁴ Pinchak, op. cit.

Other Forest Service research notes that vigorous woody plant growth and at least 6 inches of residual herbaceous plant growth at the end of the growing/grazing season typified riparian areas in excellent, good, or rapidly improving condition. This corresponded to a riparian utilization rate of 24 – 32 percent. *“Most riparian grazing results suggest that the specific grazing system used is not of dominant importance, but good management is – with control of use in the riparian area a key item.”* Degraded riparian areas may require complete rest to initiate the recovery process and recovery may require up to 15 years.³⁵ We have observed the degraded conditions on some of the streams in the Upper Green allotments. These will require complete rest to recover. As the Wagon Creek enclosure illustrates, after over a decade recovery is still occurring while adjacent grazed riparian areas and the stream banks remain degraded.

Table 7. Estimated Distance from Water to SCCD Monitoring Location, meters.

Location	Distance, m	Notes
MLE-01	1832	Location about 100 feet higher than lake
MLE-02	279	Location on ridge about 100 feet higher than lake
MLE-03	2102	Location several hundred feet higher than stream
MLW-02	1323	Location about same elevation as lake
MLW-02	1890	Location about same elevation as lake
MLW-04	3330	Location about 1,000 feet lower than lake
MLW-04	494	Location about 300 feet higher than stream, steep slopes intervene

W. S. Platts reviewed grazing systems and found that none were compatible with healthy aquatic ecosystems³⁶. A study of long-term riparian enclosures found that, after 30 years of livestock exclusion, willow canopy cover was 8.5 times greater in livestock enclosures than in adjacent grazed riparian areas.³⁷ Grasses were 4 to 6 times greater in cover within the enclosure than outside. Mean peak standing crop of grasses within the enclosure was 1950 lb/acre, while outside in caged plots, mean peak standing crop was 1083 lb/acre. Another study of upland and wet meadow communities that had livestock excluded for 9 – 18 years found major differences between the ungrazed communities and those continuing to be grazed. In each case, the area without grazing had greater belowground plant biomass, lower soil bulk density and higher soil pore space. In dry meadows the infiltration rate was 13 times greater than those dry meadows continuing to be grazed, and in wet meadows, infiltration of rested areas was 2.33 times greater.³⁸ In both areas, the results show improved water holding capacity in the absence of livestock.

³⁵ Clary, op. cit.

³⁶ Platts, W.S. 1991. Livestock Grazing. In Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication 19:389-423.

³⁷ Schulz, Terri T and Wayne C. Leininger. 1990. Differences in riparian vegetation structure between grazed areas and enclosures. Journal of Range Management 43(4):295-299.

³⁸ Kauffman, J. Boone, Andrea S. Thorpe, and E. N. Jack Brookshire. 2004. Livestock exclusion and belowground ecosystem responses in riparian meadows of eastern Oregon. Ecological Applications 14(6):1671-1679.



Figure 8. Forest Service and SCCD monitoring locations in Mud Lake Pastures

The implications of these studies relative to Forest Service NFMA requirements for sustainable use and preventing impairment of productivity are clear. Grazing systems do not compensate for over-stocking, light use is necessary to sustain productivity and long-term rest is essential to restore productivity following livestock grazing. Current livestock management practices in the BTNF are not compliant with the science or with the Multiple Use Sustained Yield Act and NFMA provisions for sustainability as evidenced by the loss of upland bluebunch wheatgrass, lowered production, presence of low vigor Idaho fescue, erosion channels in meadows, sluffing stream banks, and visible sediment impairment.

BTNF Examples: At times, the BTNF has indicated an intent to use criteria that are supported by range science when managing livestock grazing. Two examples come to mind. These are the Forage Reserve pastures and their prescribed management, and the Upper Green Allotment Complex Noble Pastures. When the permittee on the Upper Gros Ventre Allotment wished to transfer his permit to the Forest Service, the Forest Supervisor did so because the permittee wished to relinquish the permit without preference, there were no preferred applicants for the permit, and the forage reserve offered an opportunity to reduce conflicts with grizzly bears and wolves. This would assist in meeting *"management goals for the Gros Ventre Wilderness and designated Wild and Scenic Rivers"* and there are active allotments that could make use of the forage reserve in the event of wildfire or predator conflicts.³⁹

The BTNF then established the forage reserve with conditions that limited grazing use to no more than 3 seasons in ten years with no more than three years consecutive. Proper use was set at 35 percent for riparian and uplands. Given bighorn sheep concerns only cattle and horses could use the allotment. Grazing is only permitted to the extent it does not result in conflict with grizzly bears and wolves. No control action would occur in conflicts with livestock with livestock being moved until all options are exhausted, then livestock will be removed from the forage reserve.

Here, the BTNF included conditions with rest and lower utilization rates so that plant communities might recover their vigor and productivity and if, by chance, grazed by livestock in the future, conflicts with wolves and bears would be dealt with differently. If conflicts occurred, livestock would be the ones to go, not the bears or wolves. Ultimately, however, problems we have identified with the key species methods and monitoring of areas less used by livestock, the SCCD monitoring would not ensure the specified utilization level would ever be accurately determined. This would result in a failure to guarantee the terms would be met.

³⁹ USDA Forest Service. 2015. Upper Gros Ventre Allotment - Forage Reserve. Letter from Acting Forest Supervisor Conant to Dale Deiter, Jackson District Ranger. January 29, 2015.

The Upper Green Allotment Complex FEIS Executive Summary described the Modified Grazing Management for Alternative 4 which would make an exception to the general allowable use levels for specific areas. *"The exceptions to the general allowable use levels were: Noble Pasture 1 in the Noble Pastures Allotment would have a maximum forage utilization of 40 percent on key forage species in the pasture. More restrictive focus area prescriptions on Tosi Creek, Mosquito NW and SW in the Upper Green River Allotment were to have an average forage utilization of 30 percent in the upland and riparian areas over a five-year period with a maximum forage utilization of 50 percent in any given year."* This was changed in the Record of Decision to: *"The Noble Pastures Allotment will have a maximum forage utilization of 60% in uplands and 65% in riparian/meadow areas and all other allotments will incorporate a maximum of 50% forage utilization in the upland and riparian/meadow areas."*⁴⁰ Initially the BTNF proposed criteria that approach the use levels supported by science, and the retention level needed by wildlife, although it did not specify rest. Then, in its ROD, the BTNF returned to its excessive allowable use levels, which clearly cannot be supported by science, our data, and the Delong research specific to the BTNF. And with the SCCD finding only 9% average use on Idaho fescue in 2020, the terms and conditions would have always been met regardless of the specified use levels.

Then, the Upper Green FEIS relies on an erroneous allowance for forage consumption by cattle, using 26 lbs/day for both a cow and her calf. This number is oven dry weight, not air-dry weight and has been misstated by agencies for many years.⁴¹ In addition, the forage allowance ignores the consumption by calves. At the 3% of body weight used by NRCS, and at the current weight of cattle (cow plus calf = 1,680 lbs), forage consumption is 50.4 pounds of air-dry weight per day, or 1,532 pounds per month.⁴² This is almost double that stated in the FEIS.

The FEIS estimated that the 74,263 capable acres produce 104 million pounds of herbaceous vegetation. It then allocated 6.8 million pounds, or 6 percent to big game, an important wildlife and recreational resource. To generate the 104 million pounds on the 74,263 capable acres means that each capable acre must produce 1,400 pounds of forage, mainly grass preferred by cattle. Our results show current herbaceous production averages 664 lb/acre which is a fraction of potential and less than half the 1,400 pounds/acre.

The FEIS stated 9,089 cow calf pairs graze the allotments. The season is four months between June 14 and October 15. These would then require:

$$9089 \text{ pairs} \times 1680 \text{ lb/pair-month} \times 4 \text{ months} = 61,078,080 \text{ lb of forage.}$$

At a 25 percent utilization rate, the 74,263 capable acres would have to produce 244,312,320 pounds, or 2.4 times the total capacity claimed in the FEIS. The FEIS claims forage capacity is

⁴⁰ USDA Forest Service. 2019. Record of Decision Upper Green River Area Rangeland Project. Bridger-Teton National Forest.

⁴¹ Carter 2013, op.cit.

⁴² Carter, J. 2016. Updating the Animal Unit Month. Yellowstone to Uintas Connection.
<https://app.box.com/s/zx4xjekrfuht2aq12soruw0qfil8hogk>

not reliable for determining stocking rates and reliance must be placed on actual livestock use. But as we see, the SCCD monitoring situation is not lending itself to accurate determinations of utilization. Leading range scientists recommend measuring forage capacity at regular intervals and readjusting stocking levels based on the data.^{43 44} Determining forage capacity, using current forage consumption values applied to the vegetation types within the capable acres (<30% slope, <1 mile from water, adequate ground cover, production > 200 lbs/acre, and other factors) assists in preventing over stocking and guards against excessive use when agency personnel are unable to do adequate monitoring. If an actual determination was made of range readiness, forage capacity, a sustainable utilization rate applied that meets retention needed for wildlife, and adequate rest were implemented, numbers and seasons on the Upper Green and Fisherman Creek allotments would need to be reduced significantly.

How does the 2020 SCCD utilization rate of 9 percent compute? According to the AOI for 2020, approximately 5,800 pairs are currently authorized. The 74,263 capable acres would have to be producing a huge amount of forage for this to occur.

5,800 cow/calf pairs x 50.4 lbs/day x 120 days = 35,078,400 lbs of forage consumed
At a 9% utilization rate total available forage would need to be $35,078,400 / 0.09 = 389,760,000$ lbs

This means the 74,263 capable acres would have to produce 5,248 lb/acre, which ranges from 1.5 to 4.4 times the potential production from the ESDs. As we have noted, most of our sites were in poor condition based on herbaceous production, which is less than 25% of potential.

We have estimated stocking capacity for the Upper Green allotments using the average upland production found using Paired Plots in 2022. Using BTNF capable lands of 74,263 acres, average upland cage values for total herbaceous production of 664 lb/acre, forage consumption of a cow/calf pair of 50.4 lbs/day, allowable use of 25 percent, rest one year in three, and starting the grazing one month later for range readiness, the stocking rate becomes:

74,263 capable acres x 664 lb/acre herbaceous vegetation = 49,310,632 lbs
Available for livestock at 25 percent allowable use = 12,327,658 lbs
Rest one-third of pastures each year = $12,327,658 \times 2/3 = 8,218,439$ lbs
Range ready adjustment: reduce four month grazing season to three months = 90 days
Available for livestock = $8,218,439 \text{ lbs} / 90 \text{ days} = 91,315 \text{ lbs/day}$
Number of cow/calf pairs supported at 50.4 lb/day per pair = $91,315 / 50.4 = 1,811$ pairs

This is 31 percent of the approximately 5,800 pairs authorized in 2022 in the Upper Green allotments. It provides evidence that the loss of productivity is caused by past and current management. It is due to a failure to determine actual forage capacity or provide rest. This, combined with unsustainable utilization standards and monitoring that is unable to accurately

⁴³ Galt 2000, op.cit.

⁴⁴ Holechek 2004, op.cit.

determine actual use, have led to the overstocking and degraded conditions that currently exist on the allotments.

As noted, an allocation for big game was made in the FEIS. We obtained geospatial data of wildlife habitats from the Wyoming Fish and Game Department.⁴⁵ For example, Rocky Mountain Elk parturition, crucial and seasonal ranges occur in the Fisherman Creek, Elk Ridge, and Upper Green allotments. We find that current herbaceous vegetation production is a small portion of the potential that should be present and livestock use is greater than 70 percent, so there is no proof provided by the Forest Service and SCCD that there is sufficient available forage on these allotments to provide for big game such as elk.

One sage grouse lek, the Wagon Creek lek is an occupied lek occurring in the Upper Green allotment. The residual stubble heights we find in riparian meadows and in uplands is significantly lower than the 7 inches needed by sage grouse for nesting and brood-rearing.⁴⁶ In addition, the heavy use of >70 percent by livestock is directly competing with the nesting and brood rearing area needs of sage grouse chicks that require functional habitat with insects, i.e. *“great plant species richness with abundant forbs and insects characterize brood areas”* according to Connelly et al (2000).

According to the FEIS, *“The Green River and the lower reaches of its tributaries flow through open valleys and support well-developed willow riparian communities with abundant herbaceous vegetation (forbs, grasses, sedges) eaten by bears.”* The FEIS noted that 52% of the 27 grizzly bear deaths between 2010 and 2014 occurred in the project area, with 18 relocations. All were due to cattle depredation. There were other mortalities resulting from human conflicts. The FEIS described other food resources for grizzly bears, including whitebark pine seeds, ungulate and small mammals, roots, tubers, ants, and berries and stated there is limited forage overlap with livestock. Whitebark pines in the project area have suffered mortality in recent years, diminishing that food source. This increases the importance of these other foods. If livestock are consuming over 70 percent of the herbaceous vegetation, that constitutes a significant loss of food resources for bears in the summer. Currently the BTNF is proposing a Union Pass Farm Bill Salvage Project that will remove whitebark pine and other conifers for commercial harvest and salvage logging.⁴⁷ Much of this occurs in the Upper Green allotment area and will remove living trees that can generate seeds and security cover for grizzly bears and other wildlife. This project affects nearly 6,000 acres of forested cover.

⁴⁵ WGFD. 2023. Geospatial Data. <https://wgfd.wyo.gov/Wildlife-in-Wyoming/Geospatial-Data>

⁴⁶ Connelly, J.W., Schroeder, M.A., Sands, A.R., and Braun, C.E. 2000. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28(4):967 – 985.

⁴⁷ BTNF. 2023. Union Pass Farm Bill Salvage Project. <https://www.fs.usda.gov/project/?project=58615>

Conclusion

Our results demonstrate that the Upper Green and Fisherman Creek allotments are overstocked based on our measures of average upland and riparian utilization using Paired Plots at 73.1 percent and 75.5 percent respectively. These far exceed the 50 percent utilization or allowable use standard required by the BTNF. They do not meet herbaceous retention needs for wildlife and are nearly triple what range science studies recommend. We note that the current stocking rates as represented in the 2022 Annual Operating Instructions for the Upper Green allotments are approximately two-thirds of permitted numbers.

Herbaceous and grass production was lower than potential at all sites, with most in Poor Condition. The dominance by increaser species and loss of sensitive native bunchgrasses in uplands is consistent with the characterization of degraded systems in the Ecological Site Descriptions NRCS uses to characterize plant community characteristics. The loss of production is due to improper range management, overstocking, and inaccurate monitoring. This also affects wildlife such as elk and other big game, as well as grizzly bears that also rely on herbaceous vegetation and prey species that also rely on plants. In the vacant Elk Ridge allotments, after five years with no livestock, production remains low at less than 20% of potential and most sites remain visibly degraded.

Measurement of stubble heights on the key species, Idaho fescue, underestimates utilization when the herbaceous community is quantitatively assessed by the Paired Plot method. The SCCD and Forest Service measurements have underestimated utilization by a large amount. For example, in the 2020 SCCD Cooperative Monitoring Report average utilization was 9 percent using Idaho fescue. Compare this to the >70 percent results we find using the Paired Plot method. The residual heights do not meet the needs for sage grouse nesting or brood-rearing areas. Upland monitoring locations used by SCCD do not appear to meet Forest Service guidelines to monitor those areas grazed first or sensitive areas for wildlife.

Green line stubble heights were greater than those found on transects within the adjacent riparian area or AIZ that is important to migrant birds, amphibians, small mammals, and sage grouse. Some locations failed to meet the green line stubble height standard while most adjacent riparian transects AIZ would not meet the standard if it were applied to them. SCCD green line monitoring locations are in areas with protection by willows and result in no sites exceeding standards, while adjacent unprotected riparian and meadow areas are degraded.

Capacity calculations reveal a basic problem with SCCD monitoring. At the 9 percent utilization found in 2020, the 74,263 capable acres would need to produce over 5,000 lbs/acre of forage to support the 5,800 cow/calf pairs currently grazing. This ranges from 1.5 to 4.4 times what the ESDs for uplands estimate. Then, when the current Fair/Poor condition found in the allotments is considered, they are producing less than half of potential, most producing less than 25 percent of potential. Our capacity determination using the recommended range science results in 1,811 cow/calf pairs (31% of current rate) should be allowed to graze.

What needs to happen: What is needed at this point is to revamp the current monitoring protocol and also determine current forage capacity and stocking rates along with providing rest and later turn in. This can be accomplished in a true joint monitoring and management effort involving the Forest Service, SCCD, Permittees, WWP and Y2U that will:

1. Select key areas in upland and riparian areas that meet the advice in the Forest Service guidance and research we have cited. It will include areas grazed first, that is, riparian areas lacking significant willow protection and upland areas that are in valleys, on slopes less than 7% and no more than 366 meters from the nearest water source. These would then be compared to the nearest SCCD monitoring sites.
2. Place cages in these areas, at current SCCD sites, and establish paired plots.
3. Measure the key species, Idaho fescue, along upland transects. Measure sedges along transects in riparian meadows (AIZ). Measure green line stubble heights at each riparian location. Include trampling in the measures.
4. Compare the results from the different methods and locations.
5. Determine the stocking rate on capable areas using the Paired Plot production data and visiting pastures with turn-in after July and clip the vegetation. Inspection of the 2022 AOI indicates six pastures are available if the schedule remains the same.
6. Initiate this in the summer of 2023.

Exhibit 1
Photographs
July 7, 2020 Field Visit
Elk Ridge Allotments
WWP and Y2U

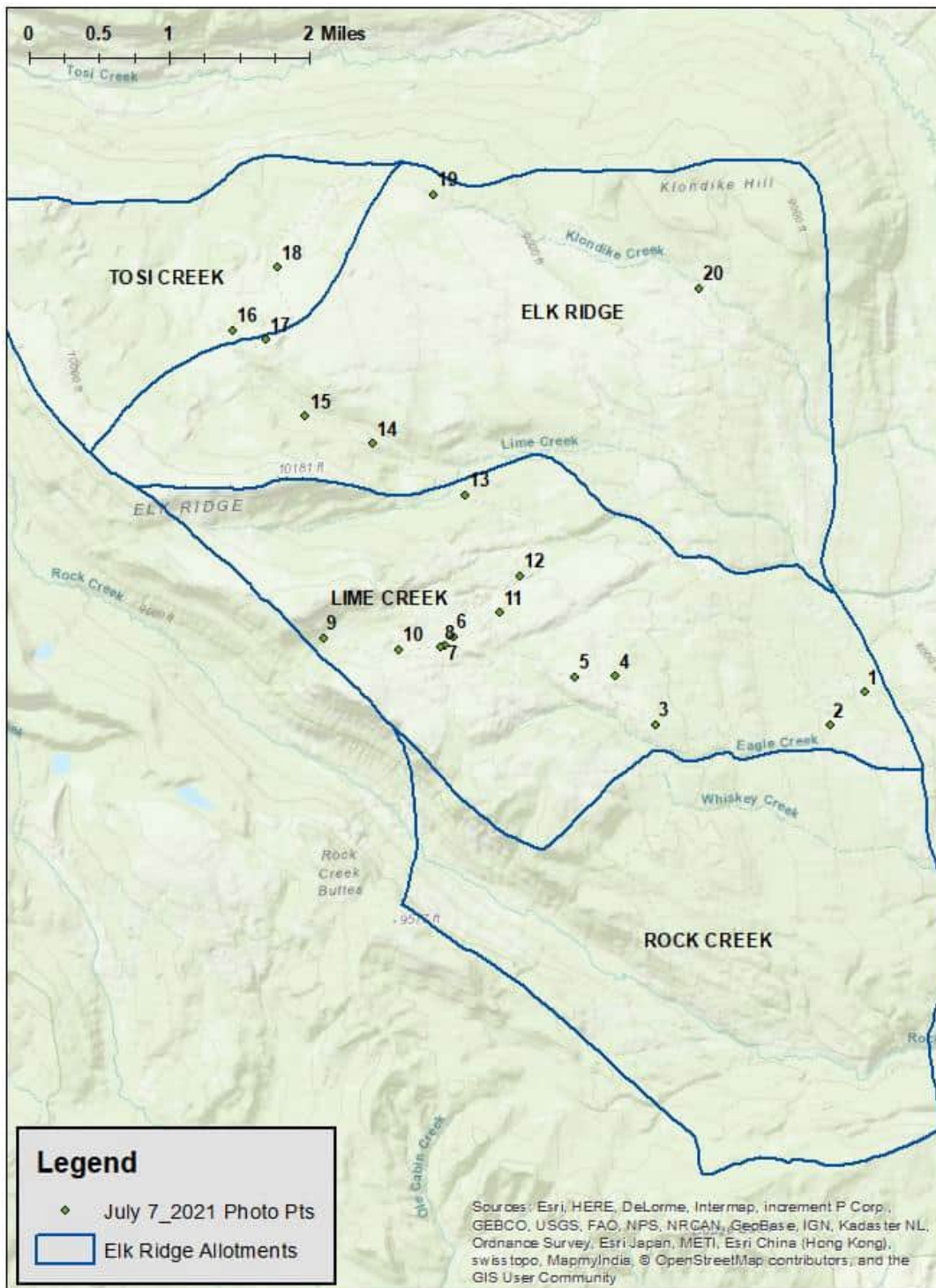


Photo point locations along initial survey route

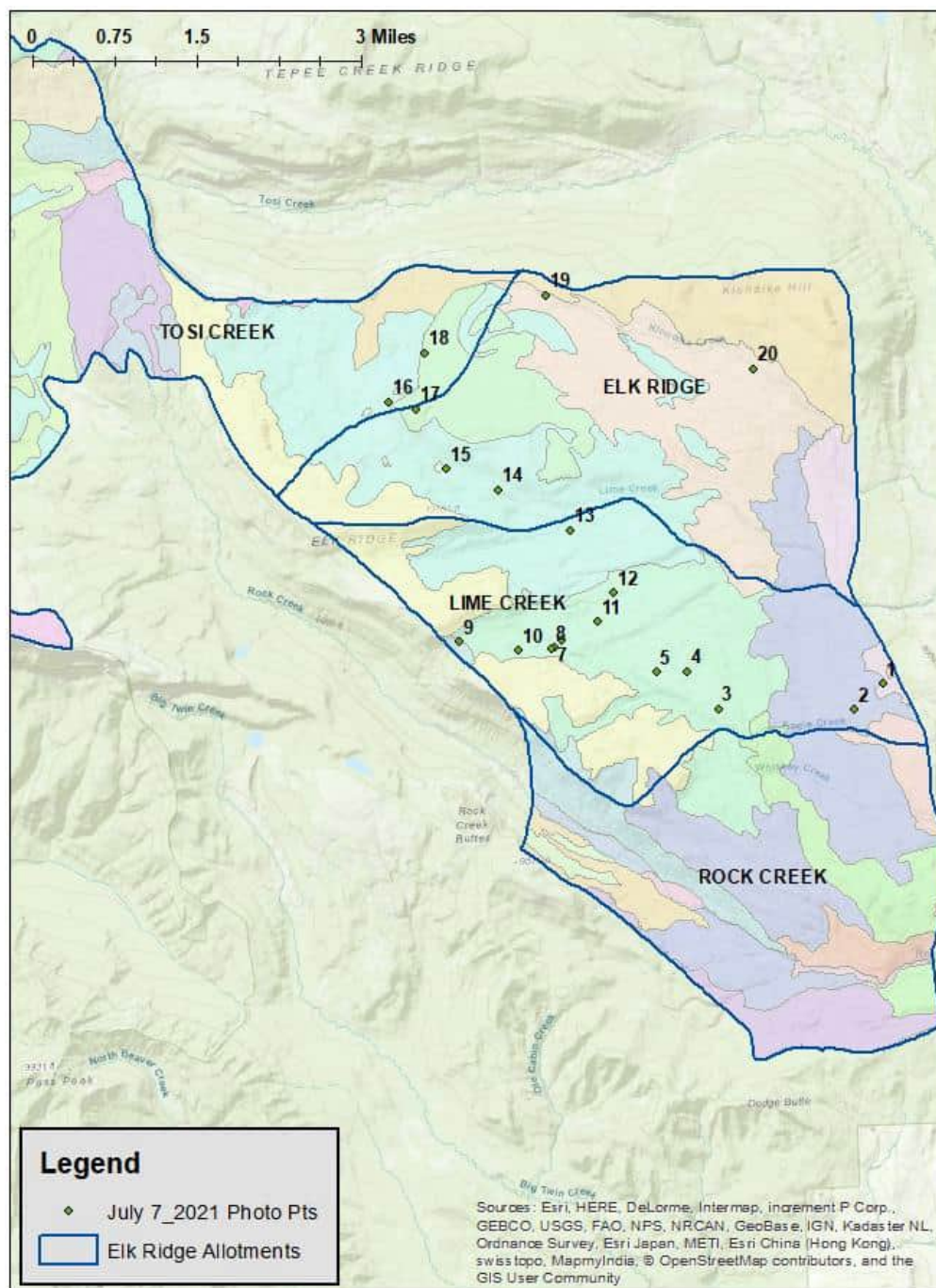


Photo point locations along initial survey route overlain on Soil Map Units from the Sublette County Soil Survey

Legend

- July 7_2021 Photo Pts

soilmu_a_aoi

<all other values>

MUSYM

1	Larkspur family-Rock outcrop-Elkpeak family	45 - 75%
1000	Water	
2	Midfork-Boatman-Larkspur families	15 - 60%
3324	Sedimentary Moraines, Big Sagebrush-Alkali Sagebrush Complex	5 - 20%
3325	Sedimentary Moraines, Silver Sagebrush-Big Sagebrush-Willow	0 - 10%
3346	Sedimentary Moraines, Subalpine Fir-Big Sagebrush Complex	5 - 25%
3511	Sedimentary Bottoms, Willow Complex	0 - 20%
3602	Sedimentary Sideslopes, Rock Outcrop-Subalpine Fir-Grassland	5 - 40%
3621	Sedimentary Sideslopes, Big Sagebrush-Silver Sagebrush	0 - 15%
3622	Sedimentary Sideslopes, Big Sagebrush-Tall Forb Complex	0 - 25%
3624	Sedimentary Residual Sideslopes, Big Sagebrush-Grassland	5 - 30%
3631	Sedimentary Sideslopes, Aspen-Big Sagebrush Complex	10 - 40%
3641	Sedimentary Till-Mantled Sideslopes (North), Subalpine Fir	5 - 45%
3643	Sedimentary Chugwater Sideslopes (North), Subalpine Fir	20 - 40%
3645	Sedimentary Sideslopes, Subalpine Fir-Big Sagebrush Complex	10 - 40%
3647	Sedimentary Chugwater Sideslopes (South), Subalpine Fir	12 - 50%
3648	Sedimentary Till-Mantled Sideslopes (West), Subalpine Fir	5 - 40%
3649	Sedimentary Sideslopes, Subalpine Fir-Big Sagebrush-Aspen	5 - 65%
3652	Sedimentary Colluvial Sideslopes, Big Sagebrush-Grassland	0 - 55%
3655	Sedimentary Sideslopes, Grassland-Meadow Complex	0 - 10%
3656	Sedimentary Sideslopes, Grassland-Rock Outcrop Complex	0 - 25%
3851	Sedimentary Ridges, Grassland	5 - 35%
8003	Rock Outcrop	
8004	Rubble Land	

Sublette County Soil Survey Key to Soil Map Units



Location 1

Low Aspen recruitment after 5 years with no livestock grazing. low vigor Idaho fescue, and significant amount of bare soil. Some evidence of pedestaling. Due to cattle preference for aspen stands for shade and forage, if grazed by livestock, these young suckers may be lost, and future recruitment suffer.





Location 2

Significant bare soil. Low vigor Idaho fescue, but with some seed stalks and last years' growth providing litter to cover the soil. With cattle grazing this litter will be lost.



Location 3

Sparse cover by herbaceous vegetation. Low level of productivity from grasses such as Idaho fescue. Cattle grazing will reduce the grasses to less than 2" which eliminates cover for sage grouse and migrant birds as well as small mammals.



Location 4

Sparse cover by herbaceous vegetation with significant bare soil. Low level of productivity from grasses such as Idaho fescue which remain in low vigor after five years rest. Cattle grazing can reduce the grasses to less than 2" which eliminates cover for sage grouse and migrant birds as well as small mammals.



Location 5

Sparse cover by herbaceous vegetation with significant bare soil. Low level of productivity from grasses such as Idaho fescue which remain in low vigor after five years rest. Cattle grazing can reduce the grasses to less than 2" which eliminates cover for sage grouse and migrant birds as well as small mammals.



Location 6

Sparse cover by herbaceous vegetation with significant bare soil. Low level of productivity from grasses. Cattle grazing can reduce the grasses to less than 2" which eliminates cover for sage grouse and migrant birds as well as small mammals. Even in this rested state, herbaceous cover height is less than needed for sage grouse.





Locations 7 (left) and 8 (right)

Herbaceous community dominated by forbs of low desirability to cattle, such as geranium. Little cattle forage here.



Location 9

At Gros Ventre Wilderness boundary. Rapidly eroding soils and slopes. High proportion of bare soil and plant community dominated by forbs of low desirability for cattle.





Locations 10 (left) and 11 (right)

At Location 10, eroding and barren soils in distance, plant community remains in low seral state with sparse grass cover and forbs of low desirability to cattle. At location 11, high cover of forbs that will degrade as the season ends. Cover dominated by forbs of low desirability to cattle.



Locations 12 (left) and 13 (right)

Location 12 on NE facing slope with Young whitebark pine, sagebrush, and good soil cover. Location 13 with significant bare soil, low herbaceous cover for migrant birds.



Location 14 (left) and 15 (Right)

Location 14 with an ancient whitebark pine. Location 15 showing whitebark die-off and valley with bare soil and significant presence of rushes of low desirability to cattle.





Location 16 (left) and 17 (right)

Location 16 valley with water and steep sides with little apparent forage and erodible slopes. Dead whitebark pines. Location 17 on ridge showing little forage or herbaceous cover in the thin soil.



Location 18 (left) and 19 (right)

Location 18 showing barren soils and little herbaceous production, absence of cover for migrant birds and small mammals. Location 19 similarly low in production and high percent bare soil. Little forage in either location.

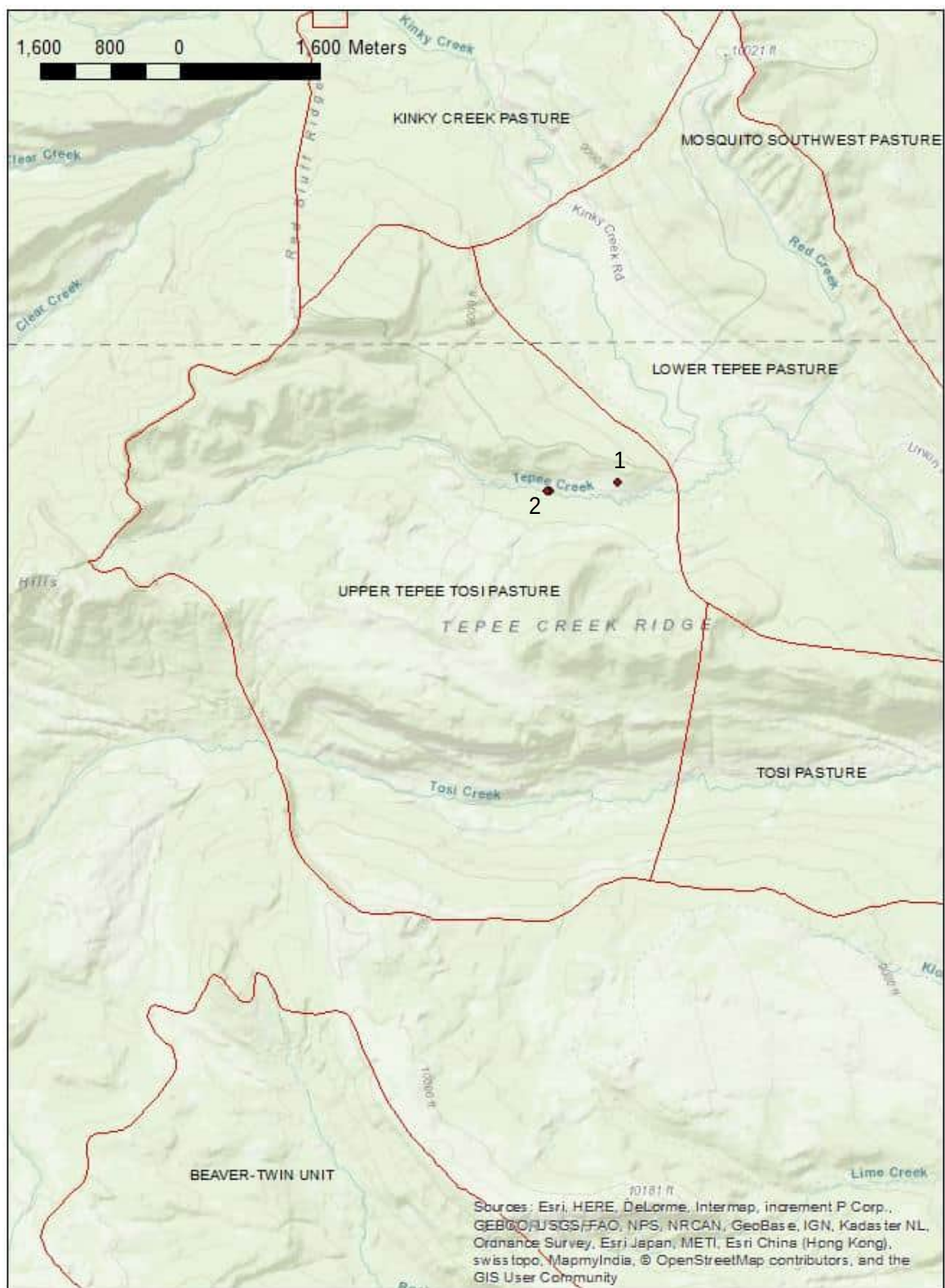




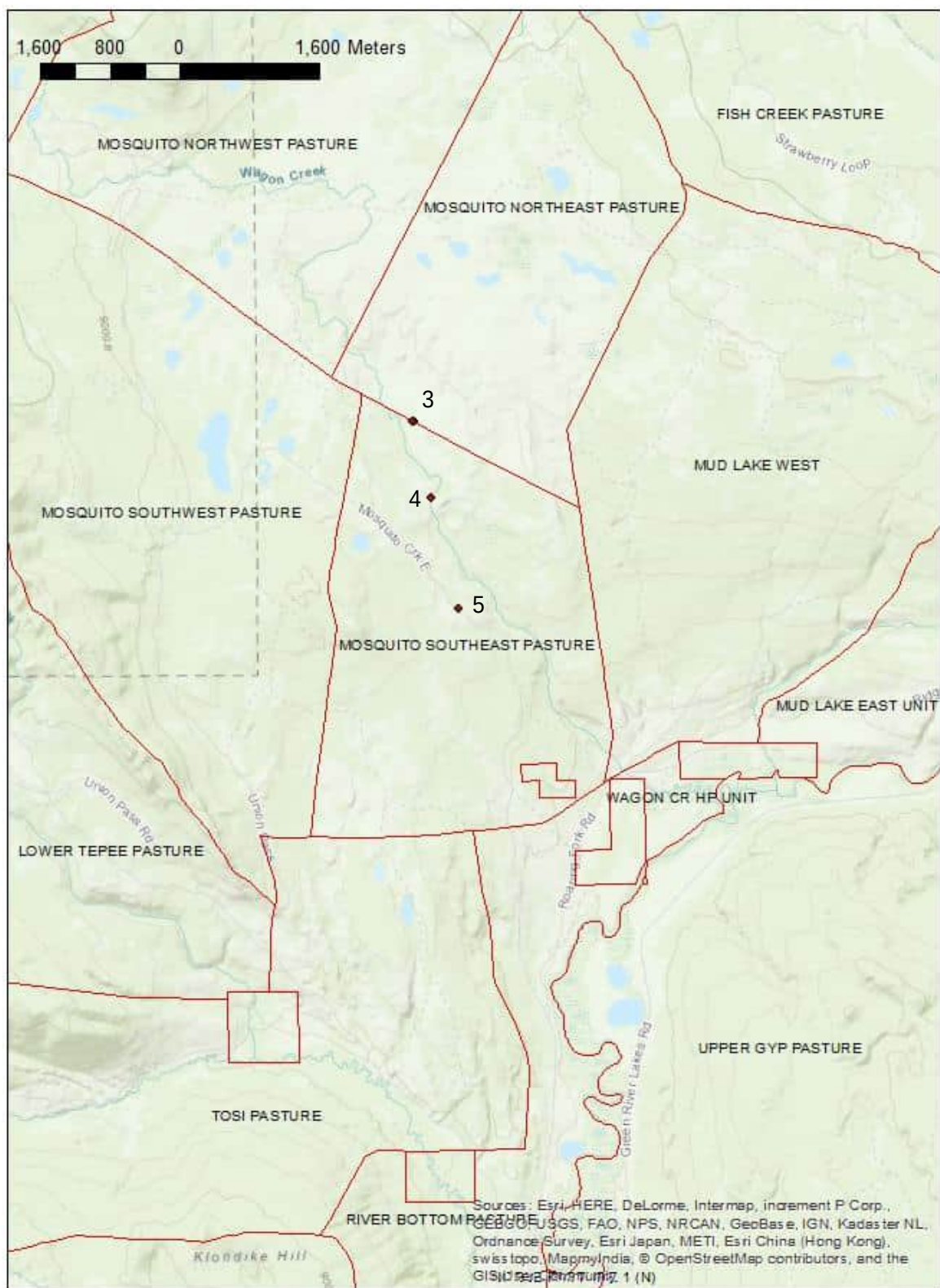
Location 20

Herbaceous cover and production in shrub interspace low.
Significant bare soil.

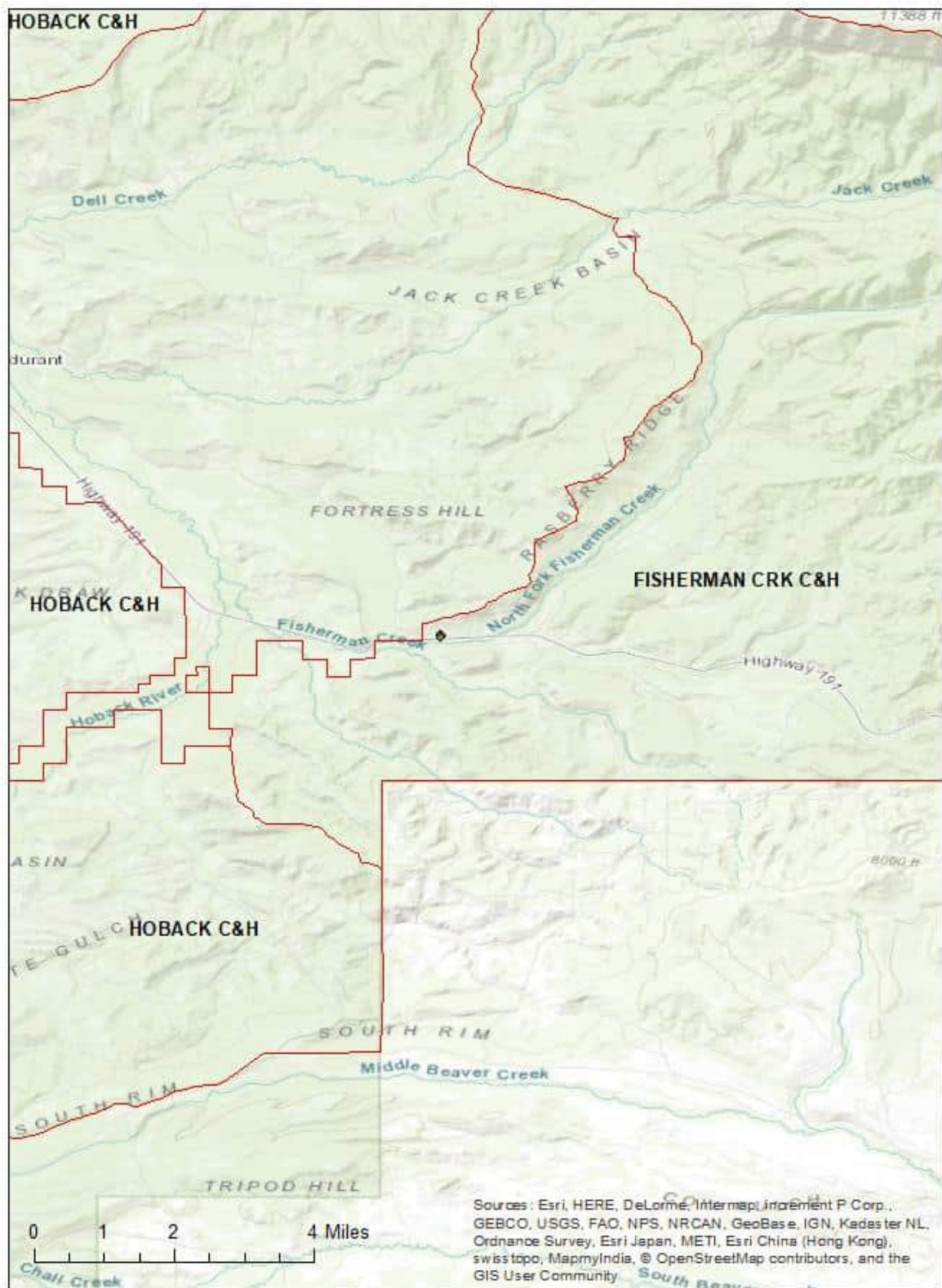
Exhibit 2
Maps and Photo Illustration of Conditions
Upper Green Allotment Prior to Grazing (July 12, 2021)
Fisherman Creek Allotments after Grazing (September 9, 2021)
WWP and Y2U



Locations 1 and 2 in Upper Green Teepee Tosi Pasture July 12, 2021



Locations 3, 4, and 5 in Upper Green Mosquito SE Pasture July 12, 2021



Riparian monitoring point on Fisherman Creek in the Fisherman Creek Allotment on September 9, 2021



Upper Green Location 1 on the ridge overlooking Teepee Creek. This is the Forest Service and Sublette County Monitoring location where line intercept was measured. Note the herbaceous community is dominated by forbs such as geranium and potentilla that are not desirable forage. Of key importance is the selection of a location well above and at distance from the water source.



Upper Green Location 2 at Teepee Creek. Conditions prior to livestock grazing. Teepee Creek is suffering from scoured banks and downcutting. The riparian zone between the greenline and uplands is suffering extensive bare soil. The Forest Service does not monitor use in the riparian zone in their Allowable Use Standards, only the greenline and uplands. So, in this case the upland monitoring site (location 1) shows good ground cover but that does not reflect conditions in the valley and valley sides near water where the cattle concentrate. Here cover is lacking for amphibians, migrant birds, and small mammals.



Upper Green Location 2 at Teepee Creek. Conditions prior to livestock grazing. Further upstream. Upper photos showing head cut where the creek is downcutting. Lower shows trampled banks and sluffing of scoured banks as they cave into the water.



Upper Green Location 3 in Mosquito Southeast and Northeast Pastures. Upper photo showing minimal residual after grazing. Lower photos showing residual after grazing (left) and prior to livestock being turned in (right). The herbaceous cover is sparse even in the ungrazed state. Following grazing there is literally no cover for migrant birds or small mammals.



Upper Green Location 4 (Wagon Creek) in Mosquito Southeast Pasture. Upper photo is an enclosure showing recovering banks and past bank sloughing. Lower photo shows conditions while being grazed, including barren and eroding banks, banks nearing collapse into the stream, minimal herbaceous residual in the riparian area and stream substrate laden with sediment. Needless to say, native fish, migrant birds, amphibians have minimal habitat under these conditions.



Upper Green Location 5 in Mosquito Southeast Pasture. Aspen stand hedged and lacking understory. Recruitment is not succeeding as small shoots are grazed or browsed before attaining a height sufficient to escape browsing.



Fisherman Creek in Fisherman Creek Allotment Pasture 2. These photos taken after livestock have left the pasture. Left photo is along the greenline where the max sedge height is 6" and the average is 3.5". Middle photo in riparian zone showing maximum sedge height of 4.5" and average is 3". Right photo in riparian meadow showing minimal residual with average below 1.5". The riparian zone is depleted with no cover for migrant birds, amphibians, and small mammals.

Exhibit 3
Elk Ridge Plot Data, Maps, and Photographs
September 14, 2021

WWP and Y2U

Idaho Fescue - Maximum and Average Heights at Plots

Plot No	Max Height, in.	Avg Height, in.
61	12	9.1
57	10	8.3
98	9	6.5
72	5	4.1
67	7	4.6
79	9	6.5
14	5	4
145	9	7.1
Averages	8.3	6.3

Elk Ridge Allotments – Plot Clipping Data

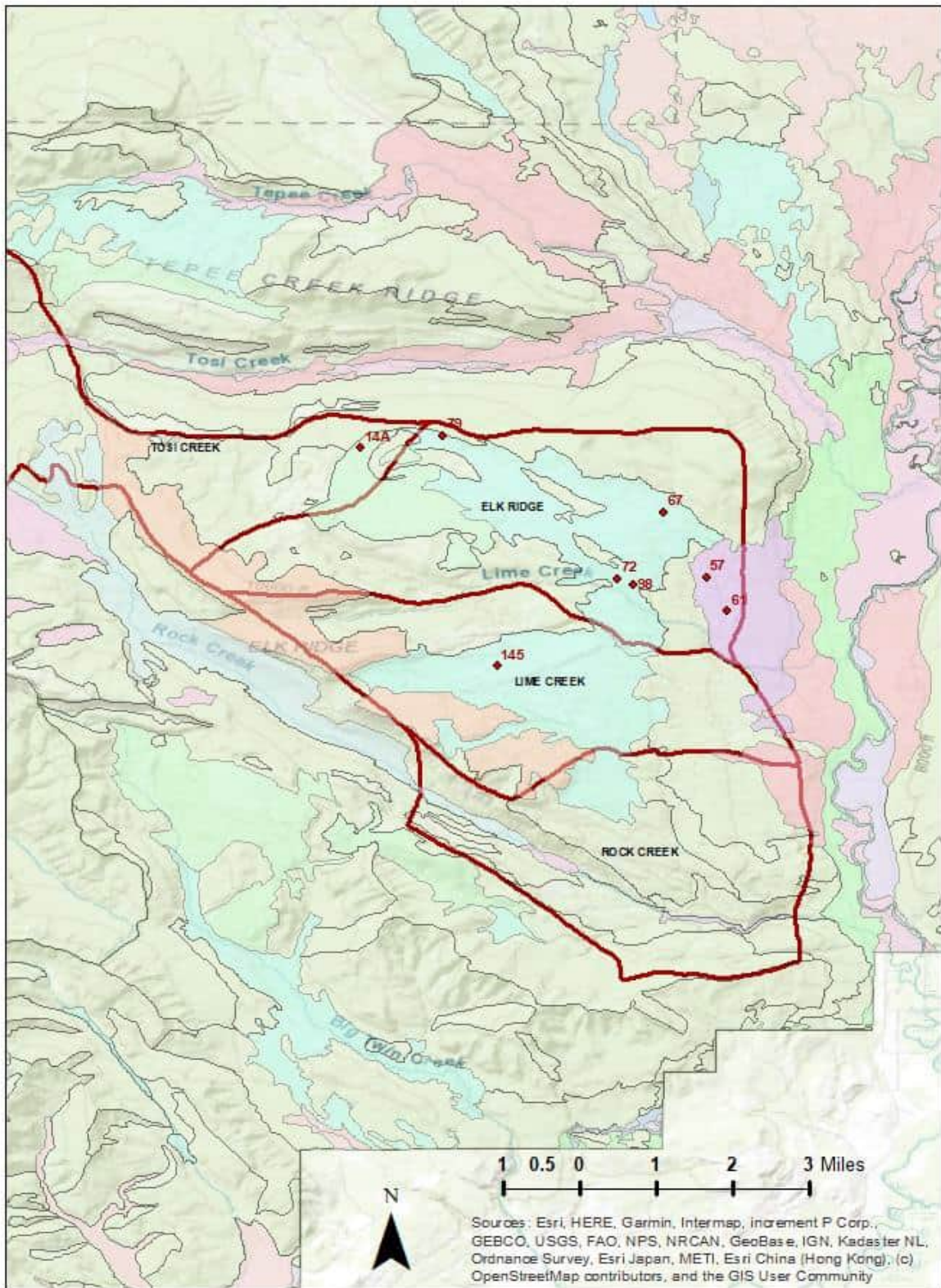
Plot #	Sub Plot #	Species	Plot Size sq. ft	Total weight, gms	Sample weight, gms	Bag Weight, gms	Pounds per Acre
14	1	FEID	9.6	30.8	23.3	7.5	233
14	1	ELTR	9.6	9.6	2.1	7.5	21
14	2	upland sedge	9.6	10	2.5	7.5	25
14	2	FEID	9.6	10	2.5	7.5	25
14	3	forb	9.6	9.2	0.4	8.8	4
14	3	grass	9.6	12.9	4.1	8.8	41
14	4	grass	9.6	22.4	13.6	8.8	136
57	1	ELTR	9.6	15.3	7.8	7.5	78
57	1	FEID	9.6	8.6	1.1	7.5	11
57	2	aster	9.6	9.1	1.6	7.5	16
57	2	ELTR	9.6	11	3.5	7.5	35
57	2	FEID	9.6	21.1	13.6	7.5	136
57	2	upland sedge	9.6	22.9	15.4	7.5	154
57	3	FEID	9.6	22.9	14.1	8.8	141
57	3	forb	9.6	10.5	1.7	8.8	17
57	4	Forb	9.6	10.2	1.4	8.8	14
57	4	grass	9.6	18.2	9.4	8.8	94
61	1	strawberry	9.6	10.9	3.4	7.5	34
61	1	ELTR	9.6	17.6	10.1	7.5	101
61	1	FEID	9.6	39.2	31.7	7.5	317
61	2	FEID	9.6	21.1	13.6	7.5	136
61	2	ELTR	9.6	12.3	4.8	7.5	48
61	3	FEID	9.6	36.2	27.4	8.8	274
61	3	forb 4	9.6	19.6	10.8	8.8	108
61	4	grass	9.6	52.9	44.1	8.8	441
61	4	strawberry	9.6	9.3	0.5	8.8	5
67	1	FEID	9.6	9	1.5	7.5	15
67	1	upland sedge	9.6	9.4	1.9	7.5	19
67	2	upland sedge	9.6	10.8	3.3	7.5	33
67	2	ELTR	9.6	16.7	9.2	7.5	92
67	2	FEID	9.6	16.6	9.1	7.5	91
67	3	grass	9.6	15.7	6.9	8.8	69
67	3	forb	9.6	9.1	0.3	8.8	3
67	4	grass	9.6	12.3	3.5	8.8	35
67	4	forb	9.6	9	0.2	8.8	2

72	1	forb 1	9.6	12.8	5.3	7.5	53
72	1	upland sedge	9.6	12.6	5.1	7.5	51
72	1	FEID	9.6	23.5	16	7.5	160
72	2	FEID	9.6	10.7	3.2	7.5	32
72	2	FEID	9.6	8.8	1.3	7.5	13
72	2	ELTR	9.6	9.4	1.9	7.5	19
72	3	strawberry	9.6	8.9	0.1	8.8	1
72	3	grass	9.6	28.6	19.8	8.8	198
72	4	grass	9.6	22.3	13.5	8.8	135
79	1	FEID	9.6	21.2	13.7	7.5	137
79	1	forb 2	9.6	9.8	2.3	7.5	23
79	2	Forb 3	9.6	8.9	1.4	7.5	14
79	2	ELTR	9.6	9.6	2.1	7.5	21
79	2	FEID	9.6	10.3	2.8	7.5	28
79	3	grass	9.6	20.1	11.3	8.8	113
79	4	grass	9.6	18.2	9.4	8.8	94
79	4	forb	9.6	10	1.2	8.8	12
98	1	ELTR	9.6	8.9	1.4	7.5	14
98	1	upland sedge	9.6	9.8	2.3	7.5	23
98	1	FEID	9.6	20.8	13.3	7.5	133
98	2	FEID	9.6	11.3	3.8	7.5	38
98	2	upland sedge	9.6	13.9	6.4	7.5	64
98	3	grass	9.6	36.8	28	8.8	280
98	4	grass	9.6	20.1	11.3	8.8	113
145	1	FEID	9.6	28.3	20.8	7.5	208
145	2	ELTR	9.6	13.1	5.6	7.5	56
145	2	FEID	9.6	10.9	3.4	7.5	34
145	3	grass	9.6	10.7	1.9	8.8	19
145	4	grass	9.6	20.3	11.5	8.8	115
145	4	forb	9.6	8.9	0.1	8.8	1

Elk Ridge Allotments – Range Condition

Site No and Ecological Site	Forage Production	Lbs. per Acre	ESD Grass and Forb Production Low/Average/Good Year	Percent of Expected	Range Condition
Site 14 Shallow Loamy Foothills	Total Forage Production - Plot 1	254	600	20%	POOR
	Total Forage Production - Plot 2	50	1,050	12%	POOR
	Total Forage Production - Plot 3	45	1,275	10%	POOR
	Total Forage Production - Plot 4	136			
	Average Total Forage Production	121			
Site 57 Clayey Overflow	Total Forage Production - Plot 1	89	1,275	14%	POOR
	Total Forage Production - Plot 2	341	2,125	8%	POOR
	Total Forage Production - Plot 3	158	2,550	7%	POOR
	Total Forage Production - Plot 4	108			
	Average Total Forage Production	174			
Site 61 Clayey Overflow	Total Forage Production - Plot 1	452	1,275	29%	FAIR
	Total Forage Production - Plot 2	184	2,125	17%	POOR
	Total Forage Production - Plot 3	382	2,550	14%	POOR
	Total Forage Production - Plot 4	446			
	Average Total Forage Production	366			
Site 67 Loamy High Mtn	Total Forage Production - Plot 1	34	1,620	6%	POOR
	Total Forage Production - Plot 2	216	2,250	4%	POOR
	Total Forage Production - Plot 3	72	2,700	3%	POOR
	Total Forage Production - Plot 4	37			
	Average Total Forage Production	90			

Site 72 Loamy High Mtn	Total Forage Production - Plot 1	264	1,620	10%	POOR
	Total Forage Production - Plot 2	64	2,250	7%	POOR
	Total Forage Production - Plot 3	199	2,700	6%	POOR
	Total Forage Production - Plot 4	135			
	Average Total Forage Production	166			
Site 79 Loamy High Mtn	Total Forage Production - Plot 1	160	1,620	7%	POOR
	Total Forage Production - Plot 2	63	2,250	5%	POOR
	Total Forage Production - Plot 3	113	2,700	4%	POOR
	Total Forage Production - Plot 4	106			
	Average Total Forage Production	111			
Site 98 Loamy High Mtn	Total Forage Production - Plot 1	170	1,620	13%	POOR
	Total Forage Production - Plot 2	102	2,250	10%	POOR
	Total Forage Production - Plot 3	280	2,700	8%	POOR
	Total Forage Production - Plot 4	321			
	Average Total Forage Production	218			
Site 145 Loamy High Mtn	Total Forage Production - Plot 1	208	1,620	7%	POOR
	Total Forage Production - Plot 2	90	2,250	5%	POOR
	Total Forage Production - Plot 3	19	2,700	4%	POOR
	Total Forage Production - Plot 4	116			
	Average Total Forage Production	108			



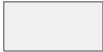
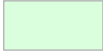
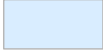
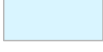
Elk Ridge Allotments and Ecological Sites
Legend on following page

Legend

- Elk Ridge Plots

Sublette_ESD

EcoSiteNm

	
	Clayey Overflow (Foothills And Mountains West)
	Coarse Upland (Foothills And Mountains West)
	Gravelly (High Plains Southeast)
	Loamy (Foothills And Mountains West)
	Loamy (High Mountains)
	Loamy (High Plains Southeast)
	Overflow (High Mountains)
	Shallow Clayey (Foothills And Mountains West)
	Shallow Loamy (Foothills And Mountains West)
	Shallow Loamy (High Mountains)
	Steep Loamy (High Mountains)
	Subirrigated (Foothills And Mountains West)
	Subirrigated (High Mountains)
	Subirrigated (Sb) 15-19 Foothills and Mountains
	Very Shallow (Foothills And Mountains West)
	Wetland (Foothills And Mountains West)
	Wetland (High Mountains)
	ElkRidgeAllotmentBoundaries

Site 61



At Site 61, the average grass and forb production was 366 lb/acre compared to ESD potential of 2125 lb/acre. This is 17% of potential and poor condition.





Site 57



At Site 57, the average grass and forb production was 174 lb/acre compared to ESD potential of 2125 lb/acre. This is 8% of potential and poor condition.





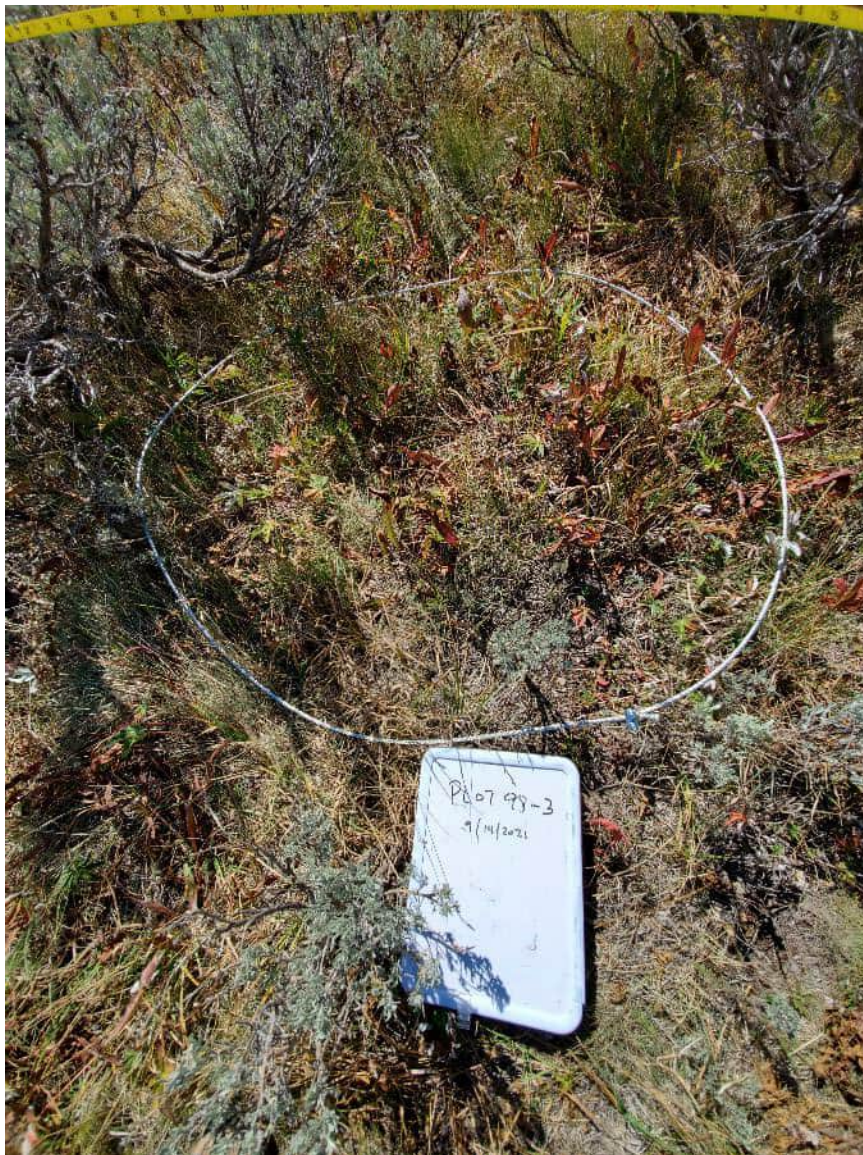
Site 57 numbered incorrectly as 67

Site 98



At Site 98, the average grass and forb production was 218 lb/acre compared to ESD potential of 2250 lb/acre. This is 10% of potential and poor condition.

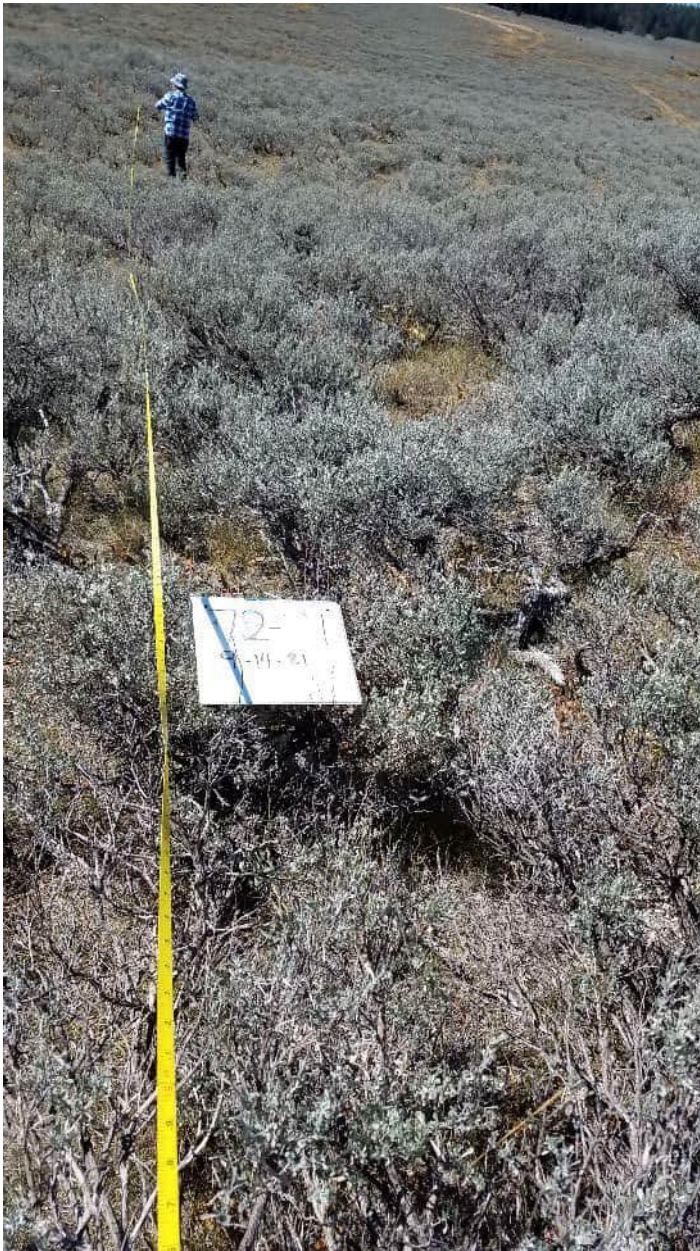


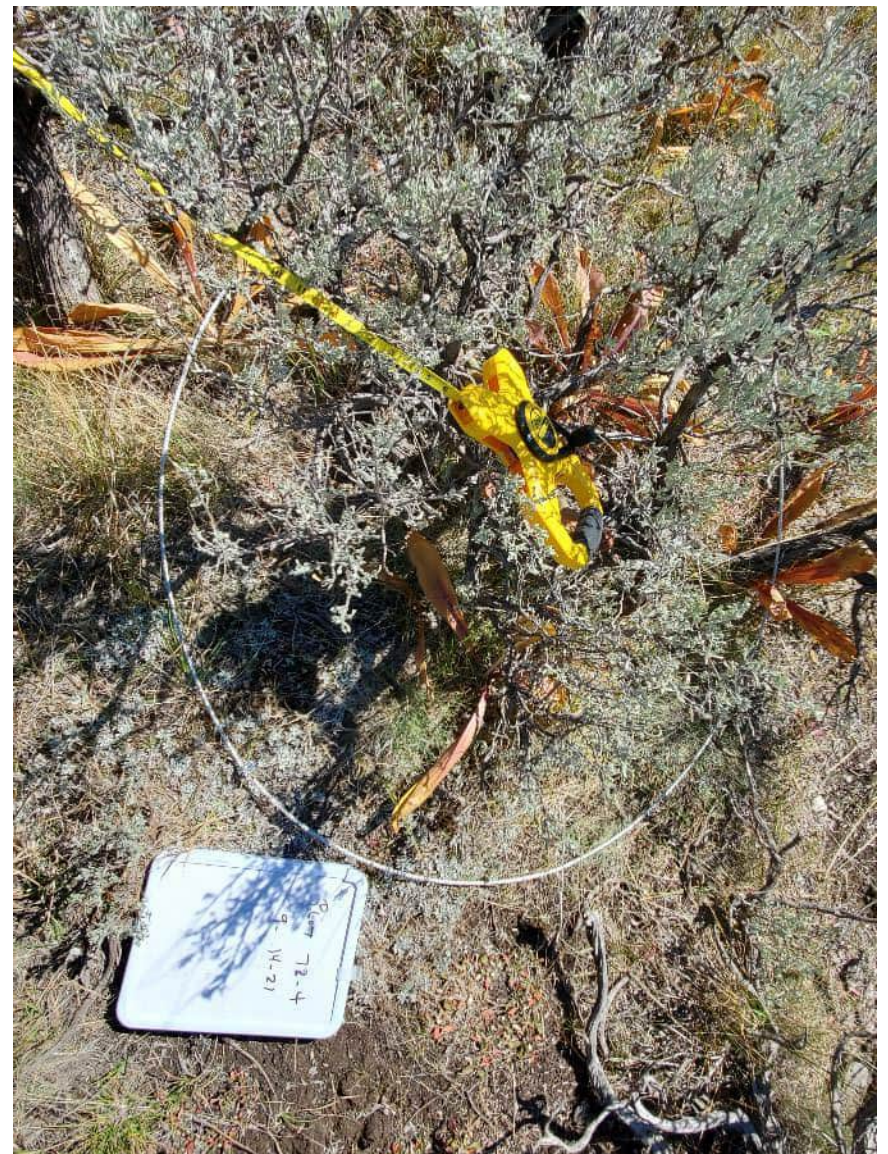


Site 72



At Site 72, the average grass and forb production was 166 lb/acre compared to ESD potential of 2250 lb/acre. This is 7% of potential and poor condition.

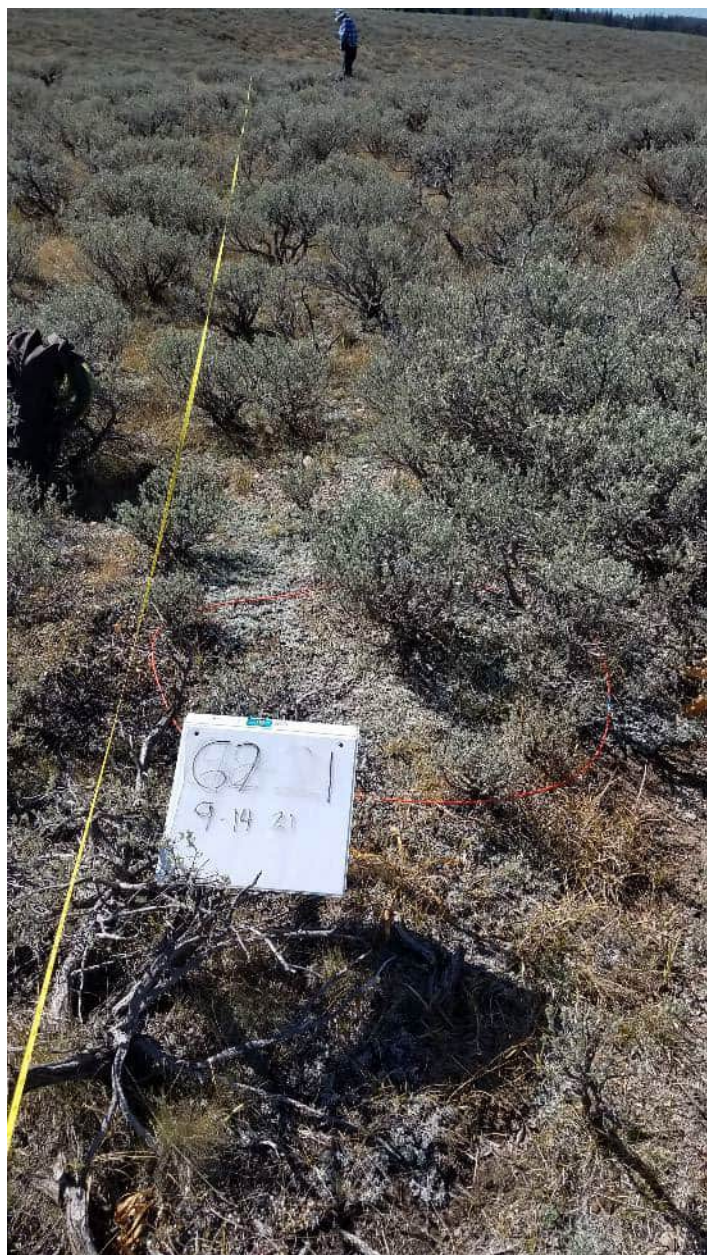


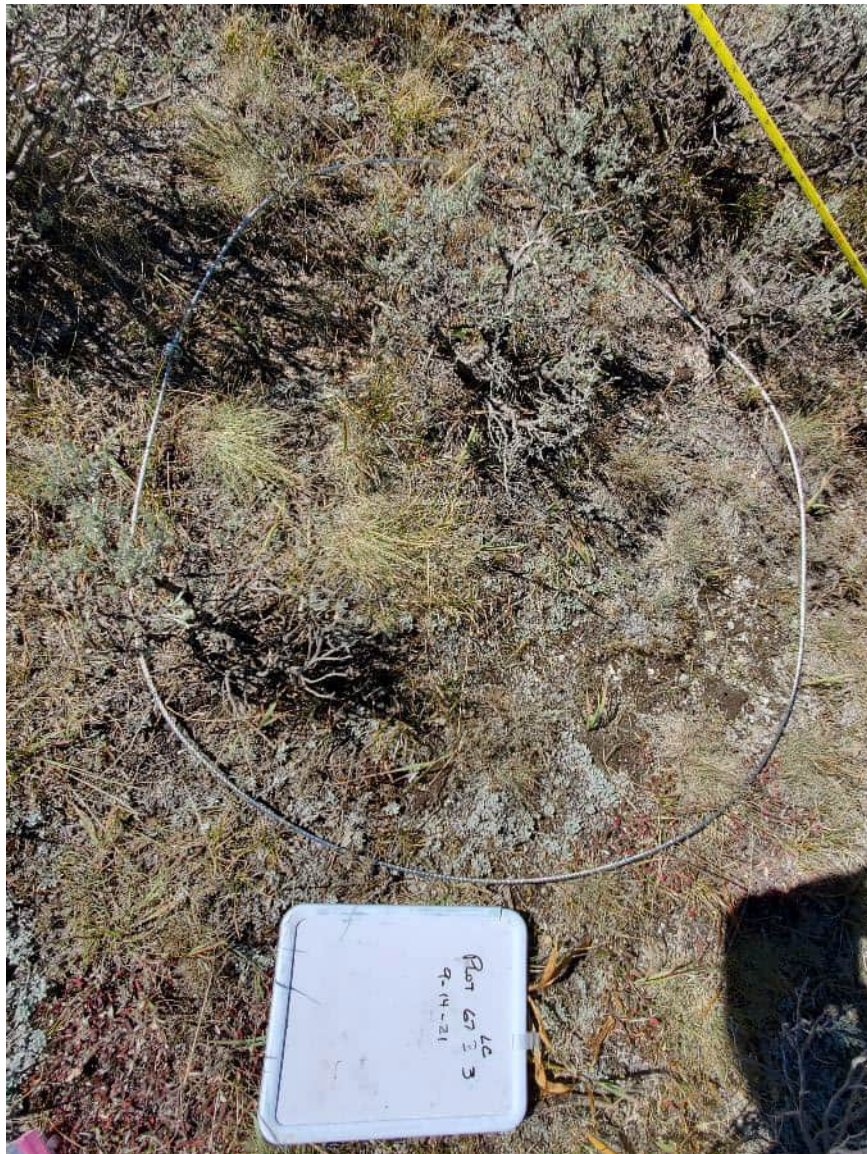


Site 67



At Site 67, the average grass and forb production was 90 lb/acre compared to ESD potential of 2250 lb/acre. This is 4% of potential and poor condition.





Site 79



At Site 79, the average grass and forb production was 111 lb/acre compared to ESD potential of 2250 lb/acre. This is 5% of potential and poor condition.





Site 14



At Site 14, the average grass and forb production was 121 lb/acre compared to ESD potential of 1050 lb/acre. This is 12% of potential and poor condition.





Site 145



At Site 145, the average grass and forb production was 108 lb/acre compared to ESD potential of 2250 lb/acre. This is 5% of potential and poor condition.

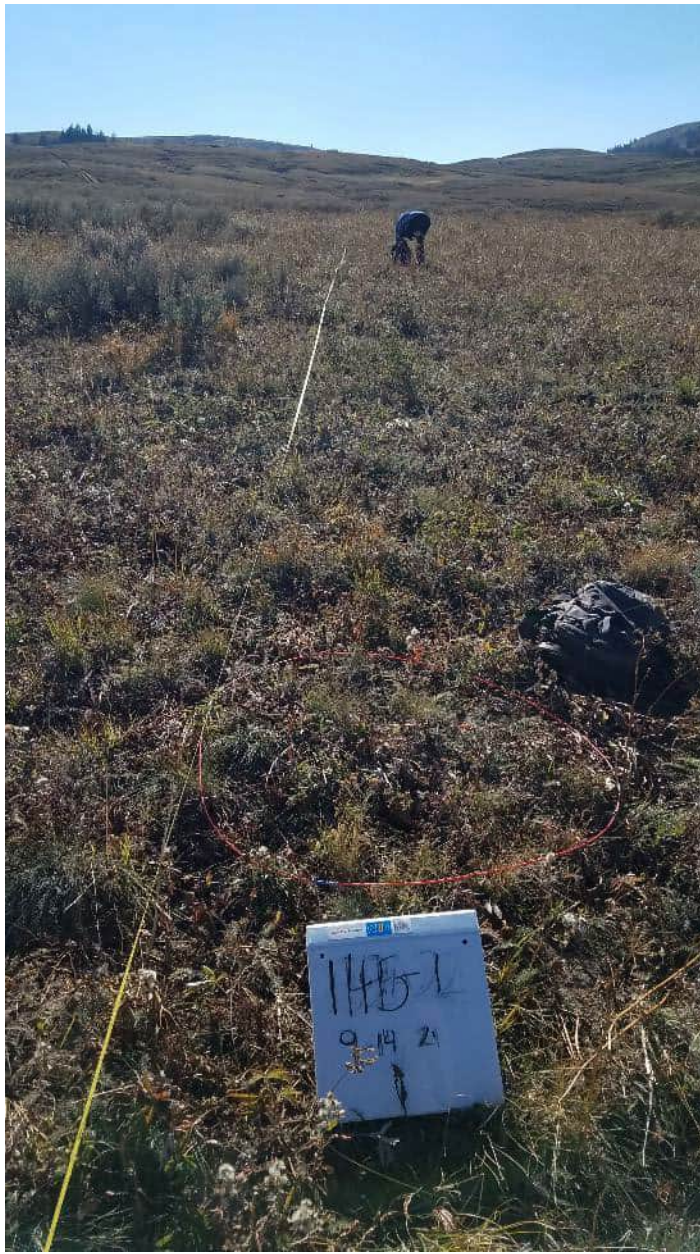




Exhibit 4
Fisherman Creek Range Ready Report
WWP and Y2U

June 12, 2022

Gregory Brooks
Big Piney Ranger District
10418 South US Highway 189
Big Piney, WY 83113



Re: Fisherman Creek Allotment, Range Ready Inspection

Cc: Ivan Geroy, Gary Hayward, Mike Henn, Anita DeLong, Kara Purser, Patricia O'Connor, Terry Padilla, Elise Boeke

Greg:

This is a follow-up to our telephone discussion after last week's Annual Upper Green River Area Rangeland Implementation Meeting. I appreciated your suggestions and the discussion. We discussed the range ready status of the Fisherman Creek allotment and my prior requests for the waypoints for Sublette County Conservation District monitoring locations on Upper Green. I have included all the folks who have been involved in our monitoring and cage discussions, so everyone is updated.

Range Ready: Today, June 12, I drove out from Hoback Ranches to Hwy 191 through Pasture 1 of the Fisherman Creek allotment. I stopped at three locations to inspect the key species, Idaho fescue, to determine its growth stage relative to entry of livestock. I measured the tallest leaf and inspected the plants for flowering stage. Location 1 was a moist site, location 2 a dry site and location 3 was in sagebrush, also a dry site. All were upgradient of the road. Idaho fescue had attained 8" height at location 1, 3.5" at location 2 and 4.8" at location 3. This was the tallest leaf. There were a very small number of Idaho fescue flowers emerging at location 1 and 2. I saw none at location 3. I suggest that it is at least two weeks or more (likely into July) until the rapid growth/flowering phase is past, which is considered a lower risk time to start grazing. My overall impression is that the Idaho fescue in the drier sites is in very low vigor from being grazed every year without rest and reflecting the long period of drought experienced. I also note that this May was an exceptionally wet month which has enhanced plant growth this spring and is not the usual situation.

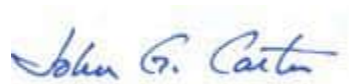
I have included the table and figure showing the growth curve and sensitive period for grazing from Holechek et al (2004) and the table from Hormay and Talbot (1961) which I sent earlier. Both indicate July is the more appropriate time for start of grazing. A map of locations and photos of what I observed are provided in the following pages. I am attaching the Hormay and Talbot paper as it is worth a read.

Upper Green Waypoints: A year ago, I asked for the waypoints being used by Sublette County for their permittee monitoring of the Upper Green complex. I asked Sublette County for them, and they referred me to the Forest. I asked Gary Hayward and he didn't have them. So, then I

submitted a FOIA to the BTNF and Anita DeLong sent me all the Forest monitoring sites she found. I mapped them all and none were the Sublette County waypoints. I know Sublette County has them as during last years' monitoring the County person was using her tablet and waypoints to navigate to the monitoring location we attended.

Western Watersheds Project recently received a special use permit to conduct monitoring on the Upper Green and Fisherman Creek allotments, including placing utilization cages. One of the provisions of that permit was that WWP provide the waypoints of all locations. This is not a problem and once the cages are installed by sometime in July, the locations will be mapped and provided to the BTNF. It seems inconsistent that WWP is required to provide the waypoints, but Sublette County is not. For whatever reason, however, we are repeating our request for the Sublette County Upper Green waypoints. These should be in a spreadsheet or table in electronic format for mapping and accurate navigation to the locations. We need these for our work in Upper Green this summer.

Sincerely,

A handwritten signature in blue ink that reads "John G. Carter". The signature is cursive and fluid, with the first name "John" and last name "Carter" clearly legible.

John Carter
Yellowstone to Uintas Connection
PO Box 464
Bondurant, Wy 82922

Jonathan Ratner
Western Watersheds Project
PO Box 171
Bondurant, Wy 82922

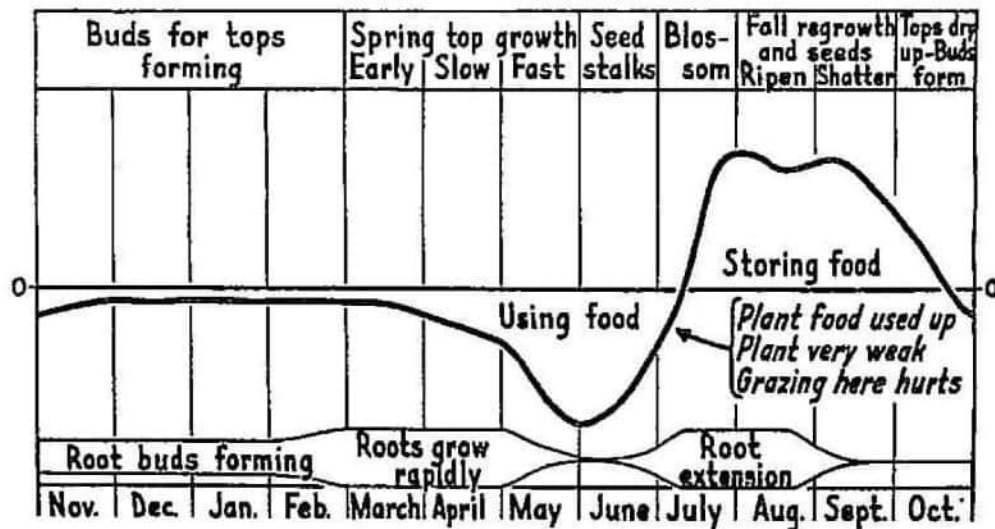


Figure 5.2 Major physiological events during the year for a typical rangegrass plant for an area with a cold winter and a dry summer. This diagram shows three things going on in a plant during the year: (1) top-growth (top line of diagram), (2) the rate at which the plant uses or stores food that it manufactures (curved heavy line), and (3) root growth. The rate of root growth is shown by the width of the strip just above the months of the year. Plants are most easily injured by grazing when their food storage is used up in the building of tops and roots. (From Parker 1969.)

Plant Phenology Figure 5.2 from Holechek et al (2004) Range Management Principles and Practices

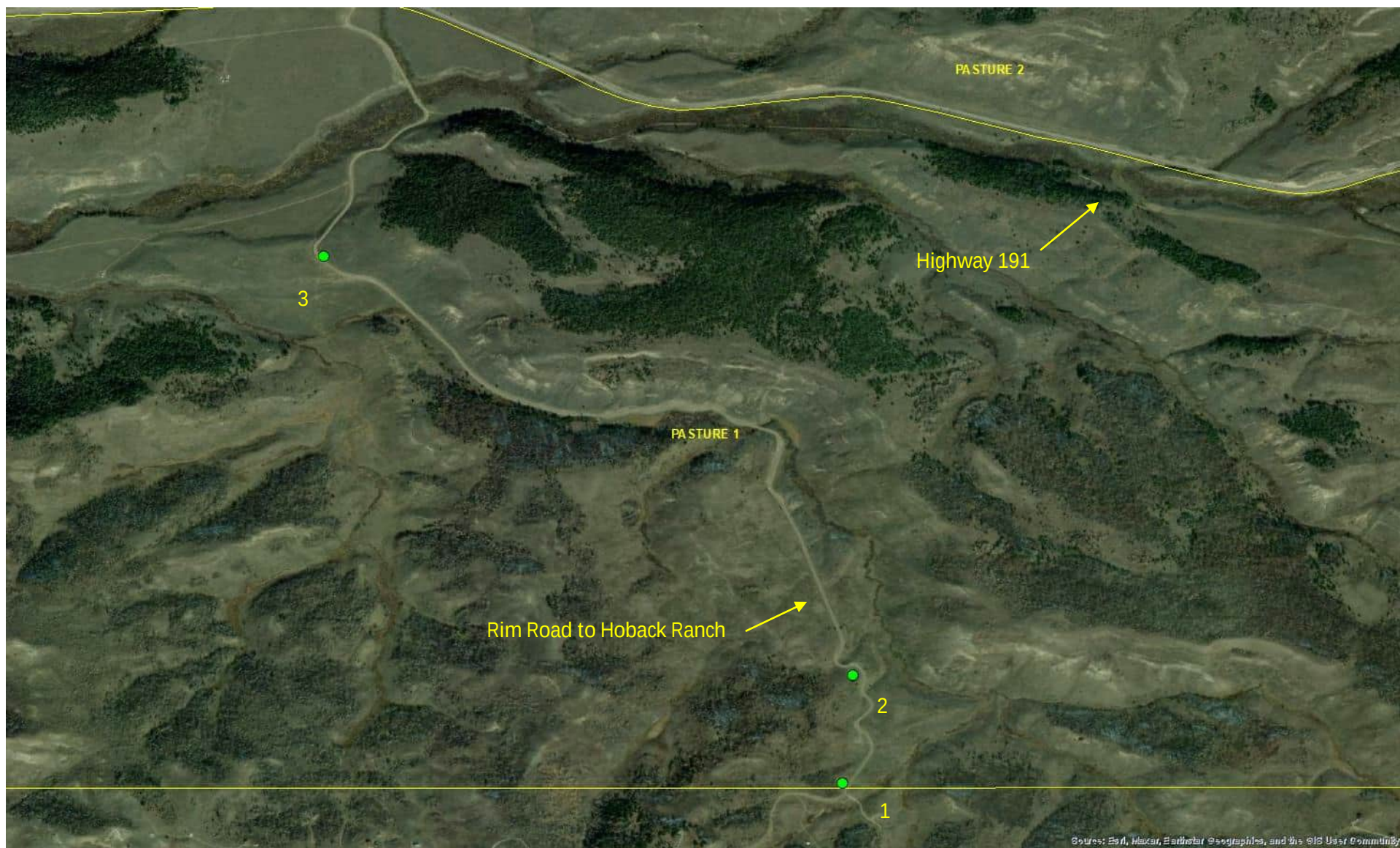
14 PROD. RESEARCH RPT. 51, U.S. DEPT. OF AGRICULTURE

TABLE 2.—Average date of flowering and seed ripening of some abundant plant species, pine type, the Burgess Spring Experimental Range, 1936-54

Species	Flowering		Seed ripening	
	Date	Basis, years	Date	Basis, years
		No.		No.
Ross sedge.....	May 15	5	June 24	7
Slender phlox.....	June 1	3	July 2	2
Littleflower collinsia.....	June 2	2	July 2	2
Lambstongue groundsel.....	June 6	4	July 10	4
Antelope bitterbrush.....	June 10	12	Aug. 5	5
Woolly wyethia.....	June 18	13	Aug. 1	6
Cheatgrass brome.....	June 19	10	July 24	8
Lemmon needlegrass.....	June 19	9	July 23	8
Sandberg bluegrass.....	June 21	10	July 24	7
Longspur lupine.....	June 25	14	July 29	6
Mountain brome.....	July 3	5	Aug. 7	5
Bottlebrush squirreltail.....	July 4	12	Aug. 6	6
Idaho fescue.....	July 9	13	Aug. 5	11
Flatpod groundsmoke.....	July 11	3	Aug. 27	2
Rabbitbrush goldenweed.....	Sept. 5	12	Oct. 5	6
Big sagebrush.....	Sept. 8	8	Oct. 6	4

Table 2 from Hormay and Talbot (1961) Rest-Rotation Grazing...A New Management System for Perennial Bunchgrass Ranges. Production Research Report No. 51. USDA Forest Service.

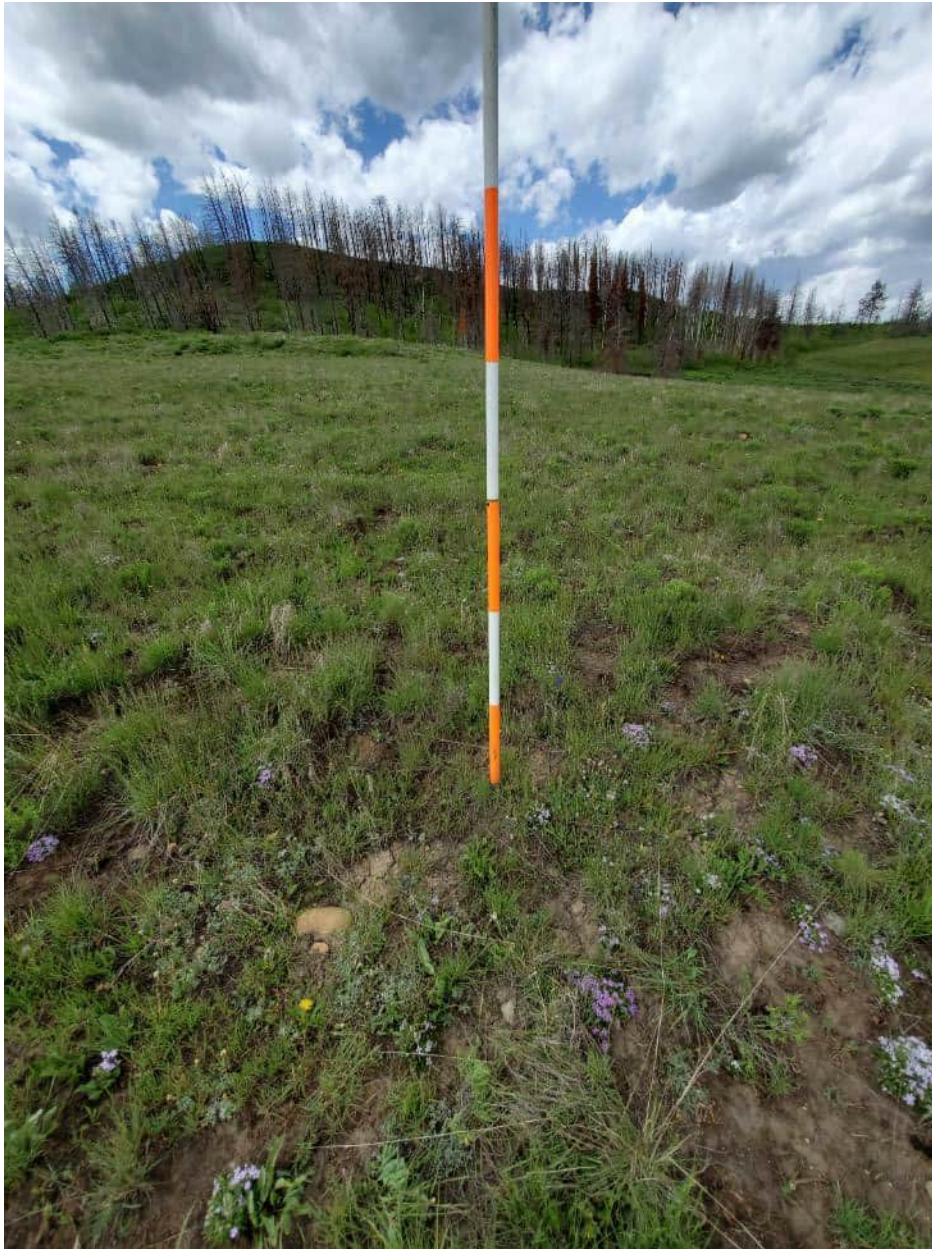
This table shows that Idaho fescue flowers on average around July 9, but that is at the lower elevation of the Burgess Experimental Range. Here in Wyoming at the elevation of Fisherman Creek and Upper Green, it would likely be later, indicating turnout should not occur before mid-July.



Fisherman Creek Allotment Pasture 1. Locations of Range Ready Inspection
June 12, 2022



Fisherman Creek Allotment Pasture 1 - Location 1 - June 12, 2022
Moist site - Idaho fescue top height 8" small number of flowers emerging from boot.
-110.283419 43.126044 Decimal Degrees



Fisherman Creek Allotment Pasture 1- Location 2 - June 12, 2022
 Dry site - Idaho fescue top height 3.5" small number of flowers emerging from boot.
 -110.283098 43.130042 Decimal Degrees



Fisherman Creek Allotment Pasture 1 - Location 3 - June 12, 2022
Sagebrush site - Idaho fescue top height 4.8" no flowers emerging from boot.
-110.303192 43.145961 Decimal Degrees

Exhibit 5

Upper Green and Fisherman Creek Monitoring 2022

Field Data and Photographs

WWP and Y2U

Location/Stubble Heights, inches	Locations	Down	Up	Greenline	Cage
Riparian - Fisherman Creek Pasture 1 Cage 1	1	7	2.5	4.5	6
Site FC - 1	2	2.5	2.5	4	7
Sedges	3	3	4.5	9	6.5
7/29/2022	4	3.5	5.5	5	6
	5	4	2.5	7.5	6
	6	3	4.5	4.5	6.5
	7	2	4	10.5	6
	8	3	6.5	10	5
	9	3	5.5	10	7.5
	10	3	2.5	3.5	7
	11	3	6	7.5	7
	12	2	3.5	11.5	7
	13	3.5	3	11.5	5
	14	2	2	6.5	5.5
	15	2	3	6.5	7
	16	2.5	3	4	7
	17	2	4	9	7
	18	2	4	9	6.5
	19	4	5.5	7	6.5
	20	3.5	3	6	6.5
	21	2.5	3	6.5	8
	22	2	5	6.5	8.5
	23	2.5	4	7	7
	24	2	5.5	6	7
	25	7	3	6.5	8
	26	3	4	4	7
	27	3	5	5.5	10
	28	3	6	4.5	10
	29	5	3	7	9
	30	3	3.5	7.5	8
	31	7	3.5	5.5	
	32	3.5	0	7	
	33	6	3.5	8	
Mean		3.3	3.8	6.9	7.0
Median		3.0	3.5	6.5	7.0
Standard Deviation		1.5	1.4	2.2	1.2

Location/Stubble Heights, inches	Locations	Down	Up	Greenline	Cage
Riparian - Fisherman Creek Pasture 1 Cage 2	1	2.5	3	8	9
Site FC - 2	2	4.5	4.5	4	8
Sedges	3	4	2.5	5	7
	4	2	3.5	7	3
	5	3	2	4	8
	6	3	2	6.5	8
	7	2	2	4	8
	8	4	3	6.5	8
	9	4.5	1.5	6.5	9
	10	2	2.5	7.5	6
	11	2	2.5	6	7
	12	5.5	3.5	5	8
	13	4.5	2.5	7	9
	14	3.5	3	7	7.5
	15	4.5	5	7	7
	16	3.5	5	3	6.5
	17	3.5		8	6.5
	18	3.5		6	8
	19	3.5		5	9
	20	2		3.5	9
	21	3.5		7	8
	22	5.5	5	6	8
	23	7.5	4	6.5	6
	24	5.5	4	3	7
	25		3	3	6
	26	10.5	2.5	7.5	7
	27	5	3	5	7
	28	3.5	2	8	6
	29	4.5	3.5	7	7
	30	5.5	3.5	4	7
	31	4	5	4	7
	32	6.5	3	6	7
	33	5	4	6	8
Mean		4.2	3.2	5.7	7.3
Median		4.0	3.0	6.0	7.0
Standard Deviation		1.8	1.0	1.6	1.2

Location/Stubble Heights, inches	Locations	Down	Up	Greenline	Cage
Riparian - Fisherman Creek Pasture 2 Cage 1	1	2	1	2.5	5
Site FC - 3	2	1.5	1.5	4	
Sedges	3	1.5	2.5	2	
7/29/2022	4	1.5	2	2.5	
	5	1.5	1.5	1.5	
	6	1	3	3	
	7	1	4.5	3	
	8	2.5	5	2	
	9	1.5	1	2	
	10	1	1	2.5	
	11	1	1.5	2.5	
	12	2	2	2.5	
	13	1	1.5	3	
	14	2	1.5	2	
	15	1	2	2.5	
	16	1	2.5	2.5	
	17	2	2.5	3	
	18	1.5	2.5	2	
	19	1	3	4	
	20	1.5	4	4	
	21	1	3	4	
	22	1.5	1.5	4.5	
	23	1.5	2.5	3	
	24	1	2	2	
	25	1	1.5	5	
	26	1	1.5	5.5	
	27	3	2	4	
	28	2	2.5	3	
	29	1.5	2	3	
	30	2	2	3	
	31	2	2	5	
	32	3	3.5	5	
	33	3	1.5	3	
Mean		1.6	2.2	3.1	5
Median		1.5	2	3	
Standard Deviation		0.62	0.96	1.05	

Location/Stubble Heights, inches	Locations	East Ungrazed	East Grazed	East All Measures	Trampled or Protected	East Grazed Net of Trample	West Ungrazed	West Grazed	West All Measures	Trampled or Protected	West Grazed Net of Trample
Upland - Fisherman Creek Pasture 4 Cage 4	1	2.5		2.5	T	0		1	1		1
Site FC - 4	2		1	1		1		2	2	T	0
Idaho Fescue	3		1	1		1		2.5	2.5	T	0
10/5/2022	4	3		3	T	0		0.5	0.5		0.5
East and West directions from Cage	5	3.5		3.5		3.5	6		6	P	6
	6	4		4	T	0	5		5	T	0
T = Trampled, P - Protected beneath shrub	7		0.5	0.5		0.5	4.5		4.5		4.5
	8	3.5		3.5	T	0		2	2		2
Forbs = cinquefoil, geranium, yarrow very little use	9		2	2		2		1	1		1
Grasses = Idaho fescue, smooth brome	10		2	2		2	6		6	T	0
Most grazed areas trampled, little vertical residual	11		2	2	T	0		1.5	1.5		1.5
Shrubs = big sage, potentilla	12	3.5		3.5		3.5		2	2		2
Gopher took 20% of cage area	13		1.5	1.5		1.5		1.5	1.5		1.5
	14	4		4	T	0	4		4		4
	15	3.5		3.5	P	3.5		2.5	2.5	T	0
	16		3	3		3		1.5	1.5		1.5
	17		1.5	1.5		1.5		0.5	0.5		0.5
	18		1	1	T	0		1.5	1.5	T	0
	19		0.5	0.5		0.5	4		4	T, P	0
	20	4		4		4		2.5	2.5	T, P	0
	21		1	1		1		2	2	T	0
	22	5.5		5.5	T, P	0	5		5	T, P	0
	23	4		4	T	0		1.5	1.5	T	0
	24		4	4	T	0		1.5	1.5		1.5
	25		1	1		1		1	1		1
	26		2	2		2		1	1		1
	27	4		4	T, P	0		1.5	1.5		1.5
	28		3	3	T	0	3		3	T	0
	29		1.5	1.5		1.5	4.5		4.5	T	0
	30		1	1		1		1.5	1.5		1.5
Mean		3.8	1.6	2.5		1.1	4.7	1.5	2.5		1.1
Median		3.75	1.5	2.25		1	4.5	1.5	2		0.75
Standard Deviation		0.72	0.94	1.35		1.28	0.97	0.59	1.62		1.47

Location/Stubble Heights, inches	Locations	North Ungrazed	North Grazed	North All Measures	Trampled or Protected	North Grazed Net of Trample	South Ungrazed	South Grazed	South All Measures	Trampled or Protected	South Grazed Net of Trample
Upland - Mosquito SE Cage 7	1		2	2	T	0	4		4	T	4
Site MSE - 7	2		1.5	1.5		1.5		1.5	1.5		1.5
Idaho Fescue	3		2.5	2.5		2.5		3.5	3.5	T	0
10/10/2022	4		3	3	T	0	5.5		5.5	P	5.5
	5		2	2		2	5		5	T	0
North and South directions from Cage	6		2	2	T	0	5		5	T	0
T = Trampled, P - Protected beneath shrub	7		2	2	T	0	4.5		4.5	T	0
	8	4.5		4.5		4.5	4		4	T	0
Forbs = geranium, buckwheat, antennaria, phlox, sneezew	9	4		4	T	0		3	3	T	0
Grasses = Idaho fescue, sedges	10	4.5		4.5	P	4.5	6		6	P	6
Shrubs = big sage, silver sage, potentilla	11		2	2		2	5		5	P	5
	12		2	2	T	0		0.5	0.5		0.5
	13		1	1		1		1	1		1
	14	7.5		7.5	P	7.5	5		5	P	5
	15		2.5	2.5	P	2.5		1.5	1.5		1.5
	16		1	1		1		1	1		1
	17		1	1		1		2	2		2
	18	4.5		4.5	P	4.5		2	2	T	0
	19	4		4	P	4	6		6	P	6
	20		1	1		1		1.5	1.5		1.5
	21		1	1		1		1.5	1.5		1.5
	22		1	1		1		1.5	1.5		1.5
	23		2	2		2		2	2		2
	24		1.5	1.5	T	0	4		4	P	4
	25		1	1		1	4.5		4.5	P	4.5
	26		2	2		2		1	1		1
	27	4		4	P	4		1	1		1
	28		1	1		1		0.5	0.5		0.5
	29		2.5	2.5	T	0		2	2		2
	30		3	3	T	0		1.5	1.5		1.5
Mean		4.7	1.8	2.5		1.7	4.9	1.6	2.9		2.0
Median		4.5	2	2		1	5	1.5	2		1.5
Standard Deviation		1.25	0.67	1.51		1.85	0.71	0.77	1.80		1.99

Location/Stubble Heights, inches	Locations	Grazed Down Transect	Willow Protected	Net Dn Grazed Stubble w/o willow	Grazed Up Transect	Willow Protected	Net Up Grazed Stubble w/o willow	Greenline
Riparian - Mosquito NE Cage 8	1	2		2	3.5		3.5	3
Site MNE - 8	2	4		4	2		2	3
Sedges	3	2		2	1		1	2
9/8/2022	4	2		2	2		2	3
	5	2		2	3		3	3
	6	2.5		2.5	3		3	2
	7	1.5		1.5	4		4	2.5
	8	1.5		1.5	1		1	1.5
	9	2		2	3		3	1.5
	10	2		2	2		2	2
	11	2		2	2		2	4
	12	2.5		2.5	3		3	4
	13	2		2	4.5		4.5	3
	14	3		3	3.5		3.5	3
	15	2		2	9.5	P		2
	16	5	P		8	P		2
	17	8	P		7	P		2
	18	6	P		4.5		4.5	2
	19	3		3	3.5		3.5	2
	20	3		3	4		4	5
	21	3		3	3		3	2
	22	5		5	2		2	2.5
	23	2		2	2		2	7
	24	2		2	3.5		3.5	2
	25	3		3	2		2	4
	26	3		3	2		2	1
	27	2.5		2.5	2		2	1
	28	4.5		4.5	2		2	2
	29	4		4	3		3	1.5
	30	3		3	1.5		1.5	2
	31	6		6	3		3	
	32	2		2	2		2	
	33							
Mean		3.1		2.7	3.2		2.7	2.6
Median		2.5		2.5	3		3	2
Standard Deviation		1.53		1.07	1.89		0.96	1.25

Location/Stubble Heights, inches	Locations	Grazed Down Transect	Willow Protected	Net Dn Grazed Stubble w/o willow	Grazed Up Transect	Willow Protected	Net Up Grazed Stubble w/o willow	Greenline
Riparian - Mosquito NW Cage 9	1	4		4	2.5		2.5	12
Site MNW - 9	2	3.5		3.5	2		2	12
Sedges	3	3.5		3.5	2		2	12
9/8/2022	4	3		3	2		2	8
	5	3		3	2.5		2.5	6
	6	6		6	2		2	4
	7	2.5		2.5	4		4	3
	8	4		4	3		3	4
	9	5		5	2		2	6
	10	7		7	2.5		2.5	4
	11	4		4	3.5		3.5	4
	12	7		7	3		3	6
	13	2.5		2.5	2		2	8
	14	2		2	2		2	5
	15	7		7	2		2	6
	16	5	P	0	2		2	6
	17	4	P	0	3		3	6
	18	3		3	2		2	6.5
	19	2		2	8	P	0	6
	20	2.5		2.5	4		4	4
	21	2		2	2		2	5
	22	3.5		3.5	11	P	0	5
	23	2.5		2.5	3		3	9
	24	3		3	4		4	9
	25				2.5		2.5	6
	26				3		3	6
	27				3		3	6
	28				2		2	6
	29				5		5	8
	30				3.5		3.5	7
	31				6	P	0	
	32				3.5		3.5	
	33							
Mean		3.8		3.4	3.3		2.5	6.5
Median		3.5		3	2.75		2.5	6
Standard Deviation		1.59		1.89	1.94		1.13	2.37

Location/Stubble Heights, inches	Locations	North Ungrazed	North Grazed	North All Measures	Trampled or Protected	North Grazed Net of Trample	South Ungrazed	South Grazed	South All Measures	Trampled or Protected	South Grazed Net of Trample
Upland - Tosi Cage 5	1		2.5	2.5	T	0		1.5	1.5		1.5
Site TT - 5	2		0.5	0.5		0.5		1	1		1
Idaho Fescue	3		1.5	1.5		1.5		1.5	1.5		1.5
10/10/2022	4		1.5	1.5		1.5		1.5	1.5		1.5
	5		1	1		1		1	1		1
North and South directions from Cage	6		2.5	2.5		2.5		1.5	1.5		1.5
T = Trampled, P - Protected beneath shrub	7	3		3	P	3		1	1		1
	8	3		3	P	3		2	2		2
Forbs = buckwheat, phlox	9	3.5		3.5	P	3.5		1	1		1
Grasses = Idaho fescue, sedges, rushes	10	2.5		2.5	P	2.5		1	1		1
Shrubs = big sage	11	5		5	P	5	3		3	P	3
Appears to be a moist site, high sagebrush can	12	2.5		2.5	P	2.5		1.5	1.5		1.5
Forbs very low stature result of trampling ove	13	4.5		4.5		4.5	5		5	P	5
Idaho fescue very low vigor, thread like leaves	14	4		4	T	0	5		5	P	5
	15		1.5	1.5		1.5		2.5	2.5		2.5
	16	4		4		4	4		4	P	4
	17		1	1		1		3	3	T	0
	18	3		3		3	5.5		5.5	P	5.5
	19	2		2		2		1.5	1.5		1.5
	20	4		4		4		1	1		1
	21	4.5		4.5	T	0	4.5		4.5	P	4.5
	22		2	2	T	0	5		5	P	5
	23		1.5	1.5		1.5		1.5	1.5		1.5
	24		1	1		1	3.5		3.5	P	3.5
	25		0.5	0.5		0.5	4.5		4.5	P	4.5
	26		1.5	1.5		1.5		1.5	1.5		1.5
	27	4		4	P	4		2	2		2
	28	4		4	P	4		0.5	0.5		0.5
	29	2.5		2.5		2.5		3.5	3.5	T	0
	30	2.5		2.5	P	2.5		1	1		1
Mean		3.4	1.4	2.6		2.1	4.4	1.5	2.4		2.2
Median		3.5	1.5	2.5		2.25	4.5	1.5	1.5		1.5
Standard Deviation		0.88	0.64	1.28		1.46	0.81	0.72	1.54		1.63

Location/Stubble Heights, inches	Locations	North Ungrazed	North Grazed	North All Measures	South Ungrazed	South Grazed	South All Measures
Upland - Lower Teepee Cage 6	1		1.5	1.5		1.5	1.5
Site TL - 6	2		2.5	2.5	5.5		5.5
Idaho Fescue	3	4.5		4.5		1	1
9/8/2022	4		1	1		1	1
	5		1	1		2	2
North and South directions from Cage	6		1.5	1.5		1	1
T = Trampled, P - Protected beneath shrub	7	5.5		5.5	3		3
Did not record trampled or protected	8		1.5	1.5	4		4
	9		1	1	4		4
	10		2.5	2.5		2	2
	11		1.5	1.5	4		4
	12		1	1		2	2
	13	3		3		2	2
	14		1	1		1	1
	15	5.5		5.5		1.5	1.5
	16		2	2		1	1
	17	5		5		2	2
	18		2	2		1	1
	19		2	2	6.5		6.5
	20		1	1		1	1
	21	3.5		3.5		2	2
	22		3	3		2	2
	23		2	2		2	2
	24		2	2		2	2
	25		1	1		2	2
	26	4		4		2	2
	27		1	1	6		6
	28		2	2		2	2
	29		2.5	2.5		1	1
	30		1.5	1.5		2.5	2.5
	31		1.5	1.5			
	32		1	1			
	33		1	1			
	34		1	1			
Mean		4.4	1.6	2.2	4.7	1.6	2.4
Median		4.5	1.5	2	4	2	2
Standard Deviation		0.98	0.60	1.36	1.29	0.50	1.52

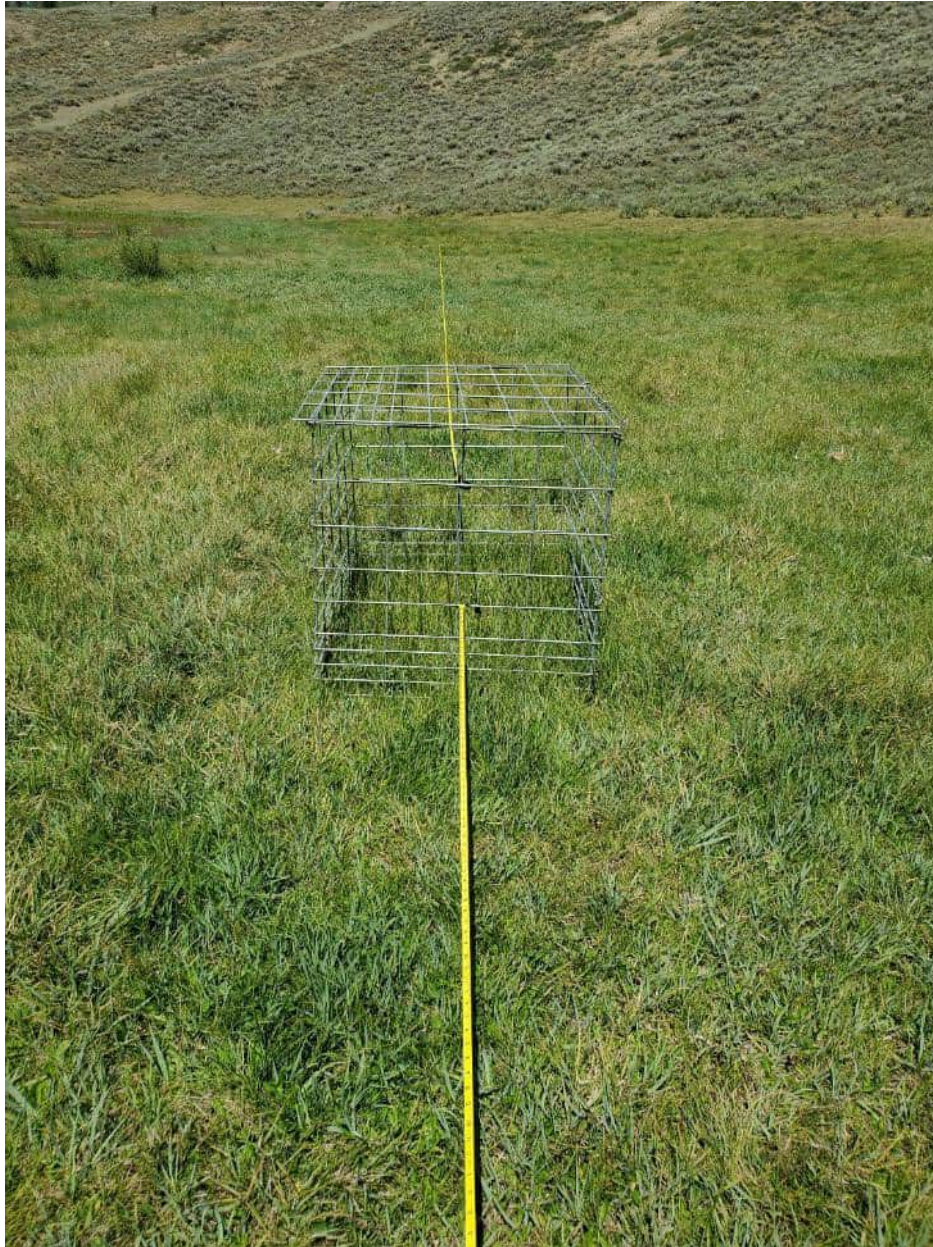
Location/Stubble Heights, inches	Locations	North Ungrazed	North Grazed	North All Measures	Trampled or Protected	North Grazed Net of Trample	South Ungrazed	South Grazed	South All Measures	Trampled or Protected	South Grazed Net of Trample
Upland - River Bottom Cage 3	1		1	1		1		1.5	1.5		1.5
Site RB -4	2	5		5	P	5		1.5	1.5		1.5
Idaho Fescue	3		0.5	0.5		0.5		1	1		1
10/13/2022	4	5		5	P	5	5		5	P	5
	5	5.5		5.5	P	5.5		1	1		1
Up (north) and downstream (south) from cage	6		2.5	2.5		2.5		2	2		2
T = Trampled, P - Protected beneath shrub	7		4.5	4.5	T	0		0.5	0.5		0.5
	8	6		6	P	6		2	2		2
Forbs = buckwheat, phlox, antennaria, aster, lupine	9		1.5	1.5		1.5		1	1		1
Grasses = Idaho fescue, sedges, rushes	10		2	2		2		2.5	2.5	T	0
Shrubs = big sage	11		3	3	T	0		1	1		1
	12							1	1		1
Forbs very low stature result of trampling over time	13		1	1		1		1.5	1.5		1.5
Idaho fescue very low vigor, thread like leaves	14		1	1		1	6		6	P	6
	15		1	1		1	4		4	T, P	0
	16		1.5	1.5		1.5		0.5	0.5		0.5
	17		0.5	0.5		0.5		2	2		2
	18	7		7	P	7		1.5	1.5		1.5
	19		1	1		1		1	1		1
	20		3	3	T	0		1	1	T	0
	21	5.5		5.5	P	5.5	5		5	P	5
	22		0.5	0.5		0.5		0.5	0.5		0.5
	23		0.5	0.5		0.5		1	1		1
	24		1	1		1		1	1		1
	25	5		5	P	5		1.5	1.5		1.5
	26		1	1		1		1.5	1.5		1.5
	27		1	1		1		1	1		1
	28		1.5	1.5		1.5		2.5	2.5	T	0
	29		1	1		1	4		4		4
	30		1.5	1.5		1.5		1	1		1
Mean		5.6	1.5	2.4		2.1	4.8	1.3	1.9		1.6
Median		5.5	1	1.5		1	5	1	1.5		1
Standard Deviation		0.73	1.00	2.02		2.10	0.84	0.56	1.45		1.51

Location/Stubble Heights, inches	Locations	East Ungrazed	East Grazed	East All Measures	Trampled or Protected	East Grazed Net of Trample	West Ungrazed	West Grazed	West All Measures	Trampled or Protected	West Grazed Net of Trample
Upland - Lower Gypsum Cage 1	1	4		4	T	4		2	2	T	0
Site GL - 1	2		1	1		1		2	2	T	0
Idaho Fescue	3		1.5	1.5		1.5		2.5	2.5		2.5
10/19/2022	4		1.5	1.5		1.5	5		5		5
	5	4		4	T	0	5		5	T	0
East and West from Cage	6		1.5	1.5		1.5		1	1		1
T = Trampled, P - Protected beneath shrub	7		1	1		1	4		4		4
	8		0.5	0.5		0.5		1	1		1
Forbs = buckwheat, lupine, buckwheat, cinquefoil	9		0.5	0.5		0.5	4.5		4.5		4.5
Grasses = Idaho fescue, sedges, slender wheatgrass	10		1	1		1		1	1		1
Meadow site - no shrubs adjacent to slope with	11		1.5	1.5	T	0		1.5	1.5		1.5
Idaho Fescue low vigor (across all sites)	12		1	1		1	4.5		4.5	T	0
	13		0.5	0.5		0.5		1	1		1
	14	4		4		4		1.5	1.5		1.5
	15		0.5	0.5		0.5	5		5	T	0
	16	3		3		3		1	1		1
	17		0.5	0.5		0.5		1	1		1
	18		2	2	T	0		1	1		1
	19	3.5		3.5		3.5		0.5	0.5		0.5
	20		1.5	1.5		1.5	7		7		7
	21		1.5	1.5		1.5		1	1		1
	22		2	2		2		1.5	1.5		1.5
	23	5.5		5.5	T	0		0.5	0.5		0.5
	24		1	1		1		3	3	T	0
	25	4.5		4.5		4.5		3	3	T	0
	26	4		4	T	0		1.5	1.5	T	0
	27		0.5	0.5		0.5		1	1		1
	28		1	1	T	0		1.5	1.5		1.5
	29		1	1		1		0.5	0.5		0.5
	30		0.5	0.5		0.5		1.5	1.5		1.5
Mean		4.1	1.1	1.9		1.3	5.0	1.4	2.2		1.4
Median		4	1	1.5		1	5	1	1.5		1
Standard Deviation		0.73	0.50	1.46		1.29	0.96	0.71	1.73		1.68

Location/Stubble Heights, inches	Locations	Up Ungrazed	Up Grazed	Up All Measures	Trampled or Protected	Up Grazed Net of Trample	Down Ungrazed	Down Grazed	Down All Measures	Trampled or Protected	Down Grazed Net of Trample	Greenline Ungrazed	Greenline
Riparian - Lower Gypsum Cage 2	1		1	1		1		1	1		1		3.5
Site GL - 2	2		4	4		4		3	3		3		3
Sedges	3		3	3	T	0		6	6	T	0		3
10/19/2022	4	7		7		7		1.5	1.5		1.5		2.5
	5	7		7		7		7	7	T	0		2.5
	6		1.5	1.5		1.5		5	5	T	0		4
	7		5	5		5		4	4		4		6
	8		3.5	3.5		3.5		1	1		1		1
	9		4	4		4		4	4		4	6	6
	10		2	2		2		7	7	T	0		2
Meadow site - few stunted willows	11	6		6		6		3	3		3		2
	12		5	5	T	0		2	2		2		3.5
	13		2.5	2.5		2.5		4	4		4		2
	14		2.5	2.5		2.5		4	4		4		2
	15		2.5	2.5	T	0		6	6	T	0		3
	16		4	4	T	0		3	3		3		3
	17		2.5	2.5		2.5		1.5	1.5		1.5		1.5
	18		2	2		2		1	1		1		2.5
	19		2	2		2	6		6		6		1.5
	20		3	3	T	0	5		5		5		2
	21	8		8		8		1.5	1.5		1.5		3
	22		1	1		1		2	2		2	6	6
	23	7		7		7		6	6	T	0	7	7
	24		2	2		2		2	2		2		1.5
	25		3	3		3		3	3		3		2
	26		1.5	1.5		1.5		3.5	3.5		3.5	9	9
	27						10		10		10		1.5
	28						8		8		8	9	9
	29							9	9	T	0	7	7
	30							2	2		2		5
							7		7		7		2
							8		8		8		3
							9		9		9		2.5
							7		7		7		4
							6		6		6	9	9
							9		9		9		
Mean		7.0	2.7	3.6		2.9	7.5	3.6	4.7		3.4	7.6	3.7
Median		7.0	2.5	3.0		2.3	7.5	3.0	4.0		3.0	7.0	3.0
Standard Deviation		0.71	1.17	2.03		2.45	1.58	2.17	2.68		2.97	1.40	2.30

Location/Stubble Heights, inches	Locations	North Ungrazed	North Grazed	North All Measures	Trampled or Protected	North Grazed Net of Trample	South Ungrazed	South Grazed	South All Measures	Trampled or Protected	South Grazed Net of Trample
Upland - Lower Gypsum Cage 3	1		2.5	2.5		2.5		1.5	1.5		1.5
Site GL - 3	2		1	1		1		1.5	1.5		1.5
Idaho Fescue, sedge, rush combined heights	3	5		5	T	5		2	2		2
10/19/2022	4	4		4		4		2	2		2
	5		1	1		1		2.5	2.5		2.5
North and South from Cage	6		1.5	1.5		1.5	6		6		6
T = Trampled, P - Protected beneath shrub	7		2.5	2.5		2.5		1	1		1
	8	6		6		6		2	2		2
Forbs = antennaria	9		2.5	2.5		2.5		3.5	3.5	T	0
Grasses = Idaho fescue, sedges, rushes, wheat	10		1.5	1.5		1.5		2	2		2
Meadow site - no shrubs adjacent to slope with	11		2.5	2.5		2.5		1	1	T	0
Idaho Fescue low vigor (across all sites)	12	4		4	T	0		3	3		3
Mesic site	13	4		4		4		2	2		2
	14		2.5	2.5		2.5		0.5	0.5		0.5
	15	4		4		4		2.5	2.5		2.5
	16	6		6		6		3.5	3.5	T	0
	17	4		4		4		1	1		1
	18		2	2		2		1.5	1.5		1.5
	19		2	2		2	5		5		5
	20	5		5		5	4		4	T	0
	21		2	2		2		4	4	T	0
	22		2	2		2	4		4		4
	23	5		5		5	6		6		6
	24		1	1		1	5		5		5
	25		2	2		2		1	1		1
	26	5		5		5		2	2	T	0
	27	6		6		6		1.5	1.5		1.5
	28		2.5	2.5	T	0	7		7		7
	29		4.5	4.5		4.5	5		5		5
	30		4.5	4.5		4.5	7		7		7
Mean		4.8	2.2	3.3		3.1	5.4	2.0	3.0		2.4
Median		5	2	2.5		2.5	5	2	2.25		2
Standard Deviation		0.83	0.99	1.59		1.78	1.13	0.93	1.89		2.19

Allotment	Pasture	Site No	Site Description	Date	Plot	Grass, Forb or Combined	Sample + Bag, gms	Bag, gms	Net Air Dry, gms
Fisherman Creek	Pasture 1	FC - 1	Riparian - Meadow/Greenline	7/29/2022	Cage (1)	C	163.3	47.5	115.8
Fisherman Creek	Pasture 1	FC - 1	Riparian - Meadow/Greenline	7/29/2022	Cage (2)	C	118.7	47.5	71.2
Fisherman Creek	Pasture 1	FC - 1	Riparian - Meadow/Greenline	7/29/2022	Dn Grazed	C	124.3	47.5	76.8
Fisherman Creek	Pasture 1	FC - 1	Riparian - Meadow/Greenline	7/29/2022	Up Grazed	C	137.5	47.5	90
Fisherman Creek	Pasture 1	FC - 2	Riparian - Meadow/Greenline	7/29/2022	Cage (1)	C	203.5	47.5	156
Fisherman Creek	Pasture 1	FC - 2	Riparian - Meadow/Greenline	7/29/2022	Cage (2)	C	151.9	47.5	104.4
Fisherman Creek	Pasture 1	FC - 2	Riparian - Meadow/Greenline	7/29/2022	Dn Grazed	C	97.5	47.5	50
Fisherman Creek	Pasture 1	FC - 2	Riparian - Meadow/Greenline	7/29/2022	Up Grazed	C	103.2	47.5	55.7
Fisherman Creek	Pasture 2	FC - 3	Riparian - Meadow/Greenline	7/29/2022	Cage (1)	C	173.3	47.5	125.8
Fisherman Creek	Pasture 2	FC - 3	Riparian - Meadow/Greenline	7/29/2022	Cage (2)	C	176.4	47.5	128.9
Fisherman Creek	Pasture 2	FC - 3	Riparian - Meadow/Greenline	7/29/2022	Dn Grazed	C	71.9	47.5	24.4
Fisherman Creek	Pasture 2	FC - 3	Riparian - Meadow/Greenline	7/29/2022	Up Grazed	C	60.8	47.5	13.3
Fisherman Creek	Pasture 4	FC - 4	Upland - Big sage	10/5/2022	Cage	F	14.9	9.2	5.7
Fisherman Creek	Pasture 4	FC - 4	Upland - Big sage	10/5/2022	E Grazed	F	10.9	9.2	1.7
Fisherman Creek	Pasture 4	FC - 4	Upland - Big sage	10/5/2022	W Grazed	F	17.1	9.2	7.9
Fisherman Creek	Pasture 4	FC - 4	Upland - Big sage	10/5/2022	Cage	G	220.3	47.5	172.8
Fisherman Creek	Pasture 4	FC - 4	Upland - Big sage	10/5/2022	E Grazed	G	63.2	47.5	15.7
Fisherman Creek	Pasture 4	FC - 4	Upland - Big sage	10/5/2022	W Grazed	G	24.6	9.2	15.4
Upper Green	Lower Gypsum	GL - 1	Upland - Mesic Meadow	10/19/2022	Cage	F	40	9.2	30.8
Upper Green	Lower Gypsum	GL - 1	Upland - Mesic Meadow	10/19/2022	E Grazed	F	23	9.2	13.8
Upper Green	Lower Gypsum	GL - 1	Upland - Mesic Meadow	10/19/2022	W Grazed	F	25.4	9.2	16.2
Upper Green	Lower Gypsum	GL - 1	Upland - Mesic Meadow	10/19/2022	Cage	G	48.1	9.2	38.9
Upper Green	Lower Gypsum	GL - 1	Upland - Mesic Meadow	10/19/2022	E Grazed	G	20.5	9.2	11.3
Upper Green	Lower Gypsum	GL - 1	Upland - Mesic Meadow	10/19/2022	W Grazed	G	18.7	9.2	9.5
Upper Green	Lower Gypsum	GL - 2	Riparian - Meadow/Greenline	10/19/2022	Cage (1)	C	46.5	9.2	37.3
Upper Green	Lower Gypsum	GL - 2	Riparian - Meadow/Greenline	10/19/2022	Cage (2)	C	53.3	9.2	44.1
Upper Green	Lower Gypsum	GL - 2	Riparian - Meadow/Greenline	10/19/2022	Dn Grazed	C	49.1	9.2	39.9
Upper Green	Lower Gypsum	GL - 2	Riparian - Meadow/Greenline	10/19/2022	Up Grazed	C	39.5	9.2	30.3
Upper Green	Lower Gypsum	GL - 3	Upland - Mesic Meadow	10/19/2022	Cage	F	14.6	9.2	5.4
Upper Green	Lower Gypsum	GL - 3	Upland - Mesic Meadow	10/19/2022	N Grazed	F	10.5	9.2	1.3
Upper Green	Lower Gypsum	GL - 3	Upland - Mesic Meadow	10/19/2022	S Grazed	F	11.1	9.2	1.9
Upper Green	Lower Gypsum	GL - 3	Upland - Mesic Meadow	10/19/2022	Cage	G	82	9.2	72.8
Upper Green	Lower Gypsum	GL - 3	Upland - Mesic Meadow	10/19/2022	N Grazed	G	51.9	9.2	42.7
Upper Green	Lower Gypsum	GL - 3	Upland - Mesic Meadow	10/19/2022	S Grazed	G	26.3	9.2	17.1
Upper Green	Lower Teepee	TL - 6	Upland - Big sage	9/8/2022	Cage	F	102.4	47.5	54.9
Upper Green	Lower Teepee	TL - 6	Upland - Big sage	9/8/2022	N Grazed	F	12.3	9.2	3.1
Upper Green	Lower Teepee	TL - 6	Upland - Big sage	9/8/2022	S Grazed	F	11.8	9.2	2.6
Upper Green	Lower Teepee	TL - 6	Upland - Big sage	9/8/2022	Cage	G	23.5	9.2	14.3
Upper Green	Lower Teepee	TL - 6	Upland - Big sage	9/8/2022	N Grazed	G	13.2	9.2	4
Upper Green	Lower Teepee	TL - 6	Upland - Big sage	9/8/2022	S Grazed	G	18.2	9.2	9
Upper Green	Mosquito NE	MNE - 8	Riparian - Meadow/Greenline	9/8/2022	Cage (1)	C	88.8	47.5	41.3
Upper Green	Mosquito NE	MNE - 8	Riparian - Meadow/Greenline	9/8/2022	Cage (2)	C	114.1	47.5	66.6
Upper Green	Mosquito NE	MNE - 8	Riparian - Meadow/Greenline	9/8/2022	Dn Grazed	C	26.6	9.2	17.4
Upper Green	Mosquito NE	MNE - 8	Riparian - Meadow/Greenline	9/8/2022	Up Grazed	C	25.7	9.2	16.5
Upper Green	Mosquito NW	MNW - 9	Riparian - Meadow/Greenline	9/8/2022	Cage (1)	C	197	47.5	149.5
Upper Green	Mosquito NW	MNW - 9	Riparian - Meadow/Greenline	9/8/2022	Cage (2)	C	161.4	47.5	113.9
Upper Green	Mosquito NW	MNW - 9	Riparian - Meadow/Greenline	9/8/2022	Up Grazed	C	105.3	47.5	57.8
Upper Green	Mosquito NW	MNW - 9	Riparian - Meadow/Greenline	9/8/2022	Dn Grazed	C	75.1	47.5	27.6
Upper Green	Mosquito SE	MSE - 7	Upland - Big sage	10/10/2022	Cage	F	36.1	9.2	26.9
Upper Green	Mosquito SE	MSE - 7	Upland - Big sage	10/10/2022	N Grazed	F	9.9	9.2	0.7
Upper Green	Mosquito SE	MSE - 7	Upland - Big sage	10/10/2022	S Grazed	F	12.3	9.2	3.1
Upper Green	Mosquito SE	MSE - 7	Upland - Big sage	10/10/2022	Cage	G	64	9.2	54.8
Upper Green	Mosquito SE	MSE - 7	Upland - Big sage	10/10/2022	N Grazed	G	16.4	9.2	7.2
Upper Green	Mosquito SE	MSE - 7	Upland - Big sage	10/10/2022	S Grazed	G	13.2	9.2	4
Upper Green	River Bottom	RB - 4	Upland - Big sage	10/13/2022	Cage	F	16.5	9.2	7.3
Upper Green	River Bottom	RB - 4	Upland - Big sage	10/13/2022	N Grazed	F	9.8	9.2	0.6
Upper Green	River Bottom	RB - 4	Upland - Big sage	10/13/2022	S Grazed	F	10.3	9.2	1.1
Upper Green	River Bottom	RB - 4	Upland - Big sage	10/13/2022	Cage	G	44	9.2	34.8
Upper Green	River Bottom	RB - 4	Upland - Big sage	10/13/2022	N Grazed	G	12.9	9.2	3.7
Upper Green	River Bottom	RB - 4	Upland - Big sage	10/13/2022	S Grazed	G	12.8	9.2	3.6
Upper Green	Tosi	TT - 5	Upland - Big sage	10/10/2022	Cage	F	13.1	9.2	3.9
Upper Green	Tosi	TT - 5	Upland - Big sage	10/10/2022	E Grazed	F	14.5	9.2	5.3
Upper Green	Tosi	TT - 5	Upland - Big sage	10/10/2022	S Grazed	F	12.8	9.2	3.6
Upper Green	Tosi	TT - 5	Upland - Big sage	10/10/2022	Cage	G	33.5	9.2	24.3
Upper Green	Tosi	TT - 5	Upland - Big sage	10/10/2022	E Grazed	G	19.8	9.2	10.6
Upper Green	Tosi	TT - 5	Upland - Big sage	10/10/2022	S Grazed	G	18.2	9.2	9

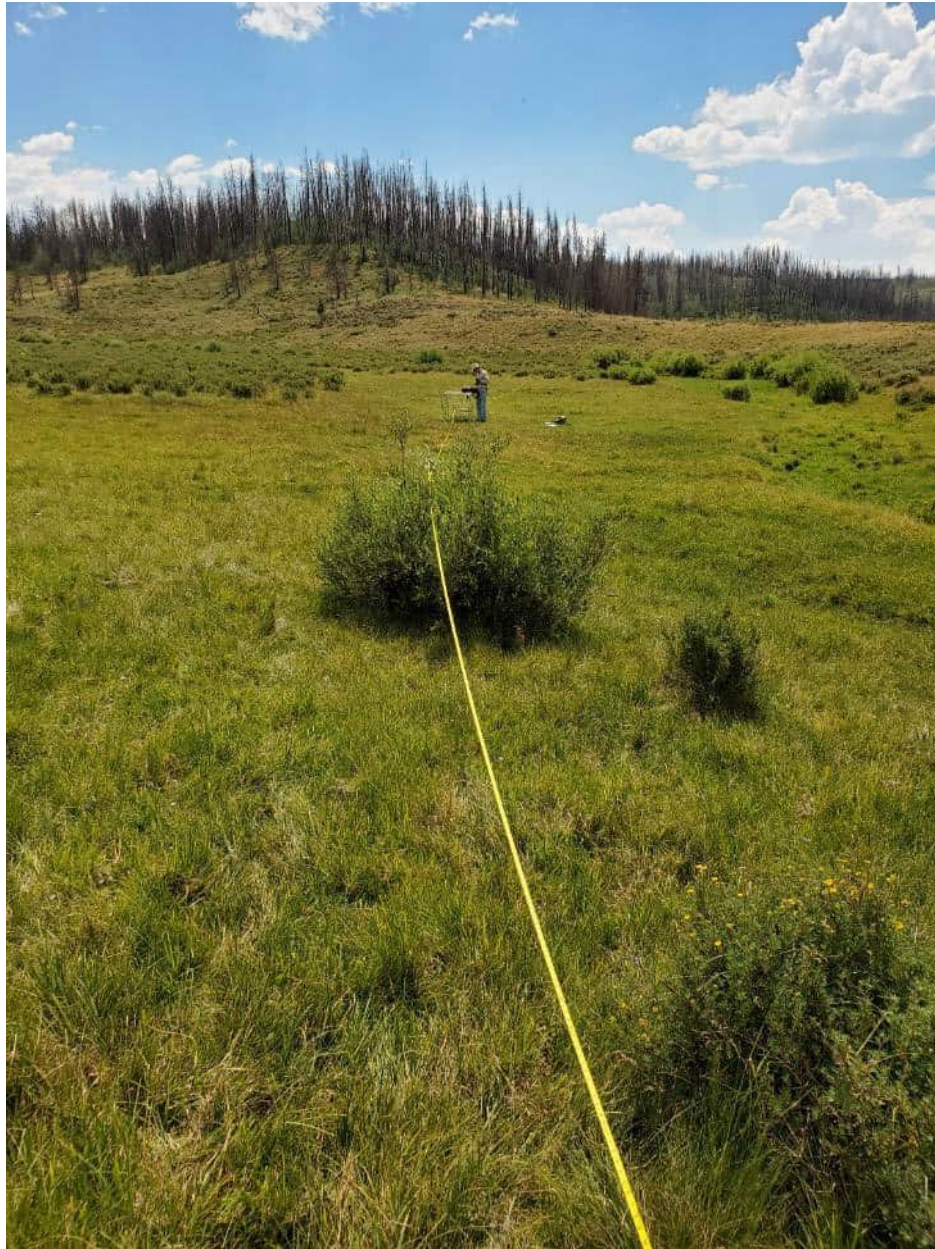


Fisherman Creek Site FC-1, July 29, 2022. Overview of transects and cage location at time of clipping. Ungrazed sedges, grasses and forbs in the cage were 2017.7 lb/acre, grazed plot residuals averaged 899.9 lb/acre for a utilization of 55.4%.



Fisherman Creek Site FC-1, July 29, 2022. Upper photo of cage plot prior to clipping, lower photo of two grazed plots prior to clipping.





Fisherman Creek Site FC-2, July 29, 2022. Overview of transects and cage location at time of clipping. Ungrazed sedges, grasses and forbs in the cage were 2809.7 lb/acre, grazed plot residuals averaged 570.8 lb/acre for a utilization of 79.7%



Fisherman Creek Site FC-2, July 29, 2022. Upper photo of cage plot prior to clipping, lower photo of two grazed plots prior to clipping.





Fisherman Creek Site FC-3, August 8, 2022. Overview of transects and cage location at time of clipping. Ungrazed sedges, grasses and forbs in the cage were 2748.2 lb/acre, grazed plot residuals averaged 203.9 lb/acre for a utilization of 92.6%



Fisherman Creek Site FC-3, August 8, 2022.
Upper photo of cage plot prior to clipping, lower
photo of two grazed plots prior to clipping.





Fisherman Creek Site FC-4, October 5, 2022. Overview of transects and cage location at time of clipping. Ungrazed grasses and forbs in the cage were 1926 lb/acre with 1864.5 lb/acre being grasses. Grazed plot grass and forb residuals averaged 220.1 lb/acre, with 168.2 lb/acre being grasses. Utilization was 88.6% on combined grasses and forbs, while utilization for grasses only was 91%. This plot was biased with smooth brome occurring in the cage but not in the grazed plots.



Fisherman Creek Site FC-4, October 5, 2022.
Upper photo of cage plot prior to clipping, lower
photo of two grazed plots prior to clipping.



Mosquito Lakes SE Site MSE-7, October 10, 2022. Overview of transects and cage location at time of clipping. Ungrazed grasses and forbs in the cage were 881.5 lb/acre with 591.3 lb/acre being grasses. Grazed plot grass and forb residuals averaged 80.9 lb/acre, with 60.4 lb/acre being grasses. Utilization was 90.8% on combined grasses and forbs, while utilization for grasses only was 89.8%. This site produced 24.5% of potential. However, it appears to be misclassified as sub-irrigated and likely is producing a greater percent of potential if reclassified into Loamy Foothills and Mountains West in which it would be producing 48.9% of potential.



Mosquito Lakes SE Site MSE-7, October 10, 2022.
Upper right photo of cage plot prior to clipping,
left photo of two grazed plots prior to clipping.



Mosquito Lakes NE Site MNE-8, September 8, 2022. Upper right photo of transect overview, at left, photos of two grazed plots prior to clipping. A photo of the caged plot was not taken. Ungrazed sedges, grasses and forbs in the cage were 1164.2 lb/acre, grazed plot residuals averaged 183.4 lb/acre for a utilization of 84.3%. This site produced 32.3% of potential.



Mosquito Lakes NE Site MNE-8, September 8, 2022. Photos of hummocks, hoof shear, and head cut in intermittent channel. The ESD for this site notes channel development is a degraded state. Channel development will gradually dewater the meadow leading to a loss in productivity and change to more xeric species.





Mosquito Lakes NW Site MNW-9, September 8, 2022. Overview of transect at time of clipping. Ungrazed sedges, grasses and forbs in the cage were 2842.1 lb/acre, grazed plot residuals averaged 460.7 lb/acre for a utilization of 84.3%. This site produced 78.9% of potential.



Mosquito Lakes NW Site MNW-9, September 8, 2022. Upper right photo of cage plot, lower left, and upper photos of grazed plots prior to clipping

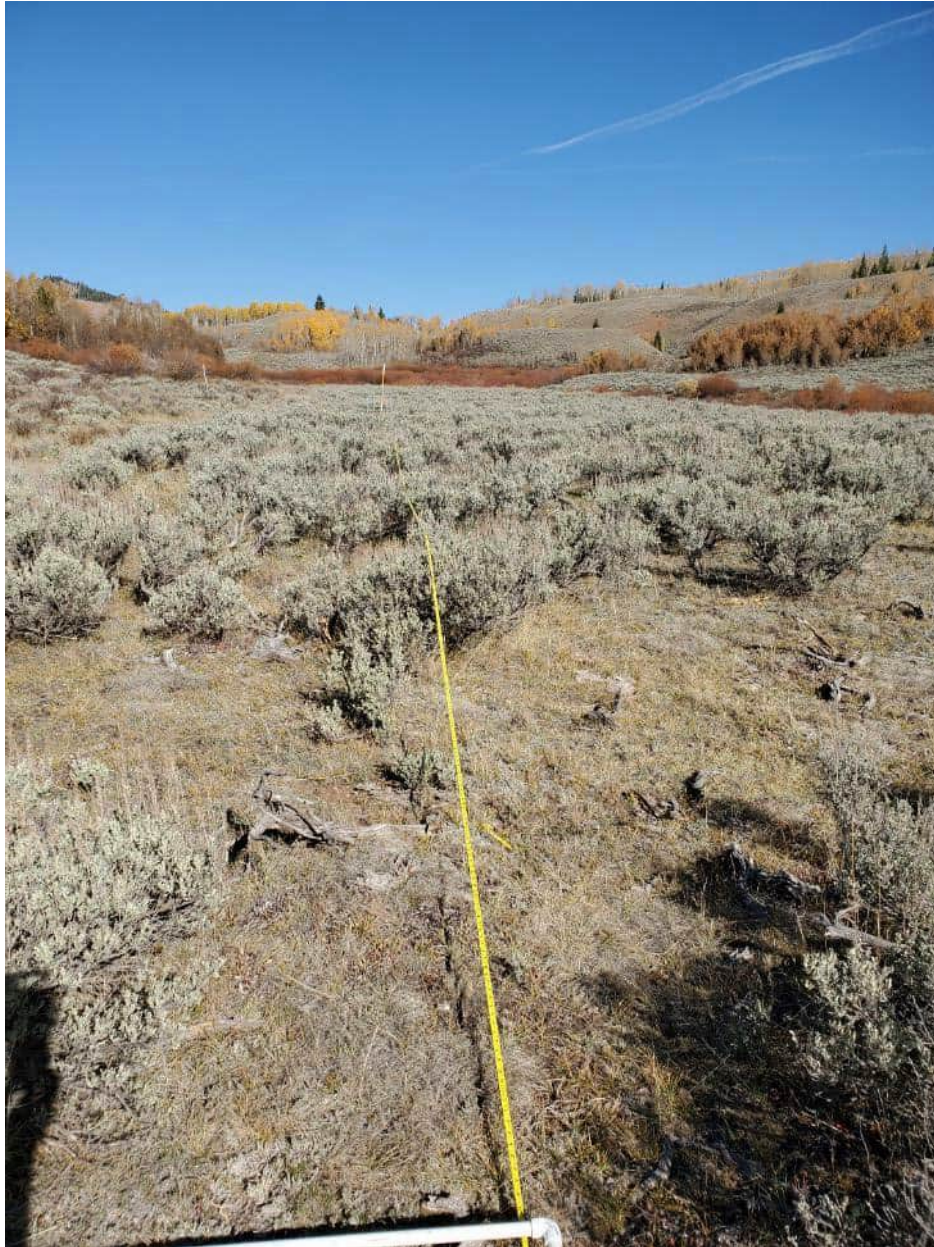


Lower Teepee Site TL-6, September 8, 2022. Overview of transect at time of clipping. Ungrazed grasses and forbs in the cage were 746.7 lb/acre with 154.3 lb/acre being grasses. Grazed plot grass and forb residuals averaged 101.4 lb/acre, with 70.1 lb/acre being grasses. Utilization was 86.4% on combined grasses and forbs, while utilization for grasses only was 54.5%.

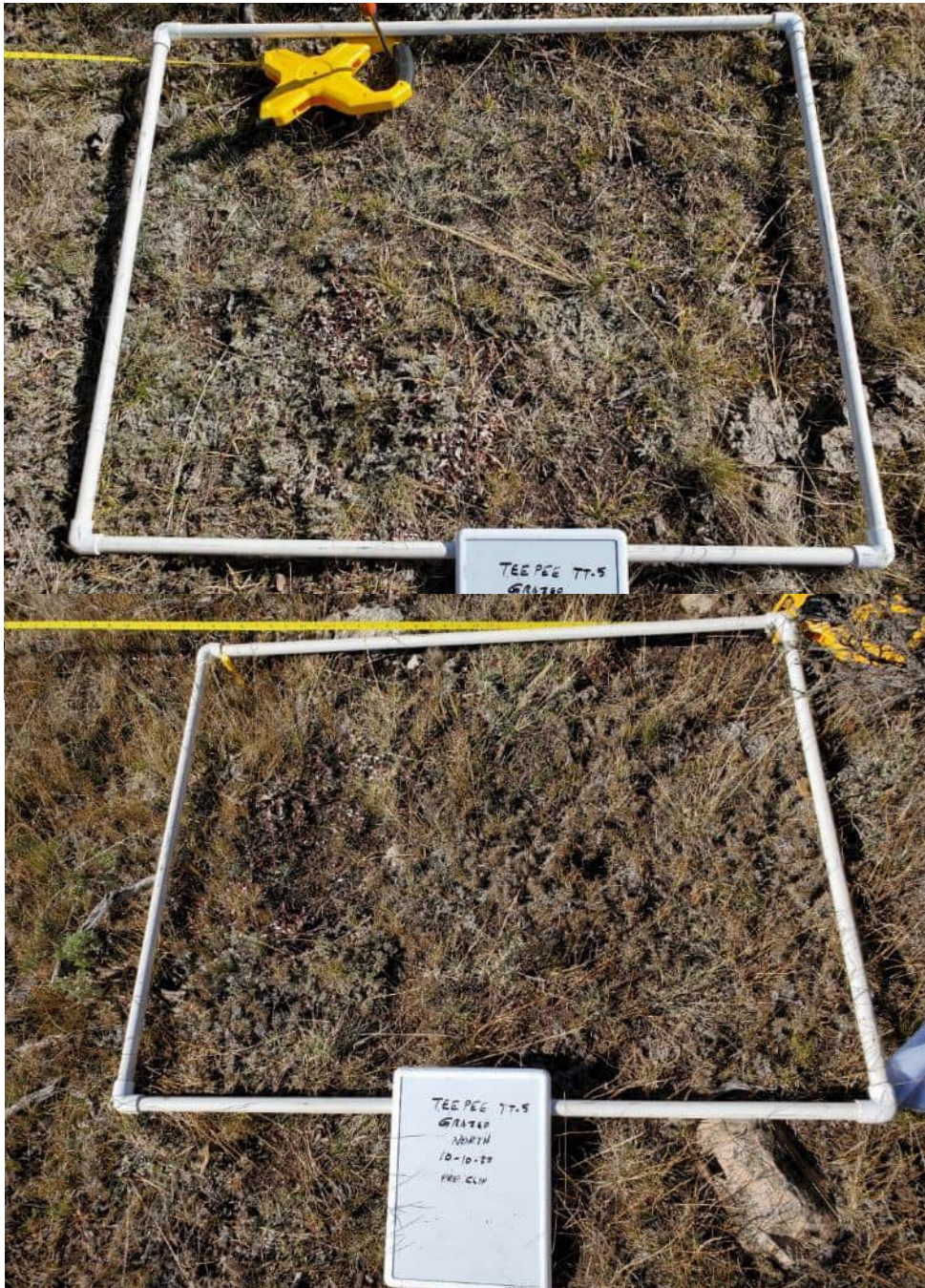


Lower Teepee Site TL-6, September 8, 2022.
Upper photo of cage plot, lower photos of grazed
plots before clipping.





Tosi Pasture Site TT-5, October 10, 2022. Overview of transect at time of clipping. Ungrazed grasses and forbs in the cage were 304.3 lb/acre with 262.2 lb/acre being grasses. Grazed plot grass and forb residuals averaged 154.3 lb/acre, with 105.7 lb/acre being grasses. Utilization was 49.3% on combined grasses and forbs, while utilization for grasses only was 59.7%. This site produced 16.9% of potential.



Tosi Pasture Site TT-5, October 10, 2022. Upper right photo of cage plot left photos of grazed plots prior to clipping.



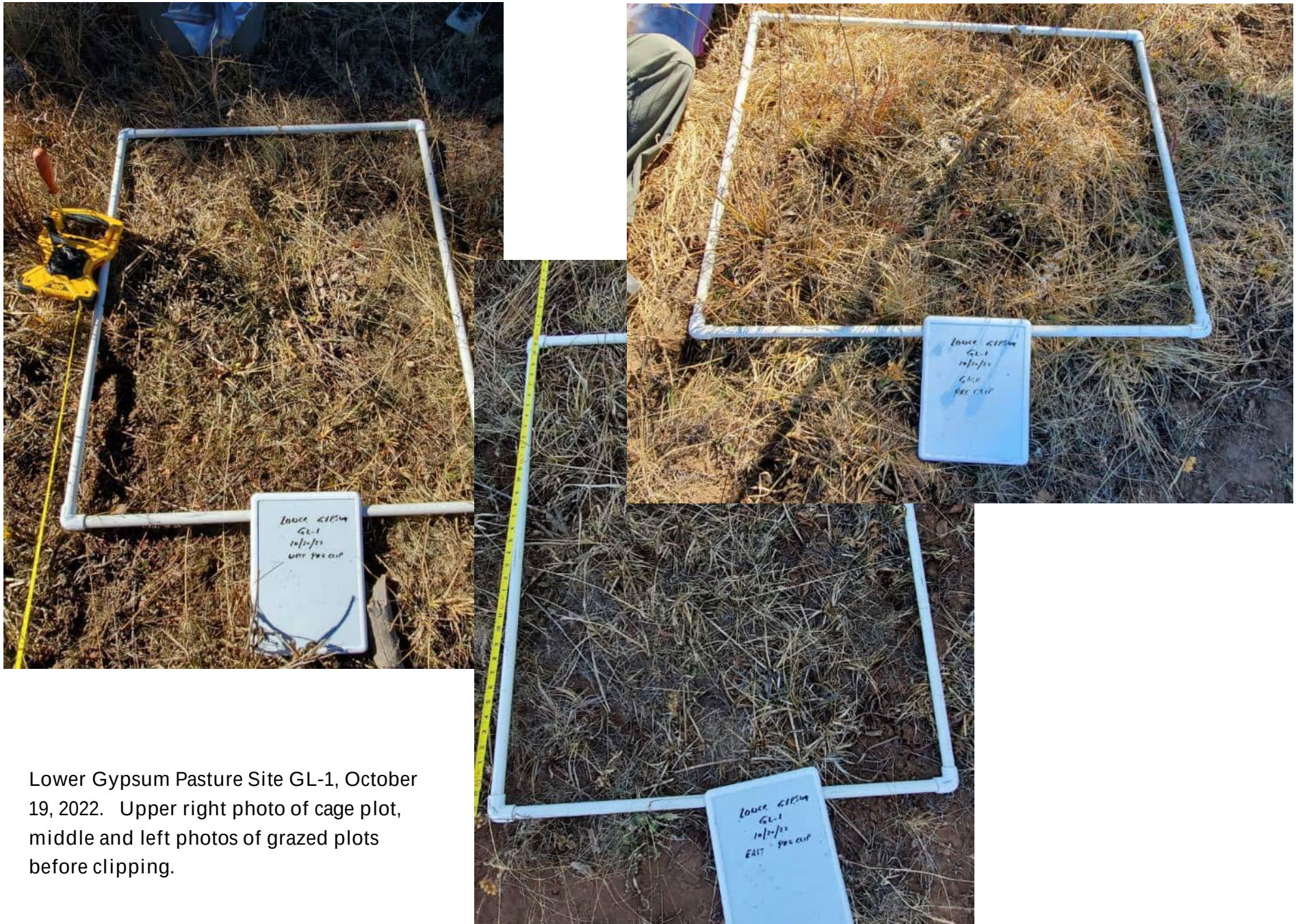
River Bottom Pasture Site RB-4, October 13, 2022. Overview of transect at time of clipping. Ungrazed grasses and forbs in the cage were 454.3 lb/acre with 375.5 lb/acre being grasses. Grazed plot grass and forb residuals averaged 101.4 lb/acre, with 70.1 lb/acre being grasses. Utilization was 86.4% on combined grasses and forbs, while utilization for grasses only was 54.5%. The site produced 24.4% of potential.



River Bottom Pasture Site RB-4, October 13, 2022. Upper left photo of cage plot, middle and right photos of grazed plots prior to clipping



Lower Gypsum Pasture Site GL-1, October 19, 2022. Overview of transect at time of clipping. Ungrazed grasses and forbs in the cage were 752.1 lb/acre with 419.7 lb/acre being grasses. Grazed plot grass and forb residuals averaged 274.1 lb/acre, with 112.2 lb/acre being grasses. Utilization was 63.6% on combined grasses and forbs, while utilization for grasses only was 73.3%.



Lower Gypsum Pasture Site GL-1, October 19, 2022. Upper right photo of cage plot, middle and left photos of grazed plots before clipping.



Lower Gypsum Pasture Site GL-2, October 19, 2022. Overview of transect at time of clipping. Ungrazed sedges, grasses and forbs in the cage were 878.3 lb/acre, grazed plot residuals averaged 378.7 lb/acre for a utilization of 56.9%.



Lower Gypsum Pasture Site GL-2, October 19, 2022.
Upper right photo of cage, left and lower right photos of
grazed plots before clipping.





Lower Gypsum Pasture Site GL-3, October 19, 2022. Overview of transect at time of clipping. Ungrazed grasses and forbs in the cage were 843.8 lb/acre with 785.5 lb/acre being grasses. Grazed plot grass and forb residuals averaged 339.9 lb/acre, with 322.6 lb/acre being grasses. Utilization was 59.7% on combined grasses and forbs, while utilization for grasses only was 58.9%.



Lower Gypsum Pasture Site GL-3, October 19, 2022.
Upper right photo is of cage plot, left photos of
grazed plots before clipping.

Exhibit 6
Correspondence With BTNF
Proposed Monitoring
WWP and Y2U

March 17, 2022

Gregory Brooks, District Ranger
Big Piney Ranger District
10418 South US Highway 189
Big Piney, WY 83113



Ivan Geroy, District Ranger
Pinedale Ranger District
Bridger-Teton National Forest
29 East Fremont Lake Rd.
P.O. Box 220
Pinedale, WY 82941

Cc: Elise Boeke, Patricia O'Connor, Deborah Oakeson, Terry Padilla, Lois Shoemaker

VIA email

Re: Request to Place Utilization Cages in Upper Green and Fisherman Creek allotments

Greg and Ivan:

Congratulations on your new positions.

It is hard to start this process over after nearly a year of correspondence, emails, phone meetings with Patricia, Rob Hoelscher, and the Region regarding our request to place a few utilization cages in the subject allotments. In our past correspondence (attached), we have addressed the need for doing this study to fill information gaps in the current monitoring effort by the permittees and their agents. Our request has been either denied with the reason that monitoring is already in place, or we are being forced to go back and forth from Region to Supervisor to District Ranger levels, with no reasonable outcome. We have had permission and carried out similar studies in the Caribou NF, Salmon-Challis NF, BLM Salt Lake Field Office, BLM Rock Springs Field Office, and BLM Lander Field Office.

Our proposed study is designed to collect data for herbaceous retention in riparian and upland areas and to compare the results with greenline stubble height measurements and upland key species residuals. We plan to begin the study in the early summer of 2022. This would help inform monitoring efforts on the BTNF. We have proposed to provide the cages, do the work, and provide a report to the BTNF. Agency staff are of course welcome to observe, take part and make suggestions. The idea was to acknowledge you have a lot to do and this would not be a staff burden or expense for the BTNF.

In her recent email¹, Patricia pointed out that you have specific monitoring protocols in place and we should work with you on the request. Rob Hoelscher had indicated to us that there were no issues with monitoring because "monitoring plans on many of our allotments were established in cooperation with the University of Wyoming Range Extension, the grazing permittees, and the Forest Service."² This leaves a glaring omission and that is that the public is not mentioned. If you look at the recent monitoring reports for the Upper Green allotment complex, these are "Prepared for: Upper Green River Cattlemen's Association" and "Prepared by: Sublette County Conservation District". There is no mention of the public or citizens in these reports.

We have made many requests to obtain the GPS points for the monitoring locations on these allotments and have been shuttled back and forth from the Range staff to the Sublette County Conservation District, with each referring us to the other but never receiving the data. Even our FOIA to the BTNF for the information did not provide it because you apparently don't possess the information. We provide all the data, maps, coordinates and methods when we do studies.

In our prior correspondence³, we have reminded the BTNF that the Forest Service Handbook FSH 2209.10 Chapter 10 stresses the involvement of the interested publics in managing range allotments, securing the necessary inventory, and monitoring information, and establishing criteria for determining allowable use levels. The Handbook also spells out the following:

- "Public Participation. Public participation should be a key element of the NFMA process as well as the NEPA process. Close consultation, cooperation, and coordination with grazing permittees is essential to help them understand the differences between existing and desired vegetation on their allotment and in identifying possible practices that will achieve desired future conditions for vegetation as well as the permittees livestock operation. Other interested parties should be involved as well to identify possible practices that will be responsive to potential concerns or issues they may express. Not only is public participation good business from the standpoint of identifying opportunities and possible practices to achieve desired conditions and reduce controversy later in the planning process, but it is a requirement of law.... Furthermore, in FLPMA's declaration of policy, Congress specifically requires the Secretary of Agriculture to consider the views of the general public, and to allow for adequate third party participation exercising his discretionary authority. (43 USC (1701(a) (5)))." (Par. 15.7).
- "Benchmark areas should be selected and/or approved by the most experienced and qualified personnel available and agreed upon or coordinated with permittees and in some cases other interested agencies, individuals or groups." (Chapter 40 Par. 40.41).

¹ Email from Patricia O'Connor dated Marcy 15, 2022.

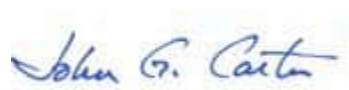
² Email from Rob Hoelscher dated May 24, 2021.

³ Letter to Patricia O'Connor dated January 3, 2022.

In the attached letters we have previously sent regarding this proposal, we have outlined some of the issues with the current monitoring program. These include the acceptability of key species being used, monitoring locations, and the absence of riparian zone monitoring. Rather than repeat this here, you can review these for yourselves.

We would like to place these cages before turnout in late May or early June and will provide a map of locations and description of methods. Please review this correspondence and let's have an in-person or phone conference if needed to resolve any details so we can proceed with the public's monitoring effort this spring.

Respectfully,

A handwritten signature in blue ink that reads "John G. Carter". The signature is fluid and cursive, with the first name "John" being the most prominent.

John Carter, Ecologist
Yellowstone to Uintas Connection
P.O. Box 464
Bondurant, WY 82922
Jcoyote23@gmail.com

Jonathan Ratner - Wyoming and Utah Director
Western Watersheds Project
P.O. Box 171
Bondurant, WY 82922

May 17, 2021



Rob Hoelscher, District Ranger
Pinedale Ranger District
Bridger-Teton National Forest
29 East Fremont Lake Rd.
P.O. Box 220
Pinedale, WY 82941

Patricia O'Connor, Forest Supervisor
Bridger-Teton National Forest
340 N. Cache
P.O. Box 1888
Jackson, WY 83001

Re: Cooperative Range Monitoring

Dear Rob:

I appreciated being on the call last Friday for the discussion on monitoring, particularly on key species and methods. As I mentioned at the end of the call, I have questions. This appears to be a controversial issue and is a QA/QC problem needing to be addressed. I have been reviewing various reports such as the Upper Green River 2019 Cooperative Monitoring Report¹ and AOIs for the Upper Green allotments.

I note that the 2020 AOI for Upper Green allotments implemented the allowable use standards from the Upper Green FEIS/ROD.^{2 3} Allowable levels for upland and riparian areas are generally 50%, with exceptions for higher levels in certain areas as presented in Table 1 of the ROD. A greenline stubble height of 4 inches is to be retained for most riparian areas with exceptions for some areas being 6" as presented in Table 1 of the ROD. The FEIS/ROD describe the riparian and upland monitoring methods as occurring on key areas and on key species and offers the opportunity to adjust or monitor additional key areas if necessary.

Our discussion raised issues of: (1) appropriateness of selected key species such as Idaho fescue which may understate utilization, (2) whether greenline stubble height represents

¹ Sublette County Conservation District. 2019. Upper Green River 2019 Cooperative Monitoring Report. Prepared for Upper Green River Cattlemen's Association.

² USDA Forest Service. 2017. Upper Green River Rangeland Project Final Environmental Impact Statement. Bridger-Teton National Forest.

³ USDA Forest Service. 2019. Record of Decision Upper Green River Area Rangeland Project. Bridger-Teton National Forest.

riparian utilization in the Aquatic Influence Zone, (3) suitability of key area locations, (4) plant vigor related to the low stature of Idaho fescue (5) use of Wyethia and certain tall forbs as key species. While other points were discussed, these appeared to me to be the principal ones.

I have had a separate brief discussion with Gary Hayward regarding visiting some of the monitoring sites this summer and the need for location data for the monitoring sites. He furnished me with the Elk Ridge Allotment Complex Allotment Monitoring Book which addresses monitoring in the closed and vacant allotments in the Elk Ridge complex.⁴

Resolution of the Issues

1. It is my intent to submit a FOIA for certain information regarding these and perhaps, other allotments, but I would like to know if the Bridger-Teton maintains an electronic database with coordinates of its monitoring locations and water developments. To make my visits to the Upper Green, Elk Ridge Complex and other areas in the Forest productive it would help to know if this information is available so that I may request it and easily find these locations. Time is of the essence here, so hopefully this question can be answered right away, and if the data is open and accessible, I could obtain it without a FOIA.
2. To address the question of whether Idaho fescue is representative of overall plant community utilization in uplands, I suggest we select an early, late and closed or vacant pasture to establish a comparison of the key species utilization by the Utilization Gauge method and that determined by the Paired Plot method by setting up one or more cages in the vicinity of the normal key area. At those locations we would collect grazed and ungrazed grasses and forbs, measure their weights (all grasses combined and all forbs combined) and compare to the result by the Utilization Gauge. This could be done on site and would be a relatively easy comparison to accomplish. If the Forest Service is willing, we should coordinate this very soon so that cages can be set prior to livestock entry into the pastures of interest.
3. To address the question as to whether the greenline stubble height represents riparian utilization, we would also select riparian sites in the same pastures and at or near your normal stubble height monitoring location, set a utilization cage in the Aquatic Influence Zone between the greenline and adjacent upland. Similar to the uplands, all vegetation would be clipped in the cage for the ungrazed plot and the previously selected grazed plot would be clipped and weighed for the residual. This would be compared to the sedge

⁴ Sublette County Conservation District. 2021. Elk Ridge Allotment Complex Allotment Monitoring Book. Prepared for U.S. Forest Service.

utilization determined by Utilization gauge based on the greenline stubble height. The cages need to be set prior to livestock entry.

4. Suitability of key locations is something we can determine from the key area location coordinates if they are available and do site visits. This is a goal of mine for summer visits to the Upper Green and something we can also discuss during monitoring visits, some of which I plan to attend. Accordingly, I need to be informed of the schedule and provided an opportunity to do so.
5. The issue of the low vigor/stature of Idaho fescue can be addressed by a joint site visit to look at currently grazed locations and then visit the Elk Ridge Complex where the allotments have been vacant for several years. Aside from drought induced low vigor, the literature indicates recovery of vigor of Idaho fescue requires several years of rest from grazing.
6. The issue of using Wyethia and other tall forbs which are normally considered not palatable could be addressed by jointly visiting some of these monitoring sites and pastures to determine if there are other alternatives. (locations or species).

I suggest an in-person meeting in the next couple of weeks as I expect most of us are vaccinated at this point and we could determine the parameters and get organized in a timely manner if the Forest Service is willing to engage in this process.

Thank you again for your consideration,



John Carter, Ecologist
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Bondurant, WY 82922
435-881-5404

Cc: Jonathan Ratner, Western Watersheds Project
Jason Christensen, Yellowstone to Uintas Connection

Patricia O'Connor, Forest Supervisor
Bridger-Teton National Forest
340 N. Cache
P.O. Box 1888
Jackson, WY 83001



Re: Upper Green Allotment Complex Monitoring Locations

Dear Ms. O'Connor:

This past Monday, July 12, I attended a "joint monitoring" foray into the Upper Green Allotment Complex. In a later report, I will give you my impressions of this effort and also reply to your June 23, 2021 letter regarding drought. This letter addresses my ongoing attempt to obtain GIS/GPS coordinates for the monitoring locations for the Upper Green Allotment Complex. I have communicated with Gary Hayward (BTNF), Rob Hoelscher (BTNF), Mike Henn (Sublette County Conservation District) and submitted FOIAs for monitoring locations. At the request of Anita DeLong, I abbreviated my request for Forest-wide data to include only the Upper Green Allotment Complex.

I understand that the Sublette County Conservation District under the leadership of Mike Henn is conducting monitoring on these allotments for the Upper Green River Cattlemen's Association. See the Upper Green River 2019 Cooperative Monitoring Report prepared for the Upper Green River Cattlemen's Association by Sublette County. I have merely wanted the actual coordinates for the sites monitored on these allotments, which should exist in a spreadsheet or electronic database as they show up on maps in the referenced report. When I asked Gary Hayward for these, he did not have them and referred me to Mike Henn. When I asked Mike, he referred me to the Forest Service.

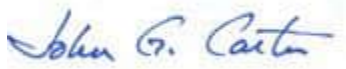
When I received your June 23, 2021 response to my FOIA requesting the monitoring locations, it included several types of locations. These were:

D7 Range Sites
EUI sites
Veg Monitoring Sites
Ground Cover Sites
SG Veg Monitoring sites

I mapped these and overlaid the location I visited on last Monday's joint monitoring effort. That location did not correspond either in location Name or coordinates to any of the provided location data points. The Sublette County person who was guiding us to the location in the Teepee Tosi pasture had these coordinates in her computer and was using them to find the monitoring location. Clearly, since Sublette County prepared the Upper Green 2019 Cooperative Monitoring Report, they have them.

I have expressed the need for these location data in order that we be able to visit the monitoring locations for these allotments this summer to evaluate them. After months of trying, I still do not have them. The Forest Service is allowing this monitoring and participating in it, so why are you unable to provide the data? I am now repeating my request for the location data for the monitoring sites used in the Upper Green Allotment Complex and referenced in the 2019 Monitoring Report. These should be provided in electronic format that is translatable into GIS mapping software, i.e. Excel, a shapefile, or geodatabase.

Thank you,

A handwritten signature in blue ink that reads "John G. Carter". The signature is written in a cursive style with a blue highlight behind it.

July 18, 2021

John Carter, Ecologist
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January 3, 2022

Patricia O'Connor, Forest Supervisor
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Jackson, WY 83001



Re: Upper Green Cooperative Range Monitoring

Dear Patricia:

This is to follow up on our letter to your office dated May 17, 2021. That is to engage in a cooperative effort to validate the current monitoring carried out by the BTNF, Permittees and Sublette County Conservation District (SCCD). That letter was a follow-up to our telephone meeting of May 14 in which Jonathan presented a Power Point about these issues. Our May 17 letter identified the issues as:

- Selected key species such as Idaho fescue may understate utilization
- Greenline stubble height does not represent riparian utilization
- Key area locations are suspect as not representing most used areas
- Low stature of Idaho fescue results from heavy use and lack of rest
- Wyethia and certain tall forbs used as key species are not forage species

There were emails back and forth with Rob Hoelscher and yourself in which the BTNF denied any problem with monitoring as currently conducted. Rob stated that the cooperative monitoring addressed the issues, technical references were followed, and using cages to test the data was too labor intensive. This ignored that we were proposing to do the work and only at four sites, two in riparian areas and two in uplands. The Forest Service has guidance on cooperative monitoring which shows the current situation is not in accordance with that guidance.

1. Cooperative Monitoring

It was suggested we participate in the 2021 Upper Green cooperative monitoring effort. We signed up to participate and were told to meet at the Forest Boundary on July 12, 2021. Apparently, the trip was organized in Pinedale, and when the others (BTNF, SCCD, Permittees) showed up, everyone piled into UTVs and bailed for points unknown. There was no attempt to brief us on the schedule or any other particulars.

Instead, Rob and the SCCD representative said to follow them. We did, but it was more like a race than an organized monitoring event.

We managed to get to the first site near Teepee Creek. Rob and the SCCD person conducted a line point intercept which identifies species along a transect. It is a method for monitoring trend. We noted this monitoring location was near the top of a ridge well above Teepee Creek in elevation and did not seem to represent areas nearer the stream that were normally used by cattle. We discussed this with Rob and pointed out the significantly more degraded vegetative conditions just downslope, closer to water, and he agreed that conditions declined as we walked downslope. This and further observations in the Upper Green that day have indicated to us there is a bias in selection of key areas so that those places regularly used (near water and in valleys) are not monitored.

After that transect was done, they took off for the next location. We had no coordinates for that location, and we had a hard time keeping up not knowing where the site was located. Finally, they headed off across country through waist high sagebrush and disappeared. There was no road or atv trail. We decided that driving a UTV cross country thru sagebrush was not something we were prepared to do, so were not able to continue.

The Upper Green River 2020 Cooperative Monitoring Report lists the participants for each site monitored.¹ The participants included BTNF, SCCD, and Permittees. No members of the public were involved. Perhaps no one asked. Our experience in 2021 was not a "cooperative" monitoring effort that involved the public. It was predetermined by the BTNF, SCCD and Permittees.

The Forest Service Handbook FSH 2209.10 Chapter 10 describes public involvement. It is supposed to:

- "Involve the permittee and interested publics in management of the range allotment." (Par. 11.3).
- "Obtain ID team, interested publics, and permittee assistance in securing the necessary inventory and monitoring information and establish criteria for determining allowable use levels." (Par. 12.2).

¹ Sublette County Conservation District. 2020. Upper Green River 2020 Cooperative Monitoring Report. Prepared for Upper Green River Cattlemen's Association.

- "The interdisciplinary (ID) team, the permittee, and interested publics should assist in the rangeland inventory and analysis and in the preparation of environmental documents." (Par. 13).
- "Public Participation. Public participation should be a key element of the NFMA process as well as the NEPA process. Close consultation, cooperation, and coordination with grazing permittees is essential to help them understand the differences between existing and desired vegetation on their allotment and in identifying possible practices that will achieve desired future conditions for vegetation as well as the permittees livestock operation. Other interested parties should be involved as well to identify possible practices that will be responsive to potential concerns or issues they may express. Not only is public participation good business from the standpoint of identifying opportunities and possible practices to achieve desired conditions and reduce controversy later in the planning process, but it is a requirement of law.... Furthermore, in FLPMA's declaration of policy, Congress specifically requires the Secretary of Agriculture to consider the views of the general public, and to allow for adequate third party participation exercising his discretionary authority. (43 USC (1701(a) (5)))." (Par. 15.7).
- "Benchmark areas should be selected and/or approved by the most experienced and qualified personnel available and agreed upon or coordinated with permittees and in some cases other interested agencies, individuals or groups." (Chapter 40 Par. 40.41).

This guidance fully supports our request to work with the Forest Service and others to validate the current monitoring methods and location of key areas as well as determining allowable use levels.

2. Key Areas in the Upper Green allotments

After reviewing past years' monitoring data for the Upper Green allotments, we were puzzled how such low levels of utilization were occurring. For example, when we reviewed the utilization data from the Upper Green River 2020 Cooperative Monitoring Report, we found average utilization for uplands was 9% using Idaho fescue as a key species. This raised two questions. First, is the BTNF monitoring where the actual use is occurring, i.e. in areas near water and in areas of more level terrain accessible to that water? Second, is the method of measuring utilization accurately reflecting actual use?

To address the first question of monitoring locations relative to areas of regular use by cattle, we based an initial look at the 2020 Upper Green Monitoring Report referenced above to see where monitoring locations occurred. We used the coordinates for the

upland monitoring locations provided in the report and mapped those. Then we examined the topography and water sources relative to these points. Two pastures are shown below in Figures 1 and 2. These are the Mud Lake East and West Pastures.

In these two pastures, the water sources are Crow Creek and small lakes, the latter of which we assumed have water. The estimated distances to water and other characteristics of the monitoring locations are shown in Table 1. As can be seen, the distances to water are very large in most instances and in others there are large elevation differences. In the case of MLW-04, steep slopes hinder access to the nearest water. Based on the propensity of cattle to remain in areas near water and gentle terrain, these monitoring locations are not capturing the areas where most use is occurring. For example, a Wyoming study found that 77% of use by cattle occurred within 366 meters of water and 79% of use was on slopes less than 7%.²

Table 1. Estimated Distance from Water to Monitoring Location, meters.

Location	Distance, m	Notes
MLE-01	1832	Location about 100 feet higher than lake
MLE-02	279	Location on ridge about 100 feet higher than lake
MLE-03	2102	Location several hundred feet higher than stream
MLW-02	1323	Location about same elevation as lake
MLW-02	1890	Location about same elevation as lake
MLW-04	3330	Location about 1,000 feet lower than lake
MLW-04	494	Location about 300 feet higher than stream, steep slopes intervene

What is most clear from this analysis is that key areas are not properly selected. **"Key areas are usually five acres or more and are selected as sites where prescribed use will occur first. Also included are sites where use must be closely monitored because of management plan requirements, such as riparian areas or areas where threatened, endangered, or sensitive species may occur."**³

The Forest Service Handbook also defines a Critical Area as **"A portion of rangeland which has a critical issue related to it, such as a threatened or endangered or sensitive**

² Pinchak, W., Smith, M., Hart, R., and Waggoner, J. 1991. Beef cattle distribution on foothill range. *Journal of Range Management* 44(3).

³ USDA Forest Service. 1996. *Rangeland Analysis and Management Training Guide*. Rocky Mountain Region, Denver, Co.

species, a high use recreation area, a key wildlife habitat, or water quality limited reach. The area serves as a monitoring and evaluation site for the critical issue." (FSH 2209.21 Zero Code 05-Definitions).

The current monitoring locations do not meet these criteria due to their distance from water or being placed on ridges which avoids monitoring the valley bottoms or riparian areas used first as the FSH describes. While the BTNF monitors greenline stubble height on sedges, it does not monitor riparian areas which are located between the greenline and uplands. These riparian areas are critical to amphibians, migrant birds, and small mammals, some of which are sensitive species.

The key areas and utility of Idaho fescue as the key species to represent utilization needs to be validated using the method we identified. That is, placing cages in riparian and upland areas that are grazed first. The Paired Plot method would be used.⁴ Following cessation of grazing in the pasture, these caged plots and grazed plots would be clipped and weighed. These results would be compared to the key species and greenline stubble height monitoring results. This would also be compared to the herbaceous retention needed for amphibians and other wildlife which the current allowable use standards do not meet.^{5 6 7 8}

The second aspect of this has to do with the use of Idaho fescue as a key species in uplands. We note that in the 2020 Upper Green Monitoring Report, average ungrazed Idaho fescue was 6.9 inches with a grazed height of 2.8 inches. As Jonathan pointed out in our May 14, 2021 telephone discussion, it is difficult for cattle to make use of the lower parts of a short stature grass such as Idaho fescue as it is occurring in the Upper Green area. The difficulty comes due to cattle being either unable or unwilling to graze the plants to the level that would correspond to 50% use if other more accessible or desirable plants are available (such as riparian areas). Figure 3 shows a utilization gage set at 6 inches for an ungrazed plant. At 50% utilization, the grazed height would have to be 5/8 inches, which is not usable by cattle.

⁴ USDA and DOI. 1996 (Revised 1997 and 1999). Utilization Studies and Residual Measurements. Interagency Technical Reference. TR-1734-3.

⁵ DeLong, D. 2016. Upper Green Allotment Management Planning EIS Supplemental Wildlife Specialist Report Migratory Birds. Bridger-Teton National Forest. 183p

⁶ DeLong, D. 2015. Summary Basis for Building Wildlife Habitat-Needs & Protection into Forage Utilization Limits. West Zone Wildlife Biologist, Bridger-Teton National Forest. 8 p.

⁷ DeLong, D. 2015b. Literature Review and Analysis of Scientific Information for the Conservation Assessment for Columbia Spotted Frogs and Boreal Toads on the Bridger-Teton National Forest

⁸ DeLong, D. 2021. Forest Plan Direction & Other Wildlife. PowerPoint. 115p.

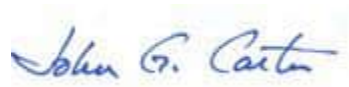
3. Conclusion

There are clear problems with the BTNF "cooperative monitoring" which does not involve the public in the design and carrying out of monitoring. As a result, selection of allowable use standards, selection of key areas and key species are not representative of grazing use nor are they protective of sensitive species.

This can be corrected by following the intent of the Forest Service Handbook and monitoring manual we have cited. A first step would be to carry out the monitoring validation test we have requested. This would include selecting riparian and upland key areas in which to place cages to collect quantitative data for grazed vs ungrazed grasses and forbs. These would be compared to utilization measured as greenline stubble height along the selected stream reaches and Idaho fescue in uplands.

We are requesting an initial call with you to first discuss this proposition and agree on setting a meeting to engage with yourself, the Pinedale District Ranger, and Range Staff to discuss this effort. We will need to work out the details needed to initiate this effort prior to livestock grazing in 2022.

Respectfully,

A handwritten signature in blue ink that reads "John G. Carter". The signature is fluid and cursive, with the first name "John" being the most prominent.

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Figure 1. Forest Service and SCCD monitoring locations in Mud Lake East Pasture



Figure 2. Forest Service and SCCD monitoring locations in Mud Lake West Pasture



Figure 3. Utilization Gauge set for Idaho Fescue 6 inch ungrazed height. Read at 50% utilization results in 5/8-inch residual grass height.

January 27, 2022

Patricia O'Connor, Forest Supervisor
Bridger-Teton National Forest
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Jackson, WY 83001



Re: Utilization Cage Study Proposal

Dear Patricia:

This is to follow up on prior correspondence (5/17/21 and 1/3/22) regarding placement of utilization cages on BTNF allotments to do some comparisons between upland key species measurements and upland utilization, and determine the correspondence between green line stubble height measurements with overall riparian zone utilization. This data would be of use to the BTNF in application of its monitoring data to grazing management. We are proposing to furnish and install the cages, collect the data, and present the results in a report to the BTNF. BTNF would be welcome to inspect the sites, observe the data collection and provide their input.

With this letter, we are requesting your approval to proceed with our preparations, including acquiring the materials, constructing the cages, and providing the BTNF with a study plan and map(s) showing proposed locations for the data collection. Our goal is to place the cages prior to livestock entry into the selected pastures in 2022.

Thank you for your help in this matter,

A handwritten signature in blue ink that reads "John G. Carter".

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Exhibit 7

DeLong Summary Basis of 70% Retention

Summary Basis for Building Wildlife Habitat-Needs & Protection into Forage Utilization Limits

Don DeLong, West Zone Wildlife Biologist – BTNF, September 9, 2015

Forest Plan Direction and Migratory Bird Requirements

Two requirements of the Forage Utilization Standard are (1) to prescribe, during allotment management planning, site-specific utilization limits needed to meet Forest Plan objectives; and (2) establish site-specific utilization limits on key wildlife ranges. As such, utilization limits must be purposely designed to meet the following Forest Plan objectives for wildlife, among other Forest Plan objectives, relative to DFC direction:

- Objective 2.1(a) — Provide suitable and adequate habitat to support game and fish population objectives established by the WGFD.
- Objective 3.3(a) — Protect sensitive species and provide an adequate amount of suitable habitat to ensure activities do not cause: (1) long-term or further declines in populations or habitats supporting these populations; and, (2) trends toward federal listing.”
- Objective 4.7(d) — An adequate amount of suitable forage and cover are retained for wildlife and fish.

The onus is on Biologists to be able to demonstrate that a maximum utilization limit would result in suitable forage and cover being retained for sensitive species, big game, migratory birds, and other affected wildlife; if this cannot be done, a lower utilization limit needs to be considered.

During allotment management planning, the Standard does not allow deference to be given to current utilization levels until monitoring data shows they are inadequate to meet wildlife needs. The standard is stated deliberately and in the affirmative, both in terms of “prescribe” utilization limits and “to meet” objectives.

As explained in the ROD for the Bridger-Teton National Forest Land and Resource Management Plan (Forest Plan), “...the first and most important part of the [Forest] Plan is.... Goals and Objectives” (USFS 1990a:6-7). The purpose of standards in the Forest Plan is to support the attainment of Forest Plan goals and objectives, with standards being subordinate to Forest Plan goals and objectives (Forest Plan 1990a:6).

To further implement the Migratory Bird Treaty Act, Executive Order 13186 requires the following of all federal agencies, to the extent permitted by law and agency missions:

- Integrate bird conservation principles and practices into agency plans like allotment management plans, and ensure that agency plans promote recommendations of migratory bird conservation plans.
- Restore and enhance migratory bird habitat, and avoid or minimize adverse effects on migratory birds and their habitat.
- Minimize the unintentional taking of migratory birds. Unintentional take includes the inadvertent killing, wounding, or capturing of migratory birds, eggs, or nests.

Related Principles of Wildlife Conservation

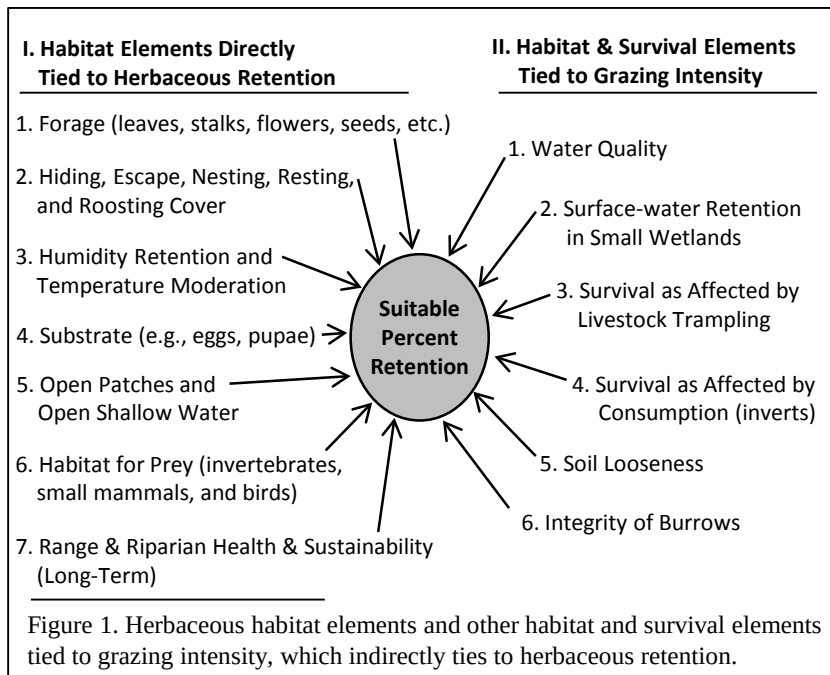
The practice of adjusting utilization limits to ensure that habitat needs of wildlife are met on livestock allotments is well recognized in the wildlife conservation literature, but in practice it remains difficult to carry out.

In herbaceous plant communities (e.g., wet meadow, moist meadow, grassland, forbland), herbaceous vegetation *IS* wildlife habitat and, in shrub-herb communities (e.g., shrubby cinquefoil, silver sagebrush, willow-herb communities), herbaceous vegetation is a major component of wildlife habitat. Because livestock eat herbaceous vegetation, the intensity of livestock grazing use has major ramifications on the ability to provide suitable wildlife habitat in herbaceous-dominated plant communities.

Habitat and Survival Elements Tied to Herbaceous Vegetation

Retained herbaceous vegetation serves two distinct roles with respect to meeting Forest Plan Objectives 2.1(a), 3.3(a), and 4.7(d); Sensitive Species Management Standard; Forage Utilization Standard; and migratory bird requirements. Percent retention of total herbaceous vegetation provides (I) direct measures of herbaceous habitat conditions, and (II) indicators of other factors directly related to the intensity of grazing use (Figure 1).

Wildlife that depend on or are associated with herbaceous vegetation respond to the elements in the category I and elements 1, 3, and 4 in category II (Figure 1); and all elements in categories I and II can affect survival. Trampling by livestock is the only direct form of mortality.



Minimum Retention Threshold for the Provision of Suitable Habitat

Detailed examinations and syntheses of more than 500 scientific studies, papers, and textbooks from a wide range of disciplines demonstrated that 70% herbaceous retention has a reasonable likelihood of (1) retaining enough herbaceous vegetation to provide suitable conditions for the habitat elements outlined in Figure 1 for most dependent wildlife, and (2) providing sufficient protection from direct impacts of livestock use (DeLong 2009, DeLong 2012, DeLong 2015a, DeLong 2015b).

There is moderate scientific support for this conclusion even though there are relatively few scientific studies *directly* showing that $\geq 70\%$ herbaceous retention is sufficient to maintain suitable forage and cover for particular wildlife species and to protect particular species from direct impacts like trampling (Figure 2). Given limited direct evidence, drawing scientific information from a wide range of disciplines and geographic locations was needed to be able to demonstrate that a low-end threshold of 70% is suitable for a range of species

It is being argued that there is too little scientific support for a minimum herbaceous retention level of 70%. There is less support showing that $\geq 60\%$ herbaceous retention will (1) retain enough vegetation to provide suitable habitat and (2) protect wildlife, and even less support for $\geq 50\%$ retention.

and for native wildlife-communities. Having only moderate support for a low-end threshold of 70% should not be surprising given the relatively large reductions in herbaceous habitat attributes (Fig. 2). It is far from optimum conditions.

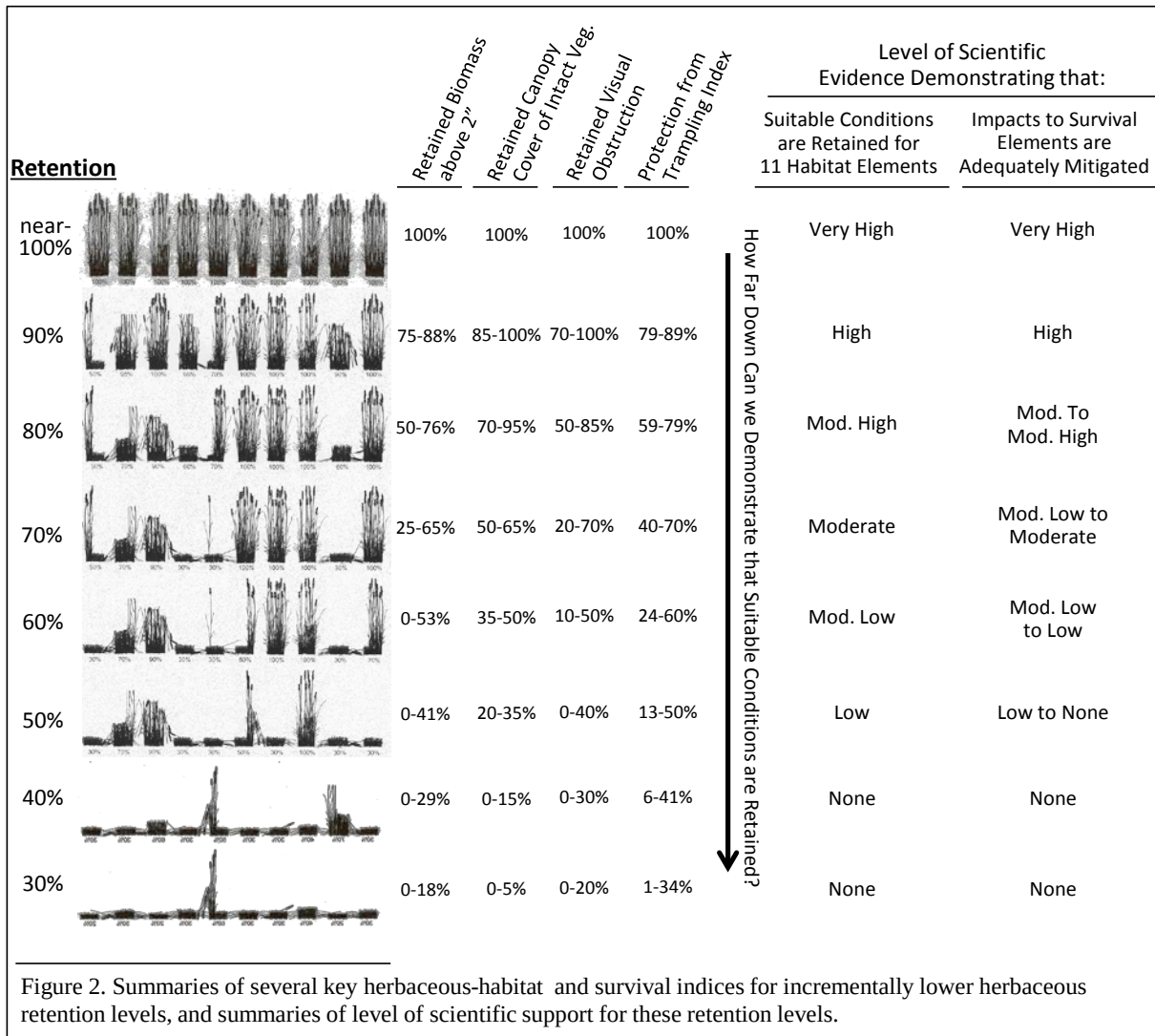
There are fewer studies directly showing that $\geq 60\%$ herbaceous retention is sufficient to maintain suitable habitat for particular wildlife species, and fewer yet directly showing that $\geq 50\%$ herbaceous retention is sufficient to maintain

suitable habitat for wildlife species. There are no studies showing that 60% or 50% herbaceous retention maintains suitable habitat for a range of wildlife species. The large pool of scientific information reviewed for the reports cited above, when looked at comprehensively (and individually), provides no more than minimal support for 60% or 50% herbaceous retention as low-end thresholds and shows there to be substantive negative impacts. This corresponds to the minor amount of herbaceous vegetation retained above about 2 inches (Fig. 2).

Attributes of pre-grazed herbaceous habitat are nearly gone by about 50% herbaceous retention and are virtually eliminated by about 40% herbaceous retention (Figure 2). Similarly, there is virtually no support for a 4-inch stubble height (away from stream channels) as a low-end threshold for suitable conditions for wildlife.

The examination and synthesis of scientific information revealed no more than minimal support for a maximum 50% utilization of *key forage species* retaining suitable forage and cover for wildlife, and the preponderance of scientific information shows there to be substantive negative impacts across a wide range of wildlife species at this utilization level.

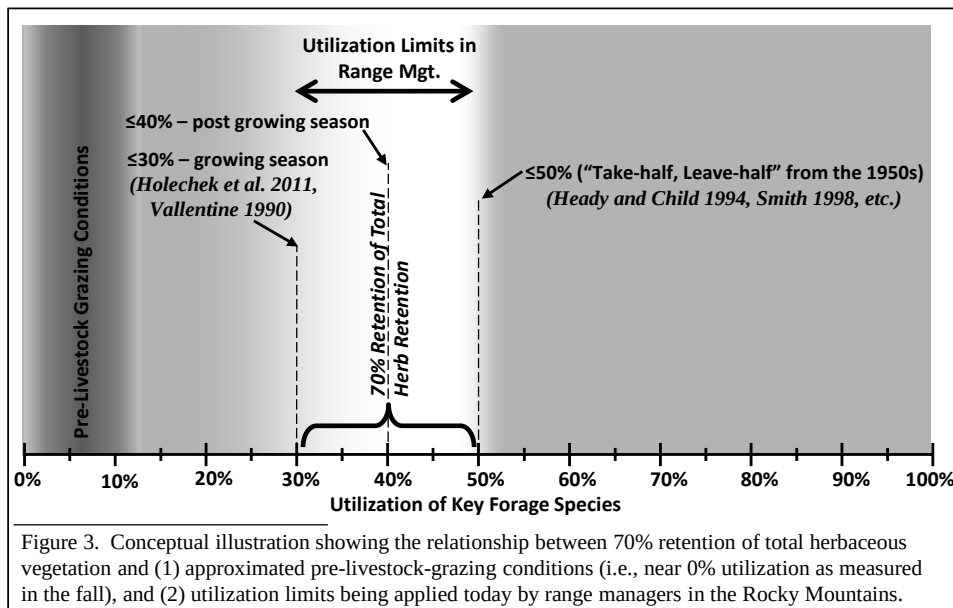
Therefore, 70% herbaceous retention is the lowest retention level that can be supported as Wildlife Program input into the process of prescribing utilization limits during allotment management planning (as per the Forage Utilization Standard). For wildlife species that forage on key forage species for livestock, 60% use of key forage species is the lowest supportable limit.



Relationship to Utilization Limits for Retaining Rangeland Health

A minimum herbaceous retention level of 70% fits completely within utilization limits currently recommended by range experts and currently in use in livestock management programs (Figure 3).

It is noteworthy that the previous District Ranger on the Pinedale District — who has a range background — characterized a maximum 35% use of key forage species as reflecting “...the contemporary understanding of the needs of the land and wildlife and livestock grazing operations” (letter dated February 12, 2015). This level of grazing translates to an estimated 65-80% retention of total herbaceous vegetation.



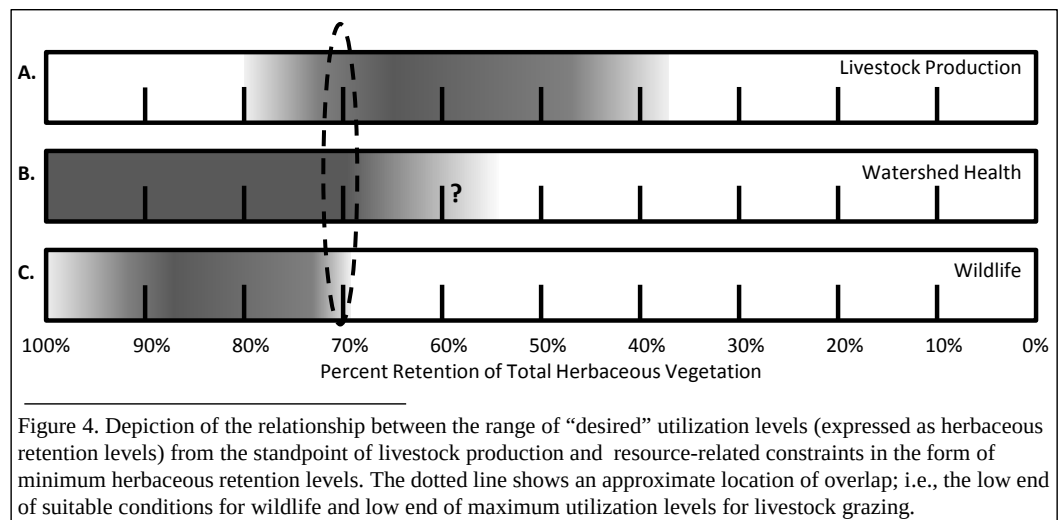
A maximum 50% use of key forage species represents an *absolute* maximum since use above this level clearly sets the stage for declining rangeland conditions (all range texts). This “take-half, leave-half” limit was devised in the 1950s to protect plant health and did not take into account wildlife needs.

Holechek et al. (2011:140) assessed that a maximum 50% use of key forage species results in deterioration of rangelands

in the coniferous forest belt of the Intermountain West. They and Vallentine (1990) recommended maximum key-forage use levels of 30% (growing season) and 40% (post-growing season) as management controls for maintaining herbaceous species composition and other aspects of rangeland health (Figure 3).

A maximum 70% herbaceous retention falls at the low end of suitable conditions for wildlife and near the low end of utilization limits recommended by range management experts (i.e., max. 30-40% use of key forage species). A maximum 30-40% use of key forage species fits within the limits of 70% herbaceous retention (Figure 3).

Until recently, the needs of wildlife had not been seriously addressed in setting utilization limits on livestock allotments of the BTNF, but meeting wildlife objectives is now part of discussions. This transition has been causing some angst in range management on the Bridger-Teton National Forest in recent years.

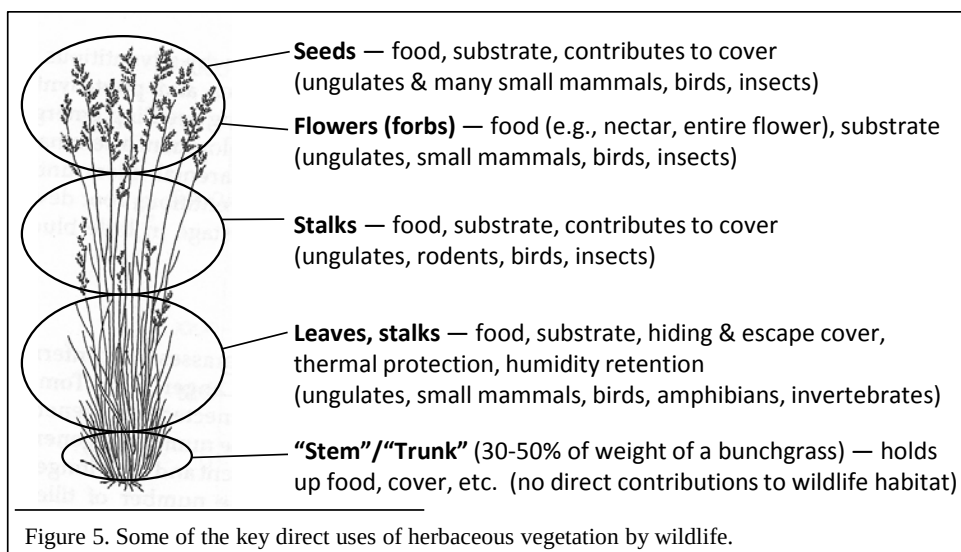


Additional Information

A large amount of scientific and ecological information supports a minimum herbaceous retention level of 70%. A small portion of the information in the referenced reports is summarized on the following pages.

How are Different Parts of Plants Used by Wildlife?

Different parts of plants contribute differently to wildlife habitat (Figure 5) and this has implications to livestock grazing because grazing removes different parts at different rates and because plant parts lowest to the ground, which are most important to maintaining plant health, are least important as wildlife habitat. Different herbivorous wildlife species favor or require different plant parts, different herbivorous



wildlife prefer different plant species, many insect species have specific host plant-species and it is common for them to only use specific parts of these plants (e.g., flowers, base of the plant, leaves high on the plant).

Contributions of Herbaceous Structure and Canopy to Wildlife Habitat

Figure 6 illustrates the culmination of all of the functions of herbaceous vegetation that contribute to the habitat of small vertebrate wildlife and invertebrate wildlife in herbaceous communities that naturally are relatively dense, such as in moist meadows (see also Figure 2). By the time 50% of the biomass of herbaceous vegetation has been removed, a major proportion of pre-grazed habitat attributes have been eliminated, and when 70% has been removed, habitat attributes of pre-grazed conditions are gone for the remainder of the season. Making a statement that 50% herbaceous retention maintains most meadow habitat attributes for wildlife does not pass the “straight-face test,” when considering Figures 2 and 6.

It is widely accepted that moderate and larger alterations to the structure of forestlands impact wildlife diversity, and it should not be surprising that the same is true of meadow habitat (Figure 7). Many of the same physical principles and wildlife-habitat relationships apply, just at much smaller scales.

Food Webs, Energy Flow, and Ecosystem Functions

Assessments of the suitability of different herbaceous retention levels need to be done in consideration of food webs and energy flow. Herbaceous vegetation is a major foundation of ecosystems. It comprises THE habitat for wildlife in herbaceous plant communities and is a major part of wildlife habitat in shrub-herb communities, and livestock nearly exclusively feed on (and remove) herbaceous vegetation. Functional plant species composition and canopy cover after the livestock grazing season — from the standpoint of wildlife habitat — does not include any plant material that was removed through grazing; it is defined only by what remains.

Not only are invertebrates, small mammals, and birds considered wildlife in their own right, they also are prey of predatory wildlife and many species play key functions in ecosystems (e.g., pollinators). A wide variety of invertebrate species and abundance of invertebrates are central to maintaining healthy populations of migratory birds, bats, insectivorous small mammals, reptiles, and amphibians. Many invertebrate species contribute to ecosystem functions through pollination and decomposition of dead animals and plants. The Forest Service is increasingly recognizing the central role of pollinators and the importance of conserving these invertebrates.

The only missing native herbivore in many parts of the BTNF is bison and available information indicates that, prior to Euro-American settlement, bison sporadically or periodically grazed parts of the BTNF (e.g., lower elevations, wide valley bottoms). However, there is no indication that they heavily grazed more than a minor portion of the BTNF on an annual or regular basis.

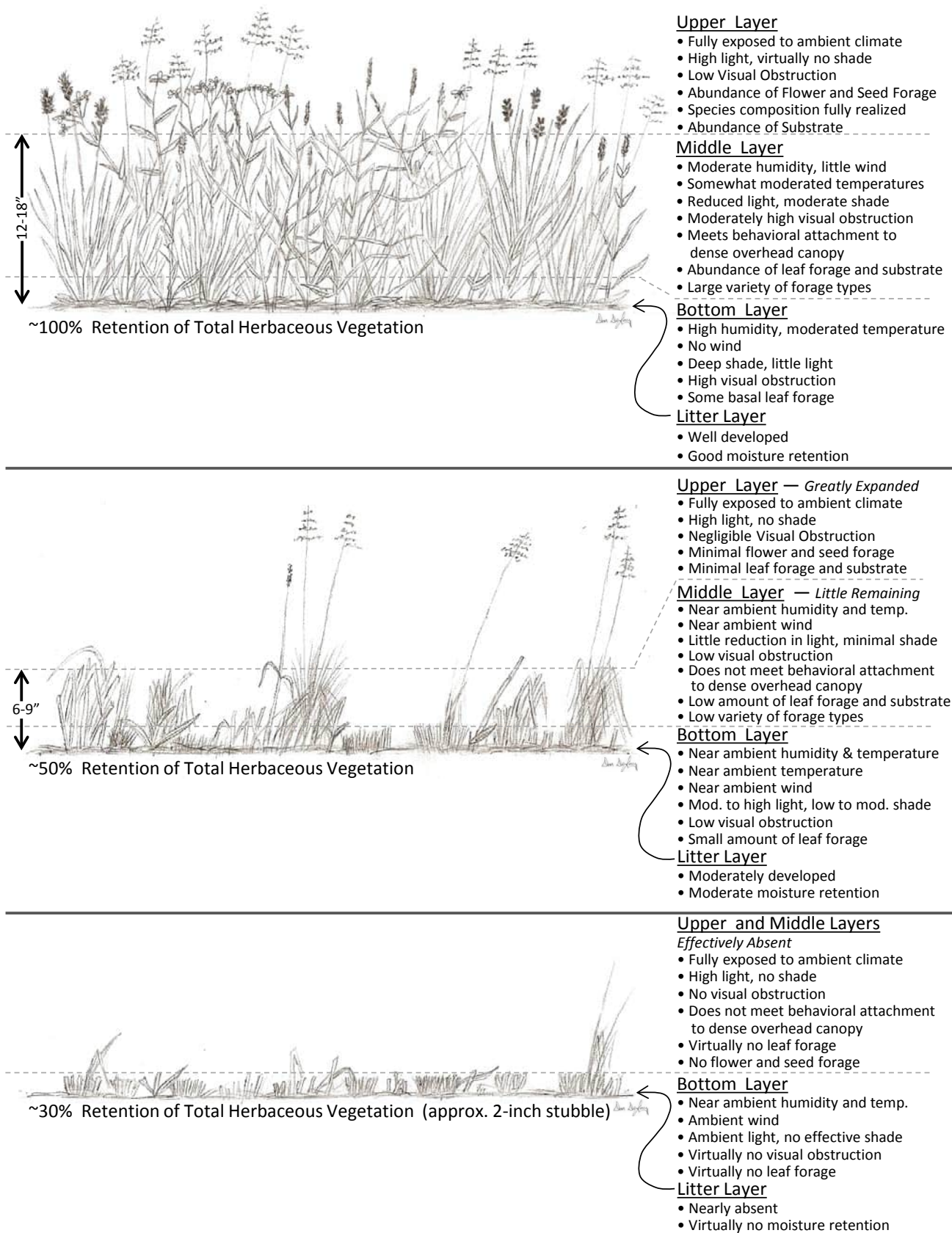


Figure 6. Contributions of meadow vegetation to wildlife habitat and changes relative to retention levels.

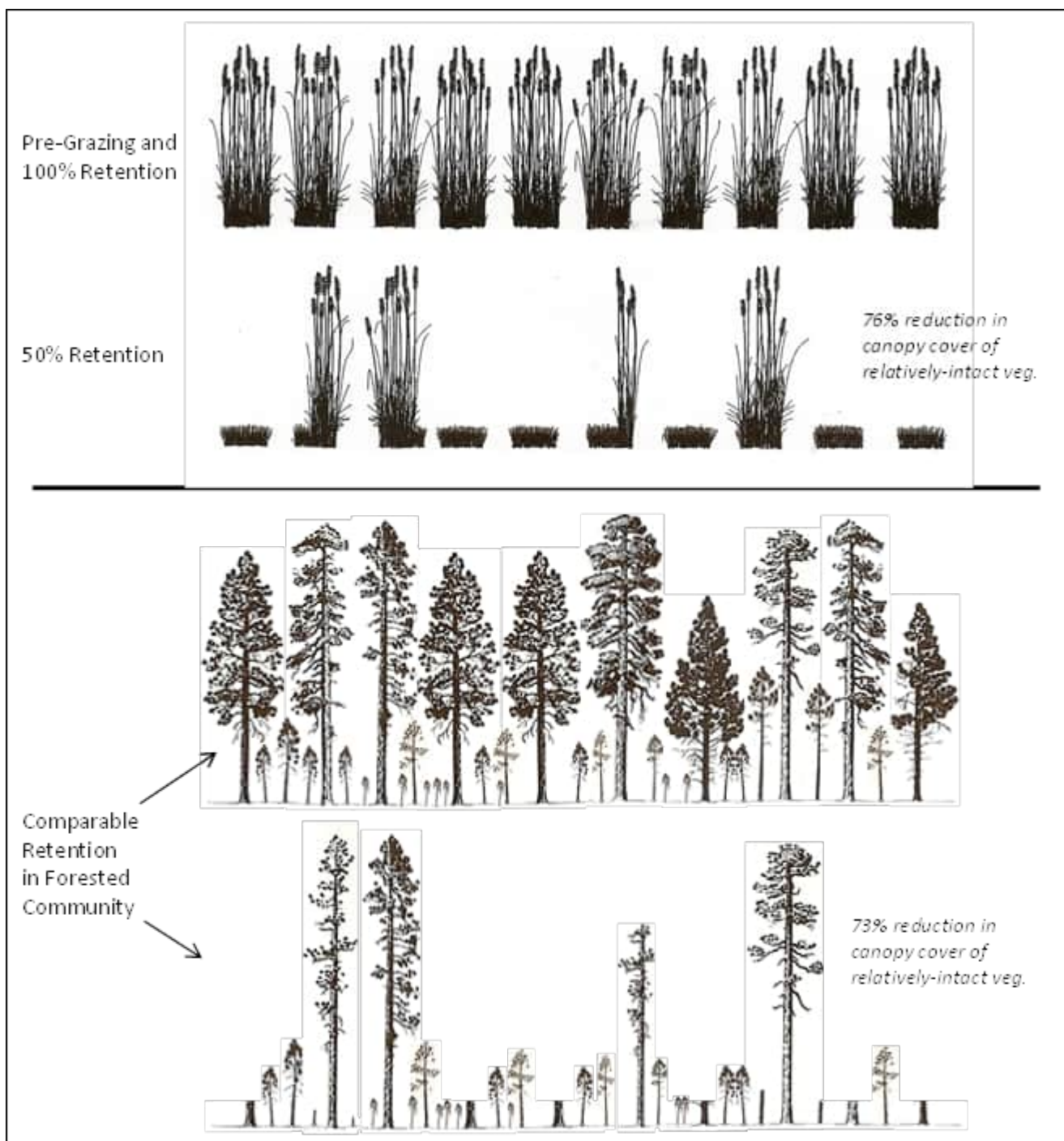
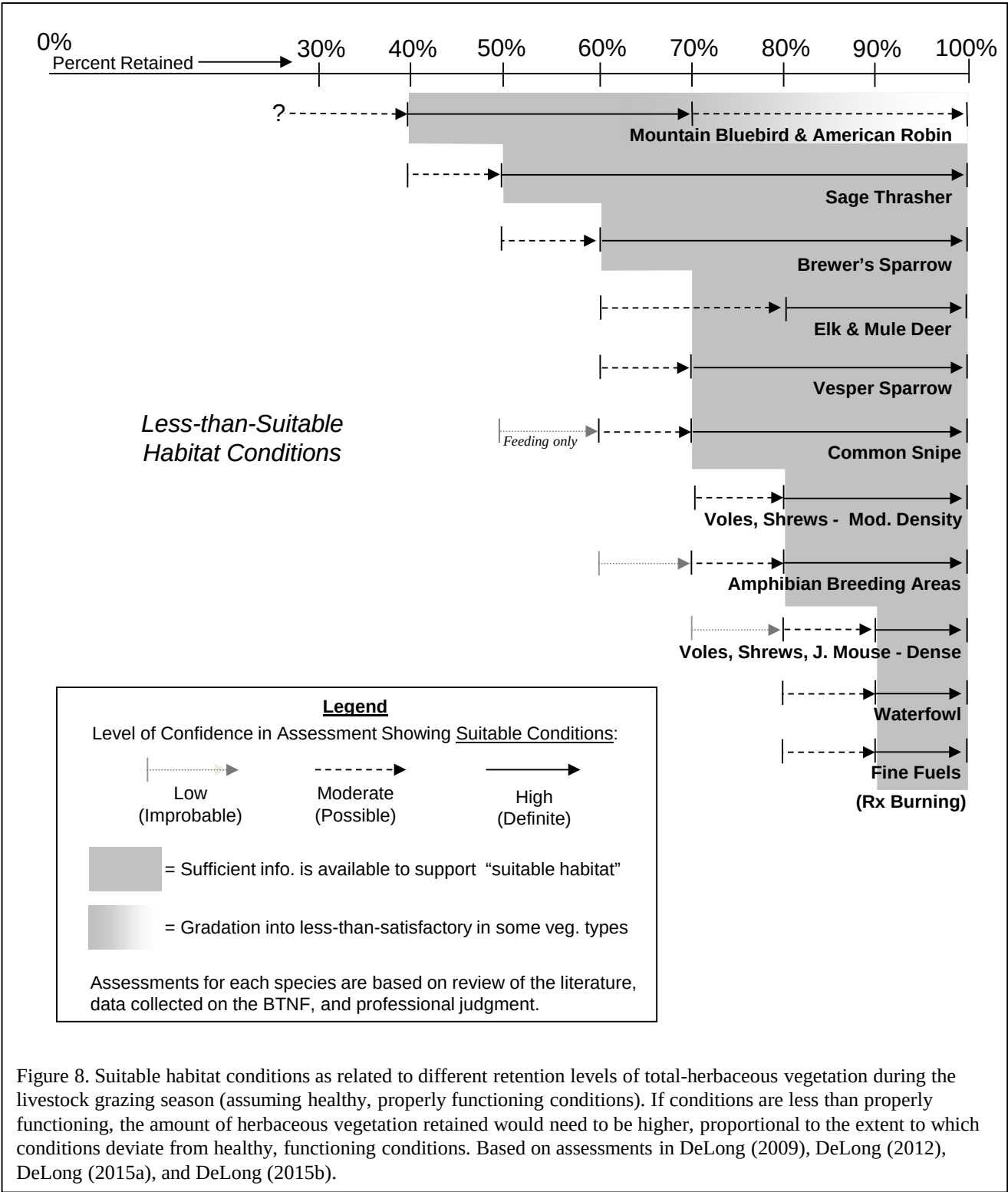


Figure 7. Comparison of 50% retention of herbaceous vegetation in a meadow to a comparable relatively-intact canopy cover in a forestland situation.

Native Wildlife-Communities

Retaining a minimum 70% herbaceous retention is not just about one, two, or even a handful of wildlife species; it is about entire wildlife communities. Some wildlife species depend on or favor relatively-tall, dense herbaceous vegetation, others favor moderate heights and densities, and only a small number require or favor short or sparse herbaceous vegetation (Figure 8). As an example, only 4 small mammal species on the BTNF are associated with or favor short or sparse herbaceous vegetation in contrast with 13 species of small mammal species that require or favor relatively-tall, moderately-dense to dense herbaceous cover.

This is particularly relevant given the underrepresentation of herbaceous vegetation and herbaceous communities on and around the BTNF, due a wide range of reasons.



ATTACHMENT F

Updating the Animal Unit Month

By Dr. John Carter

October 2016

Yellowstone to Uintas Connection

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The animal unit month (AUM) has historically been used as a unit of forage consumption and the basis of permits, stocking rates and fees for grazing public lands. This report provides a review and update of current livestock weights and forage consumption rates, clarifies the definition of an AUM and proposes means whereby agencies can validate and adjust stocking and billing rates.

It is important to ensure that forage consumption rates by livestock are based on the size of animals present on the allotment so that stocking rates are more closely balanced with available forage. It is also to ensure that grazing fees accurately represent the forage consumed by livestock so the public trust is not violated by undercharging for the actual weights and forage consumption of livestock being grazed.

The formula used for calculating the grazing fee, established by Congress in the 1978 Public Rangelands Improvement Act, has continued under a presidential executive order issued in 1986. Under that order, the grazing fee cannot fall below \$1.35 per AUM, and any increase or decrease cannot exceed 25 percent of the previous year's level. In a recent press release, the Forest Service and BLM defined an AUM as the amount of forage needed to sustain one cow and her calf, one horse, or five sheep or goats for a month¹.

In the 1994 Rangeland Reform Draft Environmental Impact Statement, BLM and the Forest Service defined an animal unit month as: *"The amount of forage needed to sustain one cow, five sheep, or five goats for a month. A full AUM's fee is charged for each month by adult animals if the grazing animal (1) is weaned, (2) is 6 months old or older when entering public land, or (3) will become 12 months old during the period of use. For fee purposes, an AUM is the amount of forage used by five weaned or adult sheep or goats or one cow, bull, steer, heifer, horse, or mule. The term AUM is commonly used in three ways: (1) stocking rate as in X acres per AUM, (b) forage allocation as in X AUMs in allotment A, and (3) utilization as in X AUMs consumed from Unit B"*.

These definitions avoid dealing with the actual weight and forage consumption of the various animals listed and ignore forage consumption by calves and lambs. Clarification and updating of these values is needed so that livestock producers are charged for the actual forage consumed by all animals grazed and the carrying capacity of the land is not exceeded. Other requirements in FLPMA stress grazing within the carrying capacity of forage within the allotment, the variability of forage production and the need for sustainable use [Sec. 4130.3-1(a); 4100.0-5]. In order to achieve the requirements for sustainable use without impairment, it is critical to align available forage with livestock stocking rates. BLM, for example, has typically used 800 lbs/month of forage as the consumption rate for a cow/calf pair³. BLM also does not clarify if this is air dry or oven dry weight. The Forest Service defines an AUM as

¹ http://www.blm.gov/ca/st/en/info/newsroom/2006/02/wonews_grazingfees_2006.html for press release announcing 2006 grazing fees. US Dept of Interior, BLM.

² U.S Department of Interior, Bureau of Land Management in Cooperation with the Department of Agriculture Forest Service. 2004. Rangeland Reform '94 Draft Environmental Impact Statement.

³ U.S. Dept. of Interior. 2006. Draft Pocatello Resource Management Plan and Environmental Impact Statement.

“The quantity of forage required by one mature cow and her calf (or the equivalent, in sheep or horses) for one month”^{4, 5}. They use a value of 26 pounds of forage per day for a cow calf pair⁶ and have used other values such as 34 pounds per day for a “head month” or cow/calf pair⁷. These inconsistencies need resolution.

NRCS, in its National Range and Pasture Handbook, defines an Animal Unit (AU) as one mature cow of approximately 1,000 pounds and a calf as old as 6 months, or their equivalent, then states, *“An animal unit month (AUM) is the amount of forage required by an animal unit for one month”*.⁸ NRCS further defines the actual forage consumption as 26 pounds of oven-dry weight or 30 pounds of air-dry weight per day as *“the standard forage demand for a 1,000 pound cow (one animal unit)”*. This is 2.6% of body weight for oven-dry weight and 3% of body weight for air-dry weight of forage. Note that there is no forage allowance for the calf in this consumption rate yet the definition of an animal unit includes a calf. The same would be true for lambs, when considering sheep grazing.

The Society for Range Management (SRM) in 1974 defined an Animal Unit *“to be one mature (1000 lb.) cow or the equivalent based upon average daily forage consumption of 26 lbs. dry matter per day.”*⁹. SRM also defined an Animal Unit Month as *“The amount of feed or forage required by an animal-unit for one month.”* In the second edition, SRM revised this definition to include an *Animal-unit (AU) as the forage consumption on the basis of one standard mature 1,000-pound cow, either dry or with calf up to 6 months old as consuming 26 pounds of air-dry forage per day or 790 pounds per month.*¹⁰

It appears from these definitions that there is confusion over the amount of forage consumed by livestock and whether that is expressed as air-dry or oven-dry forage amounts. The later SRM definition also clouds the distinction between cow and calf forage consumption, making it appear as if the forage consumed by the calf is included in the daily or monthly amount for the 1,000 pound cow. A careful reading shows that no forage is included for the calf. A review of some history provides some further insight into animal units and forage consumption.

⁴ U.S. Forest Service Wasatch Cache National Forest. 1995. Final Environmental Impact Statement Rangeland Health.

⁵ U.S. Forest Service Caribou-Targhee National Forest. 2003. Final Environmental Impact Statement for the Caribou National Forest Revised Forest Plan.

⁶ U.S. Forest Service Bighorn National Forest. 2004. Battle Park Cattle & Horse, Mistymoon Sheep & Goat Allotment Management Plan Revision EIS

⁷ U.S. Department of Agriculture Caribou-Targhee National Forest. 2002. Final Environmental Impact Statement for the Curlew National Grassland.

⁸ USDA Natural Resources Conservation Service. 2003. National Range and Pasture Handbook Revision 1, Chapter 6. Grazing Lands Technology Institute.

⁹ Society for Range Management. 1974. Glossary of terms used in range management.

¹⁰ Ortmann, John, L. Roy Roath, and E.T. Bartlett. 2000. Glossary of Range Management Terms No. 6. 105. Colorado State University Natural Resource Series.

The University of Nevada Agricultural Experiment Station published a report on cattle production in 1943¹¹. That report analyzed 14 years of ranch operation for eleven ranches in northeastern Nevada. At that time, a mature cow was defined as one unit and a branded calf or weaner as ½ cow unit, for a combined total of 1.5 cow units per cow/calf pair. Bulls were considered 1.5 cow units. For the period 1938 – 1940, the average turnoff weight (when they left the range) of mature cows was 959 pounds, calves were 381 pounds and bulls were 1222 pounds. This means that in the 1930's, a cow/calf pair was 1340 pounds. With breeding, supplements and hormones, weights have increased over time. For example, Anderson et al (ca 2000) calculated a 35% increase in dressed weights per animal between 1975 and 1995¹².

The 1964 Forest Service R-4 Range Analysis Handbook¹³ provided a detailed summary of forage consumption for cattle and sheep as air-dry amounts. This is reproduced in Table 1.

Table 1. Air Dry Forage Consumption 1964 R4 Range Analysis Handbook

Cattle	Animal Unit Factor	Daily Air Dry Weight Consumption
1,000 lb animal	1.00	24
Dry cow	1.00	24
Cow plus 300 lb calf	1.36	33
Cow plus 400 lb calf	1.46	35
Cow plus 500 lb calf	1.55	37
Yearling	0.74	18
Sheep	Animal Unit Factor	Daily Air Dry Weight Consumption
125 lb ewe	1.0	4.1
Ewe plus 30 to 40 lb lamb	1.3	5.3
Ewe plus 40 to 50 lb lamb	1.4	5.7
Ewe plus 50 to 60 lb lamb	1.5	6.2
Ewe plus 60 to 70 lb lamb	1.6	6.6
Ewe plus 70 to 80 lb lamb	1.65	6.8
Ewe plus 80 to 90 lb lamb	1.7	7.0
Ewe plus 90 to 100 lb lamb	1.8	7.4
Ewe plus 100 to 110 lb lamb	1.9	7.8

Table 2 is taken from the NRCS National Range and Pasture Handbook. It provides animal unit equivalents for different animals. Again, there appears to be inconsistency over the animal unit for cows and calves. Table 2 and their definition define an animal unit as a cow and calf, but their forage allocation does not include the calf.

¹¹ Brennan, C.A. and Fred B. Harris. 1943. Fourteen Years Cattle Production and Ranch Earning Power in Northeastern Nevada 1928 to 1941. University of Nevada Agricultural Experiment Station, Reno, Nevada.

¹² <http://agecon.uwyo.edu/RiskMgt/marketrisk/TheCattleCycle.pdf>

¹³ USDA Forest Service. 1964. Forest Service Handbook – R4 Range Analysis Handbook.

Table 2. NRCS Animal Unit Equivalents

Kind of Animal	Animal Unit Equivalent
Cow with calf	1.00
Mature bull	1.35
Mature Horse	1.25
Mature sheep	0.2
Lamb, 1 year old	0.15
Mature mule deer	0.2
Mature elk	0.6
Mature antelope	0.2
Mature bighorn sheep	0.2

To clarify this situation, USDA market statistics were researched.¹⁴ These give the average weights of slaughter cattle for the week ending August 14, 2004 as 1251 pounds. The estimate for the same week in 2005 for slaughter cattle average weight was 1260 pounds. The USDA National Agricultural Statistics Service data for average live weight of cattle slaughtered in 2004 was 1242 pounds compared to 1072 pounds in 1984, or an increase of 15.8% in those 20 years¹⁵. The chart of that data is provided in Figure 1. The Livestock Monitor is a newsletter produced by the North Dakota State University Extension Service Livestock Marketing Information Center in cooperation with USDA State Extension Services¹⁶. The Livestock Monitor shows for the week ending August 6, 2005, live weights of slaughter cattle averaged 1258 pounds.

The potential weights of mature cows can be even larger than these numbers. For example, NRCS in its National Range and Pasture Handbook, referenced above, defines body condition scores in a range of 1 to 9. A body condition score of 6 which is described as *“Good, smooth appearance throughout. Some fat deposits in brisket and over the tailhead. Ribs covered and back appears rounded.”* This body condition score relates to a pregnancy percentage of 88%, which is important as a goal for cow/calf operations. This is because dry cows are usually culled and replaced in order to maximize production of calves by the herd and the weight gain of calves is important for income. Therefore, maximizing Body Condition Score is necessary to maximize calf production.

Mature cow weight varies approximately 7 to 8 percent for each unit change in Body Condition Score (range 1 to 9), and extremes in muscling can cause weight to vary as much as 10 percent.¹⁷ Frame size (height) scores show that cows at maturity can weigh much more than 1,000 pounds¹⁸. Table 3 is reproduced from the North Dakota State University publication cited. These figures were for average condition cattle (body condition score of 5). Actual weights will vary due to differences in muscling, body

¹⁴ http://www.ams.usda.gov/mnreports/SJ_LS712.txt

¹⁵ <http://www.usda.gov/nass/pubs/agr05/acro05.htm>

¹⁶ <http://www.ag.ndsu.nodak.edu/aginfo/lsmkt/monitor.htm>

¹⁷ Hammack, Stephen P. and Ronald J. Gill. 1997. Frame Score and Weight of Cattle. Texas Agriculture Experiment Station, Texas A & M University System.

¹⁸ John Dhuyvetter. 1995. Beef Cattle Frame Scores. North Dakota State University Agriculture and University Extension Publication AS-1091 (<http://showsteers.com/Frame%20Score%20Chart.htm>).

length, condition and other factors. These figures were adapted from a 1991 publication, so represent weights from nearly two decades ago.

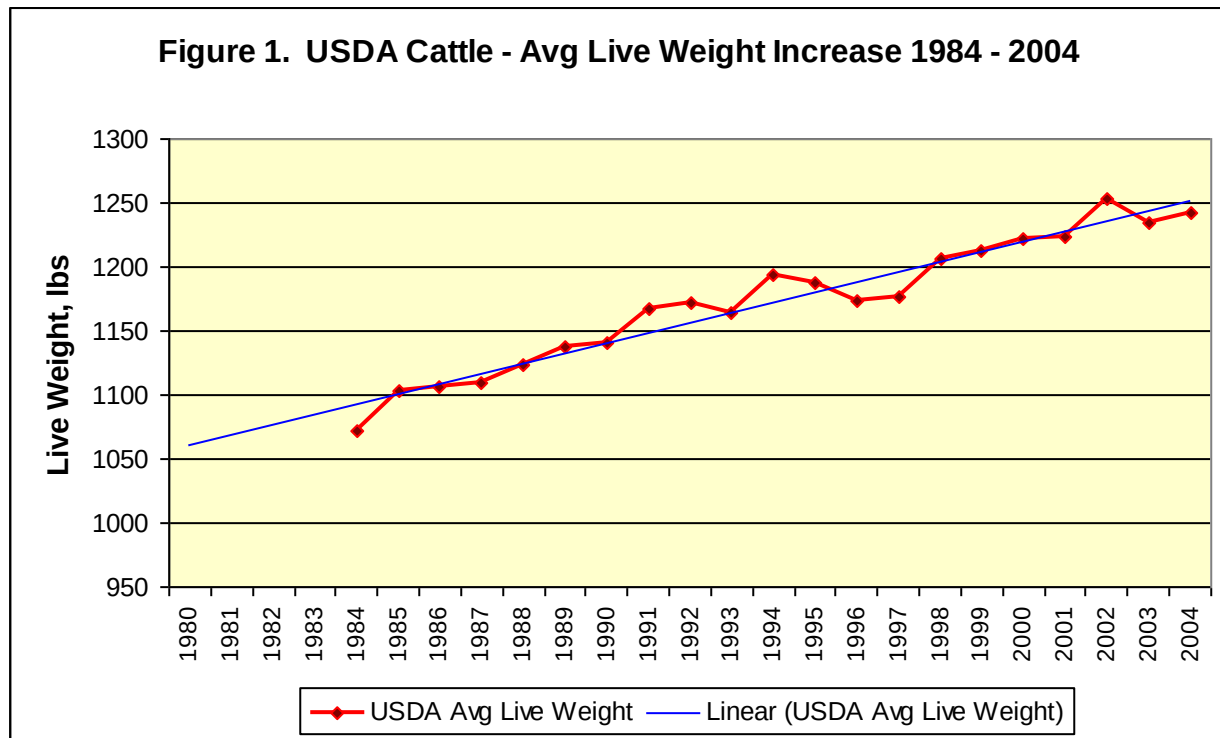


Table 3. Cattle Weight as Function of Frame Size for Average Condition Cattle

Frame Score	Frame Size	Mature Cow Weight lbs	Steer Slaughter Weight lbs	Heifer Slaughter Weight lbs
2	Small	955	850	700
3		1030	950	800
4	Medium	1100	1050	900
5		1175	1150	1000
6	Large	1250	1250	1100
7		1320	1350	1200
8		1395	1450	1300
9		1470	1550	1400

Holechek et al (2001) summarized the weaning weights of calves grazed on various types of rangelands at different stocking rates¹⁹. The data for the period since 1990 produced an average weaning weight of 430 pounds and a range of 382 – 475 pounds. Ray et al (2004) gave a weaning weight of 480 pounds for calves²⁰. Using the current

¹⁹ Holechek, Jerry L., Rex D. Pieper and Carlton H. Herbel. 2001. Range Management: Principles and Practices, Fourth Edition. Prentice-Hall, New Jersey. 587p

²⁰ Ray, D.E., A.M. Lane, C.B. Roubicek, and R.W. Rice. 2004. Range beef herd growth statistics. In: Arizona Rancher's Management Guide. Arizona Cooperative Extension, College of Agriculture, University of Arizona.

market statistics for slaughter cattle of 1250 pounds and the average weaning weight of 430 pounds provided by Holechek et al (2001) gives an estimate for the average weight of a cow/calf pair during the grazing season of 1,680 pounds.

As pointed out above, the NRCS used 26 lbs/day of oven dry weight for a 1,000 pound cow and stated this was equivalent to 30 pounds per day air-dry weight. The NRCS Range and Pasture Handbook value of 30 pounds air-dry weight would be 3% of body weight for a 1,000 pound cow. **Applying this to the current weight of 1,680 pounds for a cow/calf pair, the daily forage consumption would be 50.4 lbs of air-dry forage per day, or for a month (30.4 days), 1532 pounds of forage per AUM.**

BLM and the Forest Service should update their 790 lb/month forage consumption rates (26 lb/day) to current forage consumption rates based on this best available information. Based on these figures, BLM and the Forest Service are generally underestimating forage consumption for a cow/calf pair by 742 lb/month or 24.4 lb/day, an amount nearly equal to the current forage consumption rate used by the agencies. To account for this in grazing permits and annual billings, stocking rates must be reduced by a corresponding amount.

The forage needs for domestic sheep must also be determined. According to government statistics, in 2015, the average live weight of sheep and lambs for slaughter was 144 pounds.²¹ The average forage consumption rate is 3% of body weight on an air-dry basis.²² Since three sheep (ewe/lamb pair) can be grazed under these permits, the forage consumption by each permitted pair is 144 lb x 3 sheep x 3%, or 13 lb/day of air dry weight. **As defined, an AUM consists of 5 sheep (plus their lambs), leading to calculated forage consumption by one AUM of sheep to be 65 pounds of air dry forage per day or 1,976 pounds per month.** As for cattle, stocking rates must be adjusted to take this into account.

Federal and State Lands Agencies should begin recalculating their stocking rates, permitted numbers and grazing seasons based on this updated research. Permits, Billing Statements and Annual Operating Plans should be modified to take this update into account. If permittee sale records are available, those might be used to validate weights and therefore, forage consumption rates. Frame size and body condition scoring also provide a means of making field determinations of the sizes of cattle and could be used to calculate an allotment specific average animal weight and forage consumption rate. In our experience, cattle today are typically large frame size which leads to much higher rates of forage consumption than the averages used in this report.

²¹ <http://www.usda.gov/nass/PUBS/TODAYRPT/lstk0315.pdf>

²² http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmstn9390.pdf

ATTACHMENT G

Beef cattle distribution patterns on foothill range

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Abstract

A 3-year experiment designed to quantify the spatial and temporal utilization patterns of range sites by beef cattle on summer foothill range was conducted on the Wick Brothers Management Unit of the Wyoming Game and Fish Commission, 8 km w. of Arlington, Wyo. The grazing seasons, in replicate pastures, were from 15 July–9 August, 15 June–26 July, and 15 June–2 August in 1980, 1981, and 1982, respectively. Daily observations were made of radio-telemetry collared cattle (3 per pasture). Cattle dispersion was constrained by the spatial distribution of water and slope. Across 3 seasons, 77% of observed use was within 366 m of water. Approximately 65% of the land area was beyond 723 m from water and sustained only 12% of observed use. Cattle concentrated use (79%) on slopes less than 7%. Consequently 35% of the area, on or surrounded by slopes $>10\%$, received only 7% of observed use. Loamy, grazable woodland and wetland/subirrigated range sites were most preferred and accounted for over 65% of observed use while occupying less than 35% of the land area. Overall, coarse upland, very shallow and shallow loamy sites were not preferred; however, site preference varied as areas further from water were utilized. Observed use was significantly ($P < 0.10$) correlated (r 0.41 to 0.69) with standing crop and crude protein standing crop over various growth form characteristics of the forage component. Associated stepwise regression models accounted for 44 to 73% of the variation in observed use over the 1982 grazing season. As the forage complex became more similar, in terms of standing crop and crude protein content, significantly less ($P < 0.05$) variation in use was accounted for by the forage variables (0–37%).

Key Words: plant community preference, slope sensitivity, water availability, seasonal patterns

Achieving an equitable distribution of livestock use among areas and plant communities within a pasture is a major objective of grazing management practices (Holechek et al. 1989). Concentrated use around water sources by cattle (Squires 1978, Gillen et al. 1984, Martin and Ward 1970) can lead to an eventual decline in range condition. Cattle prefer to use level to gently sloping terrain and avoid slopes in excess of 10% (Mueggler 1965, Cook 1966, Van Vuren 1982). Consequently, physiographically diverse ranges will have areas of over utilization adjacent to areas with under utilization, because the negative interaction between slope and distance to water promotes over concentration of use on level areas adjacent to water sources (Cook 1966, Roath and Krueger 1982b, Van Rees and Huston 1983).

Cattle prefer certain forage species and plant parts from the assemblage of available forages within and among plant communities (Arnold and Dudzinski 1978). These forage preferences often lead to over utilization of individual forage species and/or plant communities and then eventual decline.

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Research was funded in part by USDA-ARS, High Plains Grassland Res. Sta., USDA Forest Service, and the Hereford Association.

The authors wish to thank M. Branine and M.K. Owens for assistance in field data collection, K.J. Young for her assistance in data summarization and graphic arts, and M.S. Stone for manuscript preparation.

This report is published with approval of the Director, Wyoming Agr. Exp. Station, as WY

Manuscript accepted 16 September 1990.

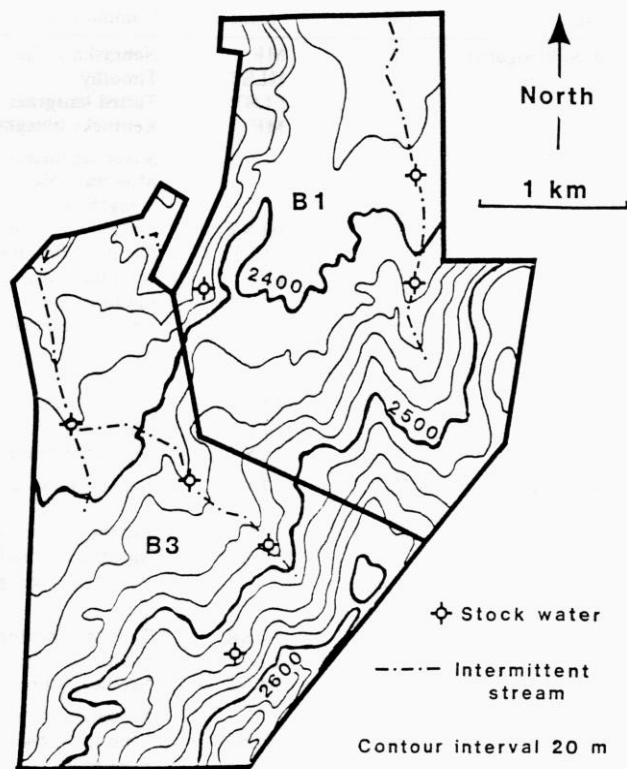
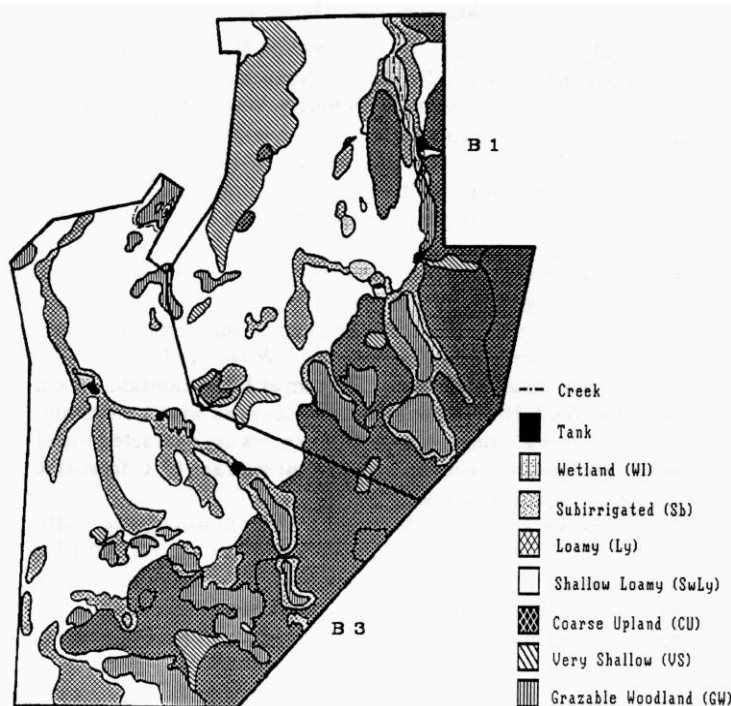


Fig. 1a. Range site composition and location of water sources in pastures B1 and B3. **Fig. 1b.** Topographic map of pastures B1 and B3.

The combined effects of physiographic diversity, spatial distribution of water, and heterogeneity of plant communities on distribution patterns of cattle grazing foothill range have not been elucidated. Our objective in this experiment was to determine the effects of these abiotic and biotic factors on cattle distribution patterns on summer foothill range.

Materials and Methods

The study area is located on the 4,597 ha Wyoming Game and Fish Department's Wick Brothers Management Unit, approximately 8 km west-northwest of Arlington, Wyo. The grazing permit period was from 15 June to 15 October, with an 800 animal unit month (AUM) allocation. In 1980, 10.6 km of 4-wire, New Zealand type electric fence was built to facilitate implementation of a deferred rotation grazing system and establish replicate pastures B1 and B3 (Fig. 1a).

Elevations of the study pastures range from 2,340 to 2,640 m (Fig. 1b). Topography is dominated by high rolling hills and benches in descending elevation paralleling perennial drainages. Aspects are dominated by NW, W, and SW facing slopes.

Annual precipitation averages 397 mm at Elk Mountain, 10 km west of the Wick Unit, most of which occurs as winter snow and early spring rains. Convective thunderstorms are characteristic of summer precipitation events. The 20-year average 0° C frost-free period is 84 days $\pm$ 15 days.

Major range sites were Wetland (WL), Sub-irrigated (SB), Loamy (LY), Grazable Woodland (GW), Shallow Loamy (SWLY), Coarse Upland (CU), and Very Shallow (VS). Wetland and SB sites were combined into WL/SB complexes because these are commonly intermingled. Major overstory and understory species in

each site type are given in Table 1. Figures 1a and b depict the spatial distribution of range sites and water and the topographic diversity of pastures B1 and B3, respectively.

Cattle Distribution

Throughout the experiment, pastures were lightly stocked (5.7 to 5.9 ha $\bullet$ AUM⁻¹) (Soil Conservation Service 1978) to facilitate animal expression of site preference. Each year, 3 animals (2 cows and 1 steer) per pasture were fitted with radio telemetry collars to facilitate daily observations of animal distributions on this foothill range. Collared animals and sub-herds not having collared animals were observed at least once daily. Observations were made during daylight hours (0600 to 2030) because we found very little nighttime movement. A sampling day was divided into 3 periods, morning (0600 to 1100), mid-day (1101 to 1600) and evening (1601 to dark), which over the 3 grazing seasons accounted for 37, 31, and 32%, respectively, of cattle observations. Employing this scan sampling design, across years 90 $\pm$ 5% of the cattle in a pasture were accounted for at each observation.

Collared animals were located using a Telonics RDP2¹ receiver and a portable, 2-element Yagi directional antenna. At each visual observation of collared animals and unassociated sub-herds, time, map location, range site type, activity, number of associated animals (within 183 m), their activity, distance from water, distance from shade, percent and length of slope, aspect, temperature, relative humidity, and wind speed and direction were recorded. Distance from water and shade were estimated utilizing a Ranging

¹Mention of a trademarked product does not represent promotion or endorsement by the University of Wyoming or USDA, ARS.

Table 1. Major overstory and understory species^a and proportion of total area in each range site type.

Range site	Area (%)	Growth ^b form	Major plant species	
			Common name	Scientific name
Wetland/Subirrigated	2	MF	Nebraska sedge	<i>Carex nebraskensis</i> Dewey
		HLST	Timothy	<i>Phelum pratense</i> L.
		LLST	Tufted hairgrass	<i>Deschampsia caespitosa</i> (L.) Beauv.
		MF	Kentucky bluegrass	<i>Poa pratensis</i> L.
Loamy	13		Silver sagebrush	<i>Artemisia cana</i> var. <i>viscidula</i> Osterh.
			Mountain big sagebrush	<i>Artemisia tridentata</i> var. <i>vaseyana</i> (Rydb.) Boivin
		HLST	Letterman needlegrass	<i>Stipa lettermanii</i> Vasey
		LLST	Slender wheatgrass	<i>Elymus trachycaulus</i> (Link) Gould ex Shinners
		LLST	Mountain brome	<i>Bromus carinatus</i> H. & A.
		HLST	Idaho fescue	<i>Festuca idahoensis</i> Elmer
		LLST	Canby bluegrass	<i>Poa secunda</i> Presl var. <i>elongata</i> (Vasey) Dorn
Grazable Woodland	8		Aspen	<i>Populus tremuloides</i> Michx.
		HLSR	Elk sedge	<i>Carex geyeri</i> Boott
		LLST	Blue wildrye	<i>Elymus glaucus</i> Buckl.
		LLST	Mountain brome	
		LLST	Slender Wheatgrass	
Shallow Loamy	45	LLSR	Griffith Wheatgrass	<i>Elymus lanceolatus</i> var. <i>griffithsii</i> (Scribn. & Sm. ex Piper) Dorn
		LLST	Sandberg bluegrass	<i>Poa secunda</i> var. <i>secunda</i> Presl
		LLST	Needleandthread	<i>Stipa comata</i> Trin. & Rupr.
			Wyoming big sagebrush	<i>Artemisia tridentata</i> var. <i>wyomingensis</i> (Beetle and Young) Welch
Coarse Upland	26	LLSR	Griffith Wheatgrass	
		LLST	Sandberg bluegrass	
		LLST	Needleandthread	
Very Shallow	6		Mountain mahogany	<i>Cercocarpus montanus</i> Raf.
		HLSR	King spikefescue	<i>Leucopoa kingii</i> (Wats.) Weber
		HLSR	Ross sedge	<i>Carex rossii</i> Boott
		LLST	Griffith Wheatgrass	

^aCommon and scientific names follow Beetle (1970) and Dorn (1988), respectively.

^bMF = mat forming, HLST = high leaf:stem tufted, LLST = low leaf:stem tufted, LLSR = low leaf:stem rhizomatous, HLSR = high leaf:stem rhizomatous.

Table 2. Observed cattle use and preference of areas away from water within pastures across years^a.

Distance from water range m	Pasture B1 ^a Year			Pasture B3 ^a Year		
	1980	1981	1982			
0 - 183	.81 ^b (P) ^c	.50 (P)	.73 (P)	.62 (P)	.36 (P)	.47 (P)
184 - 366	.17 (P)	.24 (P)	.11 (P)	.20 (P)	.15 (P)	.34 (P)
367 - 549	0 (A)	.01 (A)	.05 (A)	.04 (A)	.09 (N)	.10 (N)
550 - 732	0 (A)	.16 (N)	.03 (A)	.09 (A)	.02 (A)	.01 (A)
733 - 1097	.01 (A)	.08 (A)	.06 (A)	.06 (A)	.04 (A)	.01 (A)
1098 - 1463	.01 (A)	.02 (A)	.01 (A)	0 (A)	.14 (N)	.01 (A)
1464 - 1829	0 (A)	0 (A)	.01 (A)	0 (A)	.03 (A)	0 (A)
1830 - 2195	NA ³	NA	NA	0 (A)	.04 (A)	0 (A)
2196 - 2743	NA	NA	NA	NA	.05 (A)	0 (A)
≥2744	NA	NA	NA	NA	.09 (A)	0 (A)
Observed AUD ^d	1180	2651	2656	1094	2030	2616

^aFor ease of data presentation, the proportions of use were used in this table though the actual number of expected and observed AUD were utilized for χ^2 analyses. Calculated χ^2 for zone use among years within and across pastures (rows) and within pasture and year among zones (columns) are significant at $P < 0.01$.

^bProportion of observed AUD in a zone.

^cP = preferred, A = avoided, N = no preference. Based upon CI = observed AUD in a zone $\pm 1 - \alpha / 2k$, where K is the number of simultaneous comparisons (i.e. 10 zones).

^dTotal observed AUD.

Inc.¹ range finder and later verified with map coordinates. Percent slope was estimated and post-observationally verified utilizing an Abney level. Similarly, length of slope was verified using a 100-m tape. Activity was classified into grazing, ruminating, walking, lying, and watering. Activity distribution among time periods indicated 64 to 75% of observed activities were grazing and 22 to 32% ruminating. There was no difference among time periods in these activities.

Each observation was weighted by the number of animals within 183 m of the collared animal or within 183 m of the centroid of a sub-herd. Weighting allowed quantitation of the magnitude of preference for a location and its attributes. Weighted values were defined as animal use days (AUD), which included all activities. If multiple collared animals were observed in a group, they were counted as a single observation. Subsequently, weekly and seasonal AUD and percent AUD were utilized to determine distribution patterns.

Vegetation

Plant communities were mapped into range site types based upon SCS (1978) Technical Guidelines in 1979. Mapping resolution was to .1-ha inclusions except for certain intermingled CU/SWLY and WL/SB complexes where proportions within a location were estimated. Twenty-five percent of the representatives of each range site in each pasture were selected for range condition determination in 1979. Condition ranged from mid-fair (40%) to high good (63%) across sites and was least around water sources.

During 1981 and 1982, approximately 100 g wet weight of the

predominant grass species and select forbs (Table 1) from a representative of each range site type, in each pasture, was collected at 10-day intervals throughout the grazing period. Samples were frozen and later dried at 55° C to a constant weight. Dry matter and moisture content were determined by difference. Crude protein content was determined using a macro-Kjeldahl nitrogen technique (AOAC 1975) then multiplying percent nitrogen by 6.25.

In 1982, a 50 m $\times$ 100-m macro-plot was established in the same site representatives as previously sampled for forage quality. Standing crop of grasses and select forbs was estimated before, midway, and after grazing using the double sampling technique described by Wilm et al. (1944). On each date, twenty .25-m² quadrats were randomly sampled within a macro-plot. Five to 6 plots were estimated and clipped by species; the remainder were estimated only and adjusted by a regression model of estimated weight to clipped weight generated for each site on each sample date.

A classification scheme was developed to describe standing crop in a currency which beef cattle might discriminate on, within and among range site types. Preferences exhibited by cattle for grass over browse and leaf over stem (Arnold and Dudzinski 1978) were the basis for classification. Forages were classified by growth form and relative leaf:stem ratio into 5 functional groups: mat forming (MF), high leaf:stem tufted (HLST), low leaf:stem tufted (LLST), high leaf:stem rhizomatous (HLSR), and low leaf:stem rhizomatous (LLSR) grasses (Table 1).

Standing crop in a pasture was estimated by first multiplying the acreage of a range site by the standing crop of that range site then summing across types. Standing crop of a range site as a propor-

¹Mention of a trademarked product does not represent promotion or endorsement by the University of Wyoming or USDA, ARS.

Table 3. Range site use and preference by cattle within pastures across years^a.

Range site	Land area	Pasture B1 (570 ha)			Area (%)	Pasture B3 (574 ha)		
		1980 (1180 AUD) ^b	1981 (2651 AUD)	1982 (2656 AUD)		1980 (1094 AUD)	1981 (2030 AUD)	1982 (2616 AUD)
Coarse upland	.27	.04 ^c (A) ^d	<.01 (A)	.01 (A)	.25	.20 (A)	.05 (A)	.02 (A)
Shallow loamy	.41	.27 (A)	.28 (A)	.27 (A)	.48	.15 (A)	.32 (A)	.32 (A)
Loamy	.10	.44 (P)	.34 (P)	.41 (P)	.16	.39 (P)	.34 (P)	.39 (P)
Very shallow	.12	.03 (A)	.09 (A)	.02 (A)	.01	0 (A)	0 (A)	.01 (A)
Wetland/subirrigated	.03	.16 (P)	.18 (P)	.16 (P)	.01	.18 (P)	.08 (P)	.07 (P)
Grazable woodland	.07	.07 (N)	.12 (P)	.13 (P)	.09	.08 (P)	.22 (P)	.19 (P)

^aFor ease of data presentation the proportion of expected use (and area %) and observed use were used in the table, however, the actual number of expected and observed AUD were utilized in the χ^2 analysis. Calculated chi-squares for range site use among years within and across pastures (rows) and within pasture and year among range sites (columns) are significant at $p < 0.01$.

^bTotal observed animal use days (AUD).

^cProportion of observed AUD.

^dP = preferred, A = avoided, N = no preference. Based upon CI = observed AUD on a range site $\pm 1 - 2k$, where K is the number of simultaneous comparison (i.e. 6 range sites).

Table 4. Relationships between cattle preference for range sites and distance from water over 3 grazing seasons.

Range site	Year	Zones ^a away from water																			
		1		2		3		4		5		6		7		8		9		10	
		Pasture		Pasture		Pasture		Pasture		Pasture		Pasture		Pasture		Pasture		Pasture		Pasture	
		B1	B3	B1	B3	B1	B3	B1	B3	B1	B3	B1	B3	B1	B3	B1	B3	B1	B3	B1	B3
Coarse upland	1980	- ^b	+	-	=	=	-	=	+	+	+	-	.	.	.	na ^d	.	na	na	na	na
	1981	-	+	-	-	-	-	-	-	-	-	-	-	-	-	na	-	na	-	na	-
	1982	-	-	-	+	-	-	-	-	-	-	-	-	-	-	na	.	na	.	na	.
Shallow loamy	1980	=/-	-	+	-	.	=	.	=	-	-	+	.	.	.	na	.	na	na	na	na
	1981	=	-	=	-	-	-	-	-	+	+	-	-	.	+	na	+	na	-	na	=
	1982	-	-	+	-	+	-	+	-	=	-	-	+	+	-	na	.	na	.	na	.
Loamy	1980	+	+	-	+	.	+	.	-	-	-	-	.	-	.	na	.	na	na	na	na
	1981	+	-	+	=	+	+	+	+	+	-	-	+	.	-	na	-	na	+	na	+
	1982	+	+	+	+	-	+	-	+	=	+	-	-	-	.	na	.	na	.	na	.
Very shallow	1980	-	.	+	.	.	.	.	.	-	.	.	.	.	.	na	.	na	na	na	na
	1981	=	.	+	-	-	-	-	-	-	.	+	-	-	-	na	-	na	-	na	-
	1982	-	.	-	.	-	+	-	.	+	.	+	-	-	.	na	.	na	.	na	.
Wetland/subirrigated	1980	+	+	-	.	.	.	.	.	.	.	.	.	.	.	na	.	na	na	na	na
	1981	+	-	+	+	-	.	+	.	.	.	.	+	.	.	na	.	na	.	na	.
	1982	+	=	=	-	+	-	-	.	.	.	.	-	.	.	na	.	na	.	na	.
Grazable woodland	1980	+	-	-	+	.	-	-	-	-	-	-	-	.	.	na	.	na	na	na	na
	1981	+	+	-	-	.	+	=/+	-	-	-	-	-	.	-	na	-	na	-	na	=
	1982	+	+	-	+	-	-	-	-	-	-	=	-	-	.	na	.	na	.	na	.

^aZones 1 through 10 correspond to ranges of 0–183, 184–366, 367–549, 550–732, 733–1097, 1098–1463, 1464–1829, 1830–2195, 2196–2743, and >2743 meters away from water.

^b-, =, +; Avoided, expected, preferred within zone-pasture-year combinations; based upon CI=Proportion of observed AUD $\pm 1/2K$, where K is the number of simultaneous comparisons (10 zones).

^c.; Either no observed use within a zone or range site did not occur in the zone.

^d, na; Zone did not exist in year-pasture combination.

tion of the pasture standing crop was calculated by dividing range site standing crop by pasture standing crop. Functional group and crude protein standing crops within sites and pastures were calculated in the same manner.

Statistical Analyses

Chi-square (χ^2) analyses were employed to determine whether cattle utilized (AUD) range sites, areas around water, and range sites within areas around water in accordance with availability. Heterogeneity of χ^2 analyses were used to test effect of pasture within and across years (Zar 1974). Chi-square analyses are sensitive to a large proportion of zero cells, hence, zones around water were delineated to minimize zero occurrences among years, yet retain maximum possible resolution. Consequently, zones were not equidistantly spaced away from water: Zones 1 through 4 were 183 m wide, Zones 5 through 8 were 366 m wide, and Zones 9 and 10 were 549 m wide.

Preference for range sites, zones around water, and site types within and among zones was calculated utilizing a Bonferroni Z simultaneous confidence interval (CI) approach described by Neu et al. (1974) and modified by Byers et al. (1984). A simultaneous confidence interval at $1-\alpha/2K$, where K is the number of simultaneous comparison, (i.e., site types 6; zones 7 to 10 etc.), was constructed around observed animal use. If expected use (E) was less than CI, conditions were preferred (P). If E was within the CI, conditions had no preference (N) and if E was greater than the CI, conditions were avoided (A).

Relationships between site preference and site attributes were analyzed by simple and Spearman rank correlation and stepwise regression analyses (Zar 1974). A general linear model split-split-plot AOV was used to test for temporal differences in the abiotic characteristics of observed locations (Hicks 1973). A split-plot AOV was utilized to determine temporal differences in forage, growth form, and weighted crude protein standing crop of range site types (Hicks 1973). Analyses were conducted utilizing actual AUD; however, results are given as percent of AUD for ease of

presentation. Arc-sine transformations were utilized when percentage data were analyzed. A protected Student-Neuman-Keuls test (SNK) was utilized for *post-hoc* mean separation (Zar 1974).

Results

Across all year and pasture combinations, significantly more ($P<0.01$) use occurred within 366 m of water than was expected (77% observed AUD vs. 11% expected AUD). Approximately 65% of the available land area lay beyond 723 m from water and sustained less than 12% of observed use. In terms of preference, areas within 366 m of water were preferred while distances beyond that were avoided (Table 2).

The availability of water varied within pastures within and among years as watering locations became dry. Hence, the corresponding area of zones would expand or contract through time. The effects of these conditions were more pronounced in 1981 than 1980 or 1982, and in pasture B3 than pasture B1 (Table 2). During 1981, observed use within 366 m was 40% and 27% lower ($P<0.10$) than in 1980 and 1982, respectively. A concurrent increase in use occurred at distances beyond 732 m (Table 2). Changes in 1981 distribution patterns followed a winter where snowfall was 50% below normal, consequently, ephemeral drainages and some stock water locations were dry 3–4 weeks earlier than normal. A resultant 35% decrease (11% to 7% of the land area) of acreage within 366 m of water occurred.

During 1981, distribution patterns in pasture B3 were more affected by changes in water availability than those in pasture B1 (Table 2). Four of 5 stock water locations were dry by June 25 in B3 whereas 1 of 3 was dry in pasture B1. Presence of zones >2,195 m from water in 1981 and to less extent in 1982 indicates a major change in water availability from 1980. During 1981, 21% of the land area was beyond 2,195 m from water compared to an average of 10% over the course of the study. Associated with these changes 13% AUD occurred at distances greater than 2,195 m from water in pasture B3. The proportion of AUD with 366 m decreased 19 and 37% ($P<0.01$) in pastures B1 and B3, respectively, in 1981 com-

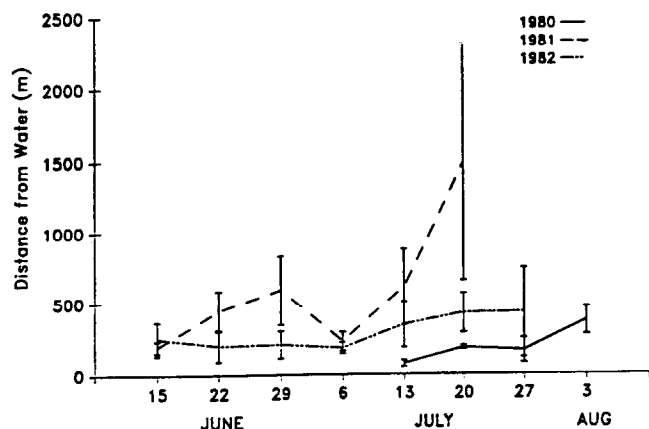


Fig. 2. Patterns of cattle dispersion away from water through time for the 1980-1982 grazing seasons. Mean $\pm$ s.d.

pared to the average of 1980 and 1982.

As time into grazing season progressed, cattle utilized areas further away from water ($P < 0.10$, Fig. 2). No year of year $\times$ week interaction existed ($P > 0.10$). After 3 to 4 weeks into the grazing season, cattle utilized areas increasingly further from water and variation about weekly means increased (Fig. 2). Concurrently, there was increased formation of sub-herd units from 1 or 2 initially, up to 6 at the end of the grazing season.

Averaged across years and pastures, cattle preferred slopes less than 4% ($P < 0.01$), but were observed on slopes ranging from 0 to 40%. Over 90% of observed animal use occurred on slopes less than 7%. As a result, 20% of land area received no observed use by cattle over 3 grazing seasons.

Range Site Use Patterns

Observed cattle use of range sites was significantly ($P < 0.01$) different from range site availability (Table 3). Individual site types varied widely in the amount of use sustained and their preference. Loamy sites sustained significantly ($P < 0.05$) greater AUD than other sites within and among pastures and years. Averaged across years, 38% of AUD occurred on LY sites. Similarly, cattle displayed a marked preference for WLSB and GW sites over the course of the study. Wetland/subirrigated sites were preferred under all pasture-year combinations, whereas, GW sites were utilized as expected during 1980 in pasture B3 and preferred under the remaining combinations (Table 3).

Cattle did not prefer SWLY, CU and VS range sites (Table 4). Shallow loamy sites occupied over 40% of the area in study pastures and were the dominant site type (Table 3). Even though SWLY sites were not selected for, over the course of the study these accounted for a significantly greater ($P < 0.05$) proportion of AUD

Table 5. Average forage standing crop, crude protein content, and crude protein standing crop among range sites during the 1982 grazing season.

Range site	Standing crop (Kg $\cdot$ ha $^{-1}$)	Crude protein (%)	Crude protein standing crop (Kg CP $\cdot$ ha $^{-1}$)
Coarse upland	174 c ¹	10.4 c	18 c
Grazable woodland	252 bc	12.3 ab	31 bc
Loamy	292 b	12.7 a	37 b
Shallow loamy	283 b	10.6 bc	30 bc
Very shallow	181 c	12.2 b	22 c
Wetland/sub-irrigated	911 a	11.3 b	103 a

¹Means within a column not having a common letter are different at $P < 0.05$.

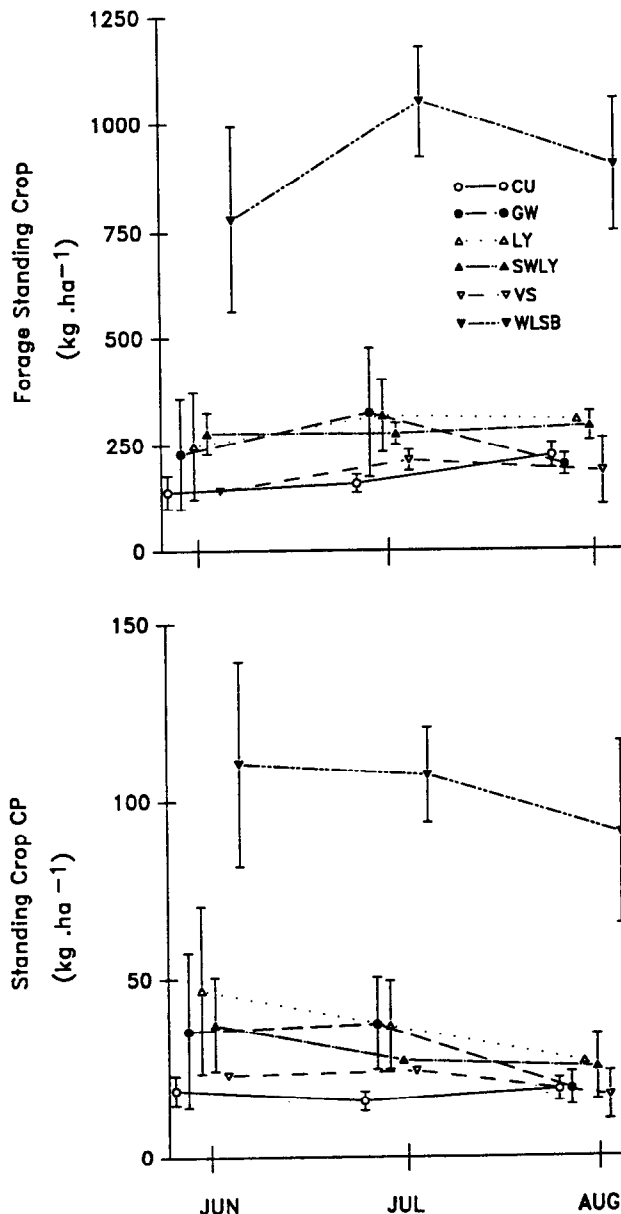


Fig. 3a. Preferred forage standing crop dynamics on range sites from 15 June through 10 August 1982. Fig. 3b. Crude protein standing crop dynamics on range sites from 15 June through 10 August 1982. Mean $\pm$ s.d.

(27 and 26% of AUD in pastures B1 and B3, respectively) than all but LY sites. Unlike CU and VS sites, the proportion of AUD on SWLY sites was remarkably consistent within pastures across years except pasture B3 and 1980 (Table 3). In this regard, SWLY sites were more similar to preferred than avoided sites. Coarse upland and VS sites on average sustained 5% of the AUD over the study period. Significantly less use was made of these sites than all other sites.

Yearly Patterns of Range Site Preference

While preference rating for a range site type remained relatively constant among years, significant changes occurred in the observed proportion of use on certain sites within and among pastures and years (Table 3). In 1980, a greater proportion of AUD occurred on CU sites than in either 1981 or 1982. Concurrently, proportional decreases of AUD on GW and SWLY sites were observed. Differences in 1980 use patterns coincided with a grazing season delayed 1 month (15 July vs. 15 June) and ending 10 days later than in 1981

Table 6. Average growth form standing crop and composition among range sites for the 1982 grazing season.

Growth form	Range site					
	Wetland subirrigated	Loamy	Grazable woodland	Shallow loamy	Very shallow	Coarse upland
Mat Forming						
Standing crop (Kg ha ⁻¹)	729 a ¹	0 b	0 b	0 b	0 b	0 b
Composition (%)	80 a	0 b	0 b	0 b	0 b	0 b
High Leaf:Stem Tufted						
Standing crop (Kg ha ⁻¹)	183 a	63 b	28 c	5 c	25 c	13 c
Composition (%)	20 a	21 a	10 abc	2 c	14 ab	7 bc
Low Leaf:Stem Tufted						
Standing crop (Kg ha ⁻¹)	0 c	190 c	73 b	70 b	15 c	14 c
Composition (%)	0 c	63 a	32 b	25 b	8 c	8 c
High Leaf:Stem Rhizomatous						
Standing crop (Kg ha ⁻¹)	0 c	27 b	133 a	<1 c	18 b	4 c
Composition (%)	0 c	9 b	51 a	<1 c	11 b	2 c
Low Leaf:Stem Rhizomatous						
Standing crop (Kg ha ⁻¹)	0 c	0 c	0 c	208 a	135 b	144 b
Composition (%)	0 c	0 c	0 c	74 ab	68 b	83 a
Forb						
Standing crop (Kg ha ⁻¹)	0 b	18 a	17 a	0 b	0 b	0 b
Composition (%)	0	7 a	7 a	0 b	0 b	0 b

¹ Means within a row without a common letter are different at $P < 0.05$.

and 1982. Furthermore, 1980 was the only year all stock water locations retained water throughout the grazing season.

Range Site Preference and Distance from Water Interaction

Cattle preference for certain range sites changed as cattle utilized areas further from water (Table 4). Year and pasture also affected range site preference within and among zones because range site composition of zones away from water changed as watering areas became dry. Insufficient occurrences of W1Sb sites beyond Zone 2 precluded further analysis. Grazable woodland sites were more consistently preferred within 183 m than any other zone (Table 4). Use of VS sites was sporadic and tended to be either very high or zero. Associated preference ratings indicate that, as distance from water increased to between 366 m and 1,463 m, cattle at times exhibited preference for VS sites though no discernible trends were detected.

Loamy sites consistently sustained the most use across pastures

and year. Preference existed for LY sites up to 732 m from water. Consistent decreases in preference occurred beyond 732 m where LY sites occupied more severe topographic positions, though under certain conditions, these sites were still preferred (i.e., >2,195 m from water).

Shallow loamy sites were not preferred at the pasture level; however, these sites were preferred under some year-pasture-zone combinations (Table 4). Generally, cattle displayed a greater preference for SWLY sites in pasture B1 than pasture B3. Similarly, cattle did not prefer SWLY sites in pasture B3 within 732 m of water. Preference of SWLY sites within a zone was in part related to the range site composition of that zone. If a large proportion of a zone was CU or VS sites, then SWLY sites were usually preferred; however, if a larger proportion of the zone was SWLY, these were avoided.

Preference ratings of CU sites within a zone were a function of

Table 7. Simple correlations between observed use, percentage of observed use, and intrinsic forage characteristics across and within months, 1982.

	Standing Crop (SC) (kg•ha ⁻¹)	Crude Protein (CP) (%)	CP Standing Crop (kg• CP ha ⁻¹)	Percent- age of Pasture SC	Percent- age of Pasture CPSC	HLST ^a SC ^b (%)SC ^c		LLST ^a SC ^b (%)SC ^c		HLSR ^a SC ^b (%)SC ^c		LLSR ^a SC ^b (%)SC ^c	
Correlation													
Across months (n=30)													
Observed AUD	.51**	.23	.56**	.36**	.42**	.33*	.21	.68*	.69**	.05	-.03	.29	-.50**
% Observed AUD	.47**	.07	.41**	.35*	.40**	.27	.17	.57**	.60**	.07	.01	-.25	-.48**
By month (n=10)													
JUNE													
Observed AUD	.39	.66**	.56*	.13	.23	.54	.50	.82**	.98**	-.06	-.07	-.45	-.64**
% Observed AUD	.38	.69**	.54	.13	.23	.55	.55*	.78**	.96**	-.03	-.06	-.46	-.66**
JULY													
Observed AUD	.68**	-.11	.60*	.67*	.70**	.33	.07	.78**	.72**	.10	.03	-.19	-.42
% Observed AUD	.73**	-.05	.67**	.61*	.64**	.38	.11	.74**	.66**	.18	.06	-.22	-.45
AUGUST													
Observed AUD	.61*	.13	.61*	.98	.49	.18	-.01	.57*	-.52	.10	-.10	-.21	-.43
% Observed AUD	.42	-.02	.36	.44	.42	-.02	-.15	.32	-.31	.25	.14	-.14	-.32

^aHigh leaf:stem tufted forages (HLST); low leaf:stem tufted forages (LLST); high leaf:stem rhizomatous forages (HLSR); low leaf:stem rhizomatous forages (LLSR).

^bAbsolute standing crop of a growth form (kg·ha⁻¹).

^cProportion of standing crop comprised of a growth form.

* $P < 0.10$

** $P < 0.05$

Table 8 . Stepwise regression analysis of relationships between observed use, percentages of observed use, and intrinsic forage characteristics of range sites throughout the 1982 grazing season. $P < .15$ for selection or rejection.

Model	b_0		b_1X_1		b_2X_2		b_3X_3		b_4X_4
Growth Form Standing Crop ($\text{kg} \cdot \text{ha}^{-1}$)									
Observed AUD $n=30$ $r^2=.61$ $P<0.01$	53.71	+	.85 LLST ²	+	537.81 PPCP	-	.62 LLSR		
% Observed AUD $n=30$ $r^2=.44$ $P<0.01$	.17	+	.89 PPCP	-	.001 LLSR				
Proportion of Standing Crop comprised of a growth form (%)									
Observed AUD $n=30$ $r^2=.73$ $P<0.01$	155.45	+	535.47 PPCP	-	2.84 PHLSR	-	3.48 PLLSR	+	8.24 CP
% Observed AUD $n=30$ $r^2=.59$ $P<0.01$	.31	+	.64 PPCP	-	.003 PHLSR	-	.004 PLLSR		

¹ b_0 =intercept, b_n =slope of variable n .

²LLST=Standing crop of low leaf:stem tufted forages.

PPCP=Standing crop percent of pasture crude protein.

LLSR=Standing crop of low leaf:stem rhizomatous forages.

PLLSR=Percentage of standing crop low leaf:stem rhizomatous forages.

PHLSR=Percentage of standing crop high leaf:stem rhizomatous forages.

CP=Average crude protein content (%) of the standing crop.

zone, pasture, and year (Table 4). Coarse upland sites within 366 m of water in pasture B3 were generally preferred or selected as expected whereas in pasture B1, CU sites were avoided. There was only 1 instance, Zone 5, 1980, where cattle preferred CU sites in pasture B1. Except in 1980, cattle avoided CU sites beyond 366 m from water.

Forage Attributes and Cattle Use of Range Sites

Across and within dates in 1982, the standing crop ($\text{Kg} \cdot \text{ha}^{-1}$) of preferred forages (PFSC) varied ($P<0.05$) among range sites (Table 5 and Fig. 3). The PFSC on WLSB sites was greater, within and among dates, than on any other site. Whereas, the PFSC associated with VS and CU sites across dates was least. A significant date by range site interaction ($P<0.08$) (Fig. 3) was attributed to site specific changes in PFSC between July and August. Ranking of cattle preference for sites (Table 2) generally followed the same ranking as average PFSC ($r_s = .9$ $n = 6$ $P<0.10$) with cattle preferring sites having greater PFSC.

Crude protein standing crops (CPSC) ($\text{Kg} \cdot \text{ha}^{-1}$) varied in a manner similar to PFSC across dates among range sites (Table 5). However, as evidenced by the absence of a date by range site interaction (Fig. 3), the seasonal dynamics of CPSC differed from PFSC. Overall, both PFSC and CPSC among sites became more similar as season advanced, though it was more pronounced and linear for CPSC. The rank correlation ($r_s = 1.0$, $n = 6$, $P<0.05$) between preference rank and CPSC rank was greater than for PFSC rank of a range site.

Growth form composition of the PFSC was significantly ($P<0.05$) different among sites across dates (Table 6). Preferred sites (WLSB, LY, and GW) had significantly ($P<0.05$) greater standing crops and proportion of standing crops of MF, HLST, and HLSR, respectively, than nonpreferred sites. While nonpreferred sites had greater ($P<0.05$) amounts and proportions of LLSR forages. The amount and proportion of LLST on LY and GW sites were greater ($P<0.05$) than CU and VS sites. However, there was no difference between GW and SWLY sites in the amount and composition of LLSR.

Relationships between site use and site forage characteristics were temporally variable within and across time in the grazing season (Tables 7 and 8). Correlation and stepwise regression analyses were conducted after removal of WLSB sites and the MF growth variables because limited availability (<2% of the total land area) restricted expression of selectivity to short periods of

very high animal densities followed by long periods of low animal use. Seasonlong, site use (AUD and % AUD) was positively correlated to the amount and proportion of LLST standing crop, total PFSC, and crude protein standing crop (Table 7). The proportion of LLSR standing crop was negatively correlated with site use. Because significant ($P<0.05$) autocorrelation existed between the standing crop of a growth form class and its associated proportion of PFSC, subsequent stepwise regression analyses were conducted utilizing either one or the other. Across dates (Table 8), models based on growth form proportion of standing crop accounted for more variation in observed use than models utilizing actual GF standing crop, though all models were significant ($P<0.01$). Approximately 73% and 59% of the variation in observed AUD and % observed AUD, respectively, was explained by a combination of growth form composition and crude protein variables.

Relationships between forage characteristics and site use varied as a function of time into grazing season (Table 9). Generally, as season progressed, the relationships between PFSC, CPSC and growth form composition deteriorated as these forage characteristics become more similar across range sites (Fig. 3). Hence, the greatest positive correlations between site use and the amount and proportion of LLST forages and the crude protein content of the forage occurred in June when use was negatively correlated to the proportion of LLSR forages. By August the proportion of observed AUD was not correlated with any measured forage characteristic. Similarly June and July regression models accounted for more ($R^2 = .72 - .99$) variation in site use than did August models ($R^2 = 0 - .34$) (Table 9).

Discussion and Conclusions

Observed distribution patterns on this foothill range were the integrated end product of water availability, physiography, and the range site mosaic. Water distribution appeared to be the major factor affecting cattle utilization patterns. As Valentine (1947), Squires (1978), and Van Vuren (1982) observed, there was a significant curvilinear decrease in observed use away from water across years and pastures. Cattle expressed preference for areas within 366 m of water and avoided areas beyond that. Gillen et al. (1984) reported comparable preference rankings from forested mountain range.

Distinct temporal dispersion patterns away from water existed (Fig. 2). Except in 1981, cattle observations were concentrated within 225 m of water 3 to 4 weeks into a grazing season, then

Table 9. Stepwise regression analysis of relationships between observed use, percentage of observed use, and intrinsic forage characteristics of range sites by month. $P < .15$ for selection or rejection of a variable.

Model		b_0		b_1X_1		b_2X_2		b_3X_3
JUNE								
Growth Form Standing Crop (kg ha^{-1})								
Observed AUD								
n=10 $r^2=.82$	$P < 0.01$	204.86	+	4.73 LLST	-	10.10 TSCCP		
% Observed AUD								
n=10 $r^2=.72$	$P < 0.02$	.21	+	.004 LLST	-	.001 TSC		
Growth Form Composition (%)								
Observed AUD								
n=10 $r^2=.99$	$P < 0.01$	-.522	+	11.06 PLLST	-	3.23 TSCCP		
% Observed AUD								
n=10 $r^2=.96$	$P < 0.01$	.005	+	.012 PLLST	-	.004 TSCCP		
JULY								
Growth Form Standing Crop (kg ha^{-1})								
Observed AUD								
n=10 $r^2=.96$	$P < 0.01$	-152.90	+	1.14 LLST	+	525.87 P/.PSC		.5308 TSC
% Observed AUD								
n=10 $r^2=.92$	$P < 0.01$	-.18	+	.001 LLST	+	.49 PPSC		.0008 TSC
Growth Form Composition (%)								
Observed AUD								
n=10 $r^2=.96$	$P < 0.01$	-207.07	+	3.39 PLLST	+	498.88 PPSC		.75 TSC
% Observed AUD								
n=10 $r^2=.90$	$P < 0.01$	-.224	+	.001 TSC	+	.493 PPCP		.003 PLLST
AUGUST								
Growth Form Standing Crop (kg ha^{-1})								
Observed AUD								
n=10 $r^2=.37$	$P < 0.07$	-108.52		11.38 TSCCP				
% Observed AUD								
n=10	$P > 0.15$	No Model Selected						
Growth Form Composition (%)								
Observed AUD								
n=10 $r^2=.37$	$P < 0.07$	-108.52	+	11.38 TSCCP				
% Observed AUD								
n=10	$P > 0.15$	No Model Selected						

¹ b_0 =intercept, b_n = slope of variable n.

²LLST = Standing crop of low leaf:stem tufted forages.

PPCP = Standing crop percent of pasture crude protein.

LLSR = Standing crop of low leaf:stem rhizomatous forages.

PLLSR = Percentage of standing crop low leaf:stem rhizomatous forages.

PHLSP = Percentages of standing crop high leaf:stem rhizomatous forages.

CP = Average crude protein content (%) of the standing crop.

presumably as available forage was depleted (Bryant 1982), cattle made use of areas further from water. During drought in 1981, cattle dispersed from water sooner and to a greater extent than in either 1980 or 1982, indicating forage resources were depleted more rapidly. Common to all temporal dispersion patterns was increased variation about weekly means of distance from water that was associated with increased formation of sub-herd units. Unlike Squires (1980), however, there was no evidence that groups of walkers and nonwalkers formed, because animals were observed to move freely among sub-herds.

The intolerance cattle have for moderate to severe slopes (Van Vuren 1982, Gillen et al. 1984) was reflected in the spatial distribution of observed use on this foothill range. Over 3 grazing seasons cattle preferred areas with less than 4% slope. Sensitivity of cattle to slope is most pronounced in foothill and mountain regions (Mueggler 1965, Roath and Krueger 1983a, Gillen et al. 1984) though patterns of utilization by cattle on any landscape having significant topographic diversity will be influenced by slope (Moorefield and Hopkins 1951, Mackie 1970, Martin and Ward 1970).

Cattle demonstrated consistent preferences for range site types across pastures and years. Wetland and subirrigated sites, analogous to meadow types reported by Roath and Krueger (1982a, 1982b) and Gillen et al. (1984, 1985), were most preferred; however, the proportion of observed use was less than reported by these authors. Unlike mountain landscapes, cattle on this foothill range

were not physiographically constrained to these sites and a greater diversity of plant communities (range sites) existed within water and slope accessible zones. Furthermore, WLSB sites in this study were associated with ephemeral streams and were neither as extensive or well developed as similar sites along perennial streams (Roath and Krueger 1982b). Hence, cattle use was intense for short time periods followed by extended periods of low animal densities.

Cattle preference for WLSB, LY, and GW sites was a complex function of forage production (Gillen et al. 1984, Hunter 1962), forage composition (Hunter 1962, Herbel et al. 1967, Senft et al. 1985), physiography (Cook 1966, Mueggler 1965), and season (Moorefield and Hopkins 1951, Stuth and Winward 1977, Salter and Hudson 1980).

Severe topographic positioning was the major factor limiting cattle access to CU and VS sites. Across years, the variation in observed use among sites was partially a function of distance from water. In this study, there was a tendency for SWLY sites to sustain more relative use as cattle grazed areas beyond 1,000 m from water. Concurrently, relative preference for GW sites declined beyond 1,000 m. Similarly, cattle preference for LY sites tended to decline, but was quite variable (i.e., preference beyond 2,700 m), as distance from water increased beyond 700 m. We attribute these changes in preference relationships with increasing distance from water to SWLY sites generally being the dominate site on slopes <10% at distances beyond 1,000 m from water.

Assuming beef cattle attempt to maximize net energy (nutrient) capture (Senft et al. 1987), there should be a relationship(s) between intrinsic forage characteristics of range sites and site use (Hodder and Low 1978). Though forage characteristics of sites were measured only in 1982, we believe these were representative of the relative differences among sites over the study period. Sites receiving the most observed use also had greater average PFSC and CPSC than sites receiving less use, in agreement with Gillen et al. (1984), Miller and Krueger (1976), and Senft et al. (1985). Season-long indices of site use were significantly correlated to SC, CPSC, and abundance of LLST and LLSR growth form forages. Across the 1982 grazing season, more variation in actual and percent observed use was accounted for by a combination of growth form, standing crop, and crude protein variables. Though we do not propose cattle have euphagic wisdom, we interpret these results to indicate that not only is absolute forage standing crop an important characteristic for site preference but also the chemical and growth form composition of that standing crop as these affect caloric density of the diet. These results are consistent with the hierachial landscape utilization hypothesis forwarded by Senft et al. (1987).

Seasonal changes in the magnitude of correlations and predictive capability of regression models between site use and site forage attributes indicate a degeneration of these relationships by the end of the grazing season. These results are interpreted to suggest that as forage resources among sites became more similar, in terms of PFSC and CP, there was insufficient energetic advantage to cattle for discrimination among range site types. Again, these findings would be consistent with the hypothesis of Senft et al. (1987) concerning forage based cues.

Based on these and previously published results, we concluded uniform cattle dispersion across foothill and mountain landscapes is first constrained by the spatial distribution of water and physiographic complexity. Subsequently, within existing dispersion constraints cattle utilize available plant communities based upon intrinsic forage characteristics that vary temporally. Finally, seasonal cattle use of extant foothill complexes can be predicted reasonably well from intrinsic forage characteristics.

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ATTACHMENT H

January 25, 2023

Jim Zelenak
Adam Zerrenner
Ben Conrad
US Fish and Wildlife Service
Ecological Services, Montana Field Office
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Re: Canada lynx Species Status Assessment – Comment Submittal

Sent VIA Email to: jim_zelenak@fws.gov; Adam_zerrenner@fws.gov and Ben_conard@fws.gov

Dear Jim, Adam, and Ben:

Yellowstone to Uintas Connection is providing these comments as input to your current species status assessment for Canada lynx. Yellowstone to Uintas Connection is a 501c3 non-profit entity working to restore fish and wildlife habitat including the Regionally Significant Wildlife Corridor connecting the Greater Yellowstone Ecosystem to the Uinta Mountains and Colorado through the application of science, education, and advocacy. We named our organization and the Corridor from the Greater Yellowstone Area that passes through SE Idaho and SW Wyoming into NE Utah, the Yellowstone to Uintas Connection (Y2UConn) in order to bring attention to it across the West.

Y2U has been working to correct habitat fragmentation and degradation in the Y2UConn. Over the decades, we have documented the destruction and degradation of the natural character, water quality, and wildlife habitat integrity of the National Forests and BLM managed lands in this region, including the Y2UConn. Human developments including energy development, mining, livestock grazing, motorized recreation, and logging on public and private land have contributed to an apparent loss of function in this connection for Canada lynx. Our focus has been on restoring this corridor to function as a linkage for Canada lynx and wolverine. We review the literature, analyze and comment on agency actions such as phosphate mining and timber projects which fragment the habitat. Motorized recreation is a massive presence and largely unregulated and uncontrolled.

In recent years, we have been addressing the phosphate mining industry in SE Idaho on lands managed by the Caribou National Forest (CNF) and identified by the CNF as linkage habitat.¹ The phosphate mines typically dig up and destroy thousands of acres for each mine plus ancillary haul roads, powerlines, pipelines, and rail lines. To date, over 20,000 acres of forested habitats that are important to many wildlife species have been lost. Wildlife and habitat studies are minimal with no population data or trend analysis for viability assessments. Monitoring of project impacts on wildlife are scarce to non-existent. The typical outcome for lynx analysis is

¹ Caribou National Forest. 2003. Revised Forest Plan and FEIS.

<https://www.fs.usda.gov/detail/ctnf/landmanagement/planning/?cid=stelprdb5228906> Accessed January 21, 2023.

for the project proponents to acknowledge they may occasionally travel through the project or analysis area but will move around the periphery of the disturbance by way of other available habitat. While the project proponents, including the agencies, also acknowledge this area is part of the linkage area designated by the CNF and FWS, the habitat integrity of that area lynx are supposed to be able to access is never analyzed in terms of functionality for lynx. The CNF RFP linkage criteria lack any force or definition related to lynx habitat components, connectivity, or snowshoe hare needs.

What is lacking are adequate regulatory and land use planning criteria that require agencies such as the Forest Service and BLM to fully analyze and correct habitat fragmentation. In the following comments, we provide a summation of this Y2UConn as linkage habitat and an analysis of the failure of data interpretation, regulation and planning criteria to provide habitat and connectivity for lynx.

After years of providing input and analysis, the CNF remains unable or unwilling to fully analyze and implement habitat protection criteria for this linkage area, while consultations with U.S. Fish and Wildlife Service (FWS) are lacking in detail with FWS approving project after project without requiring any systematic and detailed analysis of lynx habitat functionality or connectivity. The 2017 FWS Species Status Assessment (SSA) continues to deflect to Forest Planning as protective of lynx and its habitat without providing any evidence this is the case.² While we expect the FWS is familiar with the principal documents relating to protection of lynx habitat, in the following, we briefly outline and comment on these as it is a good reminder of the state of knowledge and absence of effective regulation pertaining to lynx and its protection.

Dr. John Carter, Ecologist, and founder of the Yellowstone to Uintas Connection and Kiesha's Preserve, a wildlife preserve in the Y2UConn in SE Idaho, prepared these comments for input to the current Canada Lynx Species Status Assessment. Dr. Kirk Robinson, founder of the Western Wildlife Conservancy, has worked on this Regional Corridor and carnivore ecology for many years and assisted with input on the logic of lynx occupancy in Colorado and Utah.³ The comments were reviewed by Dr. Barrie Gilbert, (retired) Utah State University.⁴

Respectfully,



John Carter, PhD Ecology
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[Kiesha's Preserve](#)
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² U.S. Fish and Wildlife Service. 2017. Species Status Assessment for the Canada lynx (*Lynx canadensis*) Contiguous United States Distinct Population Segment. Version 1.0, October, 2017. Lakewood, Colorado.

³ Kirk Robinson, J.D., PhD Philosophy. Founder and current Executive Director of Western Wildlife Conservancy. <https://westernwildlifeconservancy.org/mission-vision/> Accessed on January 24, 2023.

⁴ Barrie K. Gilbert PhD, Department of Wildland Resources, (senior scientist retired), Utah State University, Logan Utah. Dr. Gilbert is a behavioral ecologist and recent author of *One of Us: A Biologist's Walk Among Bears*.

ABSTRACT

These comments provide a brief review of the regulatory history and science involved in the ESA listing for Canada lynx and subsequent land management on National Forests. The review reveals that much of the science is misinterpreted to favor human activities that degrade and fragment lynx habitat, while absence of evidence due to lack of studies is used to claim these activities either have little effect or in the case of timber manipulations, can even be beneficial. A review of the NRLMD and its application in linkage and peripheral areas as incorporated into Forest planning uses the Caribou NF as an example. The NRLMD provides limited guidance and protection to the Caribou NF as it is deemed “unoccupied” by lynx. This is in spite of evidence that lynx persisted in the area of the CNF over historical times. This “unoccupied” status results from failing to find current evidence of lynx long after habitats have been fragmented by mines, high road density, an explosion in motorized recreation accessing nearly every acre of land, timber projects and including habitat alteration by livestock grazing. The CNF Forest Plan includes recognition of lynx linkage, but the provisions in that plan for linkage habitat lack adequate quantification and standards.

Noting that there is a lack of emphasis on landscape connections between core areas of the DPS, analysis and mapping is provided showing the existence of long recognized regional wildlife corridors. A principal corridor is the Yellowstone to Uintas Connection linking the GYA to the Uinta Mountains and Colorado by passing through SE Idaho from lynx critical habitat in Wyoming. This is the most continuous high elevation, forested corridor making these connections. It also aligns with the CNF linkage to other areas. Protection and restoration of this and other corridors is essential to promote lynx connectivity and sustain meta-populations.

This review shows that regulatory mechanisms are inadequate to protect lynx habitat and connectivity. Monitoring of snowshoe hare habitat and populations as well as lynx presence in these southern areas of the DPS is lacking. While some habitat mapping and modeling has been done, it is not being applied or expanded to identify and describe in sufficient detail the habitats and migration corridors needed for lynx to persist. Land management plans must be updated and amended to provide data-based criteria and quantitative standards to ensure habitat for lynx and snowshoe hare are connected and functional.

REGULATORY ISSUES

The Programmatic Lynx BA. Canada lynx were listed as a Threatened species under the Endangered Species Act (ESA). In December 1999, the Forest Service and Bureau of Land Management completed their “Biological Assessment of The Effects of National Forest Land and Resource Management Plans and Bureau of Land Management Land Use Plans on Canada

Lynx” (Programmatic Lynx BA).⁵ The Programmatic Lynx BA concluded that the current programmatic land management plans “*may affect, and are likely to adversely affect, the subject population of Canada lynx.*” The Lynx BA team recommended amending or revising Forest Plans to incorporate conservation measures that would reduce or eliminate the identified adverse effects on lynx. The Programmatic Lynx BA’s determination means that Forest Plan implementation is a “*taking*” of lynx and makes Section 7 formal consultation on the land management plans (LMPs) mandatory, before actions are approved. The Lynx BA “*likely to adversely affect*” conclusion was based on the rationale that land use plans within the Northern Rockies have inadequacies, including:

1. Aggressive fire suppression may limit the availability of foraging habitat.
2. Allow levels of human access via forest roads that may risk incidental trapping, shooting, or access by competing carnivores.
3. Weak in guidance for new or existing recreation developments.
4. Allow mechanized and non-mechanized recreation that may pose a risk, by allowing compacted snow trails and plowed roads that facilitate competitors and predators.
5. Weak direction for maintaining habitat connectivity.
6. Weak in direction for coordinating management activities with adjacent ownerships to assure consistent management of lynx habitat across the landscape.
7. Fail to provide monitoring of lynx, snowshoe hares, and their habitats, making the detection and assessment of adverse effects from other management activities difficult or impossible to attain.
8. Forest management has resulted in a reduction of the area in which natural ecological processes were historically allowed to operate, thereby increasing the area potentially affected by known risk factors to lynx. The Plans have continued this trend. The Plans have also continued the process of fragmenting habitat and reducing its quality and quantity. Consequently, plans may risk adversely affecting lynx by potentially contributing to a reduction in the geographic range of the species.
9. Plan revisions are needed to incorporate conservation measures included in the Canada Lynx Conservation Assessment and Strategy.⁶

The LCAS “*was developed to provide a consistent and effective approach to conserve Canada lynx on federal lands in the conterminous United States. The USDA Forest Service, USDI Bureau of Land Management, and USDI Fish and Wildlife Service initiated the Lynx Conservation Strategy Action Plan in spring of 1998.*” The LCAS was published shortly after the Canada lynx was listed as Threatened under the ESA. Risk Factors from the LCAS (2000) include:

⁵USDA Forest Service and DOI Bureau of Land Management.1999. Biological Assessment of the Effects of National Forest Land and Resource Management Plans and Bureau of Land Management Land Use Plans on Canada lynx.

⁶Ruediger et al. 2000. Canada Lynx Conservation Assessment and Strategy. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication #R1-00-53, Missoula, MT. 142 pp.

1. Timber harvest and pre-commercial thinning that reduce denning or foraging habitat or convert habitat to less desirable tree species.
2. Fire exclusion changing the vegetation mosaic maintained by natural disturbance processes.
3. Grazing by livestock that reduces forage for prey.
4. Roads and winter recreation trails that facilitate access to historical lynx habitat by competitors.
5. Incidental trapping and shooting.
6. Predation.
7. Being hit by vehicles.
8. Obstructions to movement such as highways and private land developments.

All of these factors continue to operate within the National Forests and BLM lands within and surrounding the Y2UConn. They are not effectively addressed while degradation and fragmentation of habitat continues. Monitoring of these activities is minimal to non-existent.

Northern Rockies Lynx Management Direction. We reviewed the Northern Rockies Lynx Management Direction (NRMLD).⁷ This direction “*applies to mapped lynx habitat on National Forest System land presently occupied by lynx, as defined by the Amended Lynx Conservation Agreement (CA)*⁸ *between the Forest Service and FWS...When National Forests are designing management actions in unoccupied mapped lynx habitat they should consider the lynx direction, especially the direction regarding linkage habitat.*” (NRMLD p1). [Emphasis added]. The FEIS for the NRMLD provided a map for the Northern Rockies Lynx Planning Area which is inserted as Figure 1. The CA provided this, “*As recommended in the LCAS, appropriate actions, including research, administrative studies, or monitoring, will be taken to verify the effectiveness of the lynx conservation measures.*” (CA p7). We have seen none of these monitoring or other studies that have addressed effectiveness of lynx conservation measures, while monitoring of lynx and snowshoe hare occurrence and populations in the DPS is lacking.

In the NRMLD (p3) there is reference to a FWS “*Clarification of Findings*” in a Remand Notice which basically explains away most forest activities as impacting lynx or lynx habitat, i.e. a “*threat*” to lynx. The NRMLD puts it this way:

After the LCAS was issued the FWS published a Clarification of Findings in the Federal Register (FEIS, Vol. 1, Appendix P), commonly referred to as the Remand Notice. In the Remand Notice the FWS states, “We found no evidence that some activities, such as forest roads, pose a threat to lynx. Some of the activities suggested, such as mining and grazing, were not specifically addressed [in the Remand Notice] because we have no information to indicate they pose threats to lynx” (p. 40083).

Further on in the Remand Notice they state, “Because no evidence has been provided that packed snowtrails facilitate competition to a level that negatively

⁷ USDA Forest Service. 2007. National Forests in Montana, and parts of Idaho, Wyoming, and Utah. Northern Rockies Lynx Management Direction Record of Decision.

⁸ USDA Forest Service and USDOI Fish and Wildlife Service. 2006. Canada Lynx Conservation Agreement. USFS Agreement #OO-MU-11015600-0 13.

affects lynx, we do not consider packed snowtrails to be a threat to lynx at this time” (p. 40098).

In regards to timber harvest the FWS states, “Timber harvesting can be beneficial, benign, or detrimental to lynx depending on harvest methods, spatial and temporal specifications, and the inherent vegetation potential of the site. Forest practices in lynx habitat that result in or retain a dense understory provide good snowshoe hare habitat that in turn provides good foraging habitat for lynx” (p. 40083).

These findings by FWS narrow the focus from the concerns first published in the LCAS (discussed above) about what management direction is needed to maintain or improve Canada lynx habitat. We considered this information in the development of the selected alternative, and in our decision.

So, in one fell swoop, FWS and then the USFS thru the NRLMD adopted guidance that removes the majority of Forest Service actions or permitted activities from consideration as impacting lynx. We are to believe that lack of evidence is proof these activities have no impact on lynx or their habitat. Yet, the scientists who published the Science Report⁹ which was used as the basis for the NRLMD had determined these activities adversely affect lynx and lynx habitat.

What we have observed is a gradual easing of requirements and population status of lynx over the years. Absence of lynx in SE Idaho is a foregone conclusion if you manage them out of existence by denying their presence thru history then deny impacts from logging, snowmobiles across the landscape, off road vehicles speeding thru forest roads, and that *“mining and grazing, because they were not specifically addressed ... because we have no information to indicate they pose threats to lynx.”* In this way, the agencies have relieved themselves of most responsibility to maintain or restore lynx, its habitat, and connectivity. We have reviewed the Science Report and find that the information in that report does not say roads, snowmobiles, timber harvest, mines and grazing do not impact lynx or lynx habitat. We discuss these as part of the narrative below.

Further in the NRLMD there are clarifying statements such as that standards and guidelines only apply to occupied habitat, while they can be considered for unoccupied habitats. (NRLMD p6). Regarding vegetation management direction, it *“conserves the most important component of lynx habitat: a mosaic of early, mature, and late successional stage forests, with high levels of horizontal cover and structure.”* (NRLMD p21). The objectives, standards and guidelines do not *“apply to linkage areas”*. (NRLMD Att 1 p2). Livestock grazing *“may reduce or eliminate foraging habitat in areas that grow quaking aspen and willow in riparian areas...These localized changes in habitat may affect individual lynx; however, no information indicates grazing poses a threat to overall lynx populations...”* (NRLMD p21). Livestock management

⁹ Ruggiero, Leonard F.; Aubry, Keith B.; Buskirk, Steven W.; Koehler, Gary M.; Krebs, Charles J.; McKelvey, Kevin S.; Squires, John R. 2000.. Ecology and conservation of lynx in the United States. General Technical Report RMRS-GTR-30WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. <https://www.fs.usda.gov/research/treearch/50623> Accessed on January 21, 2023.

objectives and guidelines do not apply to linkage areas. (NRLMD Att 1 p5). Over snow recreation “*Emphasizes not expanding snow compacting human uses into non-compacted areas.*” Guideline G11 “*discourages the expansion of designated over-the-snow routes and play areas into uncompacted areas.*” “*An alternative to drop all direction limiting snow compaction was not developed in detail because there is evidence competing predators use packed trails, suggesting a potential effect on individual lynx.*” (NRLMD p23). Mineral and Energy Standard does not apply to linkage habitat. (NRMLD Att1 p5).

As these statements make clear, lynx habitat, including linkage areas have virtually no protections, standards, or guidelines under the NRLMD. While it does acknowledge that there is evidence of lynx competitors using packed snow trails it does not address landscape level snow machine access, the increase in motorized recreation with fast, high-powered machines, and landscape-level use such as occurs in 97% of the CNF since the Science Report data and information was assembled. A recent paper by Olson et al (2018)¹⁰ acknowledges that lynx avoid areas of ski resort development and they altered their behavior to spend less time in areas of motorized recreation or used them at night when there was less use. The Forest Service Rocky Mountain Research Station has said, “*Lynx appear to have an upper threshold of recreation intensity which they can tolerate, and above this level, lynx may be less able to coexist. Managers, then, should keep in mind that developed or dispersed areas with very high use may displace lynx from habitat.*”¹¹ We note that the phosphate mines in SE Idaho operate 24 hours per day, 7 days per week for up to 30 years at an individual mine with some 400 blasts of explosives each week at each mine.¹² Haul roads further fragment the habitat, operating continuously.

Since these studies used in the Science Report, three decades have passed with ever increasing snowmobile and off-road vehicle use. A report by Winter Wildlands Alliance for USDA noted that snowmobile use more than doubled between the early 1980s and 2004.¹³ Cross-country skiing and snowshoeing experienced a similar increase. In the 1990s more powerful snow machines made access available to “*dominate terrain only accessible by backcountry skis or snowshoes.*” High-marking and acrobatics are common in areas previously inaccessible. Highmarking is the “*recreational maneuver of attempting to reach the highest point of a snow-covered feature such as a mountain, on a snowmobile.*”¹⁴ Groomed trails now are over 20,000 miles in the 11 Western Snow Belt States. Today, there are 1.3 million registered snowmobiles in the US and 601,000 in Canada.¹⁵ As acknowledged above, this increased access allows

¹⁰ Olson, L.E.; Squires, J.R.; Roberts, E.K.; Ivan, J.S.; Hebblewhite, M. 2018. Sharing the same slope: Behavioral responses of Canada lynx to winter recreation. Ecology and Evolution. 1-18.

¹¹ USDA RMRS. 2023. Winter Sports and wildlife: Can Canada lynx and winter recreation share the same slope? <https://www.fs.usda.gov/rmrs/winter-sports-and-wildlife-can-canada-lynx-and-winter-recreation-share-same-slope> Accessed on January 16, 2023.

¹² USDA and DOI. 2019. Final Environmental Impact Statement Proposed Dairy Syncline Mine and Reclamation Plan. <https://app.box.com/s/jmod5pcq1txhv4wmply3oxuazlm16tau> Accessed on January 16, 2023.

¹³ Winter Wildlands Alliance. 2006. Winter Recreation on Western National Forest Lands. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd528883.pdf Accessed on January 16, 2023

¹⁴ <https://en.wikipedia.org/wiki/Highmarking>

¹⁵ ISMA. 2022. Snowmobiling Fact Book. <https://www.snowmobile.org/docs/isma-snowmobiling-fact-book.pdf> Accessed on January 17, 2023.

trapping and hound hunting to occur across the landscape. In Idaho there were 1,830 trapping licenses issued for the 2017 - 2018 season¹⁶, up from 638 in the 1995-1996 season.¹⁷

We looked up some brief history of ATV and UTVs. These come from industry websites. The first four wheeled atv was produced in 1982 by Suzuki.¹⁸ This quickly turned to an emphasis on speed in 1987 with a model that could attain almost 80 mph. “*Naturally, as high-performance ATVs gained popularity, Quad Racing and ATV Motocross enjoyed massive growth and exposure in the late 1980s.*” The first UTV, the Kawasaki Mule was introduced in the late 1980s.¹⁹ A racing emphasis came about with the introduction of the Polaris RZR in 2007. Today, sales of these vehicles are around 800,000 annually with about half in the US. This is an estimate, since in many states they are not registered.²⁰

The point of this is that there are millions of snowmobiles, atvs, utvs, and dirt bikes in the US today. Add to this the pickup truck and SUV market with their TV commercials emphasizing the backcountry and off-roading. These were present only minimally during the time of most of the studies in the Science Report. The implication of this is that conclusions about forest roads and snowtrails are out the window today since these are loud, fast, and powerful machines capable of accessing most terrain and are present in large numbers. For instance, in 2017, we funded a research project at Kiesha’s Preserve to evaluate traffic on a CNF Forest access road in SE Idaho. Over 300 vehicles per day were using the road with many traveling at high rates of speed.²¹ Sound levels were over 100 DbC. In winter, snowmobiles were creating noise levels of over 100 DbC. These roads today are not quiet, low frequency roads, but as we like to say, they have become an analog to a motocross where there is no enforcement of speed, noise or even checking registrations. How are lynx to occupy an area with this level of disturbance?

The Conservation Agreement (CA). addresses its scientific basis as:

In March of 1998, an interagency lynx coordination effort was initiated in response to the emerging awareness of the uncertain status of lynx populations and habitat in the conterminous United States and the onset of the listing process. The U.S. Fish and Wildlife Service (FWS), USDA Forest Service (FS), Bureau of Land Management (BLM), and the National Park Service (NPS) have participated in this effort. Three products important to the conservation of lynx on federally managed lands have been produced through this effort: (1) "The

¹⁶ IDFG. 2018. Idaho Department of Fish and Game Furbearer. <https://collaboration.idfg.idaho.gov/WildlifeTechnicalReports/Furbearer%20Statewide%20FY2018.pdf> Accessed on January 16, 2023.

¹⁷ Melquist, W.E. 1997. Idaho Department of Fish and Game Furbearers Study III, Job 1. <https://collaboration.idfg.idaho.gov/WildlifeTechnicalReports/Furbearer%20PR94.pdf> Accessed on January 16, 2023.

¹⁸ <https://www.hqpowersports.com/blog/history-of-the-modern-atv-and-utv/> Accessed on January 17, 2023.

¹⁹ <https://shocktherapyst.com/blog/a-brief-history-of-utvs/> Accessed on January 17, 2023.

²⁰ <https://www.motorcyclesdata.com/2022/12/27/all-terrain-vehicles/> Accessed on January 17, 2023.

²¹ Unpublished data. 2017. Utah State University in Association with Kiesha’s Preserve.

Scientific Basis for Lynx Conservation" (Ruggiero et. al. 2000)²², hereafter referred to as the "Science Report"; the Lynx Conservation Assessment and Strategy (LCAS); and this Lynx Conservation Agreement (CA). Several States within the range of the lynx have contributed to this effort through interactions with participants and review of draft products.

The Science Report, prepared by an international team of experts in lynx biology and ecology, is a compendium and interpretation of current scientific knowledge about the Canada lynx, its primary prey and habitat relationships. This document serves as an important scientific reference for the various lynx activities of the cooperating Federal Agencies.

The LCAS builds upon this scientific base and identifies the risks to the species that may occur as a result of federal land management. It recommends conservation measures that could be taken to remove or minimize the identified risks. It was developed to provide a consistent and effective approach to conservation of Canada lynx on federal lands in the conterminous United States.

The LCAS and Science Report constituted the best available knowledge and were incorporated into the CA. The Science Report (p12) addressed uncertainty by suggesting that “*the burden of proof be shifted so that uncertainty favors, or at least is not destructive to conservation...*”. As we pointed out above, the LCAS identified risk factors, which are now excluded by the NRLMD and Remand Notice. These exclusions have arbitrarily discounted nearly all activities as affecting lynx and lynx habitat. Lack of regulatory mechanisms was identified as a cause in the listing notice (FR Vol 65 No 58 p16052) stated as,

The contiguous U.S. Distinct Population Segment of the lynx is threatened by the inadequacy of existing regulatory mechanisms. Current U.S. Forest Service Land and Resource Management Plans include programs, practices, and activities within the authority and jurisdiction of Federal land management agencies that may threaten lynx or lynx habitat. The lack of protection for lynx in these Plans render them inadequate to protect the species.

²² Ruggiero, Leonard F.; Aubry, Keith B.; Buskirk, Steven W.; Koehler, Gary M.; Krebs, Charles J.; McKelvey, Kevin S.; Squires, John R. 2000.. Ecology and conservation of lynx in the United States. General Technical Report RMRS-GTR-30WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Available at: http://www.fs.fed.us/rm/pubs/rmrs_gtr030.html

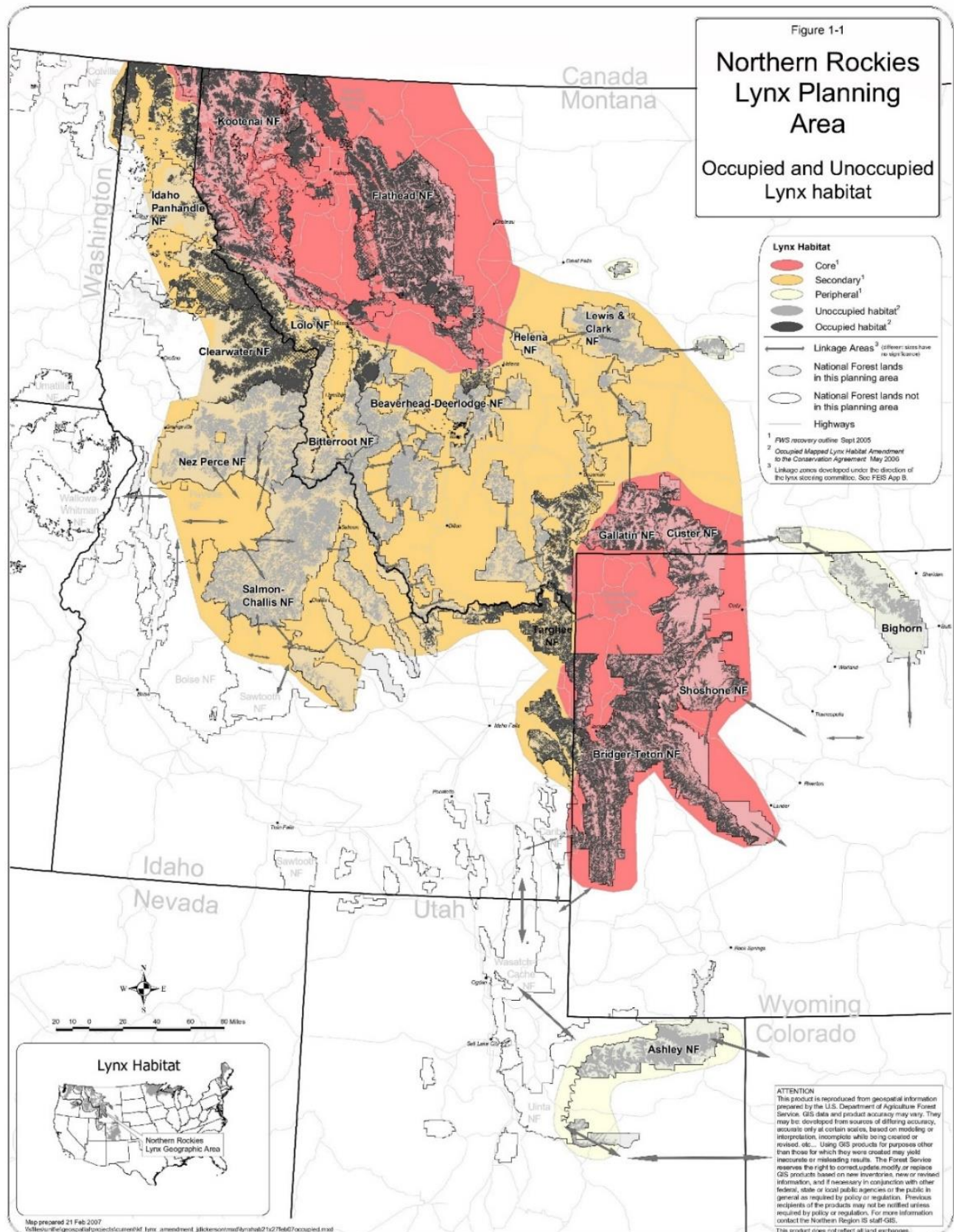


Figure 1. Map of Lynx Habitats from the FEIS for the NRLMD

The Science Report (SR) addresses fragmentation as “reduction of total area, increased isolation of patches, and reduced connectedness among patches or natural vegetation...” (SR p84). “habitat fragmentation is the most serious threat to biological diversity and is the primary cause of the present extinction crisis.” (SR p85). “rare species associated with wilderness, such as the lynx, generally are considered most susceptible to fragmentation.” (SR p86). “generalist predators tend to dominate the predator guild in fragmented landscapes.” (SR p86). Coyotes and lynxes are separated by snow conditions, but “this separation may break down where human modifications to the environment increase access by coyotes to deep snow areas. Such modifications include expanded forest openings throughout the range of lynx in which snow may be drifted, and increased snowmobile use in western mountains. Recreational snowmobile use has expanded dramatically in the United States in the past 25 years, with hundreds of thousands of km of trails (>19,000 km of groomed trails in Maine alone) within the pre-settlement range of the lynx...” (SR p94). “Fragmentation of habitats occupied by lynx (including increased openings, higher road densities, exurban residential development, and wider use of snowmobiles and devices that compact snow in areas with deep, soft snow) is a plausible mechanism for the questionable conservation status of the lynx in the contiguous United States.” (SR p95).

The data and information included in the Science Report had mostly been generated by the early 1990s, much in the 1970s and 1980s. The studies describing road density and snowmobile effects were very limited. The single study in the Science Report (p308) was based on data from the 1980s and stated that “Road densities had no significant effect on habitat selection, and lynx crossed roads at frequencies that did not differ from expectation.” There was no data on use of these roads by vehicles in summer or snowmobiles in winter. Road density averaged 1.28 miles/sq.mi. As noted above, snowmobile use was expanding. The Science Report (p391) noted that “Roads in the study area were of primitive standards that received little use in summer but were frequently used by snowmobilers in winter.” The Science Report (p295) said, “Snowmobiles became readily available in the late 1950s and early 1960s, likely influencing trapper coverage, access, and attitudes.” Science Report (p391), “Although legal harvest is no longer a conservation concern, human-caused mortality is believed to be additive in the low-density lynx populations characteristic of southern boreal forests (Koehler 1990; Table 13.3). If so, illegal or incidental harvest could significantly reduce population numbers of lynx in southern regions.”

2017 Species Status Assessment (SSA). The USFWS published a species status assessment (SSA)²³ for Canada lynx in 2017. The SSA recognized the lack of regulatory mechanisms was the reason for listing. (SSA p1). It stated:

Factors affecting lynx that were evaluated in the SSA “include the adequacy of existing regulatory mechanisms (the factor for which the DPS was listed); climate change, vegetation management, wildland fire management, and habitat loss and fragmentation (the factors considered by the Interagency Lynx Biology Team [ILBT] to have the potential to exert population-level effects on the DPS); and other factors that could influence the continued ability of particular geographic units to support resident lynx.” (SSA p3).

²³ U.S. Fish and Wildlife Service. 2017. Species Status Assessment for the Canada lynx (*Lynx canadensis*) Contiguous United States Distinct Population Segment. Version 1.0, October, 2017. Lakewood, Colorado.

“The lack of regulations protecting lynx habitat from potential threats on Federal lands at the time of listing has been largely addressed by formal and binding amendments or revisions to most Federal land management plans within the DPS range. Although uncertainty remains about the efficacy of this improved regulatory framework, Federal lands are now being managed specifically to protect and restore lynx habitats, with the goal of supporting continued lynx presence on these lands.” (SSA p231).

This last statement is incredibly dismissive of the main cause of lynx habitat degradation, lack of adequate regulation, and instead, dismisses almost all actions that the Science Report acknowledged adversely affect lynx and lynx habitat. We searched online for evidence that the CNF has adopted the NRLMD or provided any Forest Plan amendments for lynx protection. There were none to be found. Y2U sent a letter to Mel Bolling, Forest Supervisor of the Caribou Targhee NF (CTNF) requesting updated analysis of the lynx status in the CTNF, including its historical occurrence, migration corridors and connections between habitats. The letter outlined our desired analysis and mapping to include human fragmentation and historical lynx habitat use.²⁴ The response from Mr. Bolling explained the current situation in the CTNF.²⁵

Mr. Bolling explained some of the history of the lynx listing, the Science Report, LCAS and the 2013 revision of the LCAS which is now considered the primary guidance for land management agencies. His letter pointed out that the Targhee NF RFP was amended by the NRLMD in 2007. A National Lynx Survey was conducted on both the Forests in 1999 and determined that the Targhee NF met criteria for management as an occupied forest, but the Caribou did not. Therefore, the Caribou NF was not subject to the NRLMD and *“No LAU’s or lynx habitat is mapped on the Caribou due to the designation of the Caribou NF as an unoccupied forest in 2002.”* (p2). The conservation measures in the CNF RFP were *“deemed sufficient: by the USFWS through consultation on the RFP Biological Assessment to address threats to Canada lynx and provide regulatory mechanisms to ensure the continued persistence of Canada lynx on the Caribou National Forest.”* Under this arrangement, therefore it appears that the provisions of the CNF RFP would be central to analysis of lynx habitat because other protections are dismissed due to what appears to be an arbitrarily determined occupancy status that ignored historical lynx observations and only relied on absence determined by the National Lynx Survey in 1999 which occurred long after historical reported occupancy. We address this further on.

Mr. Bolling’s response included reference to a paper by Olson et al (2021)²⁶ which used lynx observations in the west, climate, and human induced factors to model lynx habitat. Using lynx GPS and tracking data from Idaho, Wyoming, Montana, Washington, and British Columbia, the study found that lynx habitat is made up of a complex array of environmental conditions, not primarily vegetation type and elevations as currently mapped. They included an index of

²⁴ Carter, J., Garrity, M., Johnson, S., and Fite, K. 2021. Request for Response on Lynx Analysis in the CTNF. Letter on behalf of Yellowstone to Uintas Connection, Native Ecosystems Council, Alliance for the Wild Rockies, and Wildlands Defense. Dated August 15, 2021.

²⁵ Bolling, M. 2021. Response to letter requesting information on Canada lynx. Dated September 13, 2021.

²⁶ Olson et al. 2021. Improved prediction of Canada lynx distribution through regional model transferability and data efficiency. *Ecology and Evolution* 11:1667 – 1690.

summer vegetation production, percentage of tree cover, road density and night light intensity as indices of anthropogenic influences. One confounding issue is their assumption of boreal forest soil pH as a factor due to the wetter conditions in boreal forests. However, we know lynx use a variety of forested types and this factor might disqualify habitats unnecessarily. The model provides insight and a basis for more detailed analysis of lynx potential habitat and its fragmentation within the linkage in SE Idaho in the CTNF. We have included an Olson et al map from that paper as Figure 2 below. It illustrates a high probability of suitable lynx habitat in SE Idaho and the CNF. So, by this model, lynx habitat is present in SE Idaho. Why are there no lynx here? It is up to the FWS in its current Species Status Assessment and review to determine this.

Our review of the 2017 SSA finds a tenor of finding continued habitat fragmentation and degradation as unimportant to persistence of lynx, while only implicating climate change as problematic. But climate change is superimposed on all the existing insults to habitat and heightens their importance in the decline of lynx and lynx habitat. For example, the SSA contends that lynx only occurred in Colorado during *“irruptions from Canada...in the early 1960s and 1970s”* concluding that there is doubt that the population in Colorado *“will receive the demographic and genetic support from the north that is thought to be important to the DPS populations.”* (p227).

There are two competing hypotheses operating regarding lynx presence in Colorado.

H1. Lynx had been present in the Southern Rockies (south of Idaho-Wyoming) in a self-sustaining population for millennia but were slowly extirpated as a result of human activities, including trapping and livestock grazing, from early 19th century through mid-20th century.

H2. The presence of lynx in the Southern Rockies in the 19th and 20th centuries prior to lynx reintroduction into the San Juan Mountains, was due mostly or entirely to periodic influxes of lynx from Canada.

Two bodies of evidence (I & II) support H1 as the correct hypothesis.

I. There is a general lack of evidence of lynx population cycles in Canada being correlated with lynx population dynamics in the U.S., let alone in Colorado. The Science Report (p242) comments on the immigration hypothesis.

“In the Canadian provinces, Alaska, Montana, and Washington, we know that there are local reproductive populations, knowledge that invalidates a pure immigration hypothesis. For these areas, we can only state that they appear to be a part of a population in which lagged synchronous dynamics occur. Because we do not know why these dynamics occur, we cannot say to what extent they are affected by changes in local dynamics and the role that immigration might play.

. . . the lack of lynx occurrence records associated with a large population peak occurring in the central provinces during the early 1980s. This population peak

was higher than any recorded in the 20th century prior to 1959, but there was no evidence from museum specimens, verified mortality records, or anecdotal observations that unusual numbers of lynx occurred in any portion of its range in the contiguous United States.”

II. Since lynx reintroductions in Colorado, lynx have reproduced and become established there. Prognostications of the eventual disappearance of lynx from Colorado are speculative and have nothing to do with whether Colorado was or is capable of supporting a self-sustaining population of lynx.

The Science Report in describing the population cycles made this observation regarding the Minnesota population: *“a three-year lag with data from the south-central Canadian provinces resulted in a strong correlation for the most recent period ($r = 0.73$, 1960-1983) but the pattern is out of phase in the previous 26 years... .”* (SR p238). We note that lynx were present in the DPS during large blocks of time other than in the 1960s and 1970s.

The 2013 LCAS. We reviewed the 2013 LCAS.²⁷ It emphasizes protection of core areas which support persistent lynx populations and *“less stringent protection and greater flexibility in secondary/peripheral areas...”* (p2). The only conservation measures provided for these peripheral areas were for vegetation management, which are general and unenforceable statements such as *“Vegetation treatments should be designed with consideration of historical landscape patterns and disturbance processes. Design timber harvest, planting, and thinning to include some representation of young densely stocked regenerating stands in the mosaic for snowshoe hare production areas”* (p95). The 2013 LCAS provided conservation measures for core areas and stated that projects *“must be consistent with the management direction contained in the forest plan.”* (p89). This would mean the analysis would be consistent with the CNF RFP and its FEIS. Conservation measures for core areas included (only examples cited, for full list see the LCAS):

1. Delineate LAUs (p89)
2. Vegetation management (includes several measures including landscape evaluation to identify opportunities for adaptation to climate change). (p89)
3. Wildland fire management (p93)
4. Habitat fragmentation (promote or retain large contiguous blocks of lynx habitat, identify linkage areas to maintain connectivity, minimize large scale development, and others (p93)
5. Recreation management (direct recreational activities away from identified linkage areas (p94).
6. Minerals and energy (locate facilities and roads outside of lynx habitat and linkage areas where possible) (p95)
7. Backcountry roads and trails (Avoid Road reconstruction and upgrades that substantially increase speeds) (p95).
8. Livestock grazing (manage in riparian areas to maintain snowshoe hares) (p95).

²⁷ Interagency Lynx Biology Team. 2013. Canada lynx conservation assessment and strategy. 3rd edition. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication R1-13-19, Missoula, MT. 128 pp.

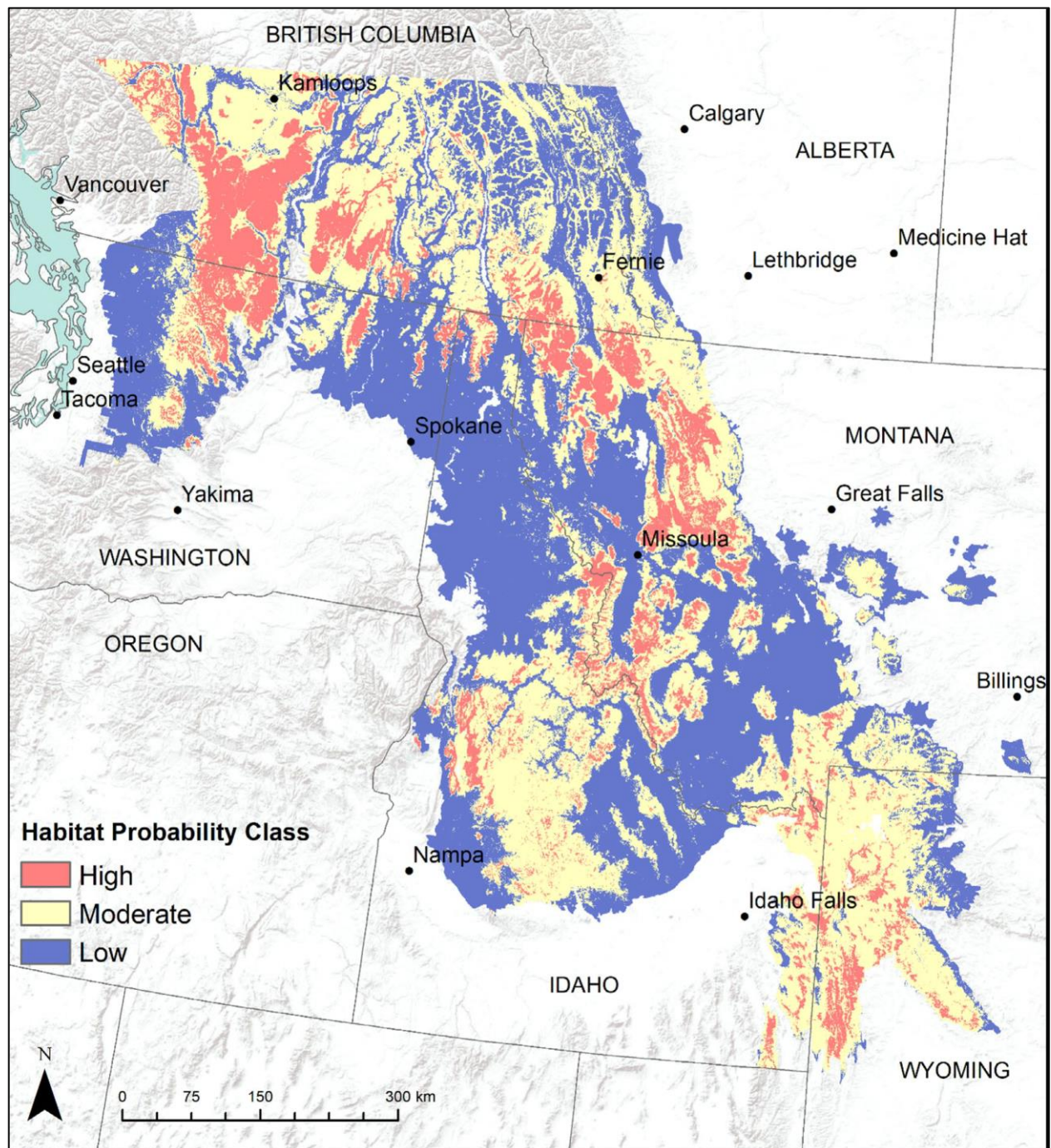


Figure 2. Prediction of Canada Lynx Habitat Probability from Olson et al 2021.

In the past two years we have seen several National Forests, the Caribou Targhee NF, the Ashley NF come out with prescribed fire and other forest manipulations that cover most, if not all, of the acreage within those Forests. These add up to nearly 2 million acres. This is happening across the West.

We have included Figure 3.1 from the 2013 LCAS here as Figure 3. That map does not show any linkage habitat. While it refers to the USFWS Recovery outline, there is no analysis of how to recover lynx. The 2013 LCAS does address factors that compromise lynx habitat and movement under the umbrella of “*anthropogenic influences*”(p68). It admits that not every human activity has been examined, but groups the activities into two tiers that can negatively affect lynx populations and habitat. The specialization of lynx on snowshoe hares and lynx “*low densities and in small populations throughout their range in the contiguous United States .. increase their susceptibility to local extirpations.*” (p68). First tier factors include climate change, vegetation management, wildland fire and habitat fragmentation “*can directly effect (sic) both snowshoe hare and lynx population dynamics.*” (p68).

“Federal agencies have amended or revised land management plans across much of the range of the lynx to provide direction to conserve lynx and lynx habitat. Thus, the impacts of anthropogenic influences have been substantially reduced.” (LCAS p68). The Caribou NF has not demonstrated that its RFP has “*conserved lynx and lynx habitat*” or reduced “*anthropogenic influences*” while continuing to propose and approve projects across the CNF, including phosphate mines, timber and prescribed fire, and off-road vehicle trails. In no case have lynx protections or criteria been invoked or analyzed and no habitat analysis of the linkage capability has been performed, and in every case when consulted, the FWS has signed off on these projects. FWS must do a better review of these projects and their implications to lynx habitat, including requiring that land management agencies conduct the proper monitoring, quantitative habitat descriptions and analysis of habitat structure and function prior to approving future projects.

The 2013 LCAS describes how these first-tier factors affect lynx and lynx habitat. Climate change is a factor which is overriding other impacts and can cause shifts in distribution, changes in snowshoe hare cycles, reduction in lynx habitat and population, among other outcomes. (LCAS p69). Vegetation management alters stand structure, composition and arrangement and occurs across the range of the lynx. (LCAS p71). Wildland fire management can result in similar alterations. (LCAS p76). Habitat fragmentation, “*accentuates the viability risk inherent in a small population and increases its vulnerability to local extirpation.*” (LCAS p76). Examples of fragmentation include, “*removal of forest cover, development of highways and associated infrastructure, and intensive minerals or energy development...*” (LCAS p77). Vehicle collisions are a factor in mortality. Here, the LCAS admits these activities have inherent risk to viability for small populations. In a direct contradiction to the Remand Notice, here “*intensive minerals development*” is a factor fragmenting habitats, yet this is excluded from any standards in the NRLMD for linkage habitats.

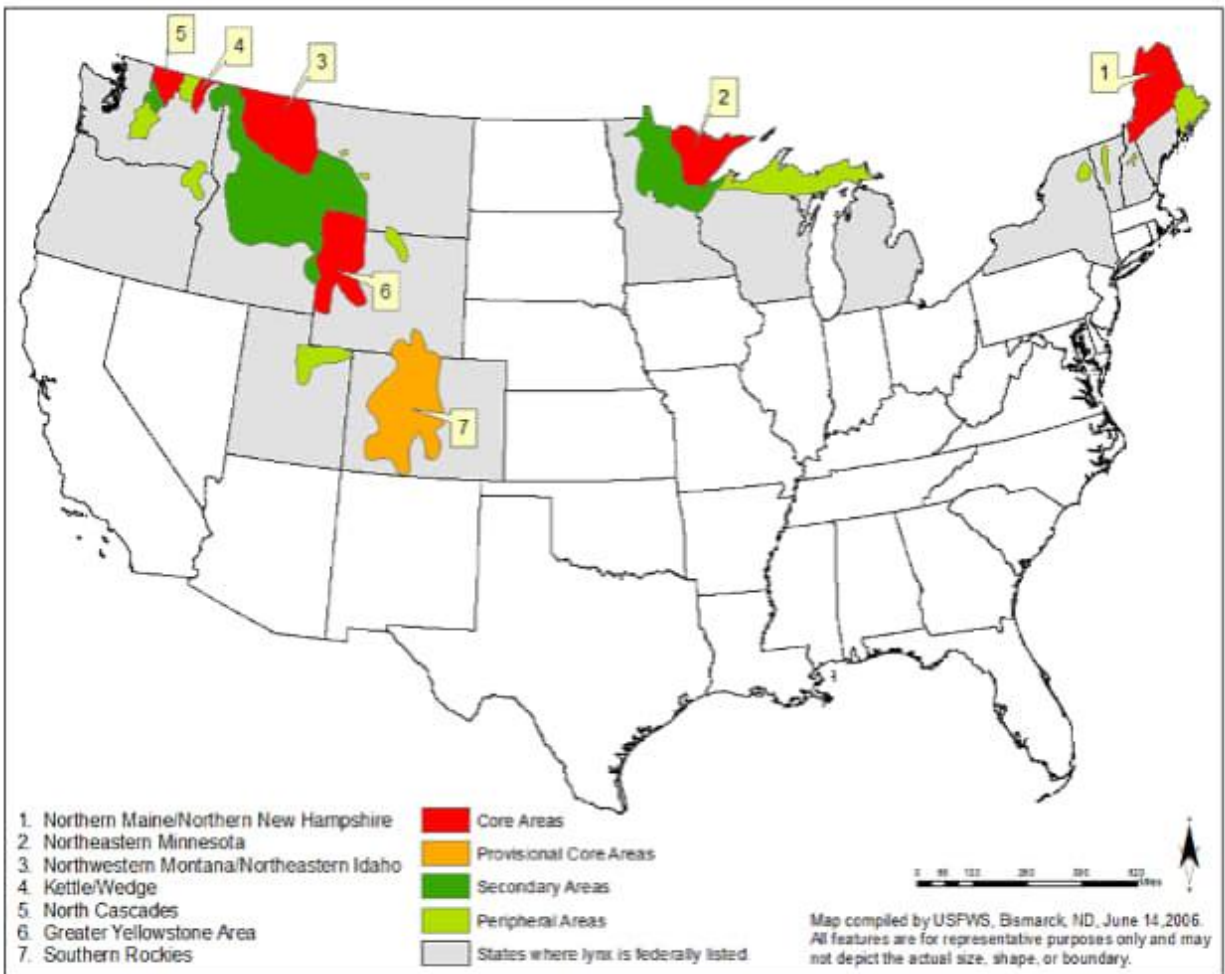


Figure 3. Taken from the LCAS Figure 3.1. Areas identified as core, secondary, and peripheral as depicted in the Canada Lynx Recovery Outline across the states where the lynx is listed (U.S. Fish and Wildlife Service 2005)

The second tier of anthropogenic influences include incidental trapping with rates of trapping *“positively related to average pelt value and appeared additive to nontrapping mortality.”* (LCAS p79). It *“can occur in areas where regulated trapping for other species...overlaps with lynx habitats.”* (LCAS p79). *“No conservation measures to address incidental trapping are included ... because trapping is regulated by the states.”* (LCAS p80). Idaho allows trapping of numerous species, hound pursuit and with snowmobile access and groomed trails, winter access is available throughout the CNF. Previously we have noted the increase in trapping licenses in Idaho. This effect is dismissed from consideration.

Recreation is noted to be increasing with millions of participants. (LCAS p80). The data reported in the LCAS is pre-2009. Recreation effects include habitat loss from construction of developed areas, disturbance from human presence with examples of den abandonment, use of

compacted trails in the snow by competitors. (LCAS p80). Minerals and energy development *“could affect lynx habitat by changing or eliminating the native vegetation and contributing to habitat fragmentation. ... development of associated roads, powerlines, and pipelines.. could also result in a loss of lynx habitat and contribute to fragmentation.”* (LCAS p83).

An illegal shooting example from Colorado is provided, showing over 14% of reintroduced lynx were shot in the first 10 years. (LCAS p84). Forest/backcountry roads and trails with low vehicular or snowmobile traffic *“had little effect on lynx seasonal resource-selection patterns” and lynx traveled on roads “unplowed during winter”*. *“Squires et al (2008) reported that lynx denned farther from all roads compared to random expectation. ... occupy dens in early May when many forest roads are still impassable... snowmobiles no longer use the roads because of intermittent and unpredictable availability of sufficient snow.”* Finally, *“fewer roads were located in denning habitat and higher road density occurred along forest edges and in managed stands, which lynx avoided...”* (LCAS p84). But these factors are all dismissed as affecting lynx in the Remand Notice and we find no regulatory standards regarding these activities relating to lynx and lynx habitat in the CNF.

Regarding livestock grazing, LCAS (p85) notes the summer diet of snowshoe hares is dominated by herbaceous food including *“forbs, grasses, and shrubs”*. Then claims that *“The habitats used by snowshoe hare that are most likely to be affected by livestock grazing are riparian willow and aspen communities.”* The conclusion is that grazing by domestic livestock is *“unlikely to reduce the snowshoe hare prey base...”* This statement can only be produced by those who have never studied the impacts of livestock grazing on ecosystems in the Rocky Mountains. We have studied the effects of livestock grazing in SE Idaho and NE Utah and found extensive habitat degradation, over-utilization of forage, and overstocking. See Appendix 1 for a brief review with photographs showing some of the degraded conditions. Habitats in many of the National Forests in the southern portion of the DPS are terribly degraded by livestock grazing. Riparian areas and other snowshoe hare foraging areas are included.

By laying out these first and second tier anthropogenic effects for core areas, the 2013 LCAS inadvertently explains why lynx may not be found today in southern areas where they existed in earlier times. Lynx have *“low densities and in small populations throughout their range in the contiguous United States .. increase their susceptibility to local extirpations.”* (LCAS p68). Almost every anthropogenic activity does have an adverse effect on lynx and lynx habitat as the science provided by the Forest Service and FWS have described in the preceding paragraphs. It is the omission of current monitoring and analysis along with the absence of adequate Forest Service standards that logic dictates is responsible for absence of lynx in places where it was observed in years gone by. We can find no monitoring or analysis of the effects of these activities to comply with the RFP and Travel Management Plan in the CNF. Lack of current data enables the CNF to deny impacts. Since our research has found an absence of recent monitoring and studies on Canada lynx habitat, populations and snowshoe hare habitats and populations across these southern Forests, it is incumbent on the current SSA effort to address this lack of information. **FWS must press for meaningful, ecological based standards, define linkages and corridors, and require they be addressed with detailed habitat, lynx, and snowshoe hare studies. Models such as we discuss later in these comments must be consolidated, evaluated, and applied to define and update core and linkage areas.**

Lynx Observations. The 2013 LCAS briefly describes lynx occurrences in the Northern Rockies. In Wyoming, lynx is a species of “*greatest conservation concern*” and “*has been documented historically and currently in western Wyoming...*” In Idaho lynx “*are classified as an S1 species of greatest conservation need.*” Most of the 35 verified records in Idaho came from north of the Snake River with 2 from Caribou and Bonneville Counties along the Wyoming border. Recent snow tracking surveys have detected no lynx. (LCAS p57). Two lynxes were captured in traps in 2012 and 2013, one was released alive, and the other was shot due to being misidentified as a bobcat. In Utah, the LCAS reports only a few historical records from the early 1900s with later records all from northwestern Utah near the borders with Wyoming and Idaho. (LCAS p58).

Lynx observations were summarized in McKelvey et al (2000)²⁸. McElvey et al used “*written accounts, trapping records, and spatially referenced occurrence data...*” (SR p207). They limited consideration of trapping records due to lack of constant effort and confusion with bobcats and where high reliability is needed, “*we used a subset of these data we call ‘verified records’*. Verified records were those “*only if it was represented by a museum specimen, or a written account in which a lynx was either in someone’s possession or observed closely....neither tracks nor sighting reports were considered to be a verified record.*” (SR p209). Yet, today tracking surveys are used.

We have extracted McKelvey’s data from Table 8.1 of their chapter and summarized the percent of observations that are “*verified*” and “*reliable*”. An extremely low percentage of total spatially referenced occurrences were “*verified*”. (Table 1). Hundreds to thousands of observations are not counted when determining lynx historical occupancy. Are we to believe they were all wrong? An example of this comes from a BLM report.²⁹ Of interest is an account by Harold Wadley, who was a Forester working for the U.S. Forest Service in Idaho and in the Uinta Mountains in Utah. Harold worked in the Uinta Mountains in 1957 and 1958. He used dogs and traveled by snowshoe to track and tree lynx. His records show he treed 20 Canada lynx in those two years. Harold encountered Canada lynx along the entire north slope of the Uinta Mountains. He estimated that there were 15 Canada lynx on the north slope of the Uinta Mountains between the West Fork of the Bear River and the Little East Fork of the Black Fork River. This essentially was the area within his ranger district. Was his report even considered? It is hard to tell. Do we just discount this as unreliable? After all, Harold worked for the U.S. Forest Service and knew lynx as do most trappers are likely to be able to do. His observations in the 1950s indicate a resident population occurred on a portion of the north slope of the Uinta Mountains at that time. This was prior to the irruptions from Canada in the 60s and 70s.

In the following paragraphs, we use an example of how one should approach these arguments surrounding whether lynx ever resided in the Uinta Mountains that was provided by Dr. Kirk

²⁸ McKelvey, K.S., K.B. Aubry, and Y.K. Ortega. 2000. History and distribution of lynx in the contiguous United States. Pages 207-264. Chapter 8. In Ruggiero, L.F., K.B. Aubry, S.W. Buskirk, G.M. Koehler, C.J. Krebs, K.S. McKelvey, and J.R. Squires (Tech Eds). Ecology and conservation of lynx in the United States. Univ. Press of Colorado. Boulder, CO. 480 p.

²⁹ Lewis, L. and Wenger, C.R. 1998. Idaho's Canada Lynx: Pieces of the Puzzle. Idaho Bureau of Land Management Technical Bulletin No. 98 - 11 in cooperation with the U.S. Forest Service.

Robinson in one of our joint efforts to address domestic sheep grazing in the Uinta Mountains of Northwest Utah.³⁰

Table 1. Spatially Referenced Occurrence Data from McElvey et al 2000.

State and time span	Total Spatially Referenced Occurrences	Verified Records	Verified as Percent of Total/Reliable
Colorado 1878 - 1974	196 Total 84 Reliable	17	8.7/20.2
Idaho 1874 - 1991	234 Total 228 Reliable	74	31.6/32.4
Utah 1916 - 1991	27 Total 17 Reliable	10	37.0/58.8
Montana 1887 - 1999	1,542 Total 1,169 Reliable*	84	5.5/7.1
Washington 1896 - 1999	765 Total 571 Reliable**	134	17.5/23.4
Wyoming 1856 - 1991	361 Total 288 Reliable	30	8.3/10.4

*Note that trapping records showed 3,012 reported between 1950 – 1997

**Trapping records show 215 between 1960 - 1989

Dr. Robinson’s logical analysis examines the use of verified vs reliable accounts, or observations. He puts it this way:

There may have only been 10 verified records of lynx occurrence in the Uintas in the 20th century, but there have been an additional 17 reliable reports of lynx in Utah in the 20th century, based on physical remains (including photographs), visual sightings and track identifications, plus another 10 of unknown reliability. The total number of records is 37. Most of these lynx occurrences were on the north slope of the Uintas, in or near the West Fork of Blacks Fork. Even if we discount the 10 reports of unknown reliability, we still have 17 reliable reports and 10 verified records of lynx, for a total of 27, most of which located the lynx in the Uintas! In other words, the historical evidence indicates a minimum of 10-37 lynxes in the Uinta Mountains over the last 103 years (not counting dispersers from Colorado). Thus, there can be little doubt that the actual number of “sightings” was greater than 10. 30 would be much more probable.

Why arbitrarily exclude the “reliable” sightings? What does “reliable” mean if you can’t rely on what is reliable? Yet the FS chooses not to rely on them for the purpose of the DEIS—a decision that would seem to be based not so much on a desire for accuracy as a desire to minimize the presence of lynx in Utah in order to make room for Alternative 2.

³⁰ Coalition comments on the High Uintas Domestic Sheep Analysis Project. 2019. Provided to the Uinta Wasatch Cache National Forest. August 5, 2019. Access at: <https://app.box.com/s/797x21rggtx1t6yayr0gi9kpbouis4sr>

At this point we should ask ourselves how many records—verified records, if you like—it would take to establish that there was a resident population of lynxes in the Uintas during some part of the 20th century. Does anyone have even the slightest clue? Of course not. And the reason is that there are no empirical data for establishing a baseline on which to base a prediction. Surely all we can reliably say is that the more records (verified + reliable), the higher the probability. Thus, this premise commits the fallacy of begging the question by presupposing what is to be proved.

As we review the table 8.1 from McKelvey, it is apparent that most historical observations and accounts are dismissed out of hand and have become the basis of today's claims by FWS and the Forest Service that there are not (and perhaps never were) resident lynx in Utah and Idaho, or Colorado for that matter even though the reintroduced population survives there today and appears stable or increasing according to the Forest Service website cited earlier.

McKelvey et al (2000) also provide a narrative describing lynx records in Idaho, totaling 73 records. Some records such as reported in Lewis and Wenger (1998), are apparently not included. The following are extracted from McElvey et al:

From 1874 – 1917, there are 22 museum specimens from areas north of the Snake River Plain. In 1939 and 1940 specimens were collected in central Idaho in Valley County and Idaho County. In 1954 and 1955 specimens were located from Bonner and Shoshone Counties. Other verified records include one from Shoshone County in 1901, one from Boundary County in 1919, one from Idaho County in 1936, one from northwest Idaho in 1939, one from Clearwater County in 1942, five from Caribou County in 1947, two from Bonneville County in 1955. (SR p225 - 226).

“There are 35 verified records from 1960 to 1991: four from 1962 to 1969, 18 from 1970 to 1979, 10 from 1982 to 1989, and three from 1990 to 1991; there are no verified records of lynx in Idaho since 1991 (Anonymous 1999, unpublished). Although most of these records are from the northern and central regions of Idaho where lynx occurred historically, six are from counties in the Snake River Plain, in areas where forest types occupied by lynx are absent or very fragmentary in extent (see “Lynx Associations with Broad Cover Types”). These include records from Blaine, Butte, Jerome, and Twin Falls Counties in 1972; one from Blaine County in 1984; and one from Power County in 1990”. (SR p227).

The Lewis and Wenger (1998) report provided numerous accounts of lynx and lynx tracks in Idaho. They noted that little is known about Canada lynx in Idaho and that “*the lack of Canada lynx studies...only adds to the puzzling nature of the species*”. It was based on interviews with individuals “*familiar with Canada lynx habitat and local fauna in general.*” (pi). These were individuals documented by Idaho Fish and Game as “*having harvested Canada lynx*”. While the report covers several areas of Idaho, it also includes Eastern Idaho accounts by 18 individuals. These are provided here for the SE Idaho area. They included accounts from residents in Island Park, St. Anthony, Rexburg, Georgetown, Ashton, Preston, Swan Valley,

Paris, Montpelier, and Alta, Wy. The reports included those who observed lynx in SE Idaho in Georgetown Canyon, Tincup Creek, and Henry's Fork, many of whom killed lynx or observed their tracks. The report paints a broad picture of lynx across much of Eastern Idaho as well as other areas of the state. Here is one from Oliver Peterson of Montpelier who was trapping prior to the 70s when lynx sightings were claimed to be due to movement from Canada due to hare cycle lows. It appears very convenient today to claim there were never resident lynx in these areas.

Oliver Peterson, Montpelier, ID —Oliver began trapping in 1945 and did most of his trapping in the 1950s and 1960s. During a one-week period in 1947 or 1948, he caught five Canada lynx ten miles northeast of Soda Springs. He trapped four Canada lynx in the 1950s and 1960s, one in the same area where he caught the five Canada lynx. He caught three Canada lynx farther east near Georgetown. Except for one Canada lynx trapped near timberline, the remaining Canada lynx were caught in areas with a mosaic of aspen, conifer, and mountain brush. (p8). He speculated that during those years there were no snowmobiles and atvs and that the demise of lynx was due to increased access and by snowmobiles, atvs, and the lack of snowshoe hares. Traplines were accessed by snowshoe or skis and now (the 1990s) there is "intensive snowmobile and atv use". He believed this was a primary factor in the demise of lynx since the 1970s. (p17).

The interviews provided information on lynx prey including jackrabbits, grouse, red squirrels, voles in addition to snowshoe hares indicating the use of alternate prey appears greater than in Canada and Alaska. The authors suggest scenarios relating lynx behavior to jackrabbit populations by lynx following jackrabbits into shrub steppe far from typical coniferous forest habitats and end up near other habitats occupied by snowshoe hares and/or may exploit jackrabbit population highs without leaving traditional habitats resulting from jackrabbits dispersing into those habitats.

They also discuss livestock grazing, noting that studies show that livestock reduce forage availability, that elk and livestock eat many of the same species as do black-tailed jackrabbits and reduce forage to the point it limits jackrabbit densities. "Grazing of the same areas by both species may have cumulative effects on both snowshoe hare and jackrabbit habitats." (p17). "Utilization of forage by both elk and livestock may thus have a significant impact on hare habitats. This may be particularly true in the southern-most portions of the Canada lynx range where grazing becomes a more dominant use." (p18).

In conclusion, Lewis and Wenger (p19) state, "there is no 'smoking gun' factor in the decline of Canada lynx in Idaho. Many variables appear to limit Canada lynx numbers in this state. The most important of these appear to be timber harvest practices; high numbers of coyotes, mountain lions, and elk; increasing motorized and nonmotorized recreational use; incidental trapping; and reduced numbers of alternate prey, including species that are not documented as Canada lynx prey in existing research. These include jackrabbits, beavers, and porcupines."

Lynx, the ESA and Forest Service Manual. The ESA promulgated regulations at 50 CFR § 402.12 delineate the purpose of a Biological Assessment (BA) as to “*evaluate the potential effects of the action on listed and proposed species and designated and proposed critical habitat...*”. It describes the contents as “*discretionary*” and depends on the nature of the federal action with consideration for including (1) results of on-site inspections; (2) views of recognized experts; (3) review of the literature; (4) analysis of the effects of the action on species and habitat, including cumulative effects and the results of related studies; and (5) analysis of alternate actions considered by the Federal agency.

In a recent typical example in the CNF in a Decision for a phosphate mine, the Husky 1 North Dry Ridge mine, the BA only based its brief analysis on the proposed action, not the suite of alternatives contained in the FEIS.³¹ It included minimal analysis. The intent of the ESA was avoided and if one applied the NEPA standard for a hard look or cumulative effects to this aspect of the analysis, the analysis would fail. “*Discretionary*” cannot be used to avoid taking a hard look in the analysis. This project, combined with other projects that are listed in the FEIS for H1NBR in addition to roads, timber harvest, and recreation, occurs within a linkage area connecting to critical habitat for lynx immediately east of the project. Figure 4 illustrates this and shows some of the phosphate leases in the CNF lynx linkage for illustration. The loss of this connection due to habitat fragmentation means the loss of the genetic connection between the critical habitat and other peripheral habitat such as in the Uinta Mountains which then connect to the current Colorado population. **How can regulations or land use plans be effective when they are “discretionary” for the project proponents? This must be addressed.**

The Forest Service Manual³² cites the ESA as “*the Act directs federal departments and agencies to ensure that actions authorized, funded, or carried out by them are not likely to jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modification of their critical habitats.*” (FSM 2670.11). The FSM (2679.12) cites Departmental Regulation 9500-4 as (1) “*Manage ‘habitats for all existing native and desired nonnative plants, fish and wildlife species in order to maintain at least viable populations of such species.’*” (2) “*Conduct activities and programs ‘to assist in the identification and recovery of threatened and endangered plant and animal species.’*” (3) “*Avoid actions ‘which may cause a species to become threatened or endangered’*”. The CNF provided guidance in its RFP FEIS to address this connectivity but has ignored its own guidance in approving the H1NDR and all the other projects we have reviewed. How can the CNF dismiss impacts to Canada lynx without actually conducting an analysis? The current analysis for H1NDR and other projects does not “*ensure*” that actions do not further endanger or adversely modify habitat. Only in the industry bias world of today’s Forest Service could total destruction of habitat not be considered an “*adverse*” impact. Degrading and fragmenting this linkage habitat compromises lynx migration and habitat adjacent to and bordering lynx critical habitat and must be considered in that context.

FSM 2670.31 provides additional guidance for T&E species.

³¹ <https://www.fs.usda.gov/project/?project=37878> Accessed on January 17, 2023.

³² USDA Forest Service. 2005. Forest Service Manual National Headquarters (WO) Washington DC. FSM 2600 – Wildlife, Fish, and Sensitive Plan Habitat Management Chapter 2670 – Threatened, Endangered and Sensitive Plants and Animals (September 23,2005).

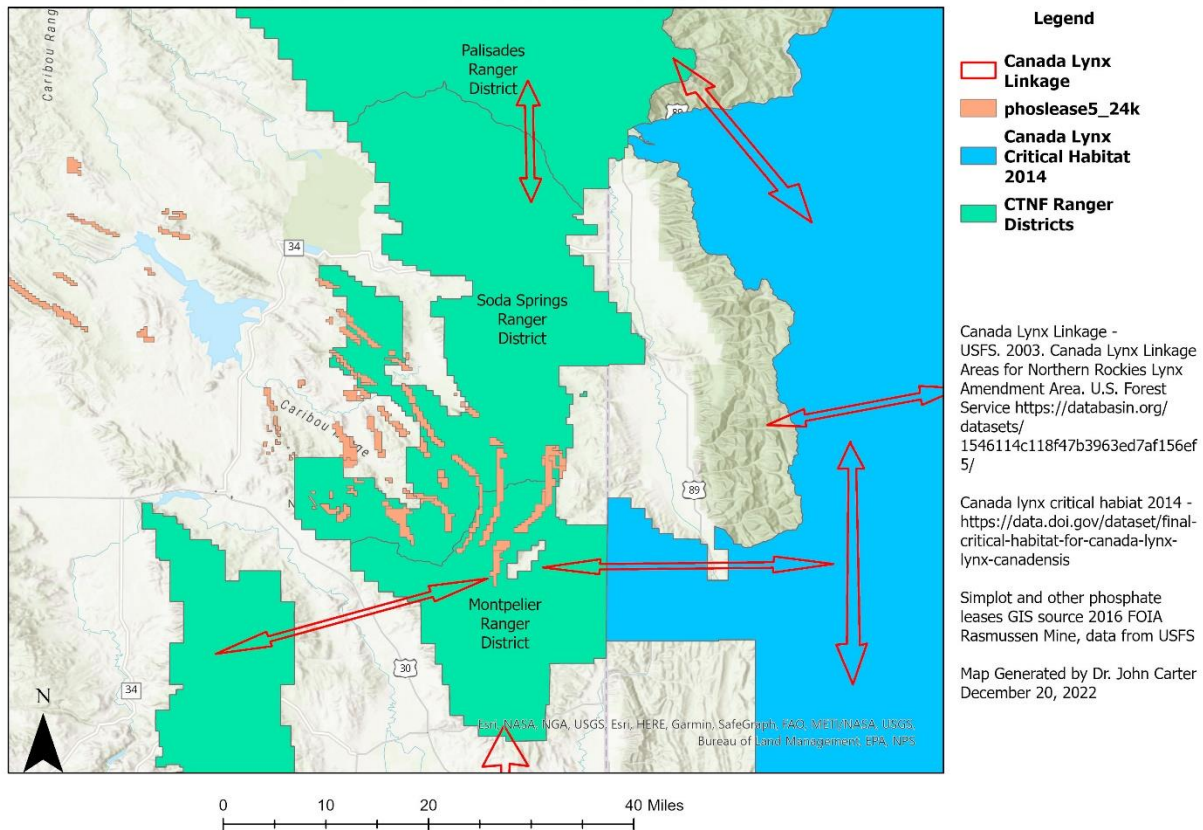
(1) *“Place top priority on conservation and recovery of endangered, threatened, and proposed species and their habitats.”* (2) *“Establish, through the Forest planning process, objectives for habitat management and/or recovery of populations.”* (4) *“Avoid all adverse impacts on threatened and endangered species and their habitats, except when it is possible to compensate adverse effects totally through alternatives identified in a biological opinion.”* (6) *“Identify and prescribe measures to prevent adverse modification or destruction of critical habitat and other habitats essential for the conservation of endangered, threatened, and proposed species. Protect individual organisms or populations from harm or harassment as appropriate.”*

Once again, the CNF has not placed top priority on conservation and recovery, has not established meaningful objectives with enforceable standards for lynx habitat, has not designated LAUs with standards to protect preferred habitats and linkages, has ignored the effect of this linkage area on the adjacent critical habitat, thus compromising the integrity of that critical habitat and what remains of the core population in the DPS. The CNF by allowing snowmobile use on 97% of the Forest is not preventing harm or harassment of lynx, wolverines or other species which are affected by snowmobile use and the associated trapping, shooting and harassment. We have witnessed multiple snowmobiles trespassing on Kiesha’s Preserve chasing and harassing a coyote and deer in an effort to “whack” the coyote and at other times, releasing dogs carried in their sleds to chase mountain lions while trespassing. With the groomed trails throughout the mountains, one hunter can cover a hundred miles in one day looking for tracks to turn out his dogs.

The FSM 2670.5 provides definitions of terms that are useful in interpreting the efficacy of the agency analysis. An **adverse effect** includes *“Any action that directly alters, modifies, or destroys, critical or essential habitats or renders occupied habitat unsuitable for use by a listed species, or that otherwise affects its productivity, survival, or mortality.”* **Essential habitat** is defined as *“Those areas designated by a regional forester as possessing the same characteristics as critical habitat without having been declared as critical habitat by the Secretary of the Interior or Commerce. The term includes habitats necessary to meet recovery objectives for endangered, threatened, and proposed species and those necessary to maintain viable populations of sensitive species.”* A **viable population** is defined as *“A population that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the species throughout its existing range (or range required to meet recovery for listed species) within the planning area.”*

The CNF has not designated Essential Habitat, but it has designated linkage for lynx. It has not identified recovery objectives or evaluated how a project leads to recovery of lynx. The analysis we have provided shows actions by the Forest Service have had an “adverse effect” as demonstrated by the lack of lynx observations and presence in SE Idaho. Given the lack of lynx observations in the recent decades, it is apparent that human activity is occurring in such a manner that lynx populations are being affected. Otherwise, why are lynx not being found here today? This example is illustrative of failures by both the Forest Service to comply with the intent of its RFP and FWS failure to require detailed analysis and protections in its role of consultation.

Figure 4. Canada Lynx Critical Habitat, Phosphate Lease Locations, Linkage Area including Soda Springs and Montpelier Ranger Districts Based on FEIS for 2003 Caribou Revised Forest Plan



FSM 2671.44 describes determination of the effects on listed species. Biological evaluations are to “conduct and document the program and activities review necessary to ensure that any action ... is not likely to jeopardize the continued existence of any listed or proposed species or to result in the destruction or adverse modification of critical or proposed critical habitat.” Internal “biological expertise” and “informal consultation” are to be used to reach “supportable determinations of effect”. Finally, “Consider effects on suitable unoccupied habitat essential to recovery of the species when doing the biological evaluation.” We do not see CNF analysis of the linkage, or “suitable unoccupied habitat” or any effort to address its current vs historical condition as delineated in the CNF RFP FEIS. FWS is not addressing failures such as these.

The lack of adequate regulatory mechanisms to protect lynx habitat and connectivity has been implicated as a central issue for lynx being able to maintain populations.³³ (FR p16052). The FSM described above makes the point that the Forest Service should establish through planning,

³³DOI USFWS. 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. Fed. Register Vol. 65, No. 58.

objectives for habitat management and/or recovery of populations and prescribe measures to prevent adverse modification of habitat essential to the conservation of T&E species. This remains to be done and the FWS should ensure that not only the CNF, but all Forests and BLM land management plans are quantitatively addressing lynx habitat and connectivity needs.

What the CNF provides for lynx linkage in its RFP is summarized below.

Caribou NF Direction for Canada Lynx. The Caribou RFP FEIS laid out a process for addressing connectivity. We have reviewed the RFP for standards or objectives relating to lynx and its habitat. Overall, these are quite generic and not specific to the habitat of lynx. The direction specified to maintain linkages for Canada lynx is found in (1) Vegetation Desired Future Conditions, (2) Vegetation Goals 1 – 4, (3) Vegetation Standard 2, (4) Wildlife Goals 2, 3, and 5, (5) Vegetation Goal 7, (6) Lands Objective 1, and (7) Lands Standard 1. (RFP 3-28) We reviewed each of these for specifics regarding lynx habitat. They are summarized below:

1. Vegetation DFC (RFP 3-17) to retain diversity of structure and composition, 30 – 40% of conifers in mature and old classes (FEIS notes this will not be attained), functional corridors are present, aspen managed to 20 – 30% mature and old, non-forested vegetation within site potential and within HRV, restoration of native shrub communities accomplished, woodland types are multi aged with balanced shrub/herbaceous understory and within HRV.

2. Vegetation Goals 1 – 4, 7 (RFP p3-17 – 3-18) to have diverse forested and non-forested ecosystems within HRV and/or restored through time, aspen managed to reduce or halt decline, forested ecosystems moving towards a balance of age and size classes in each forested type on a watershed or landscape scale, sage-steppe and mountain brush moving towards a balance of age, canopy cover, and size class on a watershed or landscape scale and within HRV, biodiversity maintained or enhanced.

3. Vegetation Standard 2 (RFP 3- 19) *“In each 5th code HUC which has the ecological capability to produce forested vegetation, the combination of mature and old age classes (including old growth) shall be at least 20 percent of the forested acres. At least 15 percent of all the forested acres in the HUC are to meet or be actively managed to attain old growth characteristics.”*

4. Wildlife Objective (RFP 3-24) *“The Forest provides habitat that contributes to state wildlife management plans; Forest management contributes to the recovery of federally listed threatened, endangered, and proposed species and provides for conditions, which help preclude sensitive species from being proposed for federal listing.”*

5. Wildlife Goals 2, 3, and 5 (RFP 3-24) states that wildlife biodiversity is maintained or enhanced by managing for vegetation and plant communities within their HRV, maintain multiple vegetation layers in woody riparian habitats, maintain, and *“where necessary and feasible, provide for habitat connectivity across forested and non-forested landscapes.”*

6. Lands Objective 1 (RFP 3-8) *“Identify land adjustments and rights-of-way to improve management, public access, and/or wildlife connectivity annually.”*

7. Lands Standard 1 (RFP 3-9) *“Priority shall be given to acquiring lands having special importance or unique characteristics such as riparian areas, historic sites, habitat for federally listed species, recreation sites, etc.”*

There is no specific direction and no enforceable standards regarding lynx habitat and linkage (which the Forest Plan itself mapped). These appear as mere afterthoughts with no relation to research on lynx or hare habitat. We have seen no evaluation in any project as to whether these have any relation to the habitat needs of lynx. In our example, the H1NDR NEPA process did not analyze these provisions or reveal how they have been applied across the affected watersheds and landscape where lynx formerly have been found, or in the linkage shown in the CNF RFP FEIS. In our example of the H1NDR FEIS, the analysis did not use the guidance in the CNF RFP FEIS on connectivity and how to analyze it. It did not analyze the risk factors described in the LCAS and the combined impact of all the various uses and projects on this linkage area. A review of IRAs in the CNF finds they are rarely different in management than other forest lands, with many user-created roads and trails, past timber harvest, mining, and livestock grazing. For example in our comments on the Dairy Syncline DEIS (p43) we cited the Idaho roadless rule description of the Huckelberry Basin IRA which was to be fragmented for a tailings pond.³⁴ *“Remoteness and solitude rate as low, because of development.” .. “Manageability of the area is considered poor, due to road intrusions and timber harvest activities.”* (Idaho roadless rule FEIS C5-46). This is typical of the characterization of IRAs under the Idaho Roadless Rule. So, if IRAs are fragmented by all these activities, where are the intact habitats for lynx and other special status species in IRAs and other habitats presumed to have lower levels of protection? **A thorough review of the science on lynx habitat characteristics needed for recovery and connectivity should be completed and used to compare current conditions in the CTNF to those needed for lynx.**

LYNX REGIONALLY SIGNIFICANT WILDLIFE CORRIDOR (Y2UConn)

The following discussion is about the need to define, protect and restore a corridor or corridors, and provide standards for habitat to provide connectivity to the southern population of lynx. This is focused on the Y2UConn (higher elevation) corridor passing through SE Idaho and NE Utah to connect critical habitat in the GYA to the Colorado lynx population.

The Colorado Division of Wildlife tracked radio-collared lynx released in Colorado.³⁵ According to the Rocky Mountain Research Station, *“By 2010, all indications were that the vast majority of animals relocated there had stayed in the state and they seemed to be surviving and reproducing well enough that the population was on a slight upward trajectory.”*³⁶ That

³⁴ USDA. 2008. Roadless Area Conservation National Forest System Lands in Idaho Final Environmental Impact Statement Appendix C.

³⁵ Devineau P, Shenk T.M., White, G.C., Doherty Jr., P.M. and R.H. Kahn. 2010. Evaluating the Canada lynx reintroduction programme in Colorado: patterns in mortality. Journal of Applied Ecology. doi: 10.1111/j.1365-2664.2010.01805.x 8 p.

³⁶ USDA RMRS. 2023. Winter Sports and wildlife: Can Canada lynx and winter recreation share the same slope?

link also noted that lynx were extirpated or greatly reduced in Colorado by the 1970s. The web report noted that *“managers really understand the need to provide for connectivity in these critical areas we’ve identified.”* Do they? Are they? Where is the evidence? FWS should require evidence.

Devineau et al (2010) show that lynx telemetry records confirm that there is a “hot spot” of lynx occurrences at the western end of the Uinta Mountains, where collared lynx from Colorado remain for a time before moving on. As of 2009, at least 22 individuals had made at least 27 visits to the state of Utah, recorded by air telemetry and satellite.³⁷ The highest concentration of lynx locations in Utah, as identified by telemetry, is in the Uinta Mountains. *“The use-density surface for lynx use in Utah indicates the primary area of use being located in the Uinta Mountains.”*³⁸ A recent report by Colorado Parks and Wildlife (CPW) using information from the tracking devices found that 19 males and 10 females reintroduced into Colorado between 1999 - 2006 were located in Utah.³⁹ Because some of these were single data points, CPW chose to evaluate 11 males and 6 females that were located in Utah between 2000 and 2010. Most of the individuals *“entered and exited Utah via the Uinta Mountains in the northeast, Abajo Mountains in the southeast, or the East Tavaputs Plateau in the east-central part of the state... .”* The report points out that a male and female occupied the same area in the Uinta Mountains for >200 days, but it is not known if there was denning or reproduction. *“Those that spent a considerable amount of time in Utah tended to find and traverse the high country running north – south through the central portion of the state.”* *“There were likely other individuals who made the trip. Also, CPW stopped monitoring collared lynx in April, 2011. Movements into Utah may or may not have continued since then, but we have no documentation.”* (p3).

The Science Report (Chapter 10) discusses the history of lynx occurrence in Colorado. *“... boreal forest habitat in Colorado is insular in nature and isolated from similar habitat in Utah and Wyoming by more than 150 km of lower elevation habitats in the Green River Valley and Wyoming Basin (Findley and Anderson 1956). All but a few specimen records are from the center of this island of boreal forest habitat in west-central Colorado.”* (SR p230). There were 15 specimens found between the 1800’s and 1936 with none thereafter until 1969, 1972, and 1974 when four additional specimens were identified. Despite snow tracking efforts, there have been no verified records in Colorado since 1974. (SR p231). As we summarized in Table 2, out of 196 records in Colorado between 1878 – 1974, there were 17 verified records, but 84 reliable records.

Figures 8.19 and 8.20 in the Science Report (p247) depicts lynx occurrences overlaid on Kuchler (1964) vegetation classes in the western U.S. It is noted that Rocky Mountain Conifer cover type enclosed 82% of lynx occurrences. Those Figures and Figure 8.17 show dense patterns of lynx occurrence in Colorado, western Wyoming and the GYA, western Montana, northern Idaho, and Washington bordering Canada. A pattern of occurrence also is shown in northeast Utah and

<https://www.fs.usda.gov/rmrs/winter-sports-and-wildlife-can-canada-lynx-and-winter-recreation-share-same-slope>
Accessed on January 19, 2023.

³⁷ Colorado Department of Wildlife (CDOW) Report, 2006-7, Tables 4 and 6, pages 23 and 24.

³⁸ Ibid. page 10; see also Figure 2, page 29.

³⁹ Ivan, J. 2019. Summary of movements of Colorado lynx in Utah. Colorado Parks and Wildlife, Fort Collins.

along the border between Idaho and Wyoming. Connecting these populations is critical for the DPS to recover and maintain gene flow.

We have been addressing connectivity in the Yellowstone to Uintas Connection since our organization was founded. The Y2UConn leg of the Regionally Significant Corridor is the high elevation, conifer dominated link needed to connect the GYA and northern Rockies to the Uinta Mountains and Southern Rockies. The CNF Forest Plan FEIS (pD-5)⁴⁰ summarizes the history/knowledge of this corridor through SE Idaho into NE Utah.

Most of the efforts to date to map corridors have focused on large-scale dispersal corridors generally from the Northern Rockies (Glacier NP) to the Greater Yellowstone Ecosystem. The USFWS, in efforts to conserve large carnivores in the Northern Rocky Mountains, has developed the concept of linkage zones. The linkage zone is an area between habitat fragments able to support both movement and low-density occupancy. The distinction between linkage zone and corridor is the width of habitat—that is the ability to support low density occupancy by species (Samson et al, 1997).

Ruediger, et al, 2000 drafted a map titled “IGBC Wildlife Habitat Linkage in the Northern Rocky Mountains.” This map also includes the northeastern portion of the Caribou in the mapped north-south linkage zone. Other agencies and groups have done mapping as well.

In May 2000, a meeting was held with several state and federal agencies as well as other interested groups, to discuss developing common criteria to help identify linkages of highest importance (Ruediger, 2000). They recommended factors to consider when identifying wildlife habitat linkages; 1) consider all scales, 2) landforms and topography are important, mountain passes, river bottoms and major ridges are often natural movement corridors, 3) vegetation is important, many species use forested areas for cover, 4) quality of habitat is important, 5) areas with low road densities and low levels of human use are important, 6) need data and 7) maintain large intact blocks of habitat (Ruediger, 2000)

The Wasatch-Cache National Forest in Utah looked at a north-south corridor passing through the Forest. They used McNab, et al, (1994) to identify Province M331 “Southern Rocky Mountain Steppe” as main north-south corridor (Williams, Forest Biologist pers. comm.) Part of this province (M331) passes through part of the Caribou NF in the Caribou/Webster/Preuss subsections. This same area has been mapped as part of the Greater Yellowstone Ecosystem and was included on Ruediger’s “IGBC Wildlife Habitat Linkages” map.

The 2003 Revised Forest Plan and FEIS for the Wasatch Cache National Forest provides this map along with a map of LAUs in the Wasatch-Cache NF, Uinta NF, and Ashley NF on its

⁴⁰ USDA Forest Service. 2003. Final Environmental Statement for the Caribou National Forest Revised Forest Plan.

website.⁴¹ Figure 5 illustrates this Regional Corridor and its connections. Figure 6 illustrates the Kuchler RMC type, and Figure 7 the topography. These maps show that the Science Report ignored this conifer dominated, high elevation connection in its claim that the Colorado boreal forest (Kuchler?) is “*isolated from similar habitat in Utah and Wyoming by more than 150 km of lower elevation habitats in the Green River Valley and Wyoming Basin.*” Distances between higher elevation forested areas are much less in the western leg (Y2UConn) than across the Green River Valley and other northern areas from Colorado.

Colorado Parks and Wildlife summarized lynx movements from the reintroductions in Colorado to Wyoming.⁴² Locations from 16 male and 15 female lynx that were released in Colorado between 1999 -2006 and were located in Wyoming between 1999 – 2010. (p2). It is interesting to note that the reintroduced lynx came from Canada populations to the north. Inspection of the maps in the report give the impression these lynx are attempting to find their way back north. As the report describes, “*Most of these individuals entered and exited Wyoming via the Medicine Bow Mountains or the Park Range and traveled no farther into the state than the northern extent of these ranges... At least 8 lynx made it to the Greater Yellowstone Area and beyond. A few entered/exited via the Uinta Mountains in Utah...*” The report notes that there were likely other individuals that made the trip, but there is no documentation since that time. (p3). Inspection of the figures in the report shows that some lynx apparently did cross the wide lower elevation valleys between the Medicine Bow Mountains and GYA, but there was no consistent path being followed and there were few conifer or high elevation areas. (Figure 6).

A least-cost path analysis of lynx connectivity between the San Juan Mountains in Colorado and the Greater Yellowstone Area reviewed the negative effects of habitat loss and fragmentation on wildlife populations and the resulting isolation of those populations.⁴³ The role of landscape linkages in providing connections and gene flow was addressed. Using GIS, current spatial data for habitats, human factors affecting lynx movement, and potential travel corridors between core patches of lynx habitat in the southern and northern Rockies were identified. Habitat suitability analysis identified the best core areas for lynx based on vegetation type and road density. Habitat types suitable for lynx were identified and scored. We have provided a general overview map in Figure 8 showing these core and corridor areas of the least cost path overlaid with the Y2UConn leg of the Regional Corridor. These are well aligned with each other. Detailed maps of vegetation classes, road densities, core areas, housing density, slope, habitat permeability, and least cost corridors are provided in the report. The analysis provides an assessment of the probability of successful dispersal for lynx as it assessed the entire landscape, while “*an animal traveling on the ground may not have prior knowledge of the territory it is crossing or obstacles it may come upon.*” (p21). The model is suitable for making conservation and management decisions.

⁴¹ <https://www.fs.usda.gov/detailfull/uwcnf/landmanagement/planning/?cid=stelprdb5076923&width=full>

⁴² Ivan, J. 2017. Summary of movements of Colorado lynx in Wyoming. Colorado Parks and Wildlife.

⁴³ Bates, W. and Jones, A. 2007. Least-Cost Corridor Analysis for Evaluation of Lynx Habitat Connectivity in the Middle Rockies. Report to the Nature Conservancy by the Wild Utah Project, Salt Lake City. <https://app.box.com/s/0g8b1ryqg1iz6r1fd61rdkc8fso97oh5>

Figure 5. **Regionally Significant Wildlife Corridor, Lynx Linkage and Colorado Potential Habitat**

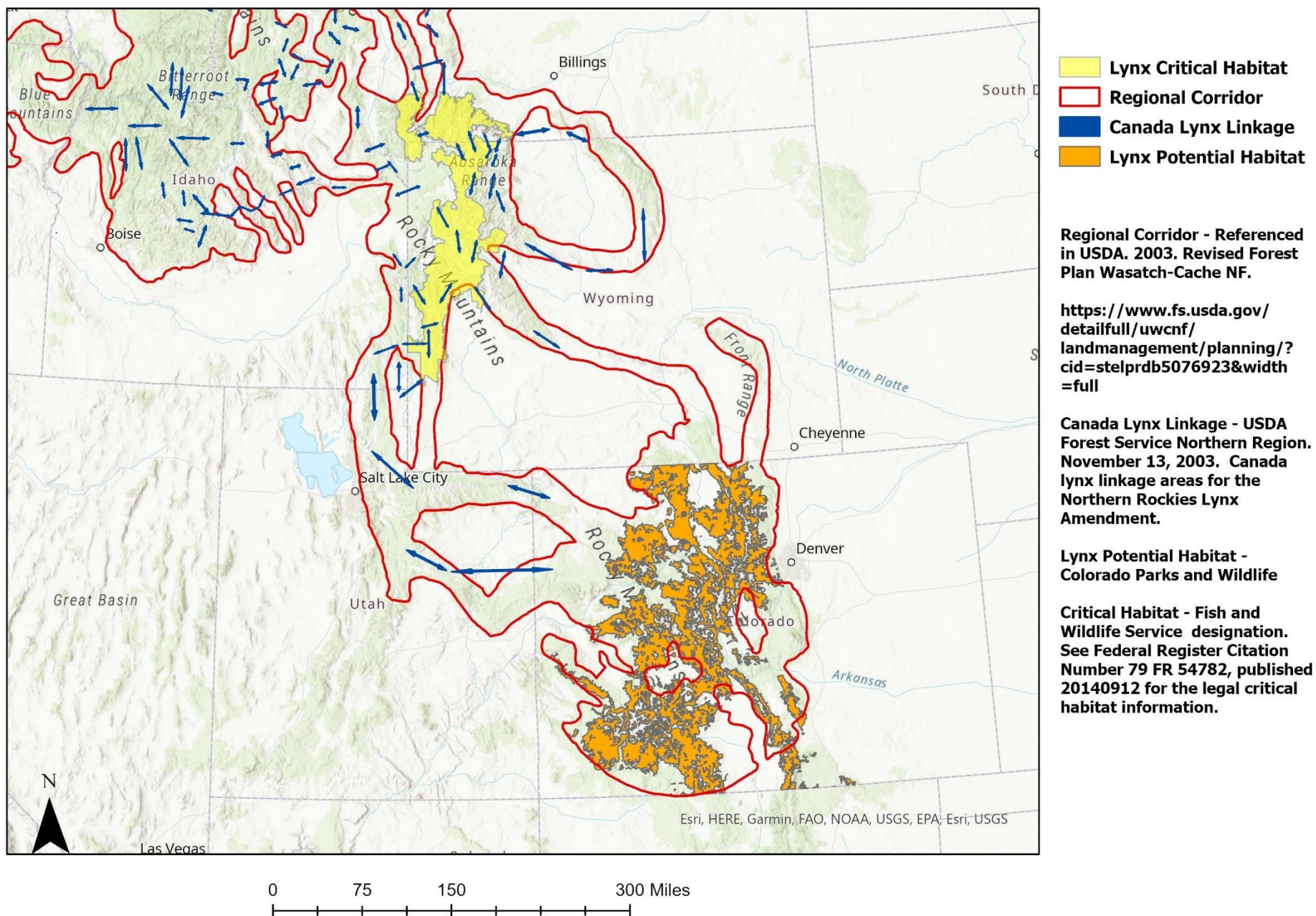


Figure 6. **Regionally Significant Wildlife Corridor
and
Kuchler Rocky Mountain Conifer**

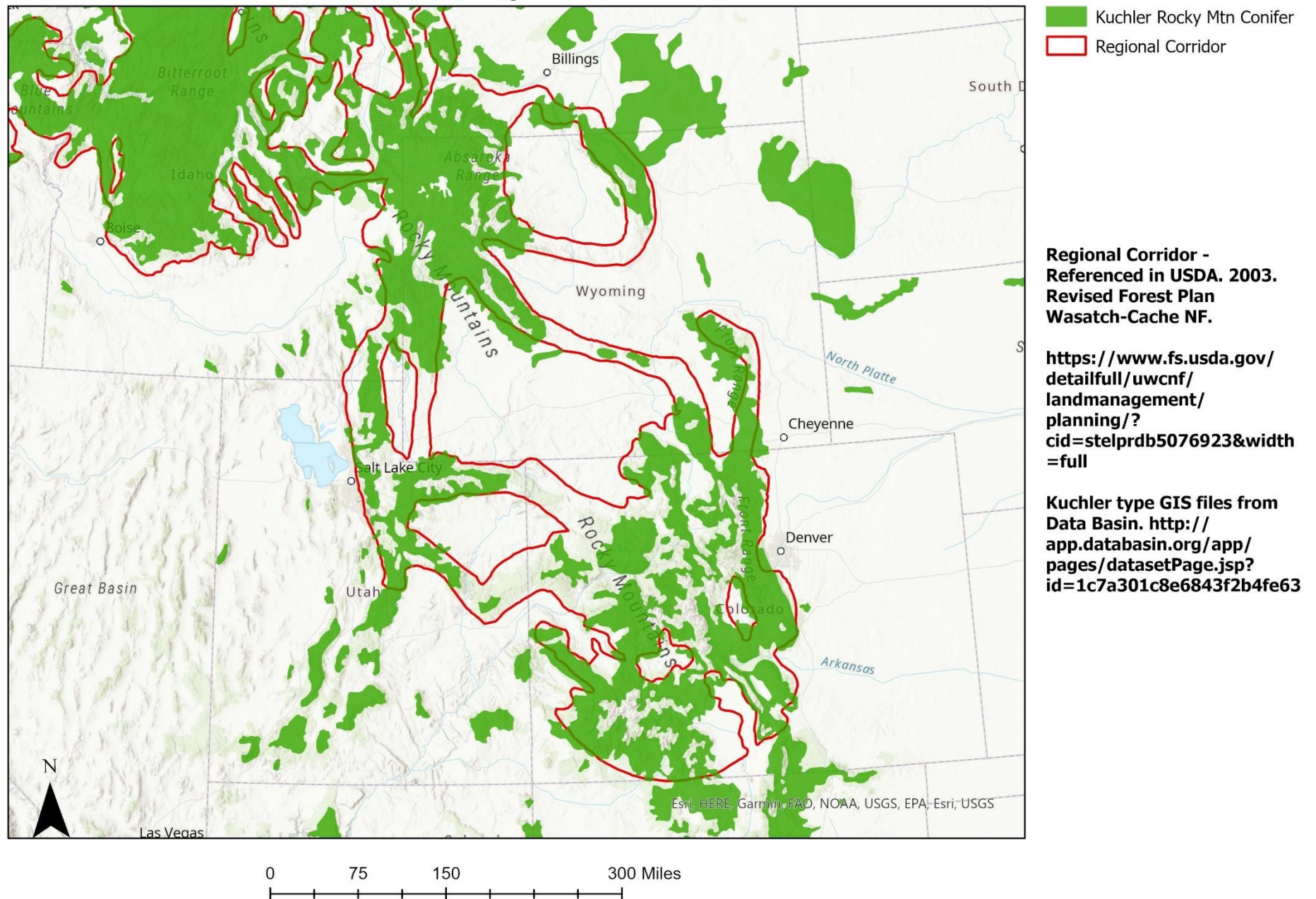
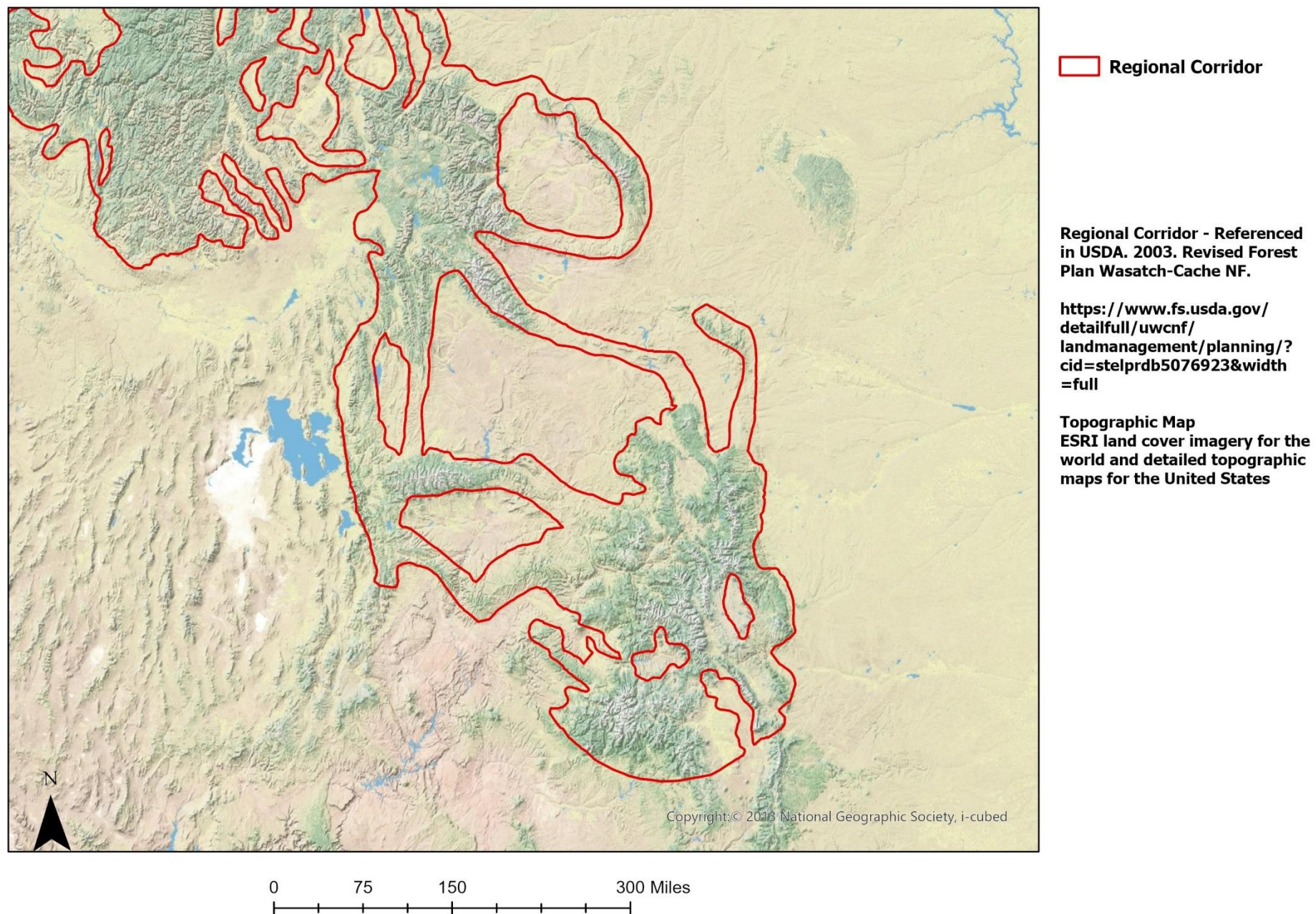


Figure 7. **Regionally Significant Wildlife Corridor
Topographic Relief**



Colorado Parks and Wildlife engaged in a similar effort to map predicted use areas in Colorado.⁴⁴ They used location data from reintroduced lynx fitted with transmitters, filtered those data to remove locations for the first six months to account for habituation, considered elevations above 8,000 feet, and included factors for housing and road density, slope, distance to forest patches and vegetation types. Summer and winter data were used to generate models for both seasons. Figures 9 and 10 are reproduced from that report.

A map of the predicted distribution for Canada lynx in the 2050's based on modeled climatic conditions is provided in Figure 11.⁴⁵ This dataset represents the predicted distribution for Canada Lynx (*Lynx canadensis*) for the 2050's (ten year period average), based on the agreement (spatial average) of 5 niche modeling techniques (BIOCLIM, Climate Space Model, Envelope Score, Environmental Distance, SMV) and monthly precipitation and average temperature from 12 GCM's from the A2 emission scenario. Localities used to produce the model were resampled from the core area (highest probability) of the predicted distribution based on 48 Worldclim 1.4 climatic variables and BIOCLIM. CPW (Ivan) have also produced maps of summer and winter predicted habitat above 8,000 ft in Colorado.

Modeling and analysis such as these examples provide should be used to delineate the final configurations for regional corridors needed to maintain connectivity for these lynx populations. The Y2UConn leg of the corridor is a viable option for the higher elevations and snow cover needed by lynx. It also includes the potential core area of the Uinta Mountains where historical observations indicate a lynx population existed there in the early 1800's prior to trapping and exploitation by people. It connects to Critical Habitat in Western Wyoming where studies documented lynx present in 2004/2005 along with populations of snowshoe hares.⁴⁶ A follow-up effort in the winter of 2008/2009 also detected lynx in the Greater Yellowstone Area.⁴⁷

⁴⁴ Ivan, J., Rice, M., Shenk, T., Theobald, D., and Odell, E. Undated. Predictive Map of Canada Lynx Habitat Use in Colorado. Colorado Parks and Wildlife. Accessed on January 20, 2023.

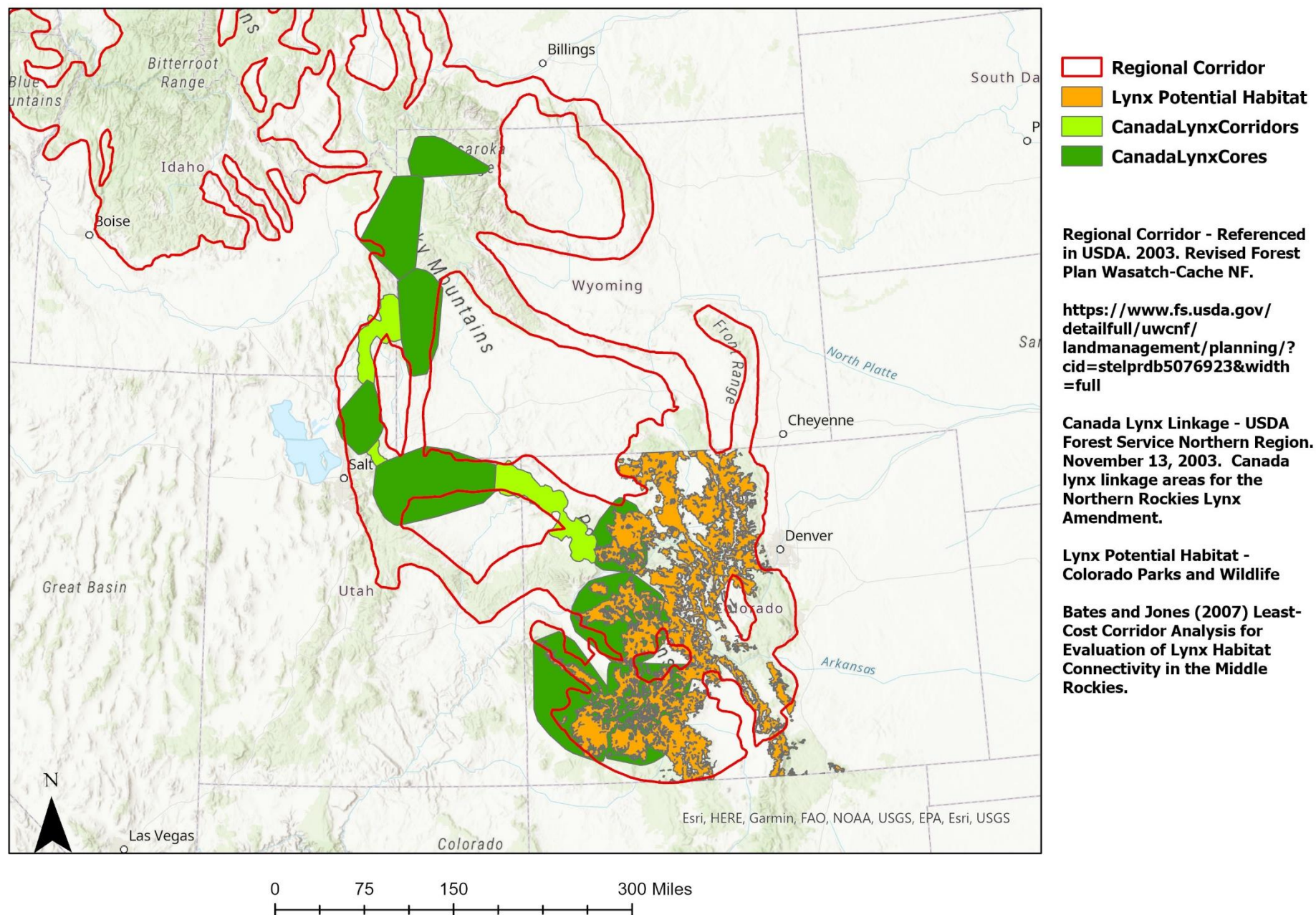
<https://cpw.state.co.us/Documents/Research/Mammals/Publications/CPWPredictiveLynxMapReport.pdf>

⁴⁵ Hamilton, H. 2008. Predicted Distribution of Canada Lynx (*Lynx canadensis*) - A2 emissions scenario - 2050's. California Academy of Sciences 07.29.2008. Map data from <https://databasin.org/datasets/3674ed71-f5b7-45a3-a778-dfc2f0990235/> Accessed on January 20, 2023.

⁴⁶ Berg, N.D., Burghardt, J., Gray, R., and Smith, B. 2005. The Greater Yellowstone Lynx Study 2004/2005 Annual Report. The Endeavor Wildlife Research Foundation.

⁴⁷ Holmes, M. and Berg, N. 2009. Greater Yellowstone Ecosystem Lynx Study. Endeavor Wildlife Research Foundation. <https://yellowstone.co/pdfs/lynxstudy2009.pdf> Accessed on January 22, 2023.

Figure 8. **Regionally Significant Wildlife Corridor, Lynx Linkage and Colorado Potential Habitat**



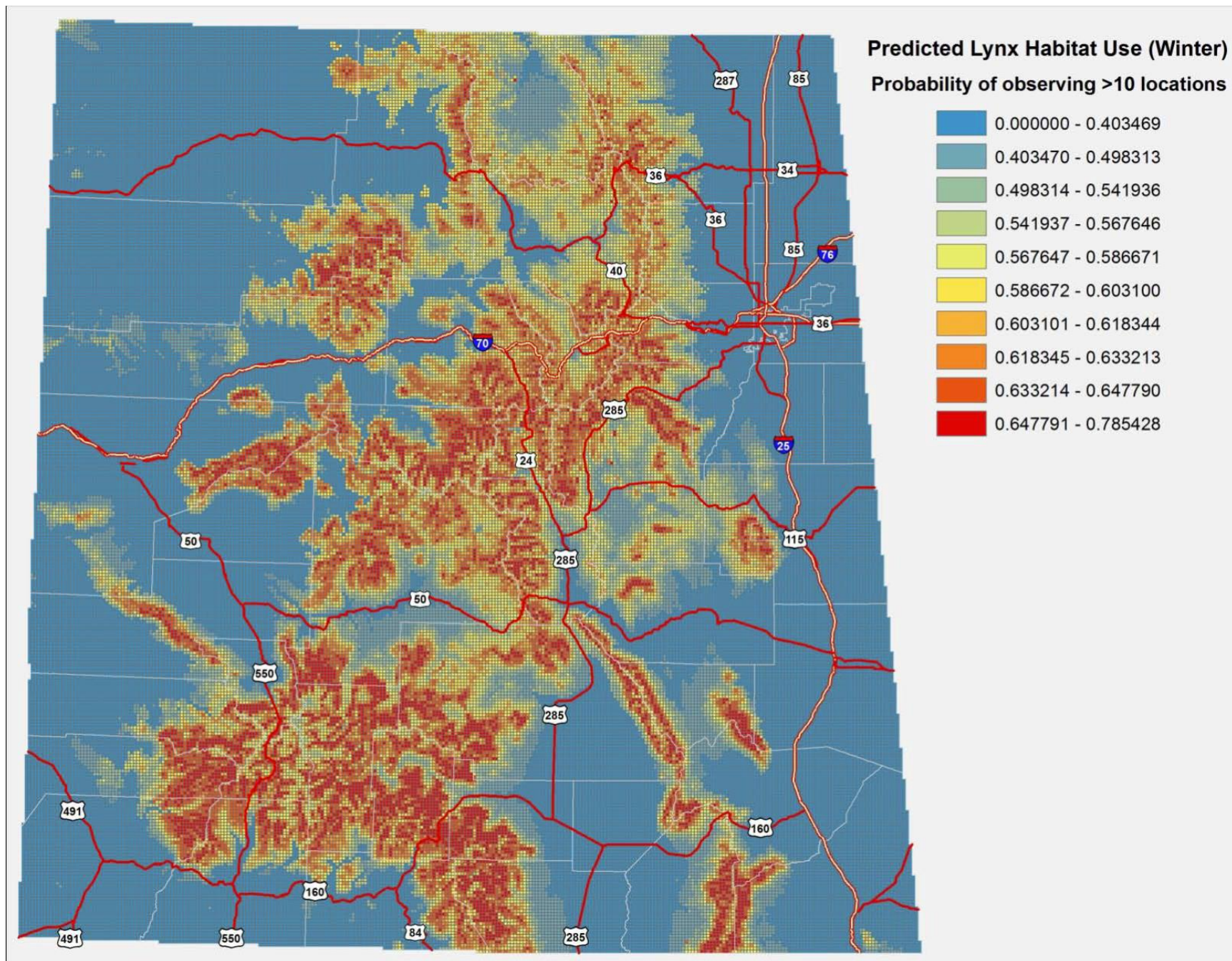


Figure 9 . Predicted winter use by Canada lynx in western Colorado. (From Ivan et al Figure 2)

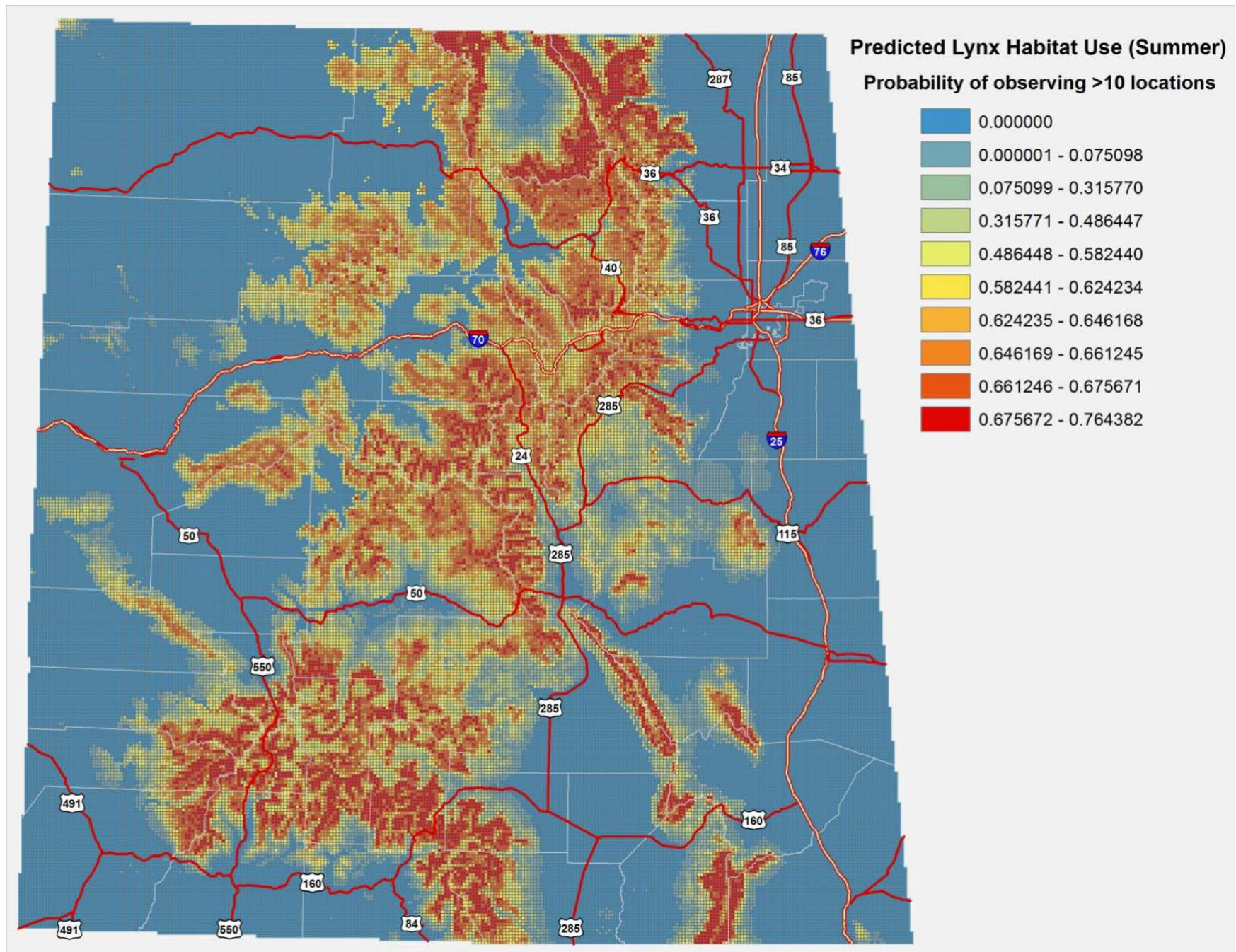
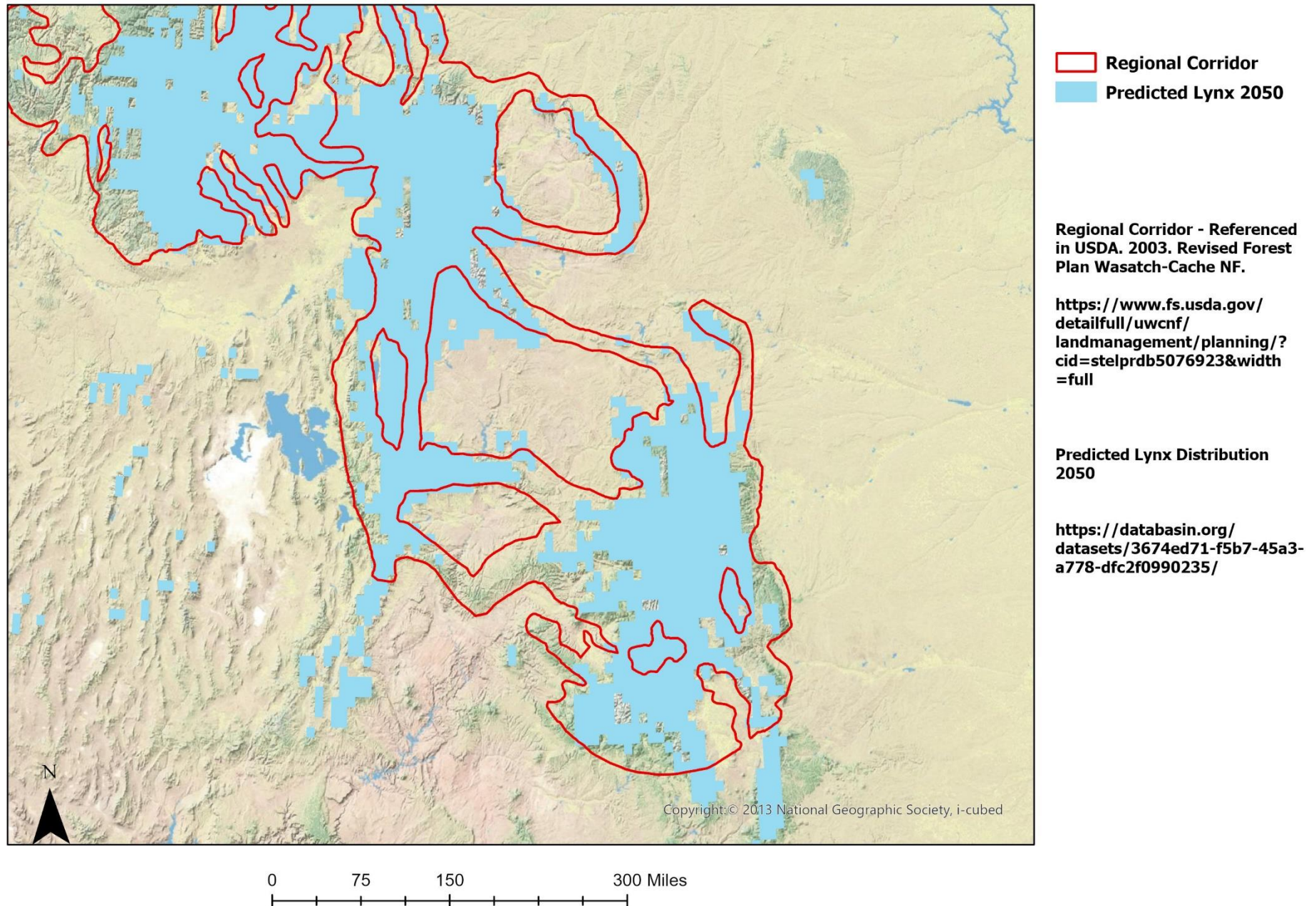


Figure 10. Predicted summer use by Canada lynx in western Colorado. (From Ivan et al Figure 3)

Figure 11. **Regionally Significant Wildlife Corridor**
Predicted Lynx Distribution in 2050s Using Climate Model



PROVIDING FOR CANADA LYNX IN IDAHO, UTAH, WYOMING, AND COLORADO

These four states are those historically used or occupied by Canada lynx that do not border the Canadian Provinces (excluding northern Idaho) and the forested habitats where the larger populations of lynx have survived. Ensuring connectivity and habitat protection in these southern core and corridor areas that are disconnected from habitats in Canada is critical to maintain the isolated meta-populations in the south. The Colorado reintroductions show lynx can survive in this southern portion of the DPS, yet research and monitoring are lacking for these areas. The Science Report (SR p338) reported only seven studies with two of those being for bobcats. In the following, we just touch on a few parameters to place some degree of definition on lynx habitat, prey, and demographics for context to illustrate some of the quantitative parameters that need to be incorporated into agency requirements.

The Science Report Chapter 13 reviewed the ecology of lynx in these southern areas and compared them to the taiga in Canada. In both regions, lynx occurred where snowshoe hares were abundant. In the southern region, lynx were known to make exploratory movements prior to dispersal. The Colorado tracking data clearly illustrate these exploratory movements. Habitats in the southern region are patchier and lynx make more use of alternate prey. For instance, lynx scats collected in north-central Washington contained 79% snowshoe hare and 24% red squirrel. (SR p376 - 377). Snow tracking studies in the southern Canadian Rocky Mountains found prey consisted of 52% snowshoe hare, 30% red squirrels, and the rest were flying squirrels, martens, voles, and grouse plus unknowns. Snowshoe hare densities were estimated to range from 0.01 - 0.47 hares/ha. (SR p377). *“In southern boreal forests, limited data suggest that because snowshoe hares typically occur at low densities (Chapter 7), alternative prey may always be important components of lynx diets, especially in the western mountains.”* (SR p378).

We previously referenced the association between lynx locations and habitat. The predominant association was with Rocky Mountain Conifer in these western interior states. Lynx use a variety of habitats and elevations between summer and winter. Generally, they use higher elevations in more southerly locations and between summer and winter. Most conifer types are included in areas used by lynx and can include Douglas-fir, western larch, lodgepole pine, subalpine fir, whitebark pine, and Engelmann spruce. Occasionally, they will occur in non-forested areas such as shrub-steppe. (SR p379). Snow tracking in Washington found that lynx traveled around meadows and used thinned stands that contained several hundred trees per ha. (SR p381).

Home ranges in these southern areas are larger than in the north. The average for males is 151 km² and females, 72 km². In west-central Wyoming they were smaller at 90 and 66 km². (SR p383 – 384). In Washington, home ranges were bounded by rivers, ridges, and major highways. (SR p385). Exploratory movements in Montana ranged from 17 to 38 km. (SR p386). Dispersal can take place over larger distances of several hundred km. (SR p386 -387). In the north-central Washington study, 8 kittens were documented in a population of 23 lynx during the three-year study. Estimates of total lynx density for the 1,161 km² area was 2.4 lynx/100 km². (SR p387). Comparisons are made to northern populations during the lows in hare cycles, indicating similar demographics occur in the southern populations compared to these lows. (SR p389).

Because lynx are highly dependent on snowshoe hares, we have looked for information on hare density in these southern states. Chapter 11 of the Science Report summarizes densities in Montana as well as the Wyoming Range. (SR p346). These ranged from 0.6/ha to 1.4/ha. Two studies cited from Utah gave densities ranging from lows in aspen with dense understory of 0.22/ha to 2.7/ha in spruce-fir habitat. Intermediate numbers occurred in Douglas-fir (0.57/ha and subalpine fir of 0.99/ha). These were estimated from pellet counts while the higher numbers from spruce-fir were from live trapping. Pellet plots in Colorado ranged from 0.26/ha in aspen, to 0.46 in Engelmann spruce. (p185).

These southern hare densities compare to population lows in areas of Canada with persistent lynx populations. For example, from the Science Report (SR p362), *“Hare densities in the southwest Yukon declined from 8.0 to 10.7/ha to 0.2 to 0.5/ha during one cycle (Ward and Krebs 1985), and another population fell from 7.5/ha to 1.3/ha during the next cycle (Slough and Mowat 1996). Similarly, a population in the Northwest Territories fell from 7 to 9/ha to 0.4 to 1.0/ha during the early 1990s (Poole 1994), and a northern Alberta population declined drastically from about 17/ha to 0.34/ha during the early 1970s (Brand et al. 1976).”* Apparently hare densities in these studies were sufficient to support lynx populations in the DPS, but the absence of recent hare studies leaves open the question as to the status and extent of current hare densities in the southern portion of the DPS. Whether snowshoe hares exist in sufficient numbers in these southern regions needs to be determined along with factors (deforestation, livestock grazing, predation, etc.) driving their population density.

A recent study looked at forest characteristics centered around lynx reproductive success.⁴⁸ Concerns were habitat fragmentation and loss of connectivity. In particular, the natural patchiness of lynx habitat at the southern extent of its range is *“subject to loss and fragmentation by some forest management practices (i.e. regeneration harvests, pre-commercial and commercial thins, prescribed burns), wildfires and insect infestations, and climate change... ”* (p2). There are data gaps on the abundance and arrangement of lynx habitat and how these relate to reproductive success. The research was conducted in the Swan, Mission, and Purcell Mountains in Montana and included low to mid-elevation ponderosa pine and Douglas-fir to high-elevation subalpine fir, spruce and lodgepole pine. (p3 - 4). Thirty - six female lynx were radio collared and monitored and produced 36 litters with an average of 2.46 kittens during the 14 year period 1998 – 2012. (p12 – 13). Mature forest was the dominant structure in core areas and home ranges with 49 and 50% of core and home ranges with young regenerating forest averaging 13 and 11% of core and home ranges, respectively. (p13). When the proportion of young regenerating forest reached 10 – 15% of the core area, the probability of producing a litter declines. (p14). Females with larger surviving litters *“had less fragmented home ranges, lower moisture variance, young regenerating forest patches with low perimeter-area ratio, and lower percent composition of old regenerating forest than home ranges of females with smaller surviving litter sizes”*. (p15). *“...connectivity of mature forest, percent composition of young regenerating forest and young regenerating forest patches with low perimeter-area ratio, and adjacency of mature to young regenerating forest types were the most important predictors for overall lynx reproductive success in our study areas.”* (p16).

⁴⁸Kosterman, Megan K., "Correlates of Canada Lynx Reproductive Success in Northwestern Montana" (2014). Theses, Dissertations, Professional Papers. Paper 4363.

The Northern Rockies Lynx Management Direction Record of Decision (NRLMD ROD) and its standards and guidelines provided no adequate standard for levels of mature forest habitat within LAUs and provided nothing for habitat not designated in LAUs. While it states that habitat connectivity will be maintained, there is no definition of what constitutes connected habitat, even though this can be defined by current science. The NRLMD ROD does not clearly define what qualifies as unsuitable lynx habitat, which is limited to no more than 30% of an LAU (VEG S1) with no more than 15% unsuitable habitat created in 10 years (VEG S2). The glossary at 12 also defines lynx habitat in an unsuitable condition as the stand initiation structural stage but notes that unsuitable habitat can also be created by shelterwood cuts and commercial thinning depending on the resulting stand composition and structure. The ROD at 9 defines lynx habitat in an unsuitable condition as those forests in a stand initiation structural stage that are too short to provide winter snowshoe hare habitat; these conditions are created by stand-replacing wildfires, prescribed burns that remove all vegetation, or regeneration timber harvest. The ROD at 10 states that the definition of VEG S2 was changed to clarify that it only applies to timber management practices that regenerate a forest, as clear-cut, seed tree, shelterwood, and group selection. The VEG S2 standard applies to all timber management projects that regenerate forests, including clear-cuts, seed tree, shelterwood and groups selective cuts. The NRLMD does not ensure persistence of lynx, since there are no restrictions on the amount of an LAU that can be converted to habitats that are avoided by lynx, and to habitats that reduce habitat connectivity via mature forests.

The 30% clear-cut standard for lynx habitat in the NRLMD is based on habitat recommendations published in 1989, while other key recommendations were ignored. Although these recommendations noted that monitoring was required to determine if they would be effective, we found no evidence such monitoring was ever done before they were partially included in the LCAS and the NRLMD. Currently, the best available science demonstrates that the 33% opening level allowed by these recommendations are invalid, while the unused recommendations of maintaining a high level of forest cover of 69% has been validated. The 1989 Brittell recommendations for lynx habitat defined a level of habitat connectivity for lynx, which included denning, travel, and stalking habitat as 66% of each square mile of lynx habitat, not an entire LAU of many square miles with no guidance as to where within that LAU habitat should be maintained.⁴⁹

While clear-cuts and sparse forests may receive some lynx use, their suitability for lynx is significantly reduced for a significant amount of time. It has been shown not only that those clear-cuts and sparse forest are strongly avoided by lynx but that restoration of lynx habitat use in these logging areas to 50% of previous use takes 20 years in forest thinnings, and 34-40 years for selection cuts and clear-cuts. Also, all logging treatments are avoided by lynx for at least 10 years.⁵⁰ Predictors for lynx reproductive success within occupied female home ranges were the connectivity of mature forest, intermediate (10 - 15%) amounts of young regenerating forest, young regenerating forest patches with low perimeter - area ratios, and the adjacency of mature

⁴⁹ Brittell, J.D., R.J. Poelker, S.J. Sweeney, G.M. Koehler. 1989. Native cats of Washington. Washington Department of Wildlife, Olympia.

⁵⁰ Holbrook, J.D., Squires, J.R., Bollenbacher, B., Graham, R., Olson, L.E., Hanvey, G., Jackson, S., Lawrence, R.L., 2018. Spatio-temporal responses of Canada lynx to silvicultural treatments within the Northern Rockies, U.S. *For. Ecol. Manage.* 422, 114–124.

forest to young regenerating types. Female lynx home ranges with greater than 50% mature forest and 10 - 15% young regenerating forest appear to be the optimum.⁵¹

More recent work has characterized habitat quality of Canada lynx at their "range periphery".

*Our results indicated that the probability of a female producing kittens was most associated with the connectivity of mature, multistoried forests (composed of mostly spruce-fir). However, the variation among female lynx accounted for ≈62% of the total variation explained in litter production, suggesting substantial individual-level variation. Thus, managers can contribute to increased reproductive success of female Canada lynx by facilitating the development of mature forests but measuring that success will be difficult given the individual variation. In core areas of high-quality females (i.e., produced kittens frequently), mature forest was 17% more abundant (i.e., ≈60% of the total core area), more connected, less clumpy, and exhibited 2.25-times larger patch sizes than the core areas of low-quality females. At the home-range extent, patterns were less pronounced while the abundance of mature forests remained high (≈50%) for high quality females. Additionally, we demonstrated that the relative density of snowshoe hares was ≥2.8 times higher in advanced regenerating forests compared to all other structural classes, including mature forest. Advanced regenerating forests accounted for ≈18–19% of the core area and home range of high-quality female lynx. Combined, our results suggest that a high-quality mosaic for female Canada lynx contains ≈50–60% mature forest and ≈18–19% advanced regenerating forest. Furthermore, we used Forest Inventory and Analysis data to characterize the approximate age distribution of advanced regeneration and mature forest, which was relevant for rotation schedules of forest silviculture. Results indicated that advanced regeneration was ≈20 to 80 years old while mature forest was ≈50 to ≥200 years old.*⁵²

In addition, lynx spend a significant amount of time at the interface between mature and advanced regeneration forest. This is likely because advanced regeneration forest provides the most hares, but mature forest habitat makes these hares more accessible. This indicates that advanced regeneration forest subsidizes the occurrence of hares in adjacent mature forest where they are more accessible to lynx.⁵³

What is lacking today is the inclusion of current knowledge of what is known about lynx, snowshoe hare, red squirrels and their habitats into quantitative criteria that define these

⁵¹ Kosterman, M.K. 2014. Correlates of Canada Lynx Reproductive Success in Northwestern Montana. Graduate Student Theses, Dissertations, & Professional Papers. 4363. <https://scholarworks.umt.edu/etd/4363> Accessed on January 22, 2023.

⁵² Holbrook, J.D., Squires, J. R., Bollenbacher, B., Graham, R. O., Lucretia E., Hanvey, G., J. S., Lawrence, R.L., Savage, S. L. 2019. Management of forests and forest carnivores: Relating landscape mosaics to habitat quality of Canada lynx at their range periphery. *Forest Ecology and Management*. 437: 411-425. <https://doi.org/10.1016/j.foreco.2019.01.011> Accessed on January 22, 2023.

⁵³ Holbrook, J.D., Squires, J.S., Olson, L.E., Lawrence, R.L., Savage, S., 2017. Multi-scale habitat relationships of snowshoe hares (*Lepus americanus*) in the mixed conifer landscape of the Northern Rockies, USA: cross-scale effects of horizontal cover with implications for forest management. *Ecol. Evol.* 7, 125–144.

habitats and their overlap in the southern DPS. The NRLMD and current Forest Plans are badly out of date and based on the omission of critical information. This is especially true in those areas not bordering the Canadian populations. While the Science Report has pointed out study and research needs, there has been a lack of definitive work in the southern-most states, particularly in SE Idaho, NE Utah, Colorado and the linkages or connections between these areas. Since these areas are heavily used by livestock as opposed to the situation further north, the effects of livestock on habitats important for cover and forage for snowshoe hares, and cover for lynx need to be determined. Also, the effects of over-snow travel, cross-country skiing, summer recreation and road density must be studied because the earlier data in the Science Report and the conclusions represented in the NRLMD, both LCAS, the 2017 SSA and the Remand Notice were based on earlier times in the absence of the levels of activity currently flooding throughout the western National Forests and BLM lands. We have regularly asked for data and maps of old growth forest residuals in these forests without success, apparently because these have not been developed. We have regularly asked for identification of the status of mined land reclamation, forest and vegetation manipulations, mapping of non-system roads and trails, temporary roads on National Forests without result.

It is in this vacuum of current data and information that the FWS must evaluate the status of Canada lynx in the DPS. Continuing to cast doubt on the historical presence of lynx in these southern areas cannot be used as a mechanism to reduce the area of potential lynx habitat, the habitat connections needed, or regulatory requirements. Instead, the current existing database and science must be applied to map and describe these areas of historical observations (not just verified records), their current habitat status and fragmentation by human uses as compared to what is known about the habitat needs of lynx. Studies and data collection need to happen to answer the questions and fill the data needs.

The criteria for identifying and managing LAUs needs to change to more specific, quantitative limitations on timber harvest, road density, mining, recreation use, perhaps using blocks of contiguous habitat and connections. Currently “unoccupied” or “peripheral” areas that had historical lynx observations must have potential lynx habitat mapped into LAUs, watershed areas, or blocks of habitat with definitive and quantitative criteria and standards reflecting what is known about lynx habitat. The parameters defining lynx habitat in places such as those studies we have cited in the contiguous states could be used to define current standards. Forest Plans and BLM Resource Management Plans must be amended with new standards to correct the current lack of regulatory requirements we have identified in our example of the Caribou NF. Corridors must be mapped and defined following the examples cited herein in which models have been used to identify lynx habitat, corridors, and connections. Those should have the same standards as occupied habitat.

Until these things are done, the Status Assessment for lynx must be that they are not only “threatened” in the western states DPS, but “endangered” and a recovery plan put in place to retain lynx in its historical habitat.

**APPENDIX 1 -LIVESTOCK GRAZING STUDIES IN LINKAGE AND PERIPHERAL AREAS
IN SE IDAHO AND NE UTAH BY DR. JOHN CARTER & ASSOCIATES**

Since the late 1980s we have been engaged in collecting data on habitat in NE Utah and SE Idaho, particularly focused on the Bear River Range and Uinta Mountains. These are areas located in the linkage and peripheral habitat described for lynx in the CNF RFP and WCNF RFP. The 2013 LCAS (p68) stated that, “*Federal agencies have amended or revised land management plans across much of the range of the lynx to provide direction to conserve lynx and lynx habitat. Thus, the impacts of anthropogenic influences have been substantially reduced.*” The presumption is that putting it in a forest plan means it will be so. The data and observations we have made over the past four decades and even earlier as we have backpacked and explored the national forests in Idaho, Utah, and Wyoming refute that presumption. Following are descriptions of some of our reports and data showing that livestock grazing management in this linkage habitat is abysmal. Figure A1 shows the National Forests occurring in the high elevation Regionally Significant Wildlife Corridor, which are where much of this data and observations have occurred. This corresponds to the linkage habitat and peripheral habitat.

We completed a survey in the Caribou NF in 2001 with a report (Report) issued in 2002.¹ This study showed tremendous degradation of plant communities and riparian areas. Monitoring in this and other areas in the Caribou and Targhee Zones and in NE Utah in the Uinta Wasatch Cache NF and Ashley NF since that time has shown no progress. When we measure use by livestock it is typically higher than sustainable levels and livestock are the base of the pyramid of damaging actions the Forest Service allows to continue. The photos in Figures A2-A6 below were taken during the 2001 survey and are from the Report. They show examples of the (a) impact of livestock grazing and water developments on vegetation, soils and aspen understory and recruitment, (b) conifer understory, and (c) riparian areas. Photo links are provided in the referenced Report for all locations surveyed.

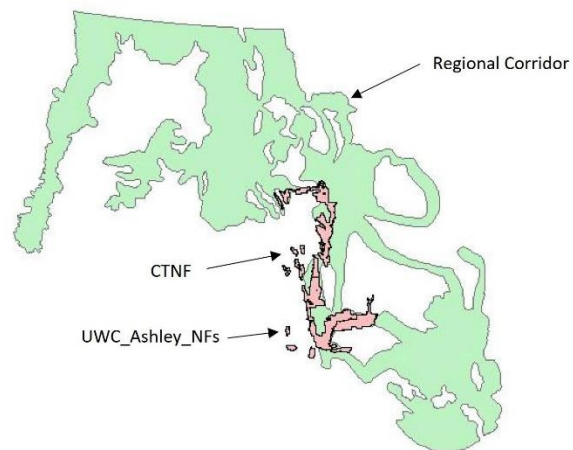


Figure A1. Forests in Which Livestock Grazing Studies Occurred

In preparing this survey, we relied on Forest Service monitoring reports, the Draft EIS for the Revised Caribou Forest Plan² and literature characterizing livestock impacts on upland and riparian habitats. In the late 1990's, the Forest Service had prepared Regional and Sub-Regional

¹ Carter, J., Chard, B. and J. Chard. 2002. Assessment of Habitat Conditions Bear River Range Caribou National Forest, Idaho. <https://app.box.com/shared/5q2hazcnfu>

² USDA. 2001. Draft Environmental Impact Statement for the Caribou National Forest Revised Forest Plan Draft Revised Forest Plan. Caribou-Targhee National Forest.

Reports characterizing departures from Proper Functioning Condition (PFC) for aspen, conifer, tall forb, sagebrush/grasslands, riparian, and wetland areas. They found livestock grazing and past timber harvest in conifer forest were fundamental issues leading to loss of PFC in these communities.^{3 4} Our Report (p18) described the structure and compositional characteristics of these habitats needed for PFC.

We assessed 86 locations for PFC in the Bear River Range including uplands, riparian areas, open basins/meadows, aspen and conifer stands. These were within one mile of water sources in areas considered "capable" for livestock based on slope and distance to water. Mapping analysis predetermined the locations at which we surveyed each habitat type present. We compared observable conditions to the Caribou RFP Draft EIS PFC guidelines. Table A1 below is reproduced from the Report and shows the number of locations of each habitat type assessed. A total of 310 individual habitats were assessed. As shown, a small percentage met the Forest Service guidelines for PFC, most did not.



Figure A2. Sheep watering and bedding area showing complete loss of understory, loss of aspen recruitment and high-lined aspen. The soil is completely exposed. Sheep are bedded in a different location each day throughout the season, leading to widespread damage that is not documented by the Forest Service.

³ USDA. 1996. Intermountain Regional Assessment: Properly Functioning Condition. USDA Forest Service, Region IV, Ogden, Utah.

⁴ USDA. 1998b. Draft Sub-regional Assessment of Properly Functioning Condition for Areas Encompassing the National Forests of Northern Utah. USDA Forest Service, Region IV, Ogden, Utah



Figure A3. Aspen stand in valley bottom. Cattle have denuded the area, browsed suckers and essentially created a single aged stand that will die out unless livestock are excluded and recruitment allowed to occur. No understory cover or herbaceous vegetation is left.



Figure A4. Grazed conifer stand with little herbaceous vegetation present



Figure A5. Grazed riparian area with barren banks, little vegetation left in riparian zone



Figure A6. Sediment-laden stream substrate from trampled and eroding banks, adjacent roads

Table A1. Results of Bear River Range PFC Assessments

Habitat type	Number of locations	Number in PFC	Percent in PFC
Aspen forest	71	17	24%
Conifer forest	68	14	21%
Forb meadow	44	2	4.5%
Sage – grass	73	8	11%
Riparian	54	12	22%

We measured ground and canopy cover along transects at 55 locations in sagebrush-grassland and tall forb habitats. Tables A2 and A3 below are reproduced from that report. Bare soil averages above 50% show ground cover is well below potential. These averages included some ungrazed exclosures, which if omitted from the analysis, would have resulted in even lower soil cover values. The Sub-Regional Assessment by the Forest Service indicated ground cover potential ranges between 80 - 95%. In our surveys of un-grazed areas in the Bear River Range and on Kiesha's Preserve, potential ground cover is near 100% in all habitats. See our Kiesha's Preserve [website](#) for photographs of these ungrazed conditions.

Table A2. Cover Data for 45 Sagebrush Locations

Cover type	Range	Average	Standard Deviation
Bare Ground	86.2 – 10.7	51.6	19.0
Litter	68.2 – 2.0	31.5	15.2
Grass	23.2 – 0.3	5.1	5.3
Forb	14.7 – 0.5	4.5	3.4
Shrub	16.7 – 0	4.7	3.6
Rock	11.9 – 0	2.2	2.8
Crust/moss	10.4 – 0	0.4	1.6
Shrub Canopy	43.0 - 0	12.4	9.0

Table A3. Cover Data for 10 Locations in Tall Forb

Cover type	Range	Average	Standard Deviation
Bare Ground	78.8 – 5.5	54.1	22.6
Litter	55.0 – 4.9	24.2	15.5
Grass	16.5 – 1.0	6.0	5.6
Forb	21.1 – 2.8	11.6	5.2
Shrub	10.3 - 0	3.0	3.4
Rock	3.6 - 0	0.8	1.2
Crust/moss	1.9 - 0	0.3	0.6

Data collected in this 2001 study as well as other surveys we have conducted in the area demonstrate that all Forest habitats grazed by livestock are well below potential. Compared to the Draft Caribou RFP EIS and other PFC manuals for Riparian Areas the best we could say is they are functioning at risk with many in non-functioning condition

We have measured utilization by livestock in numerous locations in the Bear River Range and adjacent public lands such as BLM. Compared to Forest Plan or BLM land use plan standards allowing 30 – 50% use in upland and riparian areas, universally we find utilization in riparian areas and meadows near 100% and in uplands 70 – 80%. A summary of studies is listed:

1. Unpublished data for Bear River Range riparian areas (12) using paired plots found utilization rates averaging 81%.⁵

⁵ Carter, J. 2009. Unpublished utilization data for Riparian Areas in the Bear River Range.

2. 2011 Monitoring Report 1st Hollows and Paris Canyon Allotments.⁶ I found utilization ranges from 75 – 92% in meadows, riparian area use was 63 and 82.6% at two locations monitored, upland low sagebrush sites ranged from 49 to 69%, and upland big sagebrush sites ranged from 85 to 88%.
3. Multiyear study in the Bear River Range in northern Utah looked at livestock grazing effects on plant production, soil nitrogen and carbon.⁷ That study documented losses in plant cover, plant production, soil carbon and nitrogen in areas grazed by livestock compared to long term ungrazed areas.
4. Summary of utilization data for riparian areas on the North Rich Allotment in the Bear River Range.⁸ Over a four-year period these remained nearly constant at 83 – 93%.
5. A multiyear study on a BLM managed allotment (Duck Creek) in the lower elevation foothills adjacent to the Bear River Range in Utah. We evaluated government monitoring by collecting data on grazed and ungrazed paired plots and critiqued the government monitoring effort. We found the BLM understated utilization and native plant production was greatly reduced by decades of improper management.⁹
6. A paper illustrating upland and riparian outcomes from BLM management of the Duck Creek allotment showed the installation of upland water and a deferred rotation grazing system resulted in increased use on the riparian greenline, bank alteration by trampling remained at 80%, riparian utilization remained near 100%, and upland utilization increased to near 80%.¹⁰
7. A report summarizing multiple years of data collection in the High Uintas Wilderness.¹¹ This study documented depleted alpine ground cover in grazed areas compared to those that had been excluded from sheep grazing for decades. Grazed areas had over 50% bare soil compared to 0.2% in long term rested areas. Streambanks were scoured by high runoff events due to loss of stabilizing vegetation in the watershed and stream banks. Most of the soils in the allotment are considered as high to extremely high in erosion potential, resulting in loss of the productive upper horizon.
8. A paper on livestock grazing impacts in the High Uintas Wilderness which is in designated LAUs and Peripheral habitat.¹² While all lands in this 160,000 acre set of domestic sheep allotments are grazed by domestic sheep, we determined that only a small fraction of the area

⁶ Carter, J. 2012. 2011 Monitoring Report 1st Hollows and Paris Canyon Allotments. Report prepared for Western Watersheds Project and Yellowstone to Uintas Connection. Dated March 1, 2012.

⁷ Carter, J., Chard, B., and Chard, J. 2011. Moderating livestock grazing effects on plant productivity, nitrogen and carbon storage. In Monaco, T.A. et al. comps. 2011. Proceedings – Threats to Shrubland Ecosystem Integrity; 2010 May 18-20; Logan, UT. Natural Resources and Environmental Issues, Volume XVII. S.J. and Jessie E. Quinney Natural Resources Research Library, Logan Utah, USA.

⁸ Carter, J. 2009. Allotment Summary North Rich Allotment Riparian Areas.

⁹ Catlin, J., Carter, J., and Jones, A. 2011. Range management in the face of climate change. In Monaco, T.A. et al. comps. 2011. Proceedings – Threats to Shrubland Ecosystem Integrity; 2010 May 18-20; Logan, UT. Natural Resources and Environmental Issues, Volume XVII. S.J. and Jessie E. Quinney Natural Resources Research Library, Logan Utah, USA.

¹⁰ Carter, J., Catlin, J., Hurwitz, N., Jones, A., and Ratner, J. 2017. Upland water and deferred rotation effects on cattle use in riparian and upland areas. *Rangelands* 39(4):112-118.

¹¹ Carter, J. 2006. Watershed Conditions Uinta's Wilderness, Utah. Report for Western Watersheds Project. <https://app.box.com/s/944957604b8618539585> Accessed on January 21, 2023.

¹² Carter, J., Vasquez, E. and Jones, A. (2020) Spatial Analysis of Livestock Grazing and Forest Service Management in the High Uintas Wilderness, Utah. *Journal of Geographic Information System*, 12, 45-69. <https://doi.org/10.4236/jgis.2020.122003>

(6%) is capable for grazing when we applied the Forest Service criteria for determining capable acres. The current forage on the allotments provides only 10% of the demand. The result of this is accelerated erosion, sedimentation of lakes and streams, depletion of the native plant community to below its potential. Based on the two scenarios we evaluated, the stocking rate would need to be reduced between 90 – 97%.

There were other surveys and reports with data provided to the Forest Service and BLM. No management changes have resulted from this input now decades after we first began monitoring and submitting data to the agencies. The habitats are depleted of the forage and horizontal cover needed by snowshoe hares and other wildlife. The Desired Future Conditions and Standards provided in the Forest Plans for these places have resulted in no positive change. Yet, the FWS and Forest Service claim that provisions in Forest Plans protect lynx habitat.

ATTACHMENT I

January 29, 2024

CanadaLynxRPCComments@fws.gov

Re: Comments on the Draft Recovery Plan (DRP) for the Contiguous United States Distinct Population Segment of Canada lynx (*Lynx canadensis*)

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These comments are submitted on behalf of Yellowstone to Uintas Connection (Y2U), Alliance for the Wild Rockies, Conservation Congress, Council on Wildlife and Fish, Gallatin Wildlife Association, Native Ecosystems Council, Sage Steppe Wild, and Swan View Coalition. These organizations are non-profit entities that engage on public land issues affecting wildlife.

We incorporate herein the comments submitted on January 18, 2024, by Ms. Sara Johnson of NEC on behalf of several organizations, in particular we emphasize the inadequacies of regulatory mechanisms and no measurable habitat standards, lack of monitoring, failure to include significant habitats formerly identified as lynx habitat and other points and questions Ms. Johnson delineated.

Y2U Comments (dated 1/25/2023)

We also incorporate and attach herein the comments and analysis submitted to the Fish and Wildlife Service dated January 25, 2023 by Y2U (Y2UComments). These comments reviewed much of the science leading up to listing of Canada lynx and critiqued the regulatory environment, dismissal of many human activities impacting lynx and lynx habitat, providing no criteria for maintaining habitat or linkages, and no criteria for “unoccupied” areas which we argue were formerly occupied. The comments focused on the Greater Yellowstone Ecosystem (GYE) and the linkage corridor to the Uinta Mountains and southern Rockies. Below we summarize some points from those Y2UComments to point out some of our major issues. They provide a great deal of detail that needs to be revisited for this Recovery Plan effort. We found no acknowledgement of the issues we raised in the current SSA Appendix and DRP. References cited in this summary are found in the Y2UComments.

1. Our cover letter provided an overview of our work on habitat fragmentation in the Caribou Targhee NF, particularly in SE Idaho, which is part of the GYE. Each Forest Service project we have addressed deflects around lynx issues while acknowledging this is a lynx linkage area. By doing this an actual analysis of the current condition of lynx habitat and linkage is dismissed. This demonstrates that there are no regulatory protections for lynx in this part of the GYE.
2. We reviewed and summarized the principal regulatory documents such as the Lynx BA, LCAS, NRLMD, CA, 2017 SSA, and 2013 LCAS. These summarized inadequacies in current land use plans, which do not provide quantitative criteria or standards to address risk factors such as timber harvest, trapping, livestock grazing, roads and winter recreation, and

barriers such as highways and private land developments. Yet, the Science Report had indicated that these were all issues. The NRLMD Figure 1-1 mapped occupied, core, secondary, peripheral, unoccupied and linkage habitats. These never show up in agency proposals we address over millions of acres in the GYE.

3. We pointed out the failure in the NRLMD to provide well defined criteria for protecting habitat and a lack of adequate standards. The 2013 LCAS, in spite of the prior research indicating various human activities were detrimental to lynx habitat, dismissed factors such as forest roads, mining, grazing because “we have no information to indicate they pose threats”. Similarly, it eliminated packed snow trails due to lack of evidence. Timber harvest was qualified as beneficial, benign, or detrimental depending on methods of harvest. The NRLMD only applied to occupied habitat, which eliminates a large area of former lynx habitat from any regulation.
4. We pointed out that winter recreation has exploded in the years since the Science Report and National Lynx Survey, with snowmobiles accessing most of the land within National Forests in the GYE. This has happened with increased summer recreation and ohv use. The Olson et al 2018 paper acknowledged that lynx avoid areas of ski resort development, spend less time in areas of motorized recreation. When the current level of recreation is considered, huge areas of lynx habitat are involved. However, no analysis of this has been forthcoming. Instead, it is dismissed due to lack of evidence when the evidence is there if one looks.
5. The 2017 SSA acknowledged there remains uncertainty about the efficacy of the regulatory framework. Yet, we are not seeing monitoring that evaluates those regulations and their outcome on the ground for lynx habitat. Our correspondence with the Caribou Targhee NF Supervisor about our concerns over the lack of protections and analysis led to their statement that the Olson et al 2021 model (Olson Model) was now their basis for the best available information. That model indicated a large amount of high to moderately suitable lynx habitat in the CTNF.
6. Based on the Science Report, we disputed the lynx immigration hypothesis based on large population peaks in Canada that were not reflected in records for the US.
7. The 2013 LCAS provided a map of Core, Provisional Core, Secondary, and Peripheral Areas but did not show linkages connecting southern populations. The 2013 LCAS listed incidental trapping, recreation, mineral and energy development with their roads, powerlines and pipelines, illegal shooting, livestock grazing as secondary anthropogenic effects. These include livestock competition with snowshoe hares for forbs, grasses, and shrubs. The 2013 LCAS indicated these factors combined with low lynx densities and small populations in the US “increase their susceptibility to local extirpation”. Yet, these effects are dismissed out of hand.
8. We challenged the idea that only verified observations are used for determinations of lynx historical occupancy when there are hundreds to thousands of reliable observations for western states going back to the mid-1800s. Our Table 1 of the comments summarized

those. We also summarized some of the observations in SE Idaho and NE Utah going back to the 1940s showing evidence there were resident populations in these areas. These are not acknowledged.

9. Provisions of the ESA and Forest Service Manual were addressed and used to illustrate how the CTNF has not followed those directives to maintain viable populations, provide for recovery, or identify measures to prevent adverse modification or destruction of habitat.
10. We then provided a narrative of the Regionally Significant Wildlife Corridor (Corridor) that connects the GYE to the Uinta Mountains and Southern Rockies. Maps illustrating this Corridor and its overlay with lynx linkage and modeled identification of core and corridor areas for lynx were provided. The Uinta Mountains were identified as a “hot spot” for radio collared lynx released in Colorado. Kuchler vegetation was mapped and overlaid with the Corridor showing a nearly perfect match. Similarly, topography mapped with the Corridor showed it included the higher elevations. The Bates and Jones modeling of the Corridor was summarized. It was a similar approach to Ivan et al 2023, but Ivan used location data from collared lynx and predicted distribution based on elevation, road density, slope, distance to forest patches, vegetation types and climatic factors.
11. We then summarized some recent work such as Kosterman 2014 which analyzed forest characteristics within female home ranges. The study illustrated that more successful females had less fragmented home ranges while connectivity between forest patches was most important. We pointed out that work such as the 1989 Britell recommendations that included denning, travel, and stalking habitats as 66% of each square mile of lynx habitat were not used in the NRLMD which lacked defined characteristics for many elements of lynx habitat and connectivity. Other works such as Holbrook and Squires gave well defined habitat characteristics. Current regulatory guidance is not taking these more quantitative measures into account.
12. A summary of our experience with the effects of livestock grazing on habitat function in the SE Idaho area in which Olson et al 2021 found high and moderate suitability lynx habitat demonstrated the severe habitat alteration and degradation occurring there. This is not considered across the range of lynx and snowshoe hare.

Draft Recovery Plan

In these comments, we are focused on the GYE habitat and lack of connectivity. The overall impression of the DRP and SSA Appendix is one of failing to provide adequate habitat criteria for all classes of habitat, reliance on a model to define suitability without analysis of the factors relating to habitat structure and connectivity that Kosterman, Holbrook, and others have delineated. We also dispute the characterization of the DRP’s Greater Yellowstone Area (GYA) as shown for SSA Unit 5.

Boreal Forest and the DRP GYA

One issue that has been troublesome for us is the seeming reliance on lynx being constrained to boreal forests. A recent paper has analyzed the extent of the North American boreal zone.¹ This is shown in Figure 1.² Note that it occurs exclusively in Canada with the Hemiboreal Zone

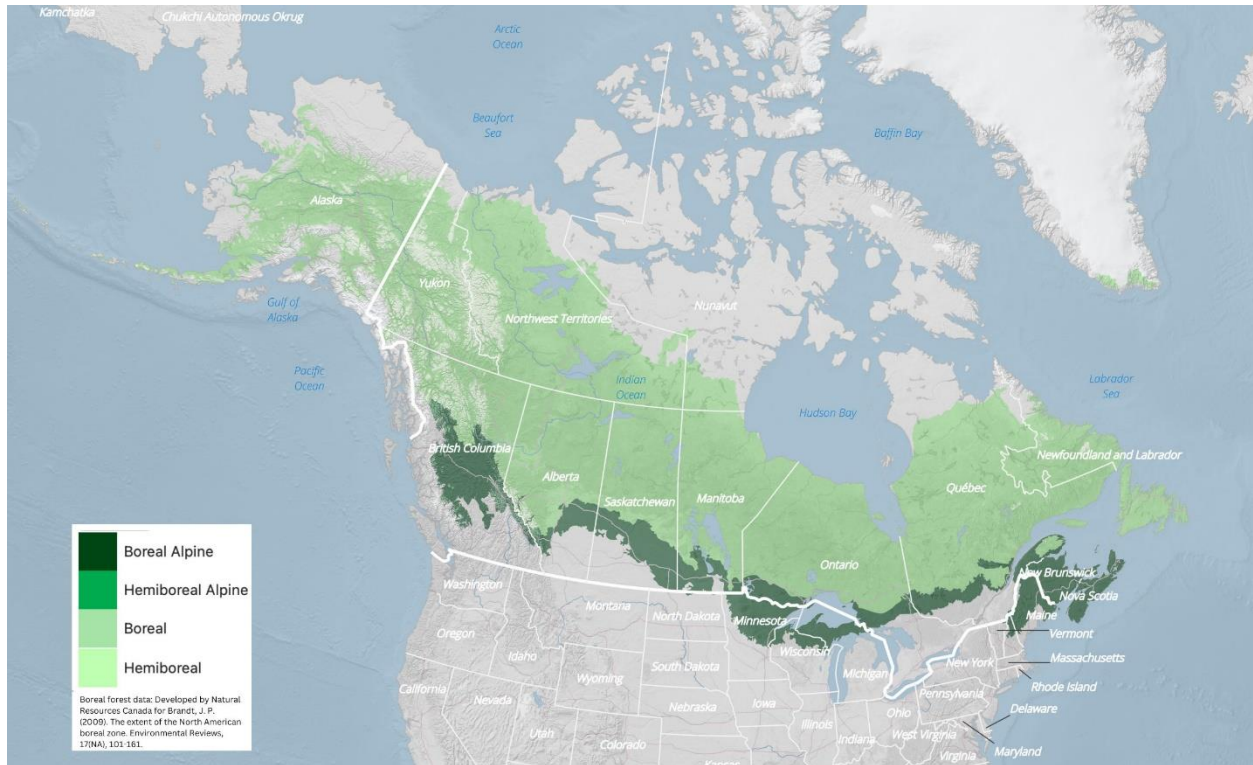


Figure 1. Map of the North American boreal zone

entering the very northern states of Maine, Michigan, and Minnesota. It does not occur in the western US. As we demonstrated in Y2UComment (see Table 1 therein), there have been thousands of verified and reliable lynx observations in Colorado, Idaho, Montana, Utah, Washington, and Wyoming beginning in the mid-1800s. These did not occur in boreal forest, but in the Kuchler forest types that would include Douglas fir, Englemann spruce, lodgepole pine, mixed conifer, whitebark pine, limber pine, and other associated types that are intermixed therein. The characteristics of these forest types constitute what should be used for habitat evaluations for the GYA. The GYA must be remapped to include the entire GYE.

¹ Brandt, J.P. 2009. The extent of the North American boreal zone. Environ. Rev. 17: 101–161 (2009) doi:10.1139/A09-004 Published by Natural Resources Canada Research Press.

² Geography Realm. <https://www.geographyrealm.com/boreal-forests-north-america-shrinking/> Accessed January 25, 2024.

We obtained GIS data for the Draft Recovery Plan Focal Units and Focal Areas for which we thank the FWS. Figures 2 – 4 illustrate these in the context of the GYE and GYA. The SSA Appendix Table 2 gives the size of the Focal Units and Focal Areas. The GYA Focal Unit SSA 5 is 30,518 km² or 7,537,946 acres. The GYA SSA Unit 5 Focal Area is 2,902 km² or 716,794 acres. The Greater Yellowstone Ecosystem itself comprises about 18,000,000 acres and includes several National Forests, plus Grand Teton and Yellowstone National Parks in addition to BLM and State Lands, and National Wildlife Refuges.³ Tribal and other private lands are also included. A recent Wyoming Law Review article describes the Greater Yellowstone Ecosystem as one of the world's largest, nearly intact temperate-zone ecosystems and a globally significant model for natural resource management.⁴ Figure 2 is a map from the National Park Service showing the Greater Yellowstone Ecosystem ranging up in area up to 22 million acres. That website indicates that YNP is mostly above 7,500 feet in elevation and is covered by snow for much of the year.⁵

Table 1 below provides some general characteristics of the Forests and Parks acreage and forest cover. We have not yet obtained data for the Custer NF or Grand Teton NP cover. Tribal and other private lands are not included. These figures show that the GYE is about 57% forested. In our summation, which lacks information for Grand Teton NP and Custer NF, we found 16 million acres of which 9.1 million are forested by conifer types. These are an underestimate because we did not have data for BLM lands, private lands, Tribal lands, wildlife refuges, and state lands. The bottom line is that the GYE likely includes a much greater land area than the 22 million acres. In addition, the estimates of forest type are an underestimate because types we lacked data for some areas. As we gather more data and do additional analysis this can be clarified. Sufficient to say at this point, this is an analysis that the FWS should have done before declaring its GYA Unit SSA 5 boundary, or its Focal Area SSA 5.

³ [The Conservation Fund](#) Accessed January 24, 2024.

⁴ Middleton, Arthur; Stoellinger, Temple; Bennett, Drew E.; Brammer, Travis; Gigliotti, Laura; Byerly Flint, Hilary; Maher, Sam; and Leonard, Bryan (2022) "The Role of Private Lands in Conserving Yellowstone's Wildlife in the Twenty-First Century," Wyoming Law Review: Vol. 22: No. 2, Article 4. Available at: <https://scholarship.law.uwyo.edu/wlr/vol22/iss2/4>

⁵ National Park Service. <https://www.nps.gov/yell/learn/nature/greater-yellowstone-ecosystem.htm> Accessed January 26, 2024.

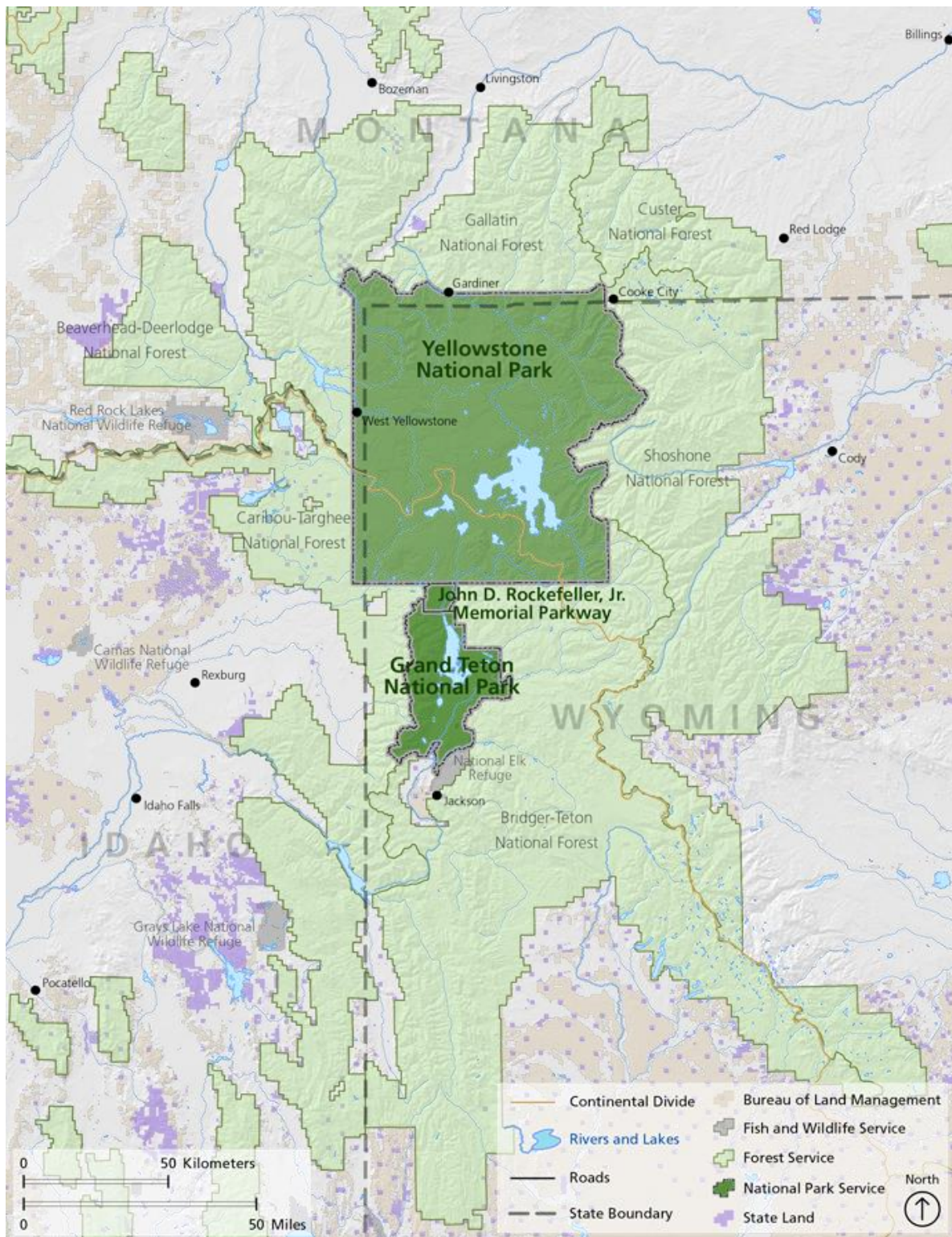


Figure 2. National Park Service map of the Greater Yellowstone Ecosystem

Table 1. National Parks and Forests of the Greater Yellowstone Ecosystem

Park or Forest	Area millions of acres	Forested Area millions of acres
Beaverhead Deerlodge NF ⁶	3.4	1.6
Bridger Teton NF ⁷	3.4	1.3 ⁸
Caribou NF ⁹	1.1	0.6
Custer NF	na	na
Gallatin NF ¹⁰	1.7	1.3
Shoshone NF ¹¹	2.4	1.3
Targhee NF ¹²	1.8	1.2
Grand Teton NP	Na	na
Yellowstone NP ¹³	2.2	1.8
Total	16 million acres	9.1 million acres

USFWS Unit 5 and Focal Area

Geospatial data defining the boundaries of the FWS SSA Units and Focal Areas were used to map these and compare to the GYE. Figure 3 shows the extent of Unit 5 (GYA) and its Focal Area. As described above, these cover 7,537,946 and 716,794 acres, respectively. As can be seen from Figure 3, SSA Unit 5 covers only a fraction of the GYE, perhaps one-third of the area. It overlays lynx critical habitat closely. (Figure 4). We note that the SSA 5 Focal Area is mostly contained within the Bridger Teton NF with a small patch in the Shoshone NF. When we compared the vegetation coverage¹⁴ across the BTNF with the Focal Area, we found both contained the same cover types which included conifer, deciduous, herbland, non-vegetated, riparian and shrubland. There did not appear to be anything that distinguished the Focal Area from the BTNF overall.

⁶ USDA Forest Service. 2009. Corrected FEIS for the Beaverhead-Deerlodge National Forest Land and Resources Management Plan.

⁷ USDA Bridger-Teton NF. 1990. Bridger-Teton National Forest Final Environmental Impact Statement. P146

⁸ Only includes lands evaluated for timber suitability and is likely an underestimate.

⁹ USDA Caribou Targhee NF. 2003. Final Environmental Impact Statement for the Caribou National Forest Revised Forest Plan. Table 3.28 (p3-86)

¹⁰ USDA Forest Service. 1987. Final Environmental Impact Statement The Gallatin National Forest Land and Resource Management Plan.

¹¹ USDA Forest Service. 2015. Final Environmental Impact Statement for the Shoshone National Forest.

¹² USDA Targhee NF. 1997. Final Environmental Impact Statement, 1997 Revised Forest Plan Targhee NF. pIII-39

¹³ <https://www.nps.gov/yell/learn/nature/forests.htm>

¹⁴ Geospatial data from BTNF. 2018. BTNFVeg2018.gdb

Figure 3 USFWS Lynx Analysis Unit 5 and Focal Area within Greater Yellowstone Area National Forests and Parks

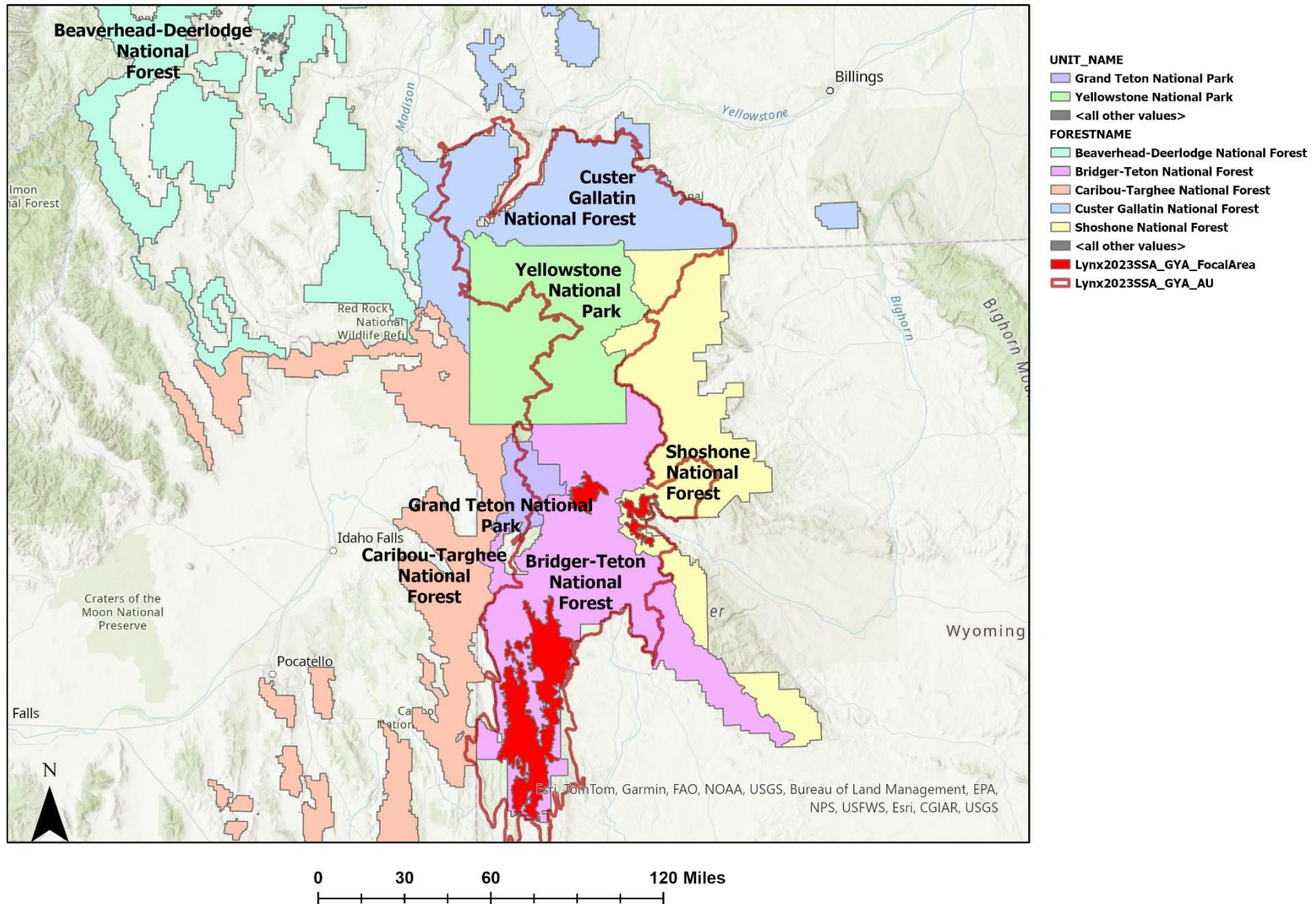
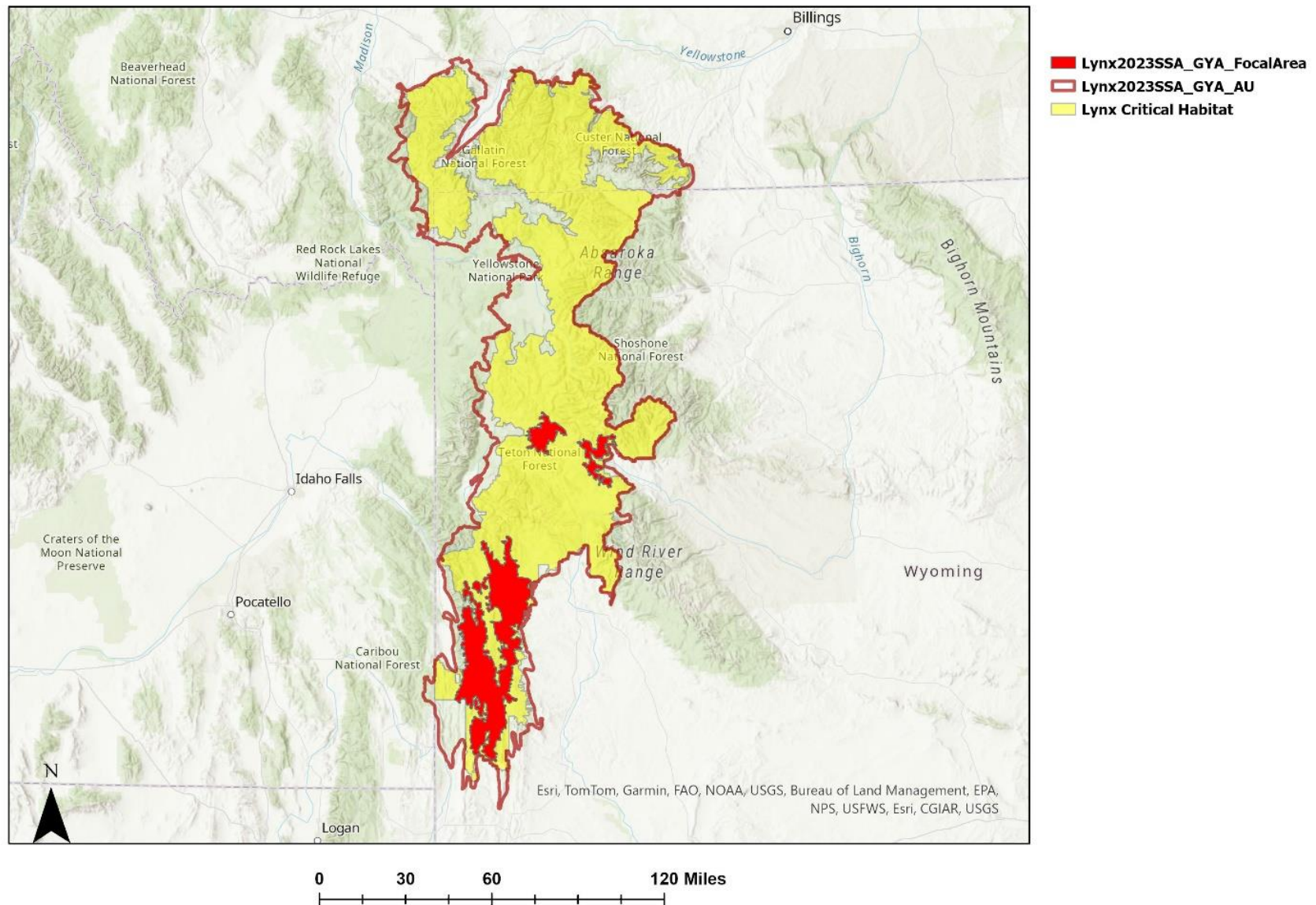


Figure 4 **USFWS Lynx Analysis Unit 5 and Focal Area**
Lynx Critical Habitat



The Olson et al 2021 Model¹⁵

According to the SSA Appendix (p5), the Olson Model found that winter temperature and precipitation covariates were most important in predicting the occurrence of resident lynx in the western US. Modeling by FWS for the Focal Areas of each SSA found that prevailing temperatures would persist longest in the GYA SSA Unit 5 and Southern Rockies SSA Unit 6.

The Olson paper described some of the limitations of species distribution modeling in terms of uncertainty, variations in geographically distinct populations in their responses to local conditions, complex models with “excessive environmental covariates” may be less generalized to novel areas and landscapes. The Olson model used 16 covariates, including climate, topographic, anthropogenic, and vegetative covariates along with GPS collared lynx locations to define habitat suitability. The vegetative component used NDVI during the growing season to characterize vegetation presence. They analyzed the data to see if their general model outcome was predictive of habitat across Montana, Washington, and Wyoming. The Wyoming models were inconsistent in transferability to other states. Thresholds applied to the Olson Model included 90% of GPS locations as high probability and 85% as medium probability lynx habitat. Wyoming contained 2,424 km², or 598,728 acres of this high probability habitat.

We obtained the (.tif) files from Olson et al 2021 authors and overlaid Focal Unit SSA 5 and its Focal Area to get a sense of how well the Focal Unit and Focal Area compared to the actual Olson Model output. (Figure 5). The Focal Area covered some high probability areas, but not others in the GYE. The Focal Unit had a similar flaw, omitting large areas of the high and medium probability habitat. In our prior Y2UComment we pointed out that there were areas of high-quality habitat delineated that also overlay the Regionally Significant Wildlife Corridor. When we overlaid timber project areas in the BTNF with the Focal Unit and Focal Area, we found that many cuts occurred within each. In particular, the northern Focal Area almost completely overlays a timber cut. (Figure 6). This raises uncertainty in that the Olson Model apparently did not distinguish these cuts from other non-fragmented areas or distinguish vegetation types.

We also mapped the 2014 Lynx Critical Habitat in comparison to the SSA Unit 5 area. (Figure 4). This indicates that the critical habitat boundary may have been used to determine the Focal Unit SSA 5 boundary rather than the Olson Model.

¹⁵ Olson et al. 2021. Improved prediction of Canada lynx distribution through regional model transferability and data efficiency. *Ecology and Evolution* 11:1667 – 1690.

Figure 5

**USFWS Lynx Analysis Unit 5 and Focal Area
Overlay with Olson Model**

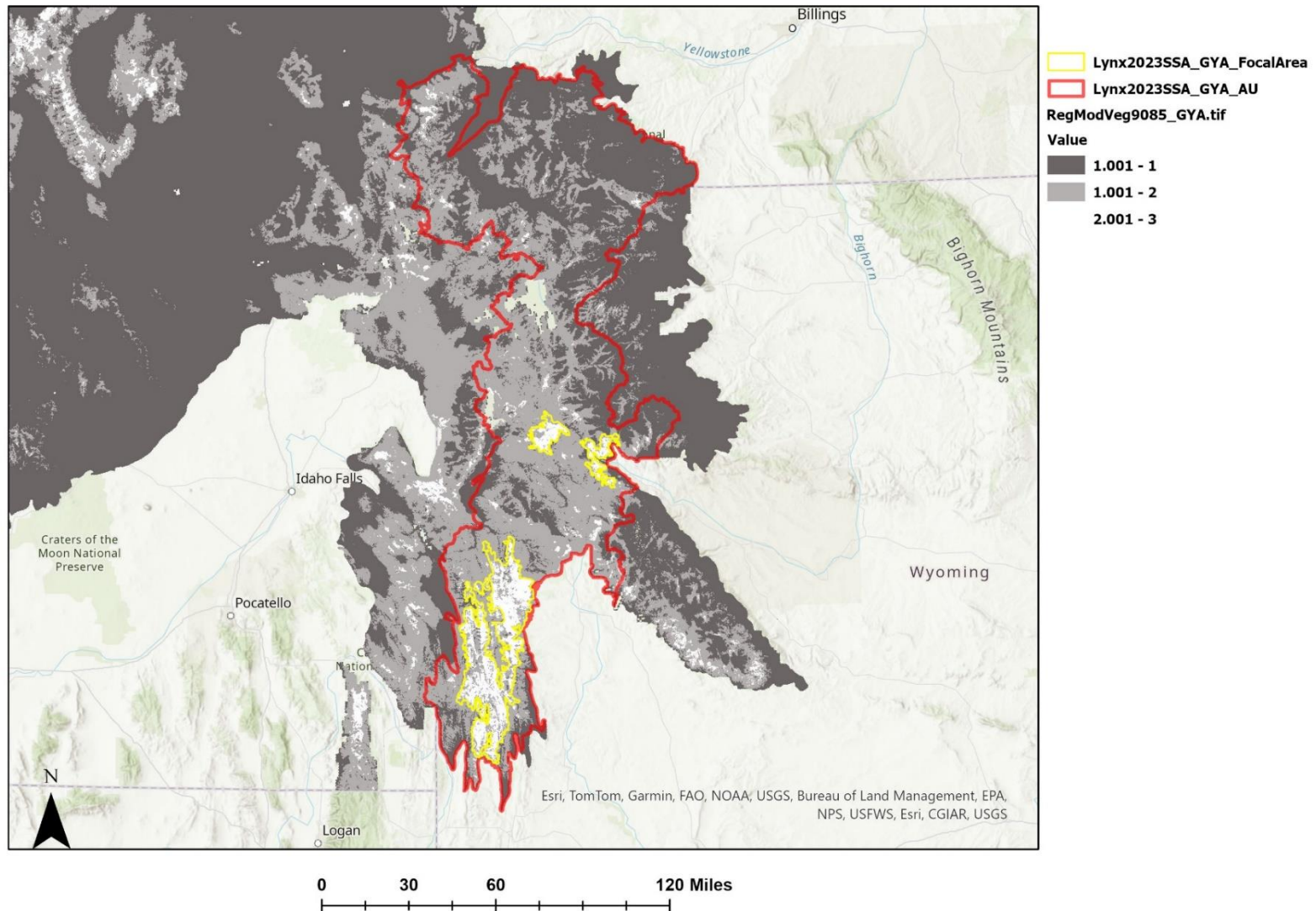
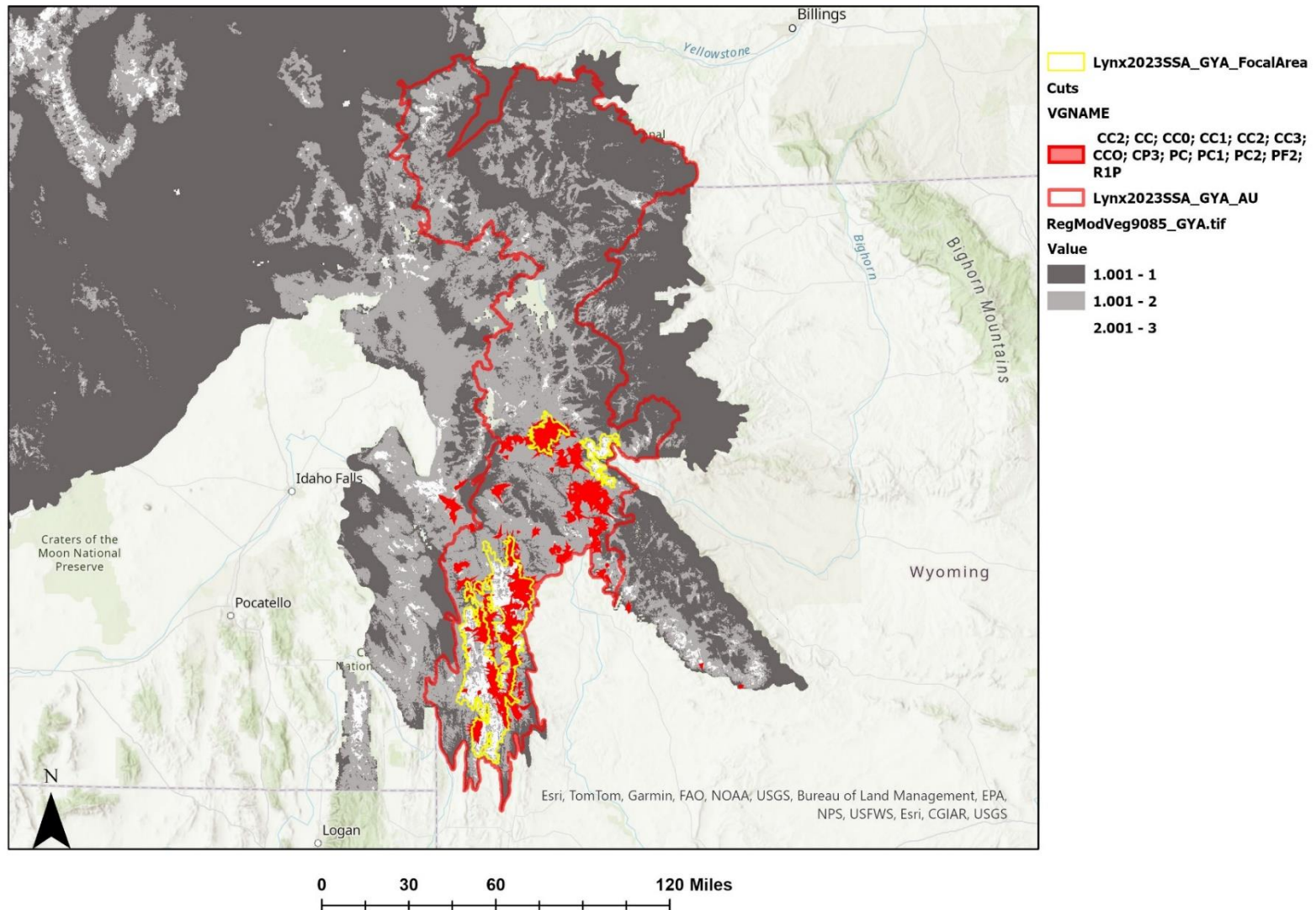


Figure 6

**USFWS Lynx Analysis Unit 5 and Focal Area
Overlay with Olson Model and BTNF Logged Units**



BLM used the Beauvais et al (2001) habitat index to map suitable lynx habitat in Wyoming.¹⁶ Beauvais developed the habitat index from GAP landcover types.¹⁷ Suitable habitat determined from vegetation coverage is shown in Figure 7. This shows that Yellowstone NP, the Bridger Teton NF, Shoshone NF are suitable habitats, which begs the question as to why there are few lynx observed today. BLM also provided a map showing the Lynx Analysis Units in the GYE on BLM and Forest Service Lands. (Figure 8). Polygons of primary vegetation types of aspen, Douglas-fir, lodgepole pine, and spruce-fir were taken from the GAP coverage. These LAU and suitable habitats were based on the actual vegetation types, an element missing from the Olson Model.

In our Y2UComment we cited the Ivan et al (undated) predictive map of Canada lynx habitat in Colorado.¹⁸ Colorado Parks and Wildlife engaged in a similar effort to map predicted use areas in Colorado. They used location data from reintroduced lynx fitted with transmitters, filtered those data to remove locations for the first six months to account for habituation, considered elevations above 8,000 feet, and included factors for housing and road density, slope, distance to forest patches and vegetation types. Similarly, we also cited Bates and Jones, (2007) that defined a least-cost path for lynx connectivity between the San Juan Mountains in Colorado and the Greater Yellowstone Ecosystem. They reviewed the negative effects of habitat loss and fragmentation on wildlife populations and the resulting isolation of those populations.¹⁹ The role of landscape linkages in providing connections and gene flow was addressed. Using GIS, they used current spatial data for habitats, human factors affecting lynx movement, and potential travel corridors between core patches of lynx habitat in the southern and northern Rockies to determine habitat suitability. Habitat suitability analysis then identified the best core areas for lynx based on vegetation type and road density. These studies (Ivan, Bates and Jones) were similar in considering vegetation types, rather than broad assumptions based on NDVI to identify habitats. Bates and Jones delineated core and corridor areas that overlay the Regionally Significant Wildlife Corridor.

While the Olson Model is a good tool for an initial look, Kosterman, Holbrook, and others we cited in our Y2UComment have laid out specific habitat parameters for lynx habitat that look

¹⁶ Ehle, D.S. and Keinath, D.A. 2002. Habitat Mapping of Lynx Analysis Units on Bureau of Land Management Lands and Surrounding Areas in Wyoming.

<https://www.uwyo.edu/wyndd/files/docs/Reports/WYNDDReports/U02EHL03WYUS.pdf>

¹⁷ Beauvais, G., D. Keinath, and J. Ratner. 2001. Habitat mapping and field surveys for lynx (*Lynx canadensis*) on lands administered by the USDI - Bureau of Land Management in Wyoming. Report prepared for the USDI Bureau of Land Management-Wyoming State Office by the Wyoming Natural Diversity Database-University of Wyoming, Laramie, Wyoming.

¹⁸ Ivan, J., Rice, M., Shenk, T., Theobald, D., and Odell, E. Undated. Predictive Map of Canada Lynx Habitat Use in Colorado. Colorado Parks and Wildlife. Accessed on January 20, 2023.

¹⁹ Bates, W. and Jones, A. 2007. Least-Cost Corridor Analysis for Evaluation of Lynx Habitat Connectivity in the Middle Rockies. Report to the Nature Conservancy by the Wild Utah Project, Salt Lake City. <https://app.box.com/s/0g8b1ryqgliz6r1fd61rdkc8fso97oh5>

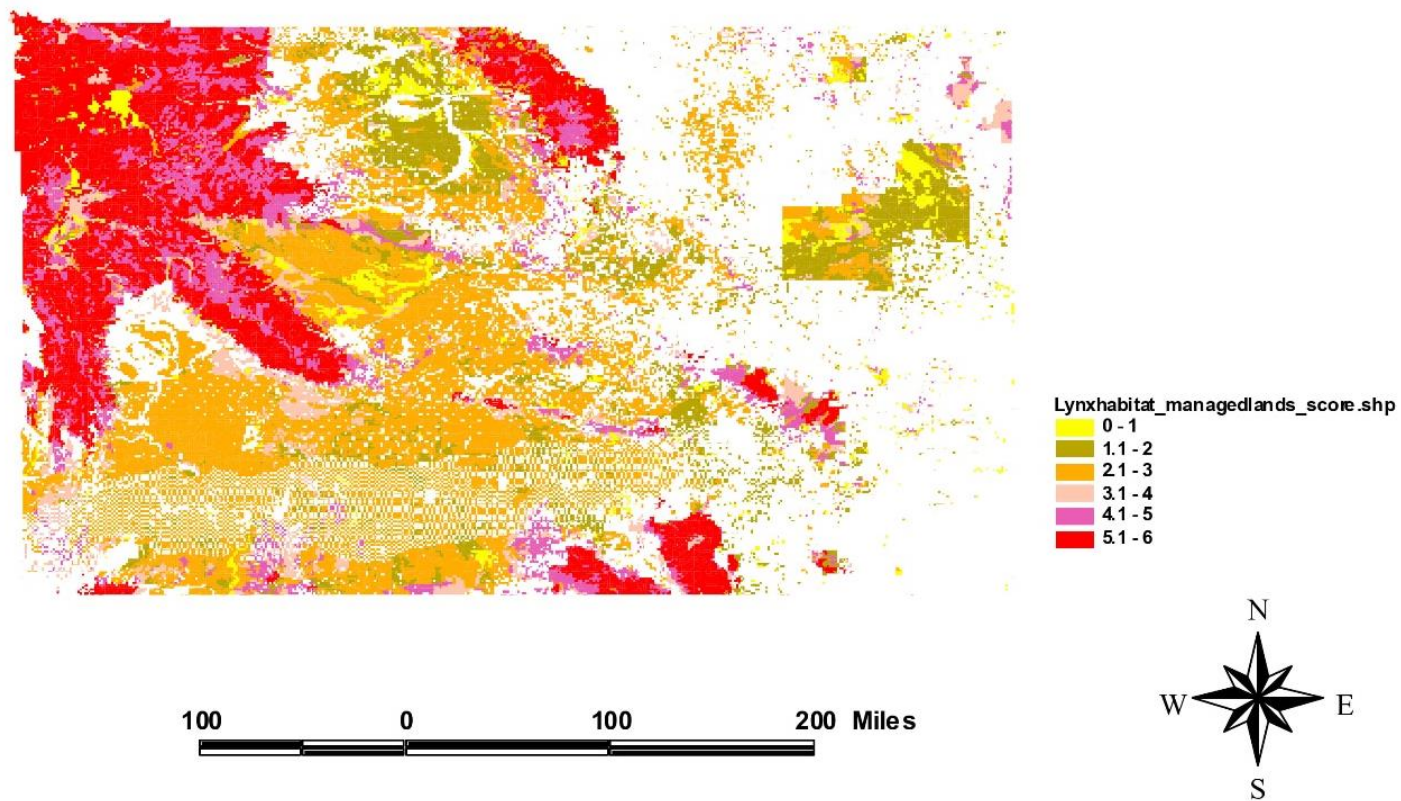


Figure 7. Index of lynx habitat suitability for managed lands in Wyoming, adapted from Beauvais et al. (2001). Higher numbers indicate higher habitat suitability.

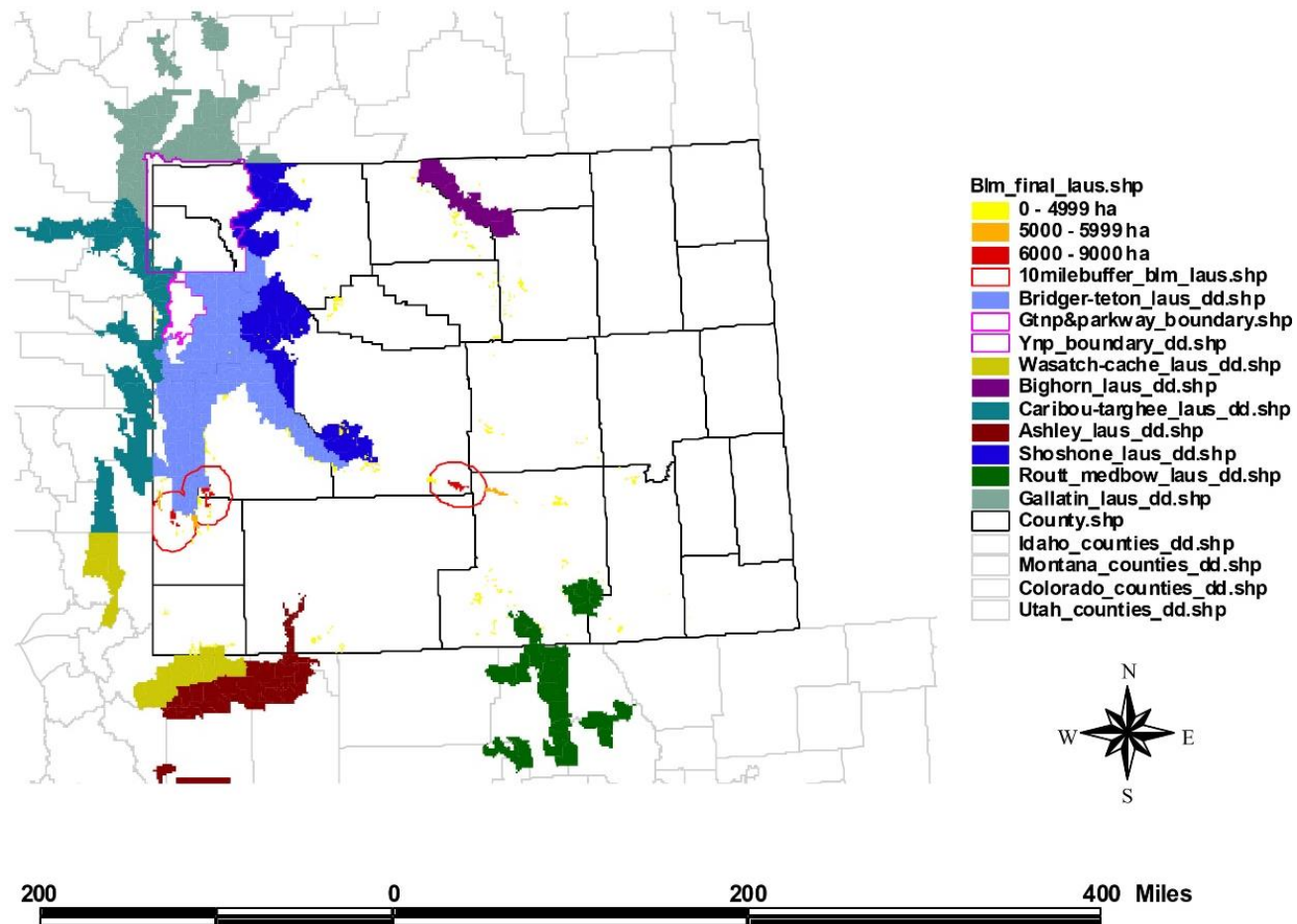


Figure 8. Lynx analysis units on Bureau of Land Management and Forest Service land in the GYE. Red polygons represent BLM LAUs. Red circles indicate 10-mile buffers around the BLM LAUs.

at vegetation types and stages of regeneration to quantify habitat. Kosterman (2014) looked at forest characteristics centered around lynx reproductive success to address habitat fragmentation and connectivity.²⁰ The relative amounts of mature and regenerating forests were addressed along with their patch size and connectivity. Holbrook et al (2018) found that while clear-cuts and sparse forests may receive some lynx use, their suitability for lynx is reduced for a significant amount of time. It has been shown not only that those clear-cuts and sparse forest are strongly avoided by lynx but that restoration of lynx habitat use in these logging areas to 50% of previous use takes 20 years in forest thinning, and 34-40 years for selection cuts and clear-cuts. Also, all logging treatments are avoided by lynx for at least 10 years.²¹

This is what is lacking in the current Draft Recovery Plan and its SSA Appendix. What are the ages of the logged areas and their utility for lynx? Wildfires? For example, the 1988 Yellowstone Fires affected 800,000 acres.²² That has now been nearly 40 years and should be in a later stage of regeneration. Lynx Analysis Units have been defined throughout the GYE. What is the current and potential habitat in each of these? What data has been collected to demonstrate that they remain functional for lynx as a result of the NRLMD? It is this more detailed look that is needed to identify both current and potential habitat and connectivity for lynx. While the Caribou NF has not been included in the Focal Unit SSA 5, in its 2003 RFP, a process for assessing connectivity was outlined.²³ While simple, it outlines a valid overall approach which we support.

The FEIS for the 2003 Caribou National Forest Revised Forest Plan (CNF RFP) provides a section on corridors in Volume IV. In that section (pages D-4 to D-8), a process for assessing connectivity is suggested. This includes:

- Assess historic patterns in vegetation and relative connectivity.
- Assess current patterns in vegetation and relative connectivity, including the impacts of human disturbance or physical barriers.
- Compare historic and current patterns of relative connectivity to determine if animal movement opportunities have been significantly interrupted.

²⁰ Kosterman, Megan K., "Correlates of Canada Lynx Reproductive Success in Northwestern Montana" (2014). Theses, Dissertations, Professional Papers. Paper 4363.

²¹ Holbrook, J.D., Squires, J.R., Bollenbacher, B., Graham, R., Olson, L.E., Hanvey, G., Jackson, S., Lawrence, R.L., 2018. Spatio-temporal responses of Canada lynx to silvicultural treatments within the Northern Rockies, U.S. For. Ecol. Manage. 422, 114–124.

²² National Park Service. <https://www.nps.gov/yell/learn/nature/1988-fires.htm> Accessed January 26, 2024.

²³ USDA Forest Service. 2003. Final Environmental Impact Statement for the Caribou National Forest Revised Forest Plan. Appendix IV.

- Consider ecologically based measures to restore historic animal movement, referring to Table 1 provided therein.

A Few Criticisms of the Draft Recovery Plan

The preceding discussion lays out much of our overall position that the current assessments and the resulting Recovery Plan have engaged in dismissing history of lynx occupancy in the southern portion of its range, have used an experimental model as opposed to actual habitat parameters such as vegetation types, and have not assessed current and potential habitat conditions. There are no quantitative habitat criteria used to describe current habitat and connectivity. Most human activities such as recreation, road density, trapping that affect lynx are dismissed due to “lack of evidence”. Connections, or linkages between core populations, and peripheral areas are not addressed. We addressed the science, history, and regulatory environment in our Y2UComment. These provide the many details that must be considered. Finally, the DRP does not lay out specific, quantitative habitat parameter and standards to evaluate lynx habitat and correct fragmentation. This leaves each agency to wander around in a maze of deflection and generalization with the same outcome we have now...nothing to protect lynx habitat.

We reference Draft Recovery Plan (DRP) page numbers. DRP statements are paraphrased and highlighted.

- **DRP:4 Lynx remain widespread and abundant in its historical range and no threats have been identified.** This is false on its face. Lynx are absent in much of the GYE today when its presence was documented historically. There are many threats such as logging, recreation, mining, roads, and trapping among others. Rather than claiming there is no evidence, the FWS and other agencies need to actually look at the current situation that have nearly extirpated lynx in the GYE.
- **DRP:4 The boreal forest becomes patchy and suboptimal as it transitions to temperate forest types that do not support lynx.** We provided a map that shows the boreal forest ends at the Canadian border. We also provided a table showing lynx occupied these temperate forests back to early records in the mid-1800s. The fact that lynx are surviving in Colorado today defeats this argument on its face.
- **DRP:7 Evaluation of verified, reliable information does not suggest broadscale breeding range contraction, substantial population declines or loss of resident breeding populations historical conditions.** The lack of monitoring since the National Lynx Survey constitutes lack of evidence. Where is the overall summary of monitoring studies in the GYE and its Parks, Forests and Public Lands? This is fundamental information that is needed. In our Table 1 in the attached Y2UComment, we summarized the reliable and verified records showing that FWS is not relying on “reliable” records.

- DRP:7 Cyclic irruptions have led to the misperception that lynx in the US were more numerous and broadly distributed than we know is ecologically possible. Not all population observations were correlated with population highs in Canadian populations. See our Y2UComment. In those comments we also described lynx observations in SE Idaho and NE Utah that occurred in the 40's and 50's which are not considered.
- DRP:8 Lynx are highly specialized hare predators and also use other prey. In our Y2UComment we addressed this topic. There are few studies in recent decades to document hare populations, red squirrels, grouse etc. in lynx habitats. In addition, the few studies indicate there are hare densities in Washington and in NE Utah that are similar to levels at lynx population lows in Canada. Studies in Wyoming have demonstrated there are adequate snowshoe hares to support resident lynx and that lynx occurred in the GYE. These are summarized here:

Berg et al 2012 studied forest structure and abundance of snowshoe hares in western Wyoming.²⁴ They estimated snowshoe hare density in classes of lodgepole pine, spruce fir in the BTNF. Physiographic and forest structure characteristics were measured to see how these affected hare abundance. They were more abundant in late seral multi storied forests than in regenerating even aged forests. "Late seral multi-storied forests with a spruce-fir component and dense horizontal cover, as well as 30-70-year-old lodgepole pine with high stem density, were disproportionately influential in explaining snowshoe hare densities in western Wyoming." They tabulated hare abundance for various forest types finding a range of 0.48 – 1.69 hares/ha. These are within the range needed to support resident lynx populations. Why are there few to no lynx here today? FWS should answer this question with data.

A study to develop a relationship between snowshoe hare pellet counts and populations was performed in sites located in the Absaroka, Gros Ventre, Wind River, and Salt River ranges in the southern portion of the GYE in the BTNF during 2006 – 2008.²⁵ Pellet counts and trapping grids were located in forested areas including lodgepole pine, spruce-fir, Douglas fir of different ages. It was noted that forests were often intermixed with riparian communities as well as sagebrush and wheatgrass communities. Hare population densities ranged from 0.16 to 4.82 hares/ha with an average of 1.51 hares/ha.

²⁴ Berg, N.D., Gese, E.M., Squires, J.R., and Aubry, L.M. 2012. Influence of forest structure on the abundance of snowshoe hares in western Wyoming. *Journal of Wildlife Management* DOI: 10.1002/jwmg.385

²⁵ Berg, N.A. and Gese, E.M. 2010. Relationship between fecal pellet counts and snowshoe hare densities in western Wyoming. *Journal of Wildlife Management* 74(8):1745 – 1751.

Murphy et al 2006 studied the presence of lynx in Yellowstone NP.²⁶ Their review found 34 references to lynx dated 1895 - 1926 and 73 sightings by park visitors or employees. Detection surveys in the northern portion of the park from 1992 – 1998 found no lynx. This underscored the need for baseline data. Hair and feces documented lynx presence in the park from 2001 – 2004. They report on the areas and characteristics of their surveys, snowshoe hare and red squirrel tracks. Hair samples documented lynx at three locations in the East sector, two females and one male. Hare and squirrel distribution and density along survey routes indicated significant presence of both. The presence of hares was positively correlated with horizontal cover. They expected improved habitat for hares as the area burned in the 1988 fires recovered.

Thus, hares and other prey, if allowed to have productive habitats, should be able to support lynx here. While more data is needed and should be required as part of this recovery effort, FWS should also be addressing the suite of factors that limit hare populations in the GYE. These would include livestock grazing.

- **DRP:9 DPS populations isolated from each other but are directly connected via dispersal to lynx populations in Canada.** Focal Units SSA 5 and 6 are not directly connected to Canada and FWS is not identifying corridors and linkages to provide connections as part of this recovery effort. In our Y2UComment we provided several maps showing the Regionally Significant Wildlife Corridor and its higher elevations that link Focal Units SSA3, 5 and 6. Units 1, 2, 3 and 5 border Canadian populations and there is a direct connection there.
- **DRP:9 Lynx have the highest level of gene flow among carnivores despite large separations between core and peripheral populations.** This conflates all populations in the DPS with those bordering Canada. Focal Units SSA 5 and 6 are not directly connected to Unit 3 and the Canadian populations, or to each other, and cannot be until a migration corridor is defined and habitat fragmentation in that corridor addressed with effective, quantitative standards and restoration where needed. We summarized the work of Bates and Jones (2007) that mapped this corridor with core and connecting habitats between the GYE and Uinta Mountains in Utah in our Y2UComment. That overlaid with the Regionally Significant Wildlife Corridor mapped by the Forest Service for the Wasatch-Cache NF RFP. But that Corridor is never addressed after 20 years.
- **DRP:11 The DRP described threats, or the lack thereof, noting that the 2017 SSA concluded that lynx conservation measures and habitat guidance by the USFS and BLM “substantially” addressed the regulatory threat.** Here again, we repeat that we have not seen the monitoring studies that document where the NRLMD, Forest and BLM land use plans have

²⁶ Murphy, K.M., Potter, T.M., Halfpenny, J.C., Gunther, K.A., Jones, M.T., Lundberg, P.A., and Berg, N.A. 2006. Distribution of Canada lynx in Yellowstone National Park. Northwest Science 80(3):199 – 206.

protected, restored, or maintained lynx habitats and connectivity. Where is the summary of these studies that characterize the current and potential state of LAUs, linkages, peripheral areas? The DRP is hugely lacking in the reporting of actual data to depict the current and potential states of lynx populations, prey populations, and habitats upon which an actual recovery effort needs.

- DRP:11 and 12 Lynx are a boreal forest and snow adapted specialist highly sensitive to the effects of climate warming and has limited capacity to adapt while prevailing temperatures persist longest in SSA 5 and 6. First, FWS should stop referencing lynx as only a boreal species. Second, the SSA Appendix and its climate model show the GYA as a reservoir for lynx during warming, indicating snowpack remains suitable over time. This should focus great attention on doing everything possible to recover habitat and develop standards with quantitative habitat criteria (road density, forest cover, forest stand stage, other) that are applied through land use plan amendments to ensure the GYA and GYE, along with the Colorado population are the reservoir for future lynx population in the southern extent of its range.
- DRP:12 Aside from climate and regulatory mechanisms, other factors were identified that are “thought” to exert population level influences on DPS populations. These include vegetation management, wildland fire management, habitat loss and fragmentation. Other factors that may affect lynx include disease, predation, competition, and incidental take. As we showed in Figure 6, the BTNF timber projects have fragmented habitat in its portion of SSA 5. The Recovery Plan should have included an analysis across the GYE and its National Forests to address the numerous prescribed fire, thinning, clear cutting, removal of hazard trees that create long swaths of openings hundreds of feet or more. We have commented on millions of acres of these projects in the National Forests in the GYE. They all fragment habitat, reduce cover, and increase road density. Similarly, road densities and their effects on security habitat should be addressed. That would include all roads and trails, snowmobile groomed trails, and Forests that have snowmobile use across the entire landscape, such as the Caribou NF that is 97% open. Incidental trapping is not so incidental as a quick look at the Game and Fish websites for Montana, Idaho, Wyoming, and Utah illustrate. Yellowstone National Park is surrounded by areas open to trapping of bobcats and wolves. A recent article reported two lynx trapped during bobcat trapping in Montana, one died.²⁷ A current report of bobcat trapping in Wyoming shows that over the past ten years, 12,349 bobcats were reported trapped. The number of trap nights ranged between 653,882 and 251,852.²⁸ This is an intensive, landscape scale effort. When you consider this is going on in all these states, how many lynxes are lost just to trapping effort? It’s likely a major factor to the absence of lynx in YNP and the GYE. It cannot be an incidental factor. We summarized some of the current statistics on snowmobile and ohvs in our

²⁷ <https://nbcmontana.com/news/local/bobcat-trappers-catch-2-lynx-in-northwest-montana> Accessed January 27, 2024.

²⁸ Wyoming Game and Fish Department. 2023. Bobcat License Summary Statewide 2022-2023.

Y2UComment showing an explosion of their use in recent years. The levels of use in many areas are similar to a ski area which Olson et al 2018 acknowledge caused behavioral (avoidance) changes in lynx use of the landscape. How do lynx navigate these National Forests in the GYE with the proliferation of play areas and groomed trails providing access for trappers, hound hunters, and high marking or play areas? The Recovery Plan should have addressed these instead of dismissing them for no evidence when the evidence is plain, people and machines occur across the landscape.

- **DRP:12** The absence of reliable information indicating lynx distribution and abundance are “substantially” reduced from historical conditions. SSA Unit 6 established by the 1999 – 2006 translocation of lynx from Alaska and Canada has demonstrated resilience so far. Absence of information once again. Why are there not region wide surveys using a consistent protocol? Where are the tabulations of lynx numbers in the GYE? If SSA Unit 6 is demonstrating resiliency, how is that so and why is the GYE any different? If not different, then lynx should be found by adequate surveys in suitable habitat. If different, then what are the habitat factors driving the difference?
- **DRP:13** Three SSA units (1,2, and 3) demonstrate high overall resiliency with two (4 and 6) moderately resilient and unit 5 not resilient. Low population in the GYA and moderate connectivity to the Core range in Canada are the reasons given. Yet, the DRP fails to designate the needed connections for these most southern areas.
- **DRP:14** We found no evidence that former persistent populations have been lost from any large areas suggesting redundancy has not been diminished. The current population in Colorado has resulted in increased redundancy. Then, why is the population in the GYE so low if there is one?
- **DRP:15** In its 2017 SSA it was concluded that lynx across the DPS occupy a narrow and specialized ecological niche defined by specific vegetation structure, snow conditions, and abundance of a single prey species. A major failing of the DRP and its SSA Appendix is the failure to define and analyze these conditions based on current and potential levels of habitat, snow, and prey abundance. The absence of actual data allows such an assumption to drive decisions when a requirement should be that Forests, Parks, and BLM should be engaged in monitoring lynx populations, prey populations, and accurately quantifying vegetation conditions and their potential. Then the **DRP says, lynx is broadly distributed across the range of ecological settings that “seems” to have supported them historically.** These ecological settings must be defined and compared to the “narrow” niche mentioned. Are they the same? If so, then why is one narrow and the other broad?
- **DRP:15** We found no threats to genetic health in the DPS. This would seem clear for SSA Units 1, 2, 3, 4 and 6. After all these are either directly connected to the Canadian populations across the border or are direct translocations from those populations to Colorado. The place to now look for genetic variation is in the GYE because it lacks any direct connection and the FWS and other agencies refuse to recognize, designate and maintain a suitable migration path or corridor to and from Units 3, 5 and 6.

- **DRP:17** The Recovery Vision only addresses five SSA Units and omits the GYA Unit 5 from consideration for identification and preservation of high-quality lynx habitat, refining regulatory mechanisms and incorporating the best available science. The Recovery Plan should have identified all vegetation types and their current suitability along with factors reducing suitability. These would be those with potential use by lynx and its prey in the GYE, not just the Focal Unit that appears artificially constructed to match critical habitat. Refining regulatory mechanisms is just kicking the can down the road instead of laying out specific, quantitative needs for analysis, restoration, and connectivity.
- **DRP:17** Then the DRP says recovery should also include conserving the modeled high quality habitat and potential refugium in the SSA Unit 5 focal area and evaluating effectiveness of regulatory mechanisms. This focuses only on a small set of isolated focal areas representing the 90% confidence level in the Olson Model, when the Olson Model also mapped the 85% or moderate habitat suitability that includes a much wider area across the GYE. In this instance the DRP is further isolating these small islands. This effort should include all the Forests, Parks, and other public lands we have shown for the GYE in Figures 2 and 3. As to the effectiveness of regulatory mechanisms for the GYE there should have been an analysis of all the Forest vegetation manipulations, mines, road density and projects proposed and approved. As we have commented on the phosphate mines the usual deflection is that lynx will travel around the “periphery” of the project area into other suitable habitat. Yet the Forest Service and BLM never analyze this habitat relative to lynx needs. This is a clear failure in the regulatory mechanism.
- **DRP:18** Recommends conservation of five extant resident breeding populations, maintenance, or recovery of connectivity between DPS populations to the extent practicable and among DPS populations to the core range in Canada. Also, the strategy recommends conservation of modeled, but currently unoccupied habitat in the GYA. Modeled habitat is not adequate as we described above. Actual mapping of vegetation types along with human activities fragmenting habitat must be used to define potential and current habitats. Due to lack of survey data provided for the GYE, we question whether it is unoccupied, or occupancy is denied due to the human activities we described earlier. We know the GYE was historically occupied, so now the thrust should be restoring and recovering lynx populations throughout the GYE, not a small subset defined as a Focal Unit. As far as limiting restoration to the extent practicable, the first step is identifying the potential habitat and connections then their current state based on the factors that fragment the habitats.
- **DRP:19** The strategy included maintain or improve resiliency, connectivity, restore habitat within focal areas and any other areas capable of supporting resident populations, remove threats by maintaining or strengthening habitat protections with regulatory mechanisms, monitor lynx demography, distribution, connectivity, habitat quality, regulatory mechanisms and progress implementing recovery. These are all things that should have been delineated, prescribed with quantitative criteria following listing in 2000. Now 24 years later we embark on another 20-year time frame under the DRP without defining the

criteria and laying out with specific requirements, the regulatory mechanisms needing implementation. Clearly the NRLMD has failed as we have pointed out, otherwise lynx populations in the GYE would have rebounded because habitat would have been protected, barriers eliminated, constraints placed on recreation and road density, timber and mining projects would have had to operate under strict requirements for habitat and wildlife (hare, squirrel, lynx), monitoring and protecting the vegetation types and cover needed for these. It has not happened, and the public has no faith that anything will change under this DRP.

- DRP:19 Here the DRP attempts to address the preceding by noting that recovery plans are merely guidance, not regulatory requirements. This statement offers little comfort because the FWS fails to clearly define the habitat needs of lynx and lay out clear criteria for incorporation into land use plans. We have seen the result of the NRLMD and Forest Plans since listing. We have not seen habitat protection, analysis, restoration, or limits on human activity.
- DRP:20 Recovery criteria for population size despite the lack of accurate population size estimates for all DPS populations. No population size is applied to the GYE while others are estimated. A potential population size should have been estimated for the GYE (not just the Focal Unit SSA5, but the entire GYE as we have mapped it. That population size could be estimated from the cover types available absent all the fragmentation and human activity so a recovery goal for the GYE could be set. The criteria presented allows for this, but it should have been done for this DRP. As we have shown, there are numerous LAUs in the GYE from which home ranges and related population sizes could have been estimated.
- DRP:21 The DRP “allows for population size estimates based on carrying capacity calculations or habitat amount”. As noted above, this should have been done as a basic analytical parameter to provide population targets.
- DRP:22 Habitat modeling for the GYA SSA Unit 5 indicates it may support a population greater than 25 individuals. The SSA 5 area is much smaller than the actual area of the GYE and is limited to the critical habitat. The analysis and parameters used to provide this estimate should have been laid out for the public so we could know how this estimate considered various factors such as vegetation types, cover, patches, connections, fragmentation. It should be expanded for the entire approximately 20-million-acre GYE to provide a clear basis for identifying problem areas and means of correcting or restoring those.
- DRP:22 Connectivity is discussed as between stepping stones and corridors identified between Units 3 and 5, and units 5, and 6 to support lynx dispersal between these units. This should have been done as the basis for this recovery plan. How can connections be restored if the agencies refuse to acknowledge the already existing paths that have been known for two decades. We laid this out in our Y2UComment. The failure of FWS to now map these critical linkages and provide criteria for their maintenance or restoration leaves the other agencies free to continue ignoring these connections far into the future while they continue to deflect around them and approve roads, mines, haul roads, logging and

recreation with no guiding document to force them to consider corridors along with habitat, which as we have noted, is ignored throughout the GYE in our experience. The FWS should review the projects approved in the Forests of the GYE in the past decade and a half since the NRLMD and point out any project that was actually modified due to lynx or snowshoe hare considerations. We have seen none.

- **DRP:23** Then the **DRP notes connectivity will be determined by monitoring lynx movements and habitats is appropriate and quantifiable for evaluation of connectivity.** The failure to define lynx habitat requirements, hare and red squirrel habitat requirements and map these out for this **DRP** leaves a future of little to no coordinated data collection, an ad hoc situation we have seen for the past decades. FWS should delineate exactly the criteria and monitoring needed with specificity across the range of lynx in the GYE and other SSAs. Without this, there is no central coordination, data analysis, or ability to monitor effectiveness of standards. The FWS, as the experts, should be providing the standards and all criteria to guide new land use plan amendments. Even that multiyear process guarantees no help for lynx and lynx habitat for much of another decade or more. Sad situation of bureaucratic delay.
- **DRP:24** Here the current habitat amounts are tabulated in Table 4 of the **DRP**. The **GYA is reduced to the small 90% Focal Area.** This Focal Area is almost insignificant compared to the Greater Yellowstone Ecosystem. It equates to roughly 5% of the entire GYE ecosystem. We critiqued this Focal Area above. It is totally inadequate and based only on the Olson Model while not considering the 85% moderately suitable habitat. This is done without mapping of the vegetation types as we have noted that others have done. It is stunning that the 20-million-acre GYE only has a few thousand acres of habitat. This entire analysis needs revisiting with specific habitat characteristics such as we have cited above by authors such as Holbrook, Kosterman, Ivan, Bates and Jones, Beauvais, and Britell.
- **DRP:26** Threats based regulatory mechanisms is generally described as being addressed through collaborative development and science based regulatory mechanism. If FWS considers our Y2UComment and those submitted by NEC for this **DRP**, it will understand that there are no meaningful regulatory mechanisms based on the actual habitat needs of lynx and snowshoe hare. FWS must define the quantitative, science-based standards and habitat criteria needed to sustain and restore lynx and lynx habitat as part of this **DRP**. FWS must provide specifics, not generalized language. It must review the current state of recreation, trapping, logging, road density, and other habitat altering actions that are occurring in the GYE and not deflect due to finding “no evidence”. You find evidence by looking and analyzing the realities on the ground, not by deflecting and doing no analysis. We have pointed this out in our prior comments.
- **DRP:28 – 31** Describes levels of priority for actions and a 20-year timeframe. These are general and meaningless without the specific analyses and specific standards and criteria which FWS should identify. It considers most actions as being not a threat and deflects back to the agencies that have been making decisions that destroy the function of lynx habitat for

the past several decades. There needs to be a specific plan without wiggle room. To now call for research for “forest management strategies to conserve lynx habitat in each SSA” ignores what is already known that is sufficient in our view to lay out these strategies. Not doing so is perpetuating the status quo.

Sincerely,



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ATTACHMENT J

January 26, 2025

To: Amity Bass, Field Supervisor (amity_bass@fws.gov)
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Federal eRulemaking Portal: <https://www.regulations.gov> FWS-R6-ES-2024-0142

U.S. Fish and Wildlife Service
Montana Ecological Services Office
585 Shephard Way, Suite 1
Helena, MT 59601

Re: Comments on the DOI Fish and Wildlife Service Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the Contiguous U.S. Distinct Population Segment of the Canada Lynx. Federal Register Vol. 89 No. 230, November 29, 2024. Proposed Rule.

Fish and Wildlife Service:

These comments are submitted on behalf of the Yellowstone to Uintas Connection, Alliance for the Wild Rockies, Conservation Congress, Council on Wildlife and Fish, Gallatin Wildlife Association, Native Ecosystems Council, Sage Steppe Wild, and Swan View Coalition. These organizations are non-profit entities that engage on public land issues affecting wildlife. More than the allotted 60 days is really needed for response, but we have summarized our findings and recommended management for Canada lynx Rocky Mountains and hope our work is read and studied carefully, as it represents a very large investment of time, and we think uniquely provides quantitative analysis using the models you have adopted.

Sincerely,



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The U.S. Fish and Wildlife Service Federal Register Notice¹ (Notice) proposes to revise the critical habitat for the contiguous population segment of the Canada lynx due to a court order for not designating critical habitat in Colorado and five National Forests in Idaho and Montana, and because there is new information on Canada lynx habitat in the western U.S. **They are seeking information on: the amount and distribution of lynx habitat; any additional areas that should be included; special management considerations and managing for climate change; land use designations and current or planned activities in the subject areas and their possible impacts on proposed critical habitat; areas for exclusion; and improving the approach to designating critical habitat.**

Prior comments

1. **January 25, 2023** ([link](#)). Species Status Assessment (SSA) for the Canada Lynx (Lynx Canadensis) Contiguous United States Distinct Population Segment. Version 1.0, October, 2017.

These comments provide a brief review of the regulatory history and science involved in the ESA listing for Canada lynx and subsequent land management on National Forests. The review reveals that much of science is misinterpreted to favor human activities that degrade and fragment lynx habitat, while absence of evidence due to lack of studies is used to claim these activities either have little effect or in the case of timber manipulation, can even be beneficial. A review of the NRLMD and its application in linkage and peripheral areas as incorporated into Forest planning uses the Caribou NF as an example. The NRLMD provides limited guidance and protection to the Caribou NF as it is deemed “unoccupied”

¹ Department of the Interior, Fish and Wildlife Service. 2024. Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the Contiguous U.S. Distinct Population Segment of the Canada Lynx. Federal Register 89 No. 230 (pp 94656 – 94680) dated November 29, 2024.

by lynx. This is despite evidence that lynx persisted in the CNF over historical times. This “unoccupied” status results from failing to find current evidence of lynx long after habitats have been fragmented by mines, high road density, an explosion in motorized recreation accessing nearly every acre of land, timber projects, and including habitat alteration by livestock grazing. The CNF Forest Plan includes recognition of lynx linkage, but the provisions in that plan for linkage habitat lack adequate quantification and standards.

Noting that there is a lack of emphasis on landscape connections between core areas of the DPS, analysis and mapping is provided showing the existence of long recognized regional wildlife corridors. The principal corridor is the Yellowstone to Uintas Connection linking the Greater Yellowstone Area (GYA) to the Uinta Mountains and Colorado which passes through SE Idaho from lynx critical habitat in Wyoming. This is the most continuous high elevation, forested corridor making this connection. It also aligns with the CNF linkage to other areas. Protection and restoration of this and other corridors is essential to promote lynx connectivity and sustain meta-populations.

This review shows that regulatory mechanisms are inadequate to protect lynx habitat and connectivity. Monitoring snowshoe hare habitat and populations as well as lynx presence in these southern areas of the DPS is inconsistent. While some habitat mapping and modeling has been done, it is not being applied or expanded to identify and describe in sufficient detail the habitats and migration corridors needed for lynx to persist. Land management plans must be updated and amended to provide data-based criteria and quantitative standards to ensure habitat for lynx and snowshoe hare are connected and functional.

2. January 29, 2024 ([link](#)). Draft Recovery Plan for the Contiguous United States Distinct Population Segment of Canada Lynx (Lynx Canadensis). November 2023.

In these comments we pointed out the misuse of the term Boreal Forest to characterize lynx habitat in the U.S. Boreal Forest occurs in Canada. Historical Canada lynx observations in the western U.S. occurred in Kuchler forest types that include Douglas fir, Englemann spruce, lodgepole pine, mixed conifer, whitebark pine, limber pine, and other associated types that are intermixed therein. We focused our analysis on the Greater Yellowstone Area which included nine National Forests and two National Parks with a total area of 16 million acres, of which 9.1 million acres are forested. Analysis Unit 5 (Unit 5) lies within these National Forests and Parks.

We illustrated the Olson (2021) Model within this area showing large areas of suitable habitat. Unit 5 Focal Areas were fragmented by prior clearcuts, and the Focal Areas were not connected. This raised uncertainty regarding the Model

ability to separate out or characterize fragmented habitat and would suggest that Focal Areas be expanded to account for the fragmentation, provide connectivity and address recovery of the fragmented areas. The Beauvais et al (2001) Model² showed most of this area to have high suitability for lynx habitat. See also Ehle (2002)³

We pointed out that the age of clearcuts and other forest projects need to be considered as habitat as their recovery takes place, citing Holbrook et al (2018)⁴. In addition, connectivity should be addressed, reflecting Kosterman (2014)⁵. We noted the 1988 Yellowstone Fires that affected nearly 800,000 acres now, nearly 40 years later should be considered as habitat as it would be a later stage of regeneration. We used the Caribou National Forest as an example of the analysis process for evaluating connectivity.⁶

Assessments and the resulting Recovery Plan have engaged in dismissing history of lynx occupancy in the southern portion of its range, have used an experimental model as opposed to actual habitat parameters such as vegetation types, and have not assessed current and potential habitat conditions. There is no quantitative habitat criteria used to describe current habitat and connectivity. Most human activities such as recreation, road density, trapping that affect lynx are dismissed due to “lack of evidence”. Connections, or linkages between core populations, and peripheral areas were not addressed.

² Beauvais, G., D. Keinath, and J. Ratner. 2001. Habitat mapping and field surveys for lynx (*Lynx canadensis*) on lands administered by the USDI - Bureau of Land Management in Wyoming. Report prepared for the USDI Bureau of Land Management-Wyoming State Office by the Wyoming Natural Diversity Database-University of Wyoming, Laramie, Wyoming.

<https://app.box.com/s/8mmrshcf2yv5dd1rwcldmg15z5gvvgtr>

³ Ehle, D.S. and Keinath, D.A. 2002. Habitat Mapping of Lynx Analysis Units on Bureau of Land Management Lands and Surrounding Areas in Wyoming. Wyoming Natural Diversity Database.

<https://app.box.com/s/oi16uss3gtljxrt53utjv4tgapodn0gx>

⁴ Holbrook, J.D., Squires, J.R., Bollenbacher, B., Graham, R., Olson, L.E., Hanvey, G., Jackson, S., Lawrence, R.L., 2018. Spatio-temporal responses of Canada lynx to silvicultural treatments within the Northern Rockies, U.S. *For. Ecol. Manage.* 422, 114–124.

<https://app.box.com/s/ycvcj6bihda4tvde5xgw0imwt282fklm>

⁵ Kosterman, Megan K., "Correlates of Canada Lynx Reproductive Success in Northwestern Montana" (2014). Theses, Dissertations, Professional Papers. Paper 4363.

<https://app.box.com/s/ku06s8g268s3p4dvwdbaglkjdr5neg1w> See also: Kosterman MK, Squires JR, Holbrook JD et al (2018) Forest structure provides the income for reproductive success in a southern population of Canada lynx. *Ecol Appl* 28:1032–1043. <https://doi.org/10.1002/eap.1707>

<https://app.box.com/s/1ecvhd4nznclwdppvyu6naufzpiwzr80>

⁶ USDA Forest Service. 2003. Final Environmental Impact Statement for the Caribou National Forest Revised Forest Plan. Appendix IV. <https://app.box.com/s/pqa6bwpzxnxwh7mx7g4i370jbzerlnne>

Specific positions contained in the DRP were challenged (p17 – 25). Please review these in the attached copy of our comments.

3. **February 15, 2024 ([link](#)).** Supplemental Comments on the Draft Recovery Plan (DRP) for the Contiguous United States Distinct Population Segment of Canada lynx (*Lynx canadensis*).

These comments pointed out the narrow focus of the SSA Appendix and Draft Recovery Plan and designated SSA 5 Focal Unit and SSA 5 Focal Area. These omit large areas of suitable modeled lynx habitat in Central and SE Idaho, Southwestern Montana, and Western Wyoming. It is our contention that the boundaries for the FU and FA are arbitrarily drawn and thereby eliminate consideration of habitat and linkages (current and potential) occurring in these wider areas.

Using the Olson (2021) Model⁷, we analyzed the National Forests, National Parks, Critical Habitat, Focal Units, and Focal Areas within the GYA and ranked the Olson probability classes for each. A chart of National Forests visualized the rankings, showing that the Bridger-Teton NF contained the most high and moderate probability habitat, followed by the Caribou-Targhee, and Bitterroot NFs. Ranger Districts within the NFs were also ranked. With those in the Bridger-Teton NF and the Caribou-Targhee NF ranking the highest.

We concluded that the SSA Unit 5 must be expanded to also include the National Forests we have identified here that are in SW Montana, Central and SE Idaho, and Western Wyoming. (Figure 3). These and other land management units contain millions of acres of potential lynx habitat that will remain without adequate analysis and regulatory protection if this DRP goes ahead under its current, limited focus.

We have focused on connectivity and linkage for lynx. These linkages tend to follow the higher elevation areas and the least cost path between those. The Bates and Jones (2007) model we provided in our initial comments mapped corridors and cores in the connection between the GYA and the Uinta Mountains in Utah.⁸ That effort needs to be expanded to identify connections within and from the Greater Yellowstone Ecosystem to both the northern and southern Rockies. This connection has already been mapped as the Regionally Significant

⁷ Olson et al. 2021. Improved prediction of Canada lynx distribution through regional model transferability and data efficiency. *Ecology and Evolution* 11:1667 – 1690.
<https://app.box.com/s/32ww5q3ci96now3zy1fd2qgxzdf4lb21>

⁸ Bates, W. and Jones, A. 2007. Least-Cost Corridor Analysis for Evaluation of Lynx Habitat Connectivity in the Middle Rockies. Report to the Nature Conservancy by the Wild Utah Project, Salt Lake City.
<https://app.box.com/s/0g8b1ryqg1iz6r1fd61rdkc8fso97oh5>

Wildlife Corridor which includes the higher elevation areas.⁹ Now, a detailed look at current and potential forest cover needs to happen and FWS needs to produce this map along with effective, quantitative criteria for maintaining and restoring these connections and core areas.

We reiterated that no evidence has been provided that demonstrates the current Northern Rockies Lynx Management Direction has been effective. The statement from the SSA Appendix that, “SSA Units that have been modified based on recent verified occurrence data to represent the current distribution of lynx in the contiguous U.S.”, indicates continued shrinkage of lynx occupancy without an actual analysis or summary of where the monitoring occurred and what was found. Were the National Forests (NF) and Parks we identify herein included in a monitoring effort? Our look at this indicates that monitoring is patchy, while recent observations are subject to ongoing habitat modification which then feeds back to less area used by lynx. We suggested next steps of analysis.

Comments on the Critical Habitat Proposal

1. Proposed Critical Habitat (CH)

The Notice cites the ESA definition of critical habitat as:

(i) the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protections; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination by the Secretary of the Interior (Secretary) that such areas are essential for the conservation of the species.

The Notice made several points regarding designation of CH for Units 3, 5, and 6.

Unit 3 was occupied at the time of listing and is currently occupied and directly connected to the habitat and population in Canada. Unit 5 has small pockets of habitat on the Bridger-Teton NF and recent modeling (Olson et al 2021) shows this area does not contain the physical and biological features necessary to support lynx residency and is not directly connected to lynx habitats elsewhere. In Unit 6 it is uncertain whether this unit historically supported a resident population or if present, it was ephemeral. It is not connected to lynx habitats

⁹ Wasatch Cache Revised Forest Plan and Final Environmental Impact Statement Regionally Significant Wildlife Corridor. 2003. Accessed on January 18, 2025.

<https://www.fs.usda.gov/detail/uwcnf/landmanagement/projects/?cid=stelprdb5076923>

elsewhere. It now supports a resident population as the result of the State of Colorado reintroductions.

We obtained historical lynx observation records from the Beaverhead-Deerlodge NF¹⁰, Montana Natural Heritage Program¹¹, and the Wyoming Game and Fish Department¹². We mapped these records to illustrate the areas historically used, some of which occur up to the current time. (Figure 1). We requested but have not received the Idaho observation records. The map shows historic lynx concentration areas in Units 3 and 5. Unit 5 has widespread observation records which argue for a broader critical habitat designation of Unit 5 in total. The Notice claim of lack of habitat doesn't match with the historical presence of lynx. While the lack of lynx in Unit 5 today might be used to argue there is no habitat, the Notice and FWS ignore that Colorado likely was not occupied at time of listing, while Unit 5 was having many lynx observations during and following listing. Even as recently as February 2022, a Canada lynx was observed in the Bridger-Teton National Forest in the Gros Ventre Range.¹³ The point is that lynx are present in the GYA Unit 5 and Unit 5 should be given the same consideration as Unit 6 which was not occupied. The lynx population in Unit 5 could be supplemented by reintroductions as was done in Colorado and critical habitat remain as designated in 2014 or increased to capture more suitable and high value habitat and connections.

We looked at how the Analysis Units, Focal Areas, and Critical Habitats captured the overall observations for the Wyoming and Montana Natural Heritage Program databases since these include observations pre- and post-listing of lynx. (Table 1). We also looked at the Flathead NF to see how the MNHP observations with low location uncertainty (100 meters or less) compared to the Olson et al (2021) habitat probability. The Olson Model output we received consists of a tiff image of pixels (250 meters square) for low (1), moderate (2), and high (3) probability. When we compared the lynx observations in the Flathead NF to the Olson Model, we found that category 2 and 3 captured 86% of the MNHP observations. (Figure 2).

¹⁰ Records obtained from the Beaverhead-Deerlodge NF in the form of a layer file: Historic Lynx Records (citing McKelvey et al, 1999). <https://app.box.com/s/6bg8w6k5ru1axlv3zcm5ba2tt3gjz9hg>

¹¹ Montana Natural Heritage Program, Montana Animal Observations. Accessed: April 24, 2024. <https://nris.mt.gov/reqapp/userMain.asp>

¹² Wyoming Game and Fish Department. Lynx_canadensis_observations_statewide. Received on January 10, 2025.

¹³ Koshmiri, M. 2024. Rare Wildcat Documented in the Yellowstone region for first time in a decade. Wyofile June 7, 2024. <https://wyofile.com/rare-wildcat-documented-in-the-yellowstone-region-for-first-time-in-a-decade/>

Figure 1. Lynx Observations in the Rocky Mountains

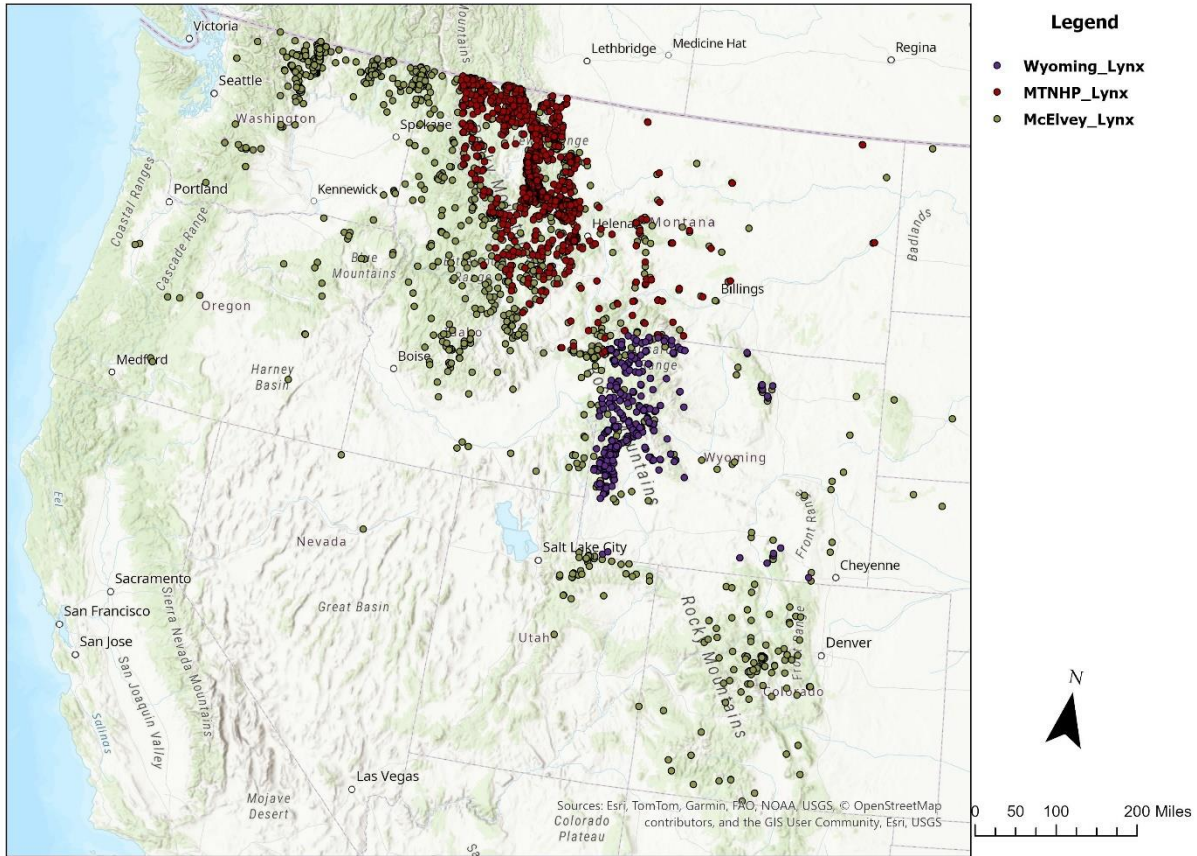
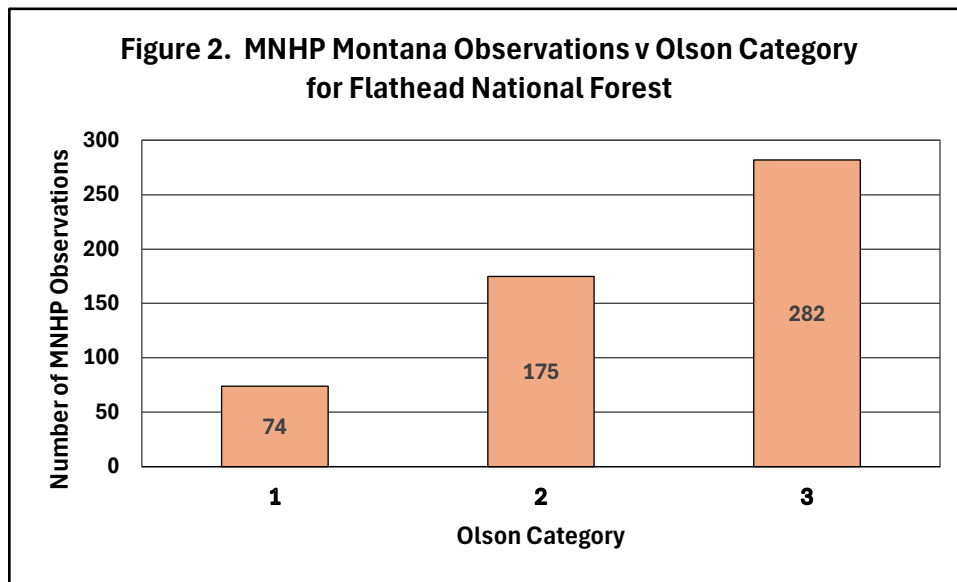


Table 1. Analysis Units 3 and 5 Lynx Observation Comparisons

Rocky Mountain Management Areas	MNHP Observations Captured/Percent of Overall	Wyoming Observations Captured/Percent of Overall
Overall Observations	2414/100%	314/100%
Unit 3	2244/93%	
Unit 3 FA	1817/75%	
Unit 3 CH 2014	1973/82%	
Unit 3 CH 2024	1821/75%	
Unit 5		198/63%
Unit 5 FA		73/23%
Unit 5 CH 2014		175/56%
Unit 5 CH 2024		73/23%



Here we see for Unit 3 that the 2024 proposed CH captured 75% of the MNHP observations which was less than the 2014 CH (82%) and much less than Unit 3 overall (93%). In Unit 5, the 2024 CH captured 23% of the Wyoming observations which was less than the 2014 CH (56%) and Unit 5 overall (63%).

Critical Habitat should be expanded in Unit 3 to include all of Unit 3 which captures 93% of observations. Critical Habitat in Unit 5 should be expanded to also capture the habitat level of Unit 3, or the 86% capture we found in the Flathead NF. In addition, connections to Units 3 and Unit 6 from Unit 5 will be necessary to retain genetic flow. Later in these comments we will address the expansion of protections into SE Idaho, NE Utah, and NW Colorado in the Yellowstone to Uintas Connection.

Squires et al (2010)¹⁴ studied lynx in the Swan River drainage near Seeley Lake, Montana. The area was bordered by the Mission Mountain and Bob Marshall Wilderness areas. See Figure 3 for a map illustrating how studies or areas accessible to people can result in more observations compared to areas such as wilderness where human presence is low in winter. Does this mean, therefore, that the wilderness is not a suitable habitat? This speaks to the need for ongoing standardized surveys. This is a necessary element of any recovery effort.

We also looked at MNHP observations in Glacier National Park (GNP). (Figure 4). This shows scattered lynx observations that are lower in density than areas outside the park. Does this

¹⁴ Squires, J.R., Decesare, N.J., Kolbe, J.A., and Ruggiero, L.F. 2010. Seasonal Resource Selection of Canada Lynx in Managed Forests of the Northern Rocky Mountains. *Journal of Wildlife Management*, 74(8):1648-1660. 2010. Published By: The Wildlife Society DOI: 10.2193/2009-184 URL: <http://www.bioone.org/doi/full/10.2193/2009-184>

mean the park has little suitable lynx habitat? Note the observations are along valleys where people may have access in winter, but not the wider area. A park-wide occupancy survey using motion activated cameras found a mean of 52 individual lynx and density of 1.28/100 km². Later, when we look at the Olson et al (2021) Model and its mean habitat probabilities across management areas, we see that Glacier NP is not rated high, yet it has a significant population. This argues for an expanded interpretation of Olson et al (2021) to include areas with mean habitat probabilities at least at or higher than Glacier NP.

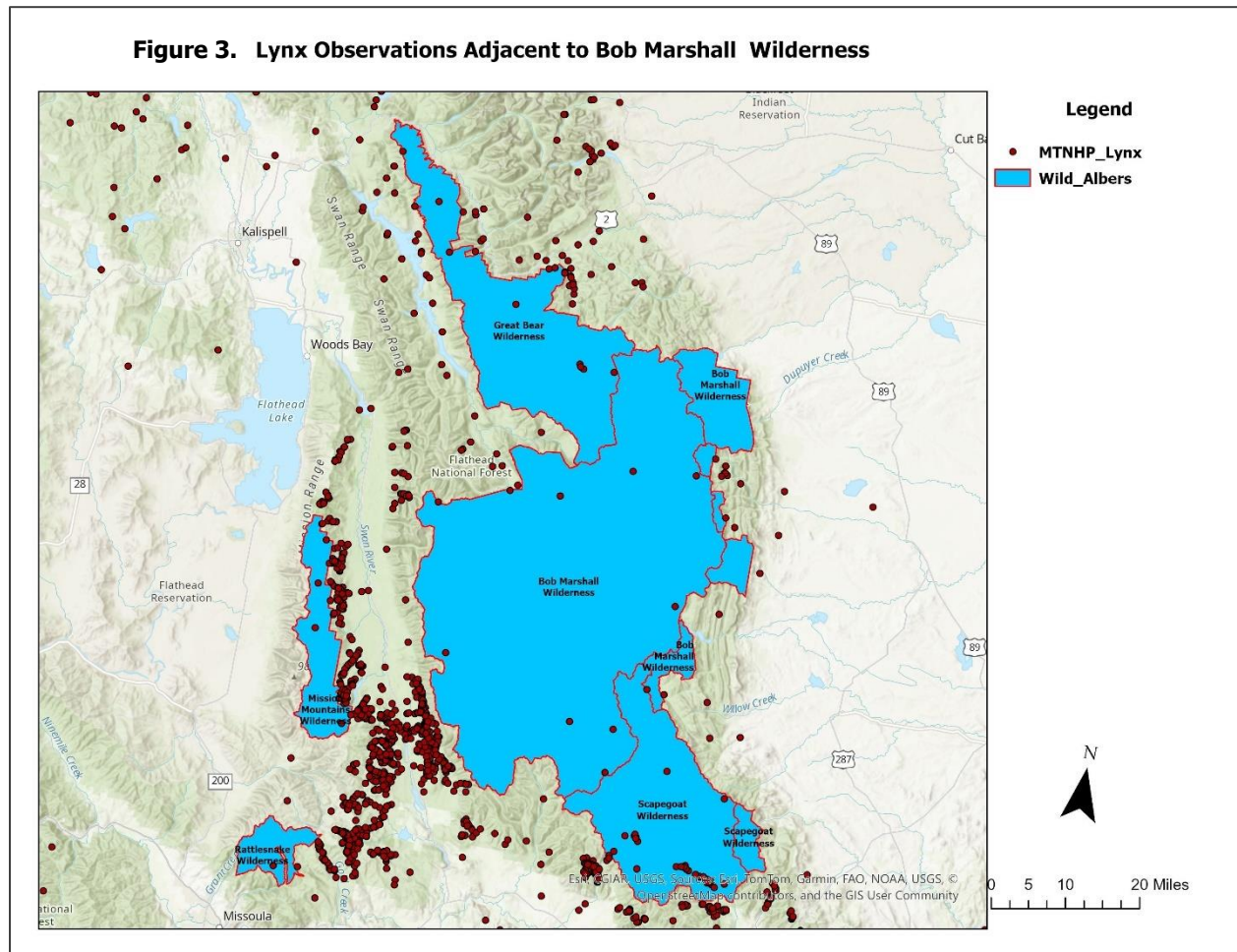
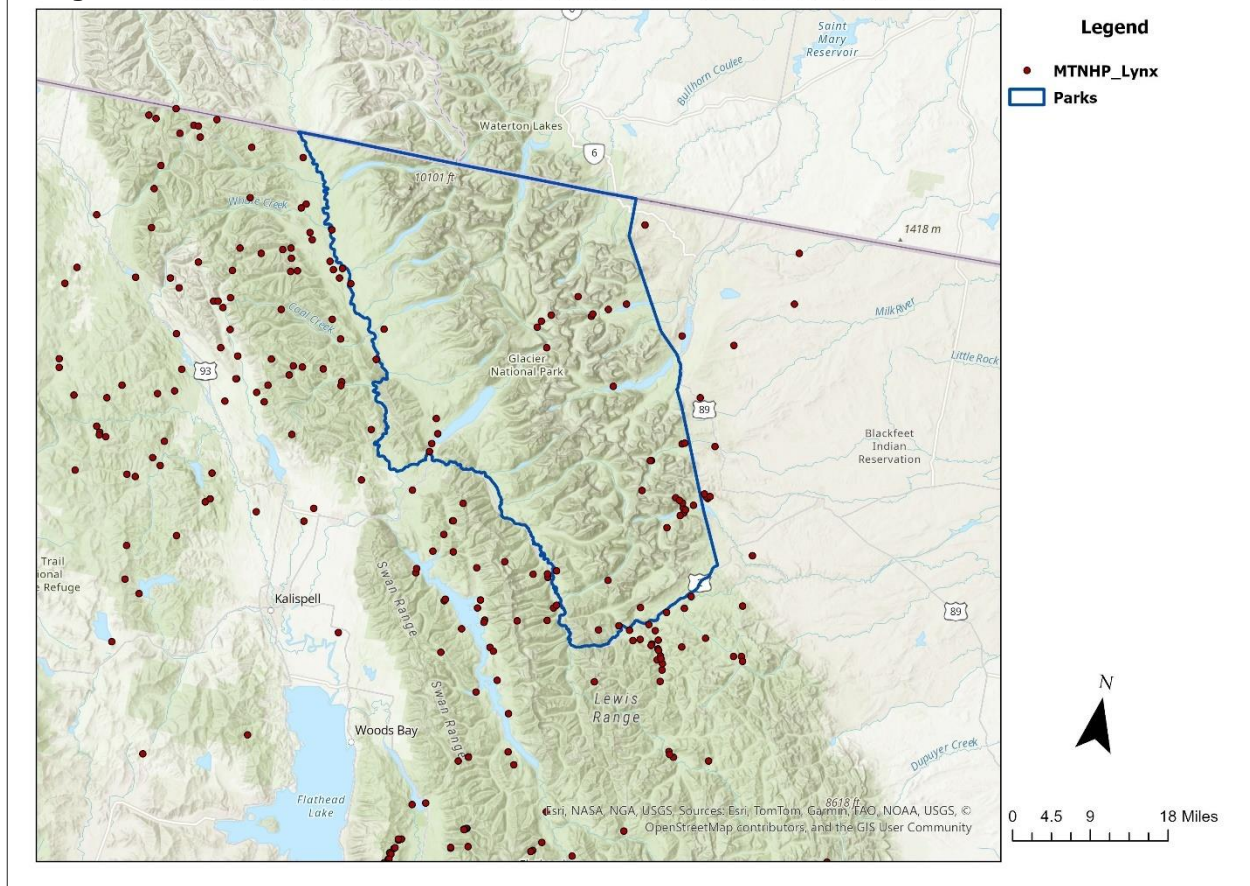


Figure 4. MNHP Lynx Observations Glacier National Park and Surrounding Area



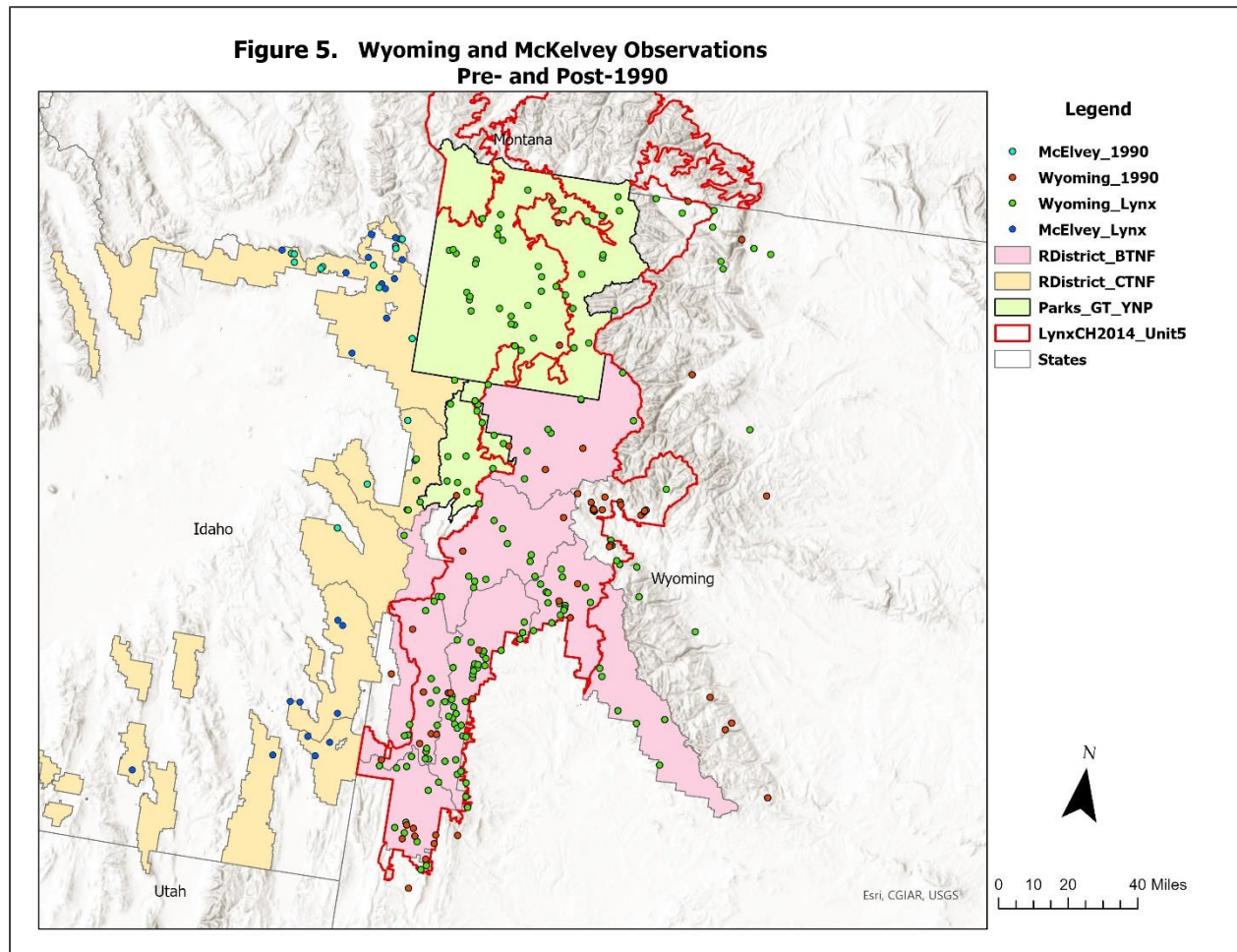
In another example, the FEIS for the Dairy Syncline Mine in the Canada lynx linkage in SE Idaho shows 6 lynx observation locations (FEIS Figure 3.7.2), but we have no coordinates and dates for these.¹⁵ The FEIS notes that IDFG Fish and Wildlife Information System records contain one observation of a female lynx with two cubs in August 2005, two miles southeast of the Blackfoot River Narrows and approximately 0.5 mile from the wildlife Study Area. (FEIS p3-169). These observations occurred in either or both the Soda Springs and Montpelier Ranger Districts of the CNF. “The Montpelier and Soda Springs Ranger Districts, including the Study Area, have been identified as potential linkage habitat between the ‘core’ Canada lynx habitat in Bridger-Teton National Forest and “‘peripheral’ habitat in the Ashley National Forest in Utah (USFS 2003b¹⁶; USFS 2007¹⁷)”. Also see [Figure 1](#) from the FEIS for the Northern Rockies Lynx Management Direction.

¹⁵ U.S. DOI. 2019. Final Environmental Impact Statement Proposed Dairy Syncline Mine and Reclamation Plan. <https://app.box.com/s/jmod5pcq1txhv4wmply3oxuazlm16tau>

¹⁶ USFS. 2003b. Final Environmental Impact Statement for the Caribou National Forest Revised Forest Plan. Idaho Falls, Idaho. <https://app.box.com/s/pqa6bwpzxnxwh7mx7g4i370jbzerlnne>

¹⁷ USFS. 2007. Final Environmental Impact Statement, Northern Rockies Lynx Management Direction. National Forests in Montana, and parts of Idaho, Wyoming, and Utah. March

We generated a map of observations before 1990 and after 1990 for the Contiguous area included in the Grand Teton and Yellowstone National Parks, Bridger-Teton NF, and Caribou-Targhee NF. (Figure 5, Table 2). This map illustrates the connection between these areas. The observations notated with _1990 are observations including 1990 forward. Some of the Wyoming observations overlay the McElvey observations, so we only include the Wyoming observations within Wyoming. Obtaining the current database for lynx observations in Idaho would fill in missing points such as the ones mentioned above in the Dairy Syncline discussion.



Referring to the Federal Register Notice citation of the ESA definition of critical habitat:

(i) the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protections; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed, upon a

determination by the Secretary of the Interior (Secretary) that such areas are essential for the conservation of the species

Table 2. Summary of Pre- and Post-1990 Observations by Area

Area	Observations Pre-1990 (Date Range)	Observations from 1990 (Date Range)	Total Observations
Grand Teton and YNP	57	5 Most recent 2008	62
Caribou-Targhee NF	32	14 Most recent 1998*	46
Bridger-Teton NF	99	25 Most recent 2010	124

*note the female and 2 kittens in 2005 from the Dairy Syncline reference should be included.

In our prior comments on the 2017 SSA, we referenced the FWS “Clarification of Findings” in a Remand Notice. ([Comments January 25, 2023, p5](#)). That document stated that “no evidence” was found that forest roads pose a threat. It also stated that mining and grazing were not “specifically addressed because we have no information to indicate they pose threats to lynx.” Then, over snow recreation was explained away due to “no evidence”. Timber harvest was described as beneficial, benign, or detrimental depending on harvest, spatial and temporal conditions. The Olson et al (2021) paper noted that human activities can displace lynx. We have argued that recreation has exploded in these Rocky Mountain Forests and that the claim that forest roads have little impact was based on little used roads in Washington.

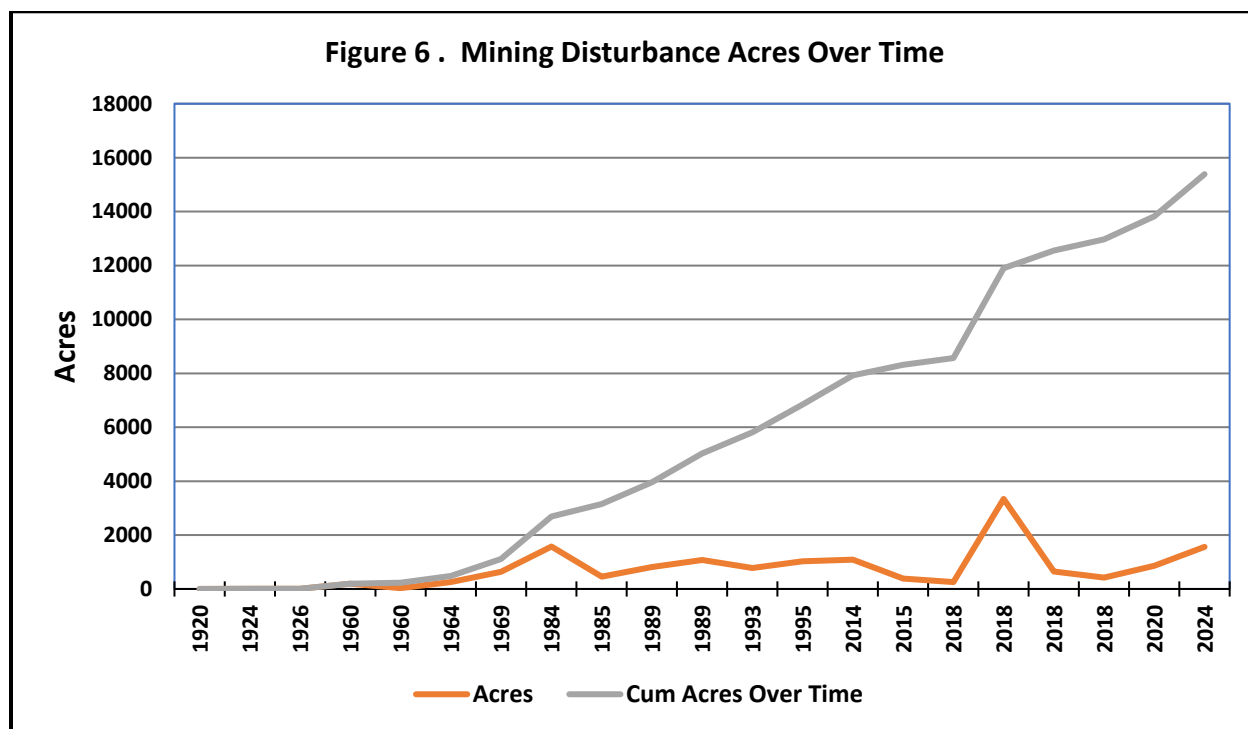
In our [comments](#) on the 2017 SSA, we noted that the 2013 Lynx Conservation Assessment and Strategy¹⁸ refute these broad assertions. An illegal shooting example from Colorado is provided, showing over 14% of reintroduced lynx were shot in the first 10 years. (LCAS p84). Forest/backcountry roads and trails with low vehicular or snowmobile traffic “had little effect on lynx seasonal resource-selection patterns” and lynx traveled on roads “unplowed during winter”. “Squires et al (2008) reported that lynx denned farther from all roads compared to random expectation. ... occupy dens in early May when many forest roads are still impassable... snowmobiles no longer use the roads because of intermittent and unpredictable availability of sufficient snow.” Finally, “fewer roads were located in denning habitat and higher road density occurred along forest edges and in managed stands, which lynx avoided....” (LCAS p84). But these factors are all dismissed as affecting lynx in the Remand Notice and we find no regulatory standards regarding these activities relating to lynx and lynx habitat in the Caribou National Forest or other Forests we have reviewed.

Even the mining industry acknowledges that mines have detrimental impacts. For example, in the Dairy Syncline FEIS, it is stated, “The year-round noise and human activity associated with

¹⁸ Interagency Lynx Biology Team. 2013. Canada lynx conservation assessment and strategy. 3rd edition. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication R1-13-19, Missoula, MT. 128 pp. <https://app.box.com/s/p80ykdfc41slqnm55j8f2qo5m7npb4aj>

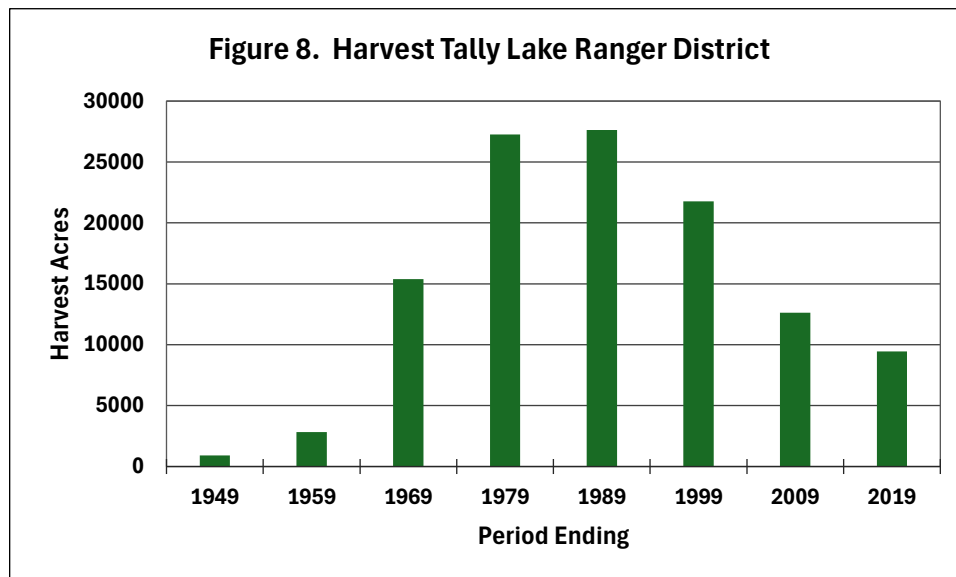
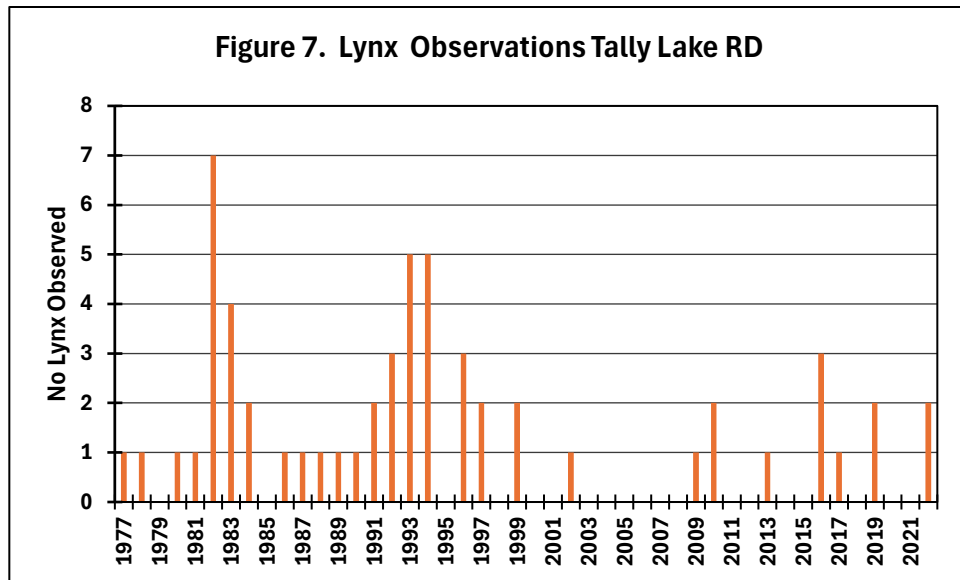
the construction and active mining phases of the Proposed Action would likely influence Canada lynx to travel around the periphery of the disturbed area". (Dairy Syncline FEIS p4-106). Note that these mines have about 400 blasts per week, excavation, and hauling going on 24/7 throughout the year.

We have argued that the increased habitat destruction by mining in SE Idaho since the 1960's has disrupted lynx habitat and occupancy. Figure 6 is a chart of mining disturbance over time in the Montpelier and Soda Springs Ranger Districts in the Caribou NF, identified as lynx linkage connecting to the areas to the south. When the haul roads and other infrastructure are added, the area of disturbance is even larger.



We recently looked at the Tally Lake Ranger District in the Flathead NF to summarize lynx observations in relation to historical timber harvest. We used the McKelvey and MNHP observation data along with forest stand actions such as logging, thinning and other silviculture activities. Forest Service national databases were downloaded for this analysis. This data may not include all actions, and we have submitted a FOIA to the Flathead and Bridger-Teton NFs for their current data.¹⁹ The trends in observations and forest timber activities are shown for the Tally Lake Ranger District in Figures 7 and 8.

¹⁹ <https://data.fs.usda.gov/geodata/edw/datasets.php> Accessed November 18, 2024.



We did a macro look at roads in the National Forests in SSA Units 3 and 5. (Table 3). This was based on the Forest Service MVUM open roads and trails.²⁰ We looked at overall density and for a rough estimate, took out the areas of IRAs and Wilderness to calculate an approximate density in unprotected areas. These do not include many classes of roads and trails such as user-created, non-system, temporary, county, highway and others. There is a wide variation and there is a need for a more detailed analysis to determine why lynx occupies some areas with higher road density and don't occupy some with low road density. Are the areas with lynx present made so by the extent of protected areas? Are connections more highly

²⁰ <https://data.fs.usda.gov/geodata/edw/datasets.php> Accessed November 18, 2024.

fragmented by roads than the overall Forest? We would suggest this is the case in the Phosphate Mining Area in SE Idaho and in the Caribou NF where snowmobile access is open in 97% of the Forest and groomed trails proliferate. A further element in the analysis would be the level of use of these roads and determination of which constitute barriers to lynx due to intensive use in summer and winter.

Table 3. Summary of Road Miles/Square Mile - Protected v Unprotected

Forest Name	Miles/SqMi Entire Forest	Miles/sqmi unprotected
Beaverhead-Deerlodge National Forest	0.83	1.92
Bitterroot National Forest	1.11	3.62
Boise National Forest	1.20	2.22
Bridger-Teton National Forest	0.41	1.89
Caribou-Targhee National Forest	0.58	1.31
Custer Gallatin National Forest	0.43	0.96
Flathead National Forest	0.86	2.08
Helena-Lewis and Clark National Forest	0.66	1.80
Idaho Panhandle National Forests	1.81	2.51
Kootenai National Forest	1.92	2.66
Lolo National Forest	1.59	2.44
Nez Perce-Clearwater National Forest	1.20	3.40
Payette National Forest	0.79	2.66
Salmon-Challis National Forest	0.58	3.32
Sawtooth National Forest	0.53	1.97
Shoshone National Forest	0.28	1.64

What is missing in the analyses we have seen for lynx critical habitat, recovery planning, and at the project level are the spatial and temporal effects of roads, timber, mining, and recreation. Project analyses for Forest projects we are familiar with in the Northern Rockies (NR) and GYA have lacked this analysis. While clear-cuts and sparse forests may receive some lynx use, their suitability for lynx is significantly reduced for a significant amount of time. It has been shown not only that those clear-cuts and sparse forests are strongly avoided by lynx, but that restoration of lynx habitat use in these logging areas to 50% of previous use takes 20 years in forest thinnings, and 34-40 years for selection cuts and clear-cuts. Also, all logging treatments are avoided by lynx for at least 10 years.²¹ Predictors for lynx reproductive success within

²¹ Holbrook, J.D., Squires, J.R., Bollenbacher, B., Graham, R., Olson, L.E., Hanvey, G., Jackson, S., Lawrence, R.L., 2018. Spatio-temporal responses of Canada lynx to silvicultural treatments within the

occupied female home ranges were the connectivity of mature forest, intermediate (10 - 15%) amounts of young regenerating forest, young regenerating forest patches with low perimeter - area ratios, and the adjacency of mature forest to young regenerating types. Female lynx home ranges with greater than 50% mature forest and 10 - 15% young regenerating forest appear to be the optimum.²²

Another factor that is dismissed is trapping and the effects on lynx. For example, Wyoming has trapping for coyotes, bobcats, wolves and other fur bearers. A recent report from Wyoming Game and Fish Department for bobcat trapping summarized the trapping effort in Wyoming. Annual trapping licenses ranged up to 2,699 and annual trap nights ranged from 251,852 – 653,682 over a ten-year period.²³ Trapping in Montana is widespread as it is in Idaho. Britell et al (1989) noted that hunting and trapping were the principal causes of mortality for lynx and that lynx are vulnerable to trapping.²⁴ They also noted that improved access encourages use of hound hunting and hound hunting is strongly influenced by road access. “Overexploitation, particularly during the critical low (population) period, minimizes the potential recovery, reduces the expansion of dispersing lynx into vacated habitats and jeopardizes sub-populations in the more accessible areas. This emphasizes the need to secure lynx distribution and numbers of low prey abundance.” In the GYA and Southern Rockies Units where habitat suitability is lower than in the Canadian and Unit 3 areas that are connected, it is even more critical to reduce stressors on lynx habitat and prey.

Referring to the Notice regarding designation of CH, in making decisions on occupancy, critical habitat, and recovery, the Olson et al (2021) Model needs to be supplemented by an analysis of these spatial and temporal factors across all National Forests in Units 3, 5, and 6 along with an expansion of the Model to cover the habitats and connections between these. In addition, the occupancy in Unit 6 was based on a barely begun reintroduction program with lynx dispersing north to the Uinta Mountains and GYA. These areas with suitable habitat such as in the Caribou-Targhee NF and the higher elevation corridor connecting the Unit 6 to Unit 5 should be given the same consideration. If lynx were supplemented in Unit 5, the Uinta Mountains and elsewhere, they might have also been considered for critical habitat.

Later in these comments we refer to the Squires et al (2024) analysis and model which took disturbance factors into account. We suggest that the Northern Rockies and Greater Yellowstone Area and the connections between these and the Southern Rockies (Model Gap)

Northern Rockies, U.S. For. Ecol. Manage. 422, 114–124.

<https://app.box.com/s/hmpchp3j22gew0a1r54fzsovqw0hvfq>

²² Kosterman, M.K. 2014. Correlates of Canada Lynx Reproductive Success in Northwestern Montana. Graduate Student Theses, Dissertations, & Professional Papers. 4363.

<https://scholarworks.umt.edu/etd/4363> Accessed on January 22, 2023.

²³ Wyoming Game and Fish Department. 2023. Bobcat License Data Summary Tables I and II.

<https://app.box.com/s/5jip64tw16qy2inwclzd4gxb11rrw7ws>

²⁴ Britell, J.D., Poelker, R.J., Sweeney, S.J. and Koehler, G.M. 1989. Native Cats of Washington. 49p.

<https://app.box.com/s/8ijb4b47bgp2xnhrhjuloi9joh4bex9j>

be provided with the same modeling protocol to identify connections and priority habitat protections on the National Forests and other public lands.

2. Snow Depths as a Limitation

The Notice indicates that snow conditions (consistency, depth and duration) are needed to allow lynx to outcompete competitors. Squires et al (2010)²⁵ found that snow depth was deeper at 86 cm (SD=34) than generally available at 80 cm (SD=32), not significantly different, within home ranges but found no evidence that snow penetrability affected lynx travel routes. Gatlin (2020)²⁶ in updating lynx Analysis Units for the Beaverhead-Deerlodge NF, determined from these data and watershed evaluations that lynx selected habitats with a minimum snow depth of 50 cm (20 inches).

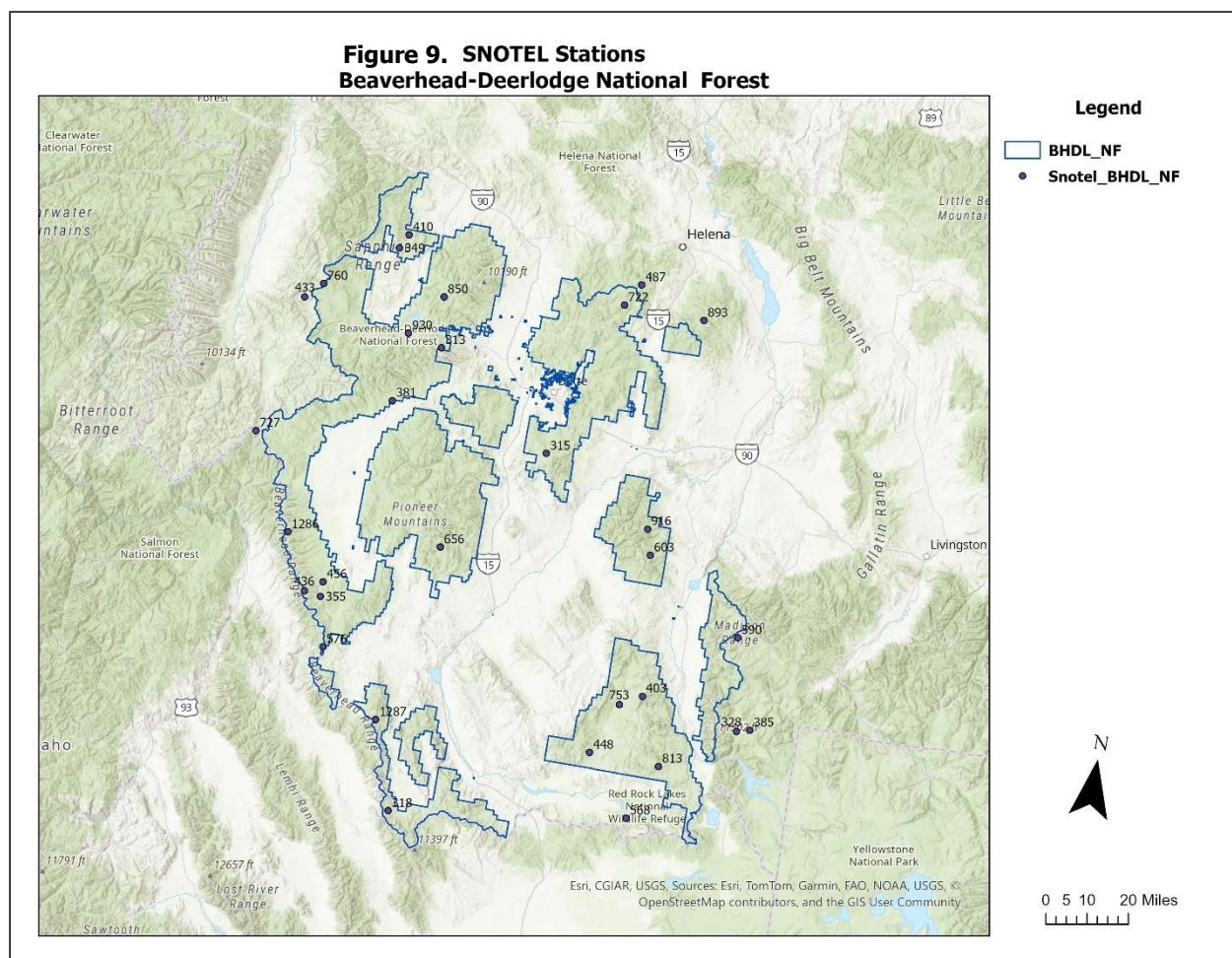
We analyzed snow depths at snow monitoring stations over a 21-year period ending in March 2024 within and adjacent to the Beaverhead-Deerlodge NF in conjunction with a project there. (Table 4, Figure 9). There were 29 monitoring stations covering all elevations and areas within and adjacent to the Forest. This analysis illustrates that in most years at all elevations sufficient snow depth is available to accommodate lynx. Even at the lowest elevations, there is sufficient snow in nearly half to 90% of the years.

Table 4. Years At or Above Minimum Snow Depth of 20 Inches in Wisdom Ranger District, Beaverhead-Deerlodge NF

Station	Elevation, ft	Count of Years/percent of 21-year record
Combination 410	5600	9/43%
Daly Creek 433	5780	21/100%
Calvert Creek 381	6430	18/85%
Frohner Meadow 487	6480	21/100%
Tizer Basin 893	6880	21/100%
11 Stations	7000 - 8000	21/100%
13 Stations	8000 – 9000	21/100%

²⁵ Squires, J. R., Decesare, N. J., Kolbe, J. A., & Ruggiero, L. F. (2010). Seasonal resource selection of Canada lynx in managed forests of the northern rocky mountains. *Journal of Wildlife Management*, 74, 1648–1660. <https://doi.org/10.2193/2009-184>. <https://app.box.com/s/fy8nll964ai9wzju67jcgvgb84ce9l88>

²⁶ Gatlin, J., and O.Neil, J. 2020. Habitat Mapping Documentation for Canada Lynx (*Lynx Canadensis*) on the Beaverhead-Deerlodge National Forest – 2020 Update. In: Gatlin (2021) Biological Assessment for Canada Lynx -Effects of the 2009 Revised Forest Plan and the Northern Rockies Lynx Management Direction. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd901415.pdf



Then we located lower and higher elevation snow monitoring stations in Wyoming, SE Idaho, and NE Utah. (Figure 10). These are located in the Yellowstone to Uintas Connection. The Wyoming SNOTEL (East Rim 460) is in the lynx migration path in the GYA connecting the Wyoming and Wind River Ranges mapped by Squires and Oakleaf (2005)²⁷. The Bondurant station is an ACIS station. Table 5 shows the number of days these stations exceed the 20-inch depth minimum as well as the East Rim Divide station relative to the 36-inch mean depth from Squires et al (2010). Both locations have significant numbers of days exceeding these snow depth limits.

²⁷ Squires, J.R. and Oakleaf, R. 2005. Movements of a male Canada Lynx crossing the Greater Yellowstone Area, Including Highways. Northwest Science 79(2&3):196 – 201.
<https://app.box.com/s/67s5soh1bi5stphx7mojstclqouxadz1>

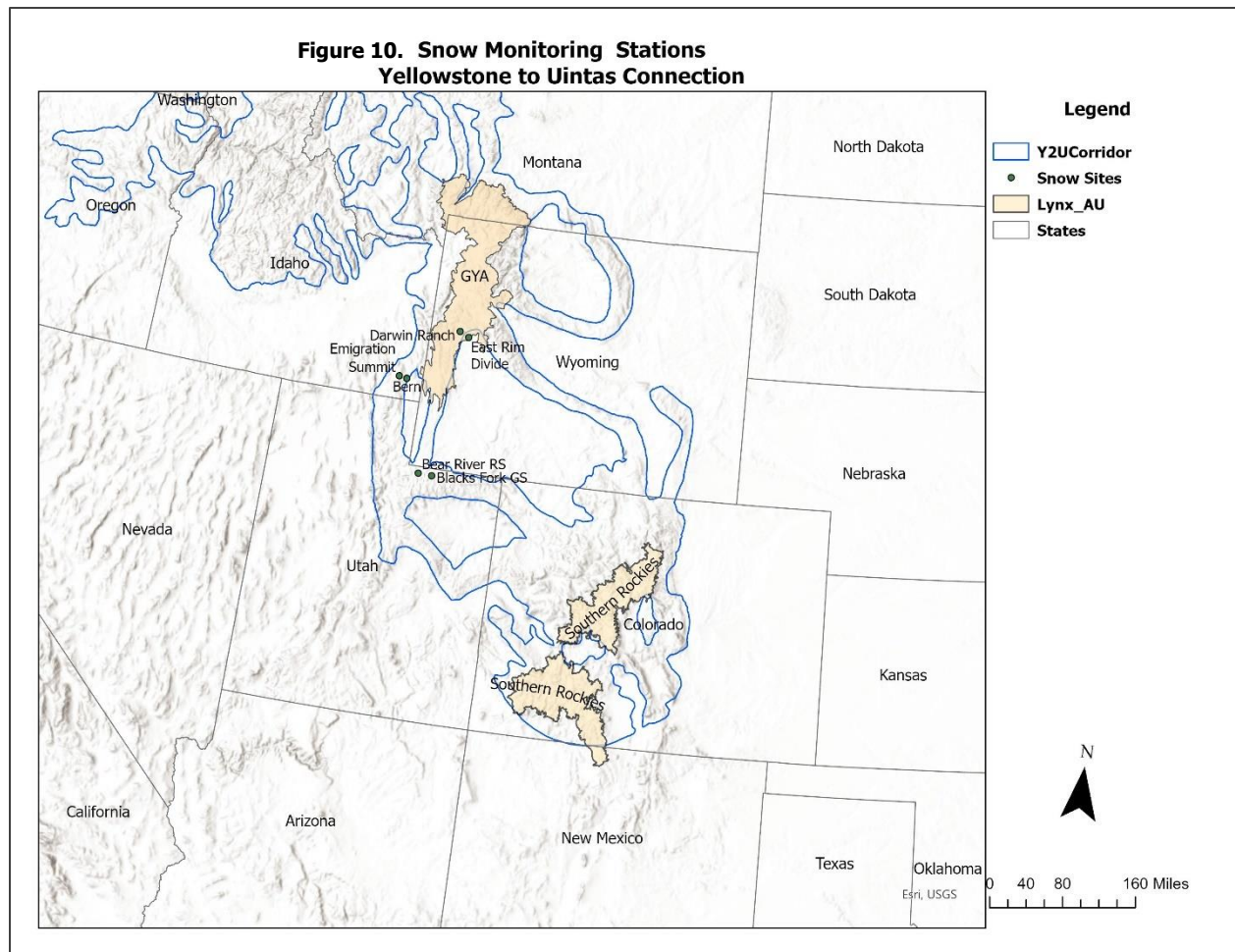


Table 5. Snow Depth Statistics for SNOTEL and ACIS Network Stations Wyoming 2011 - 2021

Station Name	Min/Mean/Max Days Above	Date Range for Onset of Depth Limit	Date Range for End of Depth Limit
Bondurant Darwin Ranch	0/68/128 > 20 in.	12/21 - 2/8	3/15 - 5/1
East Rim Divide	95/123/152 > 20 in.	11/26 - 1/4	4/9 - 5/4
East Rim Divide	1/49/94 > 36 in.	1/7 - 3/22	3/3 - 4/21

In SE Idaho we used the higher elevation Emigration Summit SNOTEL (471) and the lower elevation Bern ACIS station. Note that these are in the Bear River Range and its foothills. This area is rated as high probability habitat in the Olson et al (2021) Model. We also used SNOTEL stations for the Uinta Mountains where lynx was historically observed and had lynx

occurrence from the Colorado reintroductions. These are summarized in Table 6 and charted below in Figures 11 - 16. These are provided as indicative of the adequacy of snow in these important areas in the GYA and the Regionally Significant Wildlife Corridor (Yellowstone to Uintas Connection) connecting the GYA to the Uinta Mountains and Southern Rockies. That corridor follows the Bear River Range in SE Idaho through the higher elevation areas in Utah to the Uinta Mountains. Table 5 shows that at the higher elevations snow depths are adequate in all years, while the lower elevations have snow exceeding the 20-inch minimum in over half the years. Having cross-country skied and snowshoed in these areas, we can attest to the great snow, and it is also important to recognize that the Y2U connection in Utah contains historic ski areas that rely on deep snow. Snow in Unit 3, 5 and 6 is not limiting for Canada lynx.

Table 6. Snow Depth Monitoring Stations Wyoming, SE Idaho, and NE Utah

Station Name	Elevation	Years of Record Used	Years Above 20" minimum	Percent of Years exceeding 20" Minimum
Emigration Summit	7390	22	22	100%
Bern	5964	22	15	68%
East Rim Divide	8010	11	11	100%
Darwin Ranch	6620	13	11	85%
Bear River RS	8510	15	15	100%
Blacks Fork GS	9360	15	15	100%

Figure 11. East Rim Divide Snotel 460

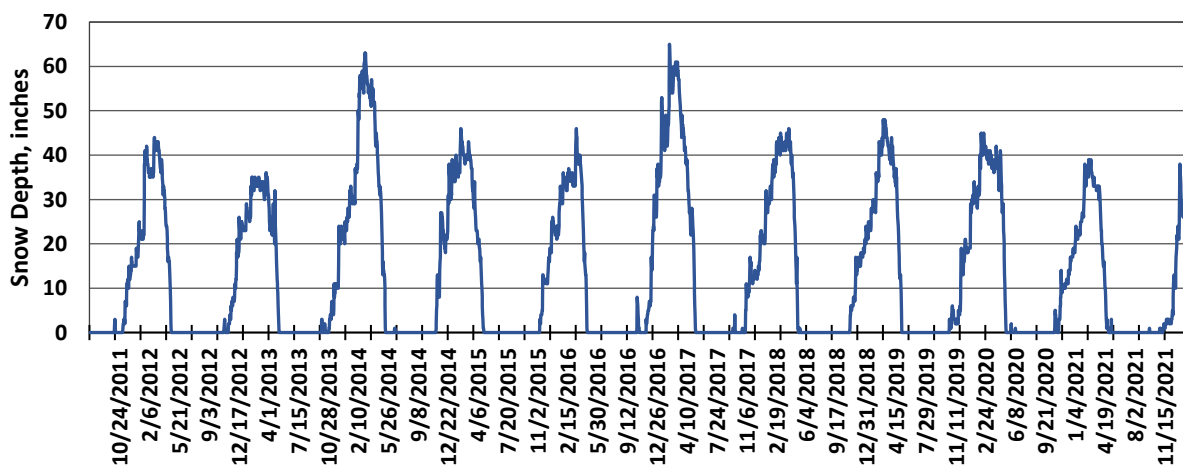


Figure 12. Bondurant Darwin Ranch

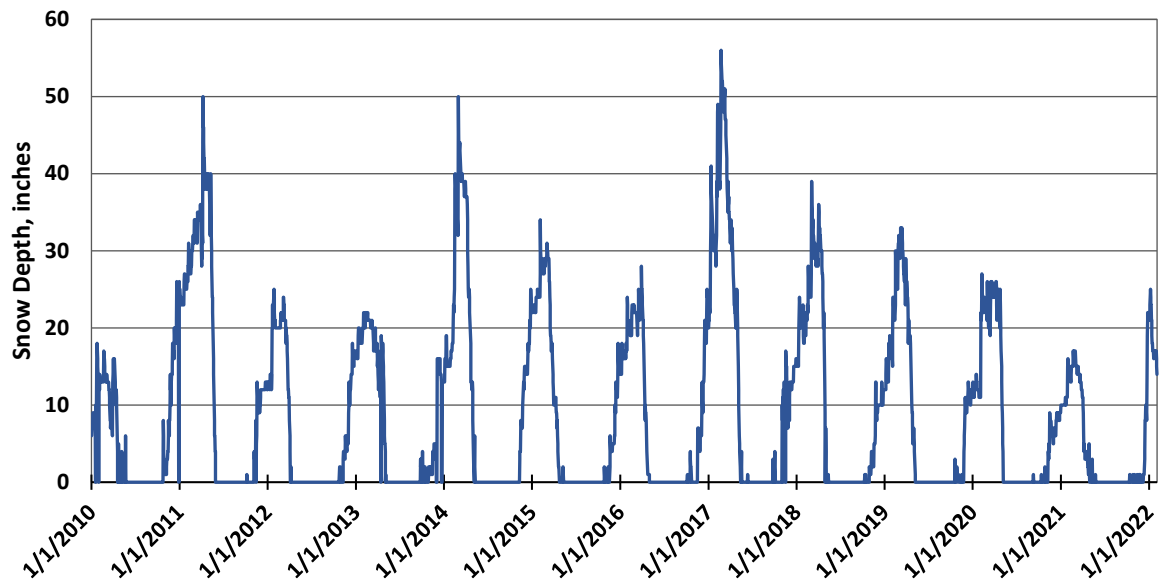


Figure 13. Emigration Summit Snow Depth

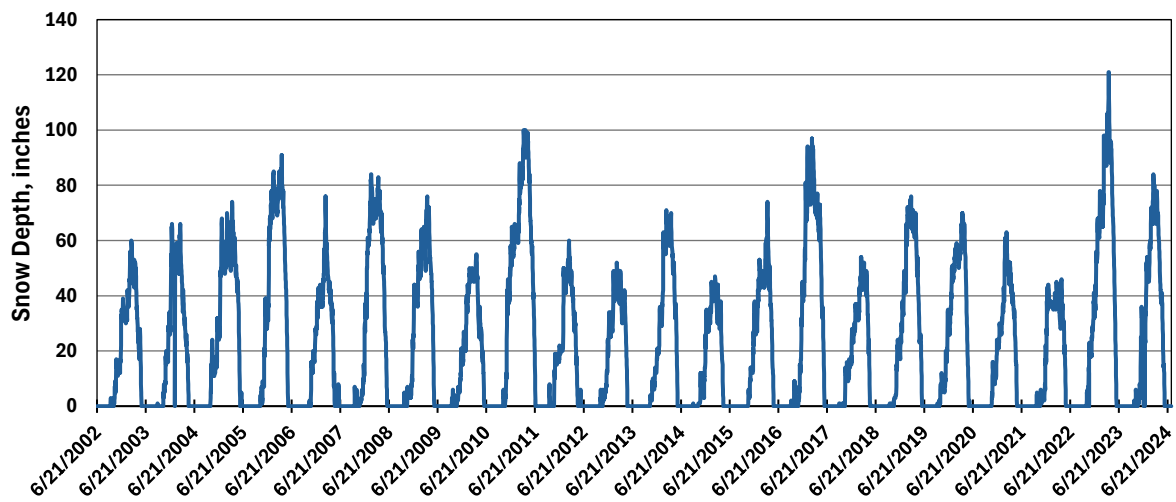


Figure 14. Bern Station Snow Depth

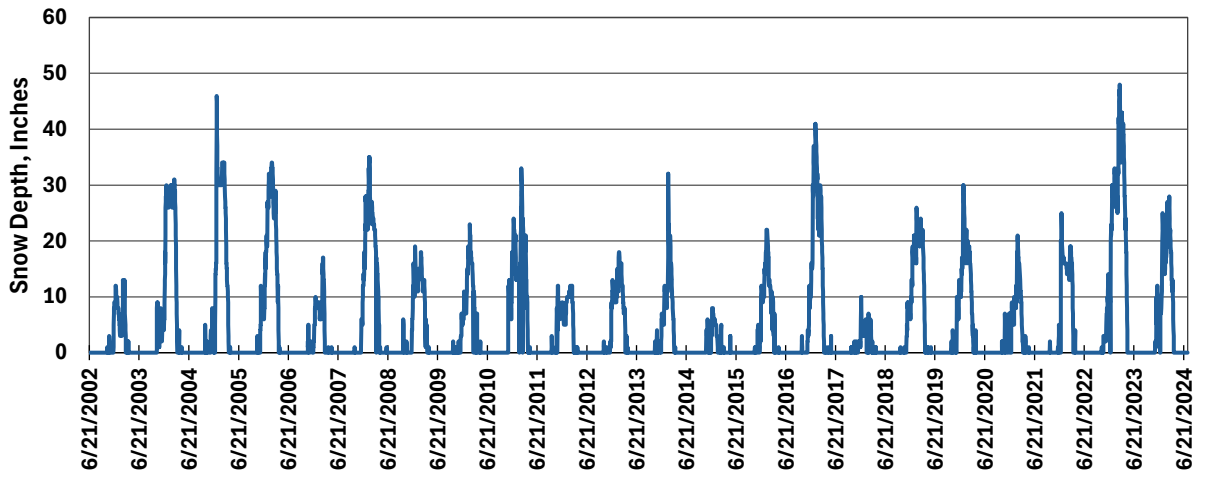
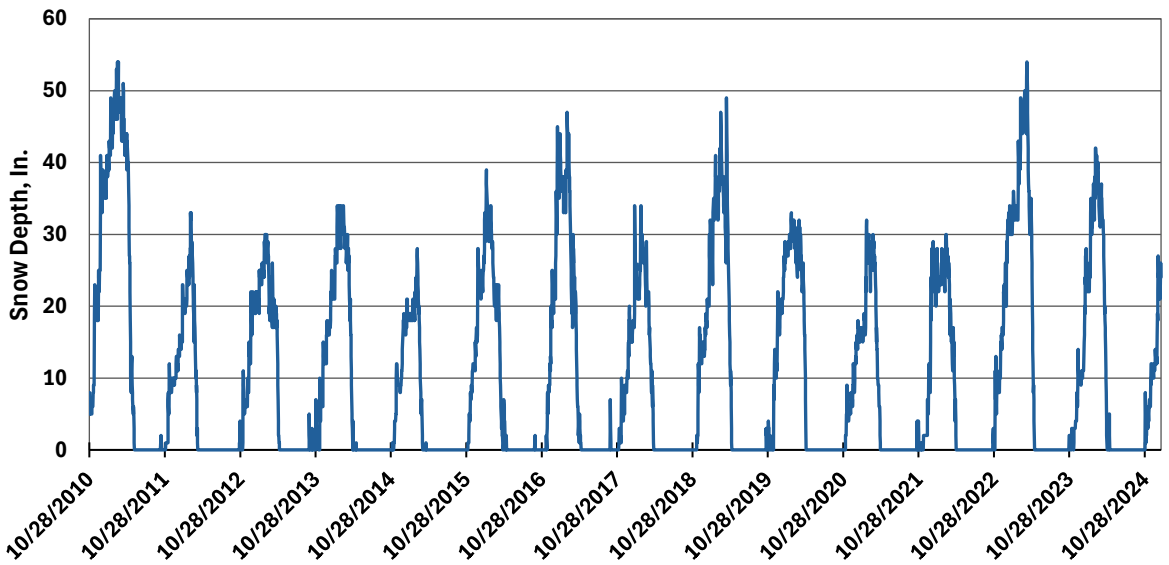
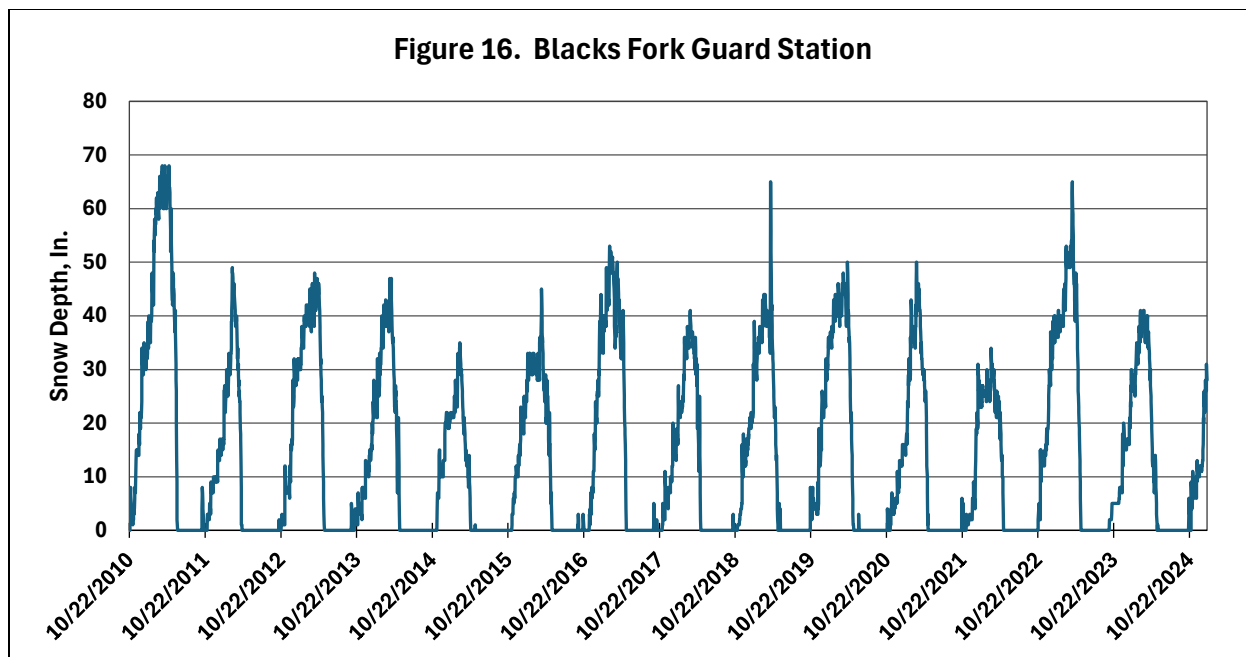


Figure 15. Bear River Ranger Station





3. Snowshoe Hare Populations

The Federal Register Notice also limits Unit 5 due to low snowshoe hare abundance, but in our prior comments on the Species Status Assessment, we pointed out that monitoring is spotty and that the Science Report indicates there are sufficient snowshoe hare present. When we request snowshoe hare studies from the Forest Service, they are few and far between. The Lynx BA²⁸ noted that land use plans have failed to provide monitoring of lynx, snowshoe hares, and their habitats.

The Science Report (SR) Chapter 13 reviewed the ecology of lynx in these southern areas and compared them to the taiga in Canada.²⁹ In both regions, lynx occurred where snowshoe hares were abundant. In the southern region, lynx was known to make exploratory movements prior to dispersal. The Colorado tracking data clearly illustrates these exploratory movements. Habitats in the southern region are patchier, and lynx make more use of alternate prey. For instance, lynx scats collected in north-central Washington contained 79% snowshoe hare and 24% red squirrel. (SR p376 - 377). Snow tracking studies in the southern Canadian Rocky

²⁸USDA Forest Service and DOI Bureau of Land Management.1999. Biological Assessment of the Effects of National Forest Land and Resource Management Plans and Bureau of Land Management Land Use Plans on Canada lynx. <https://app.box.com/s/pc4oefty80a9gd4sa0757tne6020hp4>

²⁹ Ruggiero, Leonard F.; Aubry, Keith B.; Buskirk, Steven W.; Koehler, Gary M.; Krebs, Charles J.;McKelvey, Kevin S.; Squires, John R. 2000.. Ecology and conservation of lynx in the United States. General Technical Report RMRS-GTR-30WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Available at: http://www.fs.fed.us/rm/pubs/rmrs_gtr030.html

Mountains found prey consisted of 52% snowshoe hare, 30% red squirrels, and the rest were flying squirrels, martens, voles, and grouse plus unknowns. Snowshoe hare densities were estimated to range from 0.01 - 0.47 hares/ha. (SR p377). *"In southern boreal forests, limited data suggest that because snowshoe hares typically occur at low densities (Chapter 7), alternative prey may always be important components of lynx diets, especially in the western mountains."* (SR p378). This refutes the total reliance on snowshoe hares that is being used to discount occupancy and habitat in these southern regions.

We previously referenced the association between lynx locations and habitat. The predominant association was with Rocky Mountain Conifer in these western interior states. Lynx uses a variety of habitats and elevations between summer and winter. Generally, they use higher elevations in more southerly locations and between summer and winter. Most conifer types are included in areas used by lynx and can include Douglas-fir, western larch, lodgepole pine, subalpine fir, whitebark pine, and Engelmann spruce. Occasionally, they will occur in non-forested areas such as shrub-steppe. (SR p379). Snow tracking in Washington found that lynx traveled around meadows and used thinned stands that contained several hundred trees per ha. (SR p381).

Home ranges in these southern areas are larger than in the north. The average for males is 151 km² and females, 72 km². In west-central Wyoming they were smaller at 90 and 66 km². (SR p383 – 384). These compare favorably with the Glacier National Park results cited earlier. In Washington, home ranges were bounded by rivers, ridges, and major highways. (SR p385). Exploratory movements in Montana ranged from 17 to 38 km. (SR p386). Dispersal can take place over larger distances of several hundred km. (SR p386 -387). In the north-central Washington study, 8 kittens were documented in a population of 23 lynx during the three-year study. Estimates of total lynx density for the 1,161 km² area was 2.4 lynx/100 km². (SR p387). Comparisons are made to northern populations during the lows in hare cycles, indicating similar demographics occur in the southern populations compared to these lows. (SR p389).

Because lynx are dependent on snowshoe hares for a majority of prey, we have looked for information on hare density in these southern states. Chapter 11 of the Science Report summarizes densities in Montana as well as the Wyoming Range. (SR p346). Hare densities from these studies ranged from 0.6/ha to 1.4/ha. Two studies cited from Utah gave densities ranging from lows in aspen with dense understory of 0.22/ha to 2.7/ha in spruce-fir habitat. Intermediate numbers occurred in Douglas-fir (0.57/ha and subalpine fir of 0.99/ha). Hare densities in Colorado ranged from 0.26/ha in aspen, to 0.46 in Engelmann spruce.

These southern hare densities compare to population lows in areas of Canada with persistent lynx populations. For example, from the Science Report (SR p362), *"Hare densities in the southwest Yukon declined from 8.0 to 10.7/ha to 0.2 to 0.5/ha during one cycle (Ward and Krebs 1985), and another population fell from 7.5/ha to 1.3/ha during the next cycle (Slough and Mowat 1996). Similarly, a population in the Northwest Territories fell from 7 to 9/ha to 0.4 to 1.0/ha during the early 1990s (Poole 1994), and a northern Alberta population declined drastically from about 17/ha to 0.34/ha*

during the early 1970s (Brand et al. 1976).” Hare densities at population lows in these studies were sufficient to support lynx populations, although at numbers. Based on the Science Report, hare densities alone are sufficient to support resident populations in these southern regions. When alternate prey is considered, they should be able to persist in the absence of fragmentation by human activities.

Berg and Gese (2010) used fecal pellets and live-trapping to estimate snowshoe hare density in the Bridger-Teton NF.³⁰ Snowshoe hare densities ranged between 0.07 – 4.82 hares/ha with a mean of 1.6 hares/ha. Data we received from the Ashley National Forest included numerous surveys.³¹ While we have not analyzed the complete data set due to time constraints, a summary of seven locations was included with the data provided. The overall estimate from those sites averaged (0.26 – 0.5 hares/ha), with the highest reported site ranging from (0.92 – 1.74 hares/ha). These data show hare densities at or above the levels reported in the Science Report for Colorado and confirm those for Utah. When all prey is considered, it is clear that sufficient prey exists in these southern Forests to support lynx populations, but likely at lower lynx densities.

4. Fragmented Critical Habitat

The currently proposed critical habitat is fragmented between and within Rocky Mountain Analysis Units. (Figure 17). The Biological Assessment³² for Canada lynx documents the importance of peripheral areas as:

Peripheral populations may contain valuable genetic, physiological or behavioral adaptations that are unique to their ecological success. Because suitable habitats in areas where populations act as metapopulations are spatially separated, the persistence of a metapopulation is dependent on the efficiency and success of dispersing animals in reaching isolated patches of suitable habitat. When patches are fragmented and connections between patches do not exist, recolonization becomes problematic and the metapopulation may be unable to persist, even though patches of suitable habitat remain (Meffe and Carroll 1997). Additional fragmentation and isolation of suitable habitat occurring as a result of land management activities can not only affect small isolated habitat patches supporting smaller populations but also large contiguous patches supporting higher population levels.

³⁰ Berg, N.D., and Gese, E.M. 2010. Relationship between fecal pellet counts and snowshoe hare density in Western Wyoming. Journal of Wildlife Management 74(8):1745 – 1751.

<https://app.box.com/s/wej11h7xartsy5qe1vje80aw2wfam2y9>

³¹ Ashley National Forest. 2024. Response to April 4, 2024 FOIA from Yellowstone to Uintas Connection.

³² USDA Forest Service 1999. Biological Assessment of the Effects of National Forest Land and Resource Management Plans and Bureau of Land Management Land Use Plans on Canada Lynx. 149p.

<https://app.box.com/s/pc4oefty80a9gd4sa0757tne6020hp4>

Ruggiero et al (1999) also discusses the effects of fragmentation on competition with lynx by other carnivores and the loss of connectivity.³³ Ruediger et al (2000)³⁴ citing McElvey et al (2000)³⁵ notes that **“a system of reserves embedded in a fragmented and non-natural landscape would not be sufficient to sustain lynx populations. Rather, a strategy that encompasses the entire landscape may be necessary”**. Squires et al (2024)³⁶ notes, “future expansion of human-caused disturbance from urbanization and resort development in the relatively low-elevation valleys that intersect patches of lynx habitat in the Southern Rockies may threaten population connectivity and persistence, but that disturbance threshold is unknown.” This points out the need for specific standards to prevent the destruction of lynx habitat, particularly in these sensitive Units 5 and 6.

Kosterman et al (2018) “The forest characteristics that defined high success included (1) abundant and connected mature forest and (2) intermediate amounts of small-diameter regenerating forest.”³⁷ Holbrook et al (2019)³⁸ “the probability of a female producing kittens was most associated with the connectivity of mature, multistoried forests”. Habitat fragmentation, *“accentuates the viability risk inherent in a small population and increases its vulnerability to local extirpation.”* (LCAS p76). Examples of fragmentation include, *“removal of*

³³ Ruggiero, L.F., Aubry, K.B., Buskirk, S.W., Koehler, G.M., Krebs, C.J., McKelvey, K.S., Squires, J.R. (Eds.), Ecology and Conservation of Lynx in the United States. University of Colorado Press, Boulder, CO. (pp84-86). <https://app.box.com/s/6bg8w6k5ru1axlv3zcm5ba2tt3gjz9hg>

³⁴ Ruediger et al. 2000. Canada Lynx Conservation Assessment and Strategy. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication #R1-00-53, Missoula, MT. (p2-19).

<https://app.box.com/s/xr7z1581gtmap9h46zbdzjp8sjzrvocy>

³⁵ McKelvey, K. S., K. B. Aubry, J. K. Agee, S. W. Buskirk, L. F. Ruggiero, and G. M. Koehler. 2000d. Lynx Conservation in an Ecosystem Management Context. Pages 419-441 In Ruggiero, L.E, K. B. Aubry, S. W. Buskirk, G. M. Koehler, C. J. Krebs, K. S. McKelvey, and J. R. Squires. (Tech. Eds.). Ecology and Conservation of lynx in the United States. Univ. Press of Colorado. Boulder, CO. 480 pp.

<https://app.box.com/s/6bg8w6k5ru1axlv3zcm5ba2tt3gjz9hg>

³⁶ Squires, J.R., Olson, L.R., Ivan, J.S., McDonald, P.M., and Holbrook, J.D. 2024. Anthropogenically protected but naturally disturbed: a specialist carnivore at its southern range periphery. Biodiversity and Conservation: <https://doi.org/10.1007/s10531-024-02978-8>

<https://app.box.com/s/qirh6aet9aqkfiwzix9uol1z2mzzuxgp>

³⁷ Kosterman, M.K., Squires, J.R., Holbrook, J.D., Pletscher, D.H., and Hebblewhite, M. 2018. Forest structure provides the income for reproductive success in a southern population of Canada lynx. Ecological Applications 28(4):pp 1032-1043. <https://app.box.com/s/1ecvhd4nznclwdppvyu6naufzpiwzr80>

³⁸ Holbrook, J. D., Squires, J.R., Bollenbacher, B., Graham, R., Olson, L.E., Hanvey, G, Jackson, S., Lawrence, R.L., and Savage, S. L. 2019. Management of forests and forest carnivores: Relating landscape mosaics to habitat quality of Canada lynx at their range periphery. Forest Ecology and Management, 437: 411–425. DOI: <https://doi.org/10.1016/j.foreco.2019.01.011>

<https://app.box.com/s/c2jelk9v0gnyex1r5s2w2myhiws9p3hl>

forest cover, development of highways and associated infrastructure, and intensive minerals or energy development..." (LCAS p77).³⁹

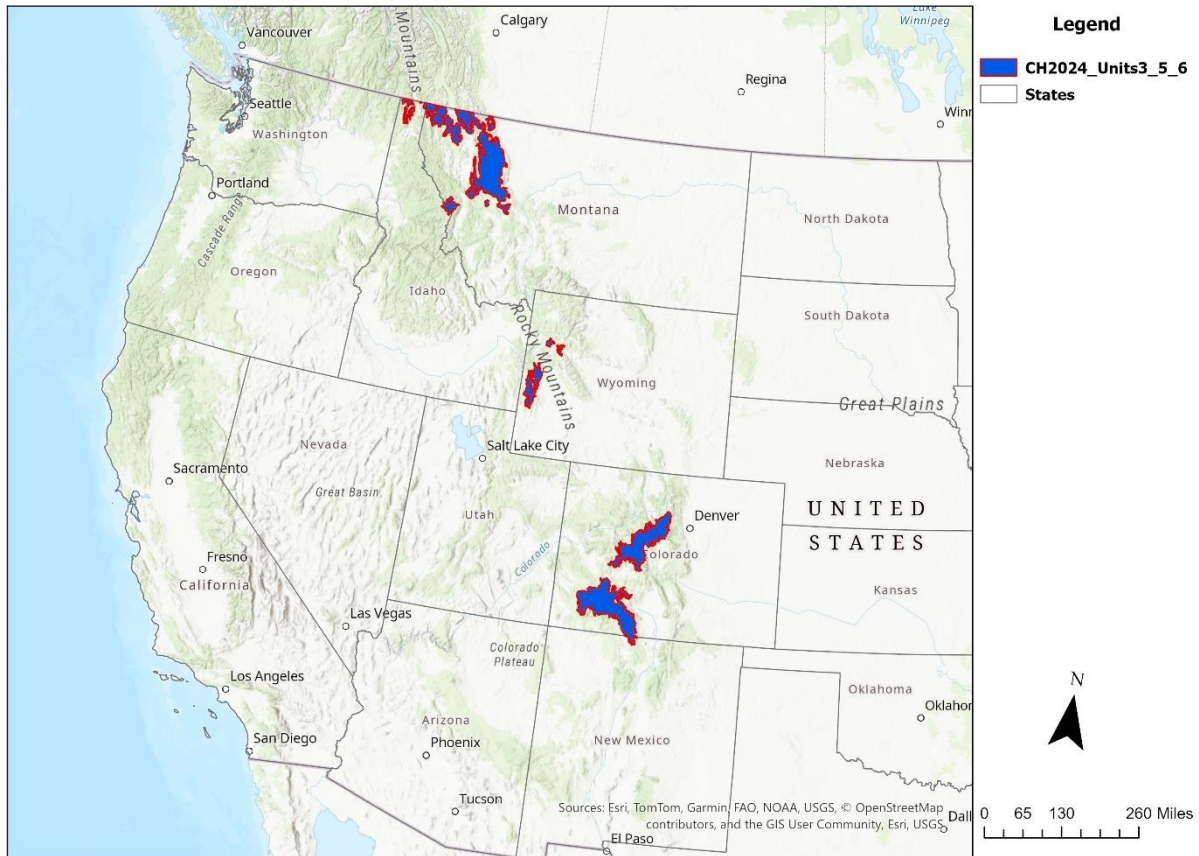
Anderson et al (2023) in their GNP study noted in their camera survey that "odds of lynx detection decreased by 0.8 times (95% CI = 0.7–1.0 times) for a 1 standard deviation increase in average human detections per day".⁴⁰ "Another explanation for a muted response of lynx to recreation could be that recreation in GNP is mostly concentrated on trails and may occur in a predictable enough fashion that lynx were able to cope to some degree. Other carnivores respond more strongly to off-trail versus on-trail recreation (Heinemeyer et al. 2019, Gunther and Haroldson 2020)." Human presence and activities are a factor in fragmentation of habitat.

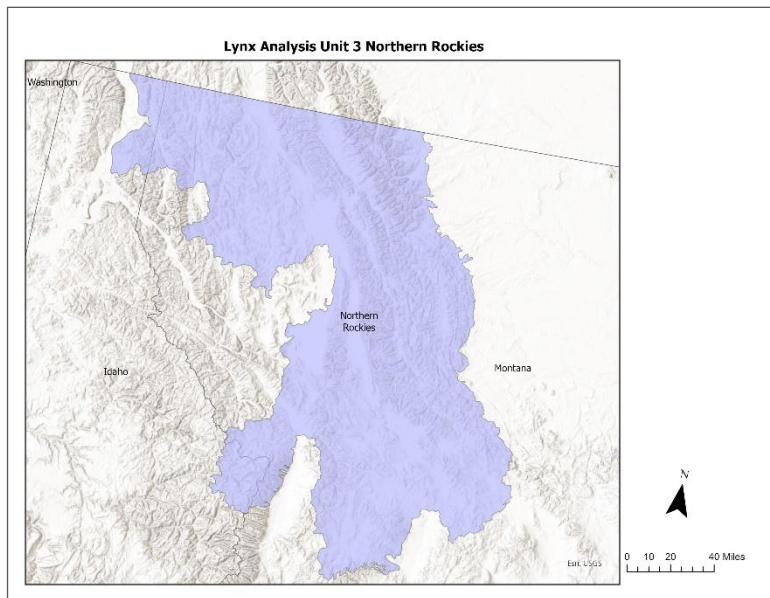
Using the publicly available GIS data from FWS, we compared the Analysis Units, Focal Areas and Critical Habitat to determine changes in area. (Figures 18 – 20, Table 6).

³⁹ Interagency Lynx Biology Team. 2013. Canada Lynx Conservation Assessment and Strategy. 3rd edition. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication R1-13-19, Missoula, MT. 128 pp.
<https://app.box.com/s/p80ykdfc41slqnm55j8f2qo5m7npb4aj>

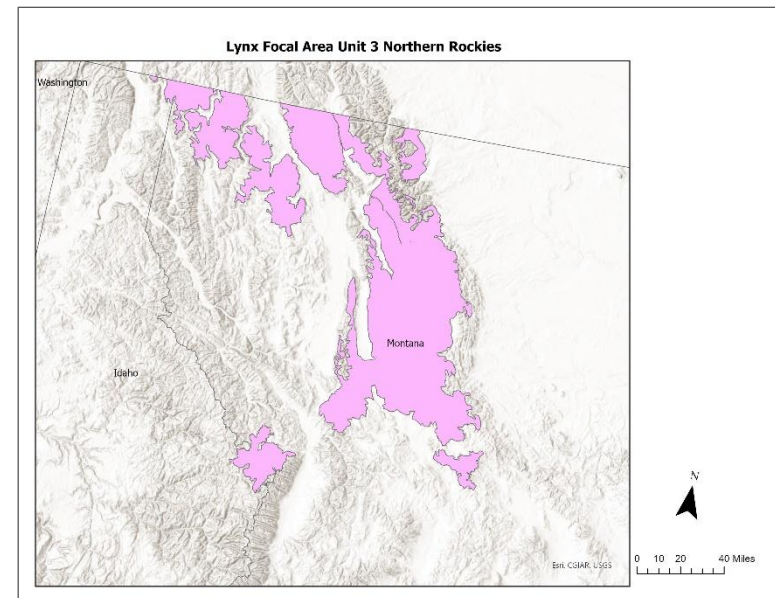
⁴⁰ Anderson, A. K., J. S. Waller, and D. H. Thornton. 2023. Canada lynx occupancy and density in Glacier National Park. *Journal of Wildlife Management* 87:e22383.
<https://doi.org/10.1002/jwmg.22383> <https://app.box.com/s/fiu2oxhqe0gs4nswps9tcd12l5p6rlz9>

Figure 17. 2024 Proposed Critical Habitat

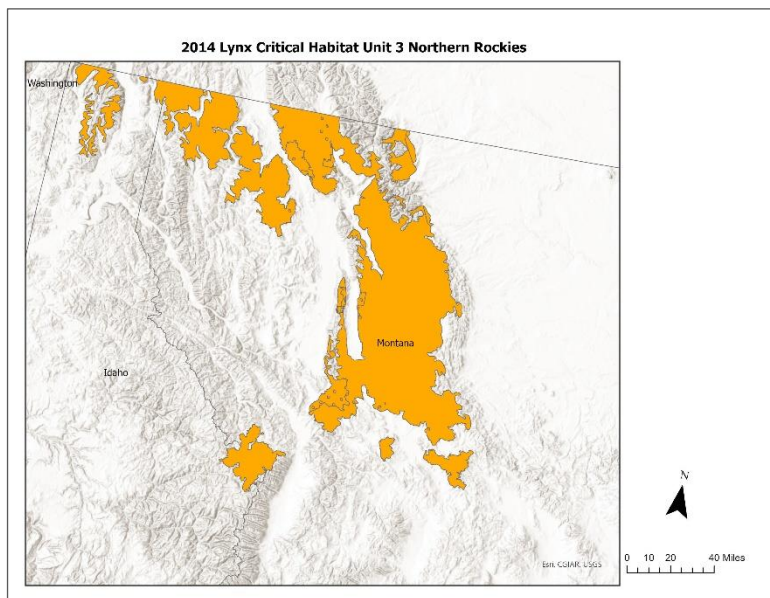




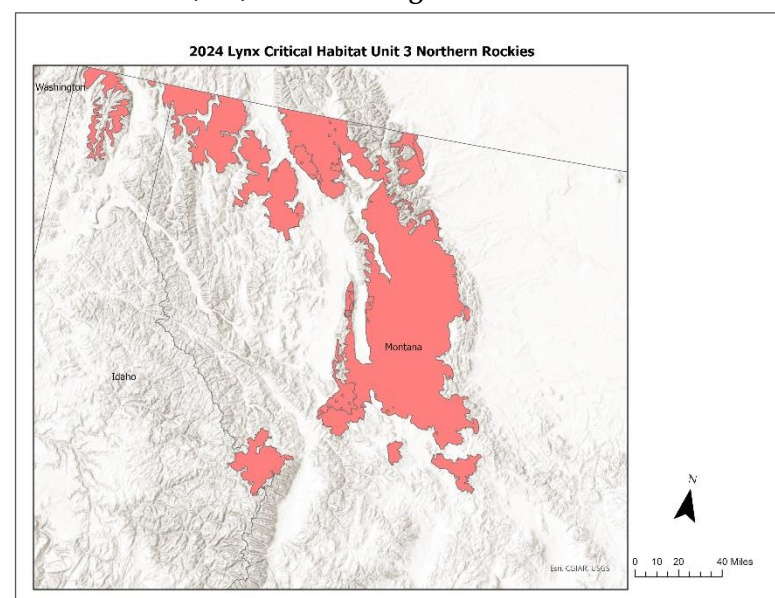
13,263,764 Acres Intact



4,867,820 Acres Fragmented

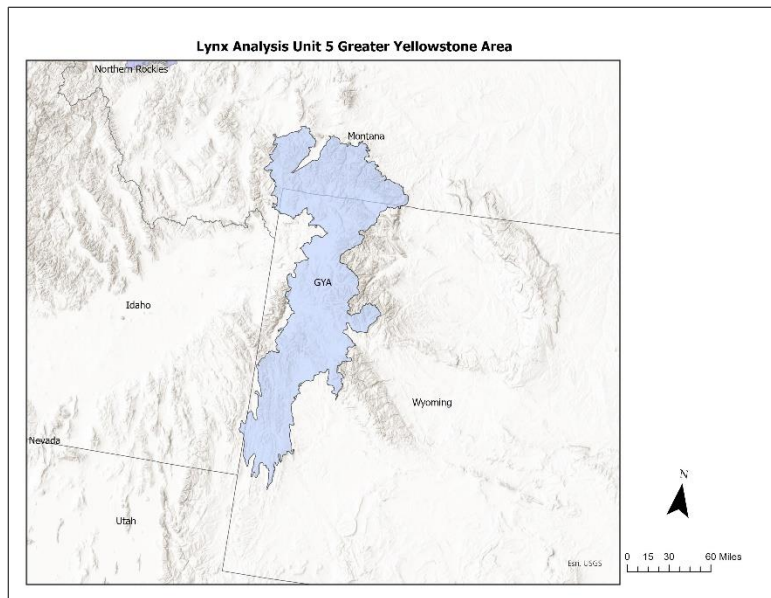


6,260,861 Acres Fragmented

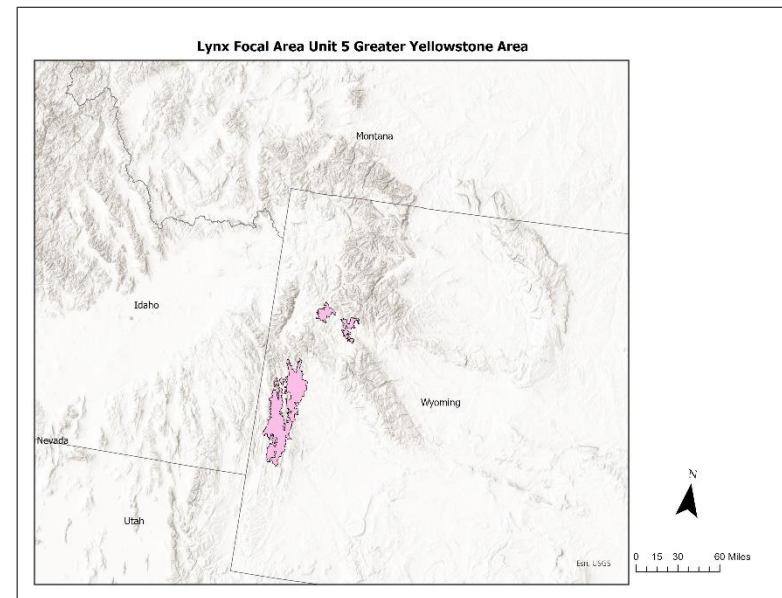


5,093,479 Acres Fragmented

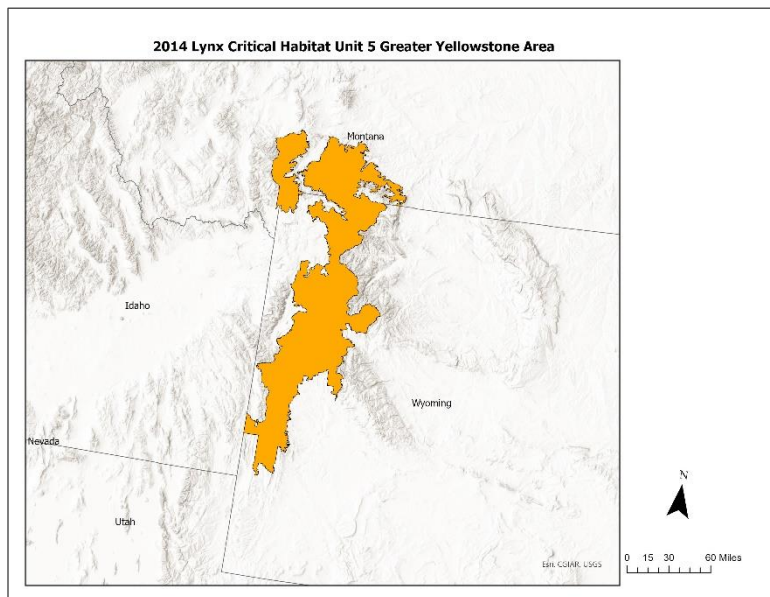
Figure 18. Evolution of 2024 Critical Habitat Analysis Unit 3 Northern Rockies



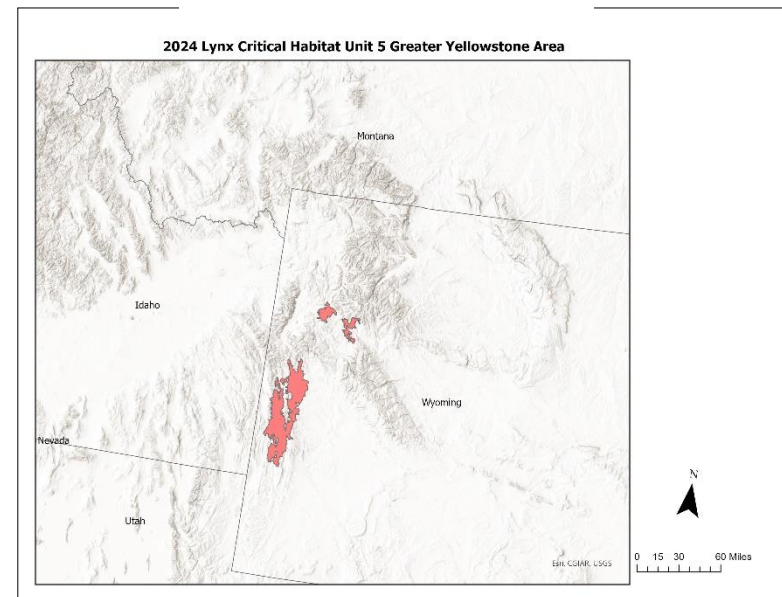
7,541,043 Acres Intact



717,141 Acres Fragmented

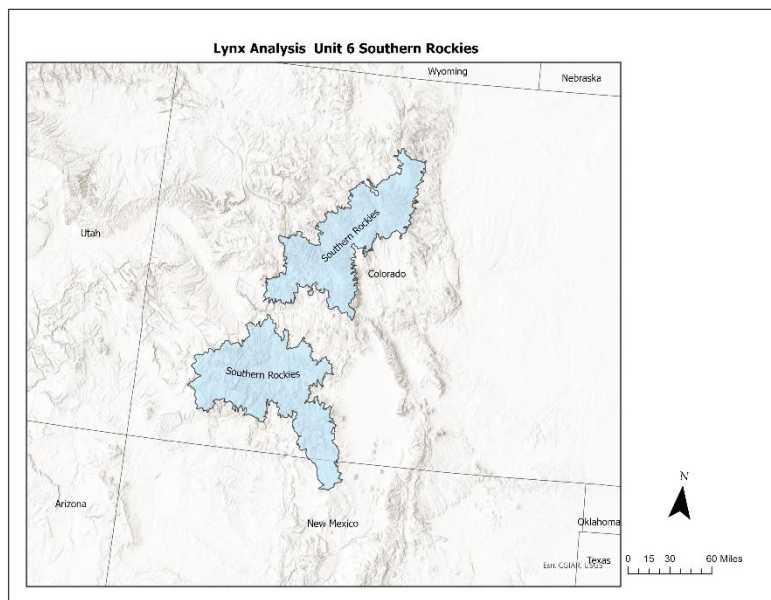


5,853,154 Acres Fragmented

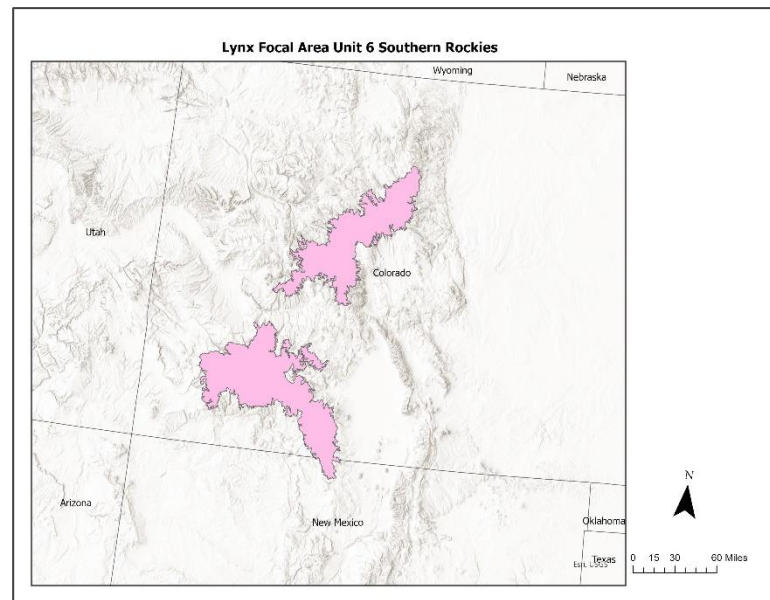


717,140 Acres Fragmented

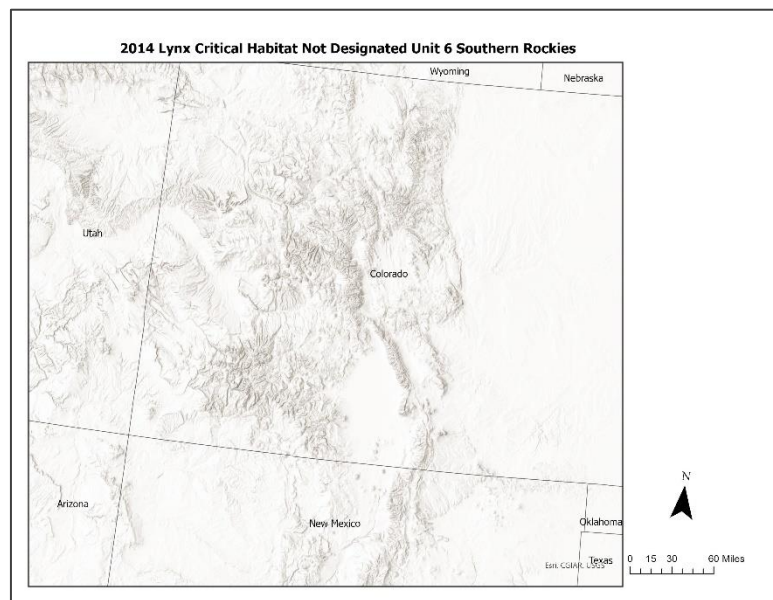
Figure 19. Evolution of 2024 Critical Habitat Analysis Unit 5 GYA



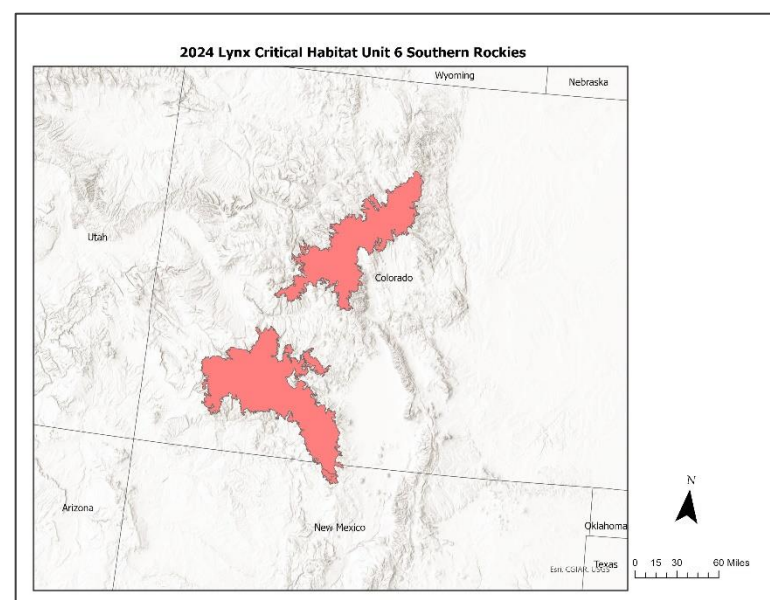
6,821,605 Acres Fragmented



4,867,820 Acres



0 Acres



4,914,547 Acres Fragmented

Figure 20. Evolution of 2024 Critical Habitat Analysis Unit 6 Southern Rockies

Table 6. Changes in Lynx Critical Habitat from 2014 to 2024 Proposed

Rocky Mountain Management Areas	Acres	CH Change %
2014 CH	12,114,016	
2024 CH proposed	10,725,166	11% loss
Total RM AU 2023 SSA	27,626,412	
AU3	13,263,764	
AU5	7,541,043	
AU6	6,821,605	
FA3	4,867,620	
FA5	717,141	
FA6	4,795,468	
2014 CH AU3	6,260,861	
2014 CH AU5	5,853,154	
2024 CH AU3	5,093,479	19% loss
2024 CH AU5	717,140	88% loss
2024 CH AU6	4,914,547	na

Overall, CH declined 11% from the 2014 CH status. The CH for Unit 3 declined 11% and for Unit 5 declined 88%. Colorado had no CH in 2014 and gained nearly 5 million acres, while Units 3 lost 1.4 million acres and Unit 5 lost 5.1 million acres. This appears contradictory in that Colorado (Unit 6) which was not occupied at the time of listing, is now proposed for nearly 5 million acres of CH. Meanwhile, Unit 5, which was occupied, is now facing an 88% reduction. The proposed CH for AU3, 5, and 6 are fragmented into smaller units with no identified protecting links. No linkages are provided within the Analysis Units nor between the Analysis Units.

Basing critical habitat on areas occupied at the time of listing has the effect of discounting historical observations prior to listing and depends on the effort expended to document observations. It also depends on how an area is defined. For example, a National Forest may have lynx observations at a particular point in time, while a smaller management unit such as a Ranger District might have none, so the Forest is occupied, while the Ranger District is not. A Ranger District may have observations while others do not, but using the Forest as a measure, the Forest would be occupied. We have pointed out that the rationale to now add critical habitat in Unit 6 should be used to expand critical habitat in Unit 5 to include the moderate and high probability habitat from Olson et al (2021), and in addition include the connecting corridor between Unit 5 and 6 which passes through the Caribou-Targhee NF, the Uinta-Wasatch-Cache NF, the Ashley NF and the BLM lands we identify later in these comments.

Using the McElvey historical observations⁴¹, we tabulated these by management areas. (Table 7) Unit 3 (Montana and Idaho), being directly connected to the Canadian populations had the most observations (1200) with Unit 5 (219) and Unit 6 (57). Here, Unit 5 had four times the observations of Unit 6, yet Unit 6 added CH while Unit 5 lost most of its CH.

At a minimum, to correct the fragmentation in proposed management within Units 3, 5, and 6, the Analysis Units themselves should become critical habitat. A further level of fragmentation occurs between the Analysis Units and their critical habitats. Neither are the Olson et al (2021) Model⁴² or the Squires et al 2024⁴³ Model areas connected. (Figure 21). This is an obvious omission since lynx were historically observed in the area including the Uinta Mountains in Utah and Wyoming in the area we call the Model Gap. Figure 21 illustrates the Olson and Squires model areas, 2024 proposed critical habitat and historic observations from McElvey. A large gap occurs while the modeling analyses have omitted the consideration of the higher elevation corridor between the GYA and Uinta Mountains which we address next.

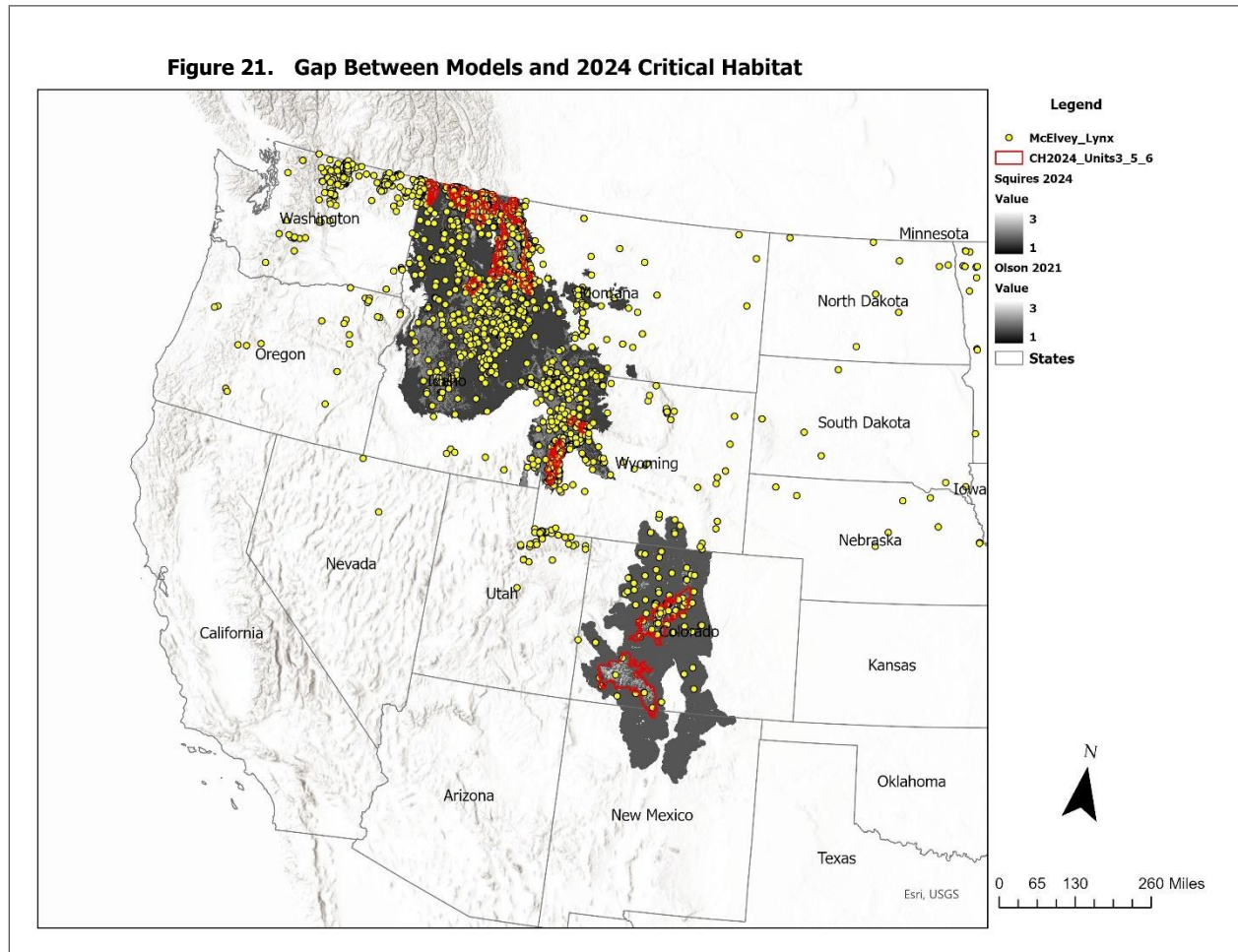
Table 7. McElvey Lynx Observations by Management Area

Rocky Mountain (RM) Management Areas	McElvey Observations	Percent of RM Historical	CH Percent of AU
Rocky Mtn States	2286	100	
2014 CH	1106	44.6	
2024 CH proposed	804	35.1	
AU3	1200	52.4	
AU5	219	9.6	
AU6	65	2.8	
2014 CH AU3	827	36.1	68.9
2014 CH AU5	189	8.3	86.3
2024 CH AU3	729	31.9	60.8
2024 CH AU5	75	3.3	34.2
2024 CH AU6	57	2.5	87.7

⁴¹ Records obtained from the Beaverhead-Deerlodge NF in the form of a layer file: Historic Lynx Records (citing McKelvey et al, 1999). <https://app.box.com/s/6bg8w6k5ru1axlv3zcm5ba2tt3giz9hg>

⁴² Olson et al. 2021. Improved prediction of Canada lynx distribution through regional model transferability and data efficiency. Ecology and Evolution 11:1667 – 1690. <https://app.box.com/s/32ww5q3ci96now3zy1fd2qgxzdf4lb21>

⁴³ Squires, J.R., Olson, L.E., Ivan, J.S., McDonald, P.M., and Holbrook, J.D. 2024. Anthropogenically protected but naturally disturbed: a specialist carnivore at its southern range periphery. Biodiversity and Conservation. 27p. <https://doi.org/10.1007/s10531-024-02978-8> <https://app.box.com/s/qirh6aet9aqkfiwzix9uol1z2mzzuxgp>



Lynx were documented in the Uinta Mountains and Greater Yellowstone Area from the Colorado reintroductions.⁴⁴ Ivan (2018)⁴⁵ characterized the lynx movements into Utah:

Lynx that went to Utah were there long enough to transmit 1–136 ($\bar{x}$ = 42) locations per individual across approximately 1–287 ($\bar{x}$ = 100) days (Table 1; tally is approximate because we do not know where animals were in between weekly locations). **Most of these individuals entered and exited Utah via the Uinta Mountains in the northeast, Abajo Mountains in the southeast, or the East Tavaput Plateau in the east-central part of the state (Figures 1–29).** Those that spent a considerable amount of time in Utah tended to find and traverse the high country running north-south through the central portion of the state. Of the 17 individuals that spent time in Utah, 3 were known to have died there (Table 1).

⁴⁴ Ivan, J. 2017. Summary of movements of Colorado lynx in Wyoming. Colorado Parks and Wildlife. 36p. <https://app.box.com/s/da8t9fbd3l587gpd1kmaqnsikzugeir07>

⁴⁵ Ivan, J. Summary of movements of Colorado lynx in Utah. Colorado Parks and Wildlife. 34p. <https://app.box.com/s/7cwyp8cw68bxzsis0o8hyd9pb5lo6k61>

Six others were known to have died elsewhere (Colorado, Nebraska, New Mexico,) and the fates of the other 8 were unknown because their collars failed before they died (Table 1).

CPW has no direct data indicative of reproductive activity for reintroduced lynx that traveled to Utah. **However, a male (BC05M03) and female (QU05F05) did occupy the same area of the Uinta Mountains for >200 days, including during breeding season, of 2006.** It is not known whether or not these individuals bred, denned, and/or produced kittens.

Clearly, these two lynx were able to survive in the Uinta Mountains.

We looked further at fragmentation in Analysis Unit 5, particularly in the Bridger-Teton NF and Caribou-Targhee NF. This illustrates that high probability habitat in Olson et al (2021) is fragmented by roads, clearcuts and mines. It further illustrates that Inventoried Roadless Areas are subject to disturbance and are fragmented. The [Idaho Roadless Rule](#) allows the IRAs to be divided up into prescriptions allowing timber harvest, mining, livestock grazing and in the case of SE Idaho, IRAs are traded away for tailings ponds and mine expansions. For example, the tailings pond for the Dairy Syncline Mine referenced earlier.

Figure 22 shows the SE Idaho linkage in the Soda Springs and Montpelier Ranger Districts. Phosphate mine leases effectively block the linkage as they operate 24/7 year-round, have heavy haul road and railroad traffic, and engage in blasting up to 400 times per week.⁴⁶ The roads shown do not include all roads, non-system Forest Service roads, illegal or user-created roads and trails. Nor is snowmobile activity represented. Ninety-seven percent⁴⁷ of the Caribou National Forest is open to snowmobiles, groomed trails fragment the Bear River Range and there is active trapping and dog pursuit of lions and other animals.

Figure 23 widens the view into Wyoming and the 2024 Proposed Critical Habitat. In the Wyoming portion, the linkages and proposed critical habitat are fragmented by timber harvest (clearcuts) and roads. Inventoried Roadless Areas are also fragmented by roads. Not all timber and thinning, prescribed fire, hazardous fuel reduction activities, or non-system roads are shown.

What is clear is that so-called protected areas such as IRAs cannot function for lynx unless they are given specific protection from roads, mines, and recreational vehicles as well as trapping and dog pursuit of predators. This should be part of the management going forward in designated critical habitat and connecting corridors.

⁴⁶ Draft Environmental Impact Statement Dairy Syncline for the proposed Dairy Syncline Mine and Reclamation Plan p2-9. <https://app.box.com/s/8jte3c3jttt4e0xppcytr9jwash9mao>

⁴⁷ USDA. 2003. Revised Forest Plan and FEIS Caribou National Forest. <https://app.box.com/s/seeaqtwqfyzlqcu64th3byuga9e0c5vb>

Figure 22. SE Idaho Linkage Areas, IRAs Fragmented by Mines and Roads

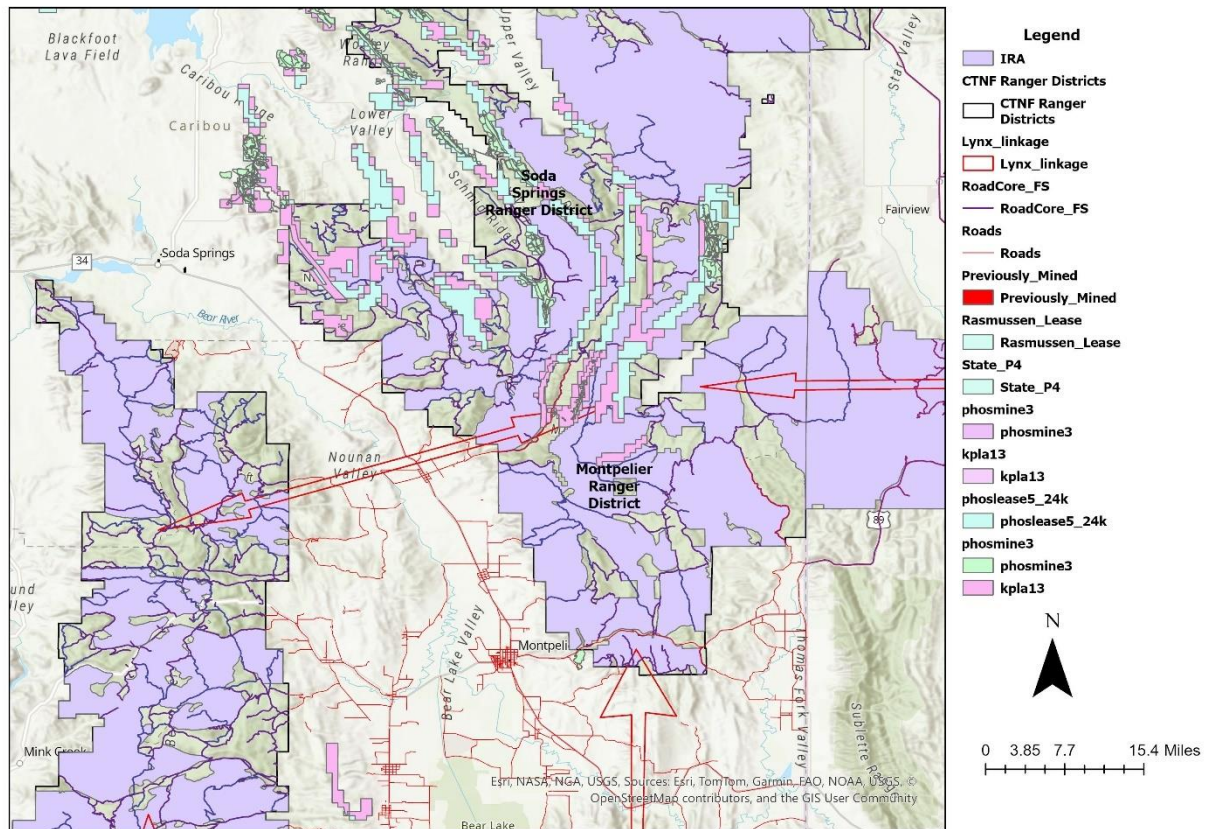
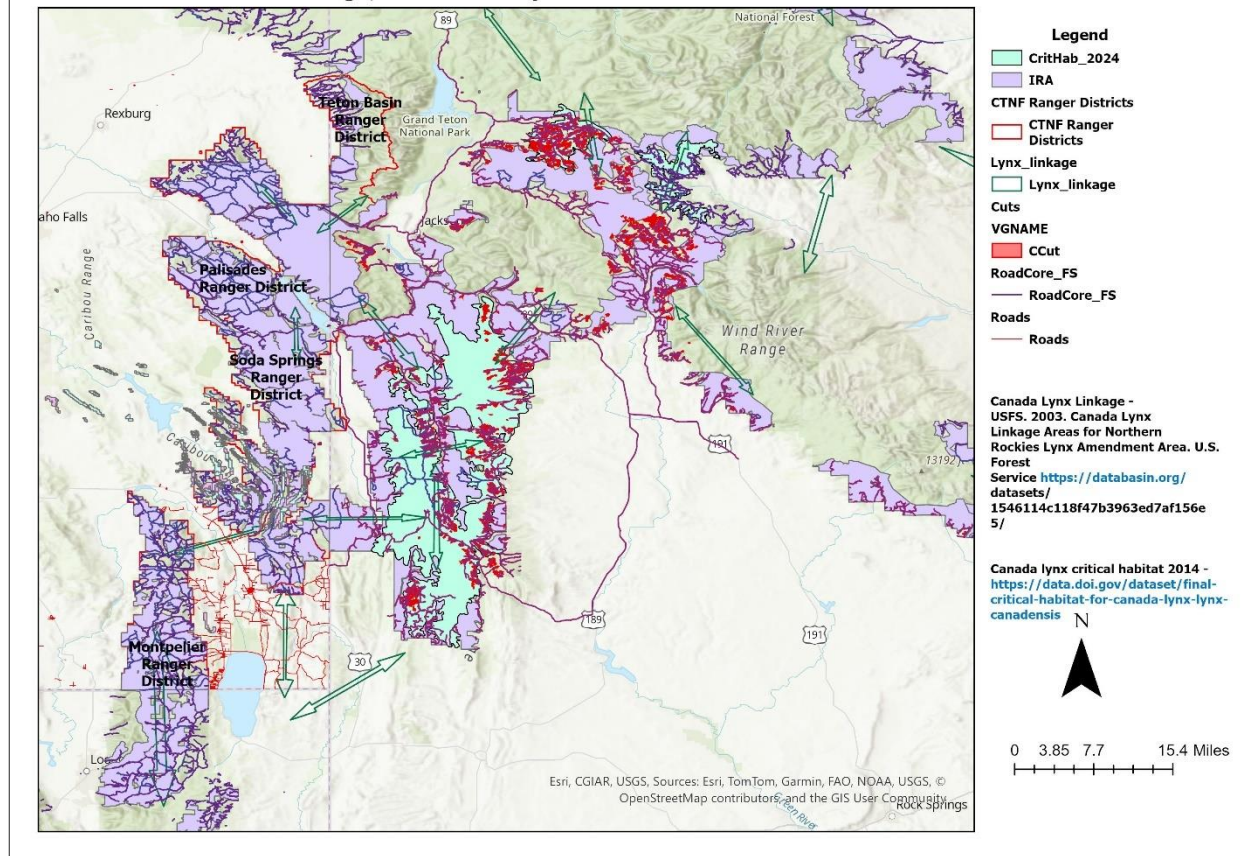


Figure 23. Greater Yellowstone Analysis Unit 5 Clearcuts, Roads, Mines, Linkage, and 2024 Proposed Critical Habitat



5. Applying Olson 2021 and Squires 2024

Squires et al (2024) constructed a model and analysis for the Southern Rockies lynx population in Colorado, southern Wyoming and northern New Mexico.⁴⁸ The modeling was similar to that in Olson et al (2021), which we find useful in prioritizing management areas for protection of lynx habitat and connectivity. An additional value of the Squires et al (2024) analysis is they incorporated natural disturbance such as fire and insect outbreaks, forest management such as timber harvest, protected areas such as National Parks and roadless areas, and human disturbance such as recreation use.

This is an analysis we have hoped to see in the numerous National Forest projects (mining, timber harvest, fire-related practices, ohv routes) but those projects avoid this level of analysis, resulting in litigation. What is now important is that the Fish and Wildlife Service map and

⁴⁸ Squires, John R.; Olson, Lucretia E.; Ivan, Jacob S.; McDonald, Peter M.; Holbrook, Joseph D. 2024. Anthropogenically protected but naturally disturbed: A specialist carnivore at its southern range periphery. Biodiversity and Conservation. <https://doi.org/10.1007/s10531-024-02978-8>. <https://app.box.com/s/qirh6aet9aqkfiwzix9uol1z2mzzuxgp>

protect lynx habitat and connectivity through expansion of critical habitat across the landscape. In this section, and due to time constraints, we focus on SSA Unit 5 and 3, the GYA and Northern Rockies using the Olson et al (2021) model. What is needed now is the blank portion of the map (Model Gap) between SSA Unit 6 (Southern Rockies) and Unit 5 (Greater Yellowstone Area) to be mapped, protected, and connected to the Greater Yellowstone Area and Northern Rockies.

In the following, we have also mapped the Regionally Significant Wildlife Corridor that was part of the Wasatch-Cache National Forest Plan⁴⁹ and the National Forests present within the models and the Corridor. We have used National Forests to analyze the models as they constitute the major portion of the modeled areas and they encompass most of the higher elevations in the regions of interest. Other land management areas must be included in critical habitat. These lands would include BLM, Tribal, State, Wildlife Refuges, National Parks and Monuments.

When we mapped National Forests, Ranger Districts, National Parks, Wilderness Areas, and Inventoried Roadless Areas we found there are 16 National Forests, 81 Ranger Districts, 3 National Parks, 25 Wilderness Areas, 482 individual polygons representing the fragmented IRAs. There are three National Forests in the Yellowstone to Uintas Connection in NE Utah, and 9 National Forests in the Squires et al (2024) model area. (Figures 24 – 27).

We used ArcGIS Pro Zonal Statistics to visually categorize the National Forests, Ranger Districts, National Parks, Wilderness Areas, and Inventoried Roadless Areas within the Olson et al (2021) modeled area. The maps provide ranges of the Olson et al (2021) habitat probability, with the red and orange representing those land management units with higher probabilities. Using these categories, visual patterns emerge across the landscape.

⁴⁹ Wasatch Cache Revised Forest Plan and Final Environmental Impact Statement Regionally Significant Wildlife Corridor. 2003. Accessed on January 18, 2025.
<https://www.fs.usda.gov/detail/uwcnf/landmanagement/projects/?cid=stelprdb5076923>

Figure 24. National Forests Olson Probability Northern Rockies and Greater Yellowstone Area

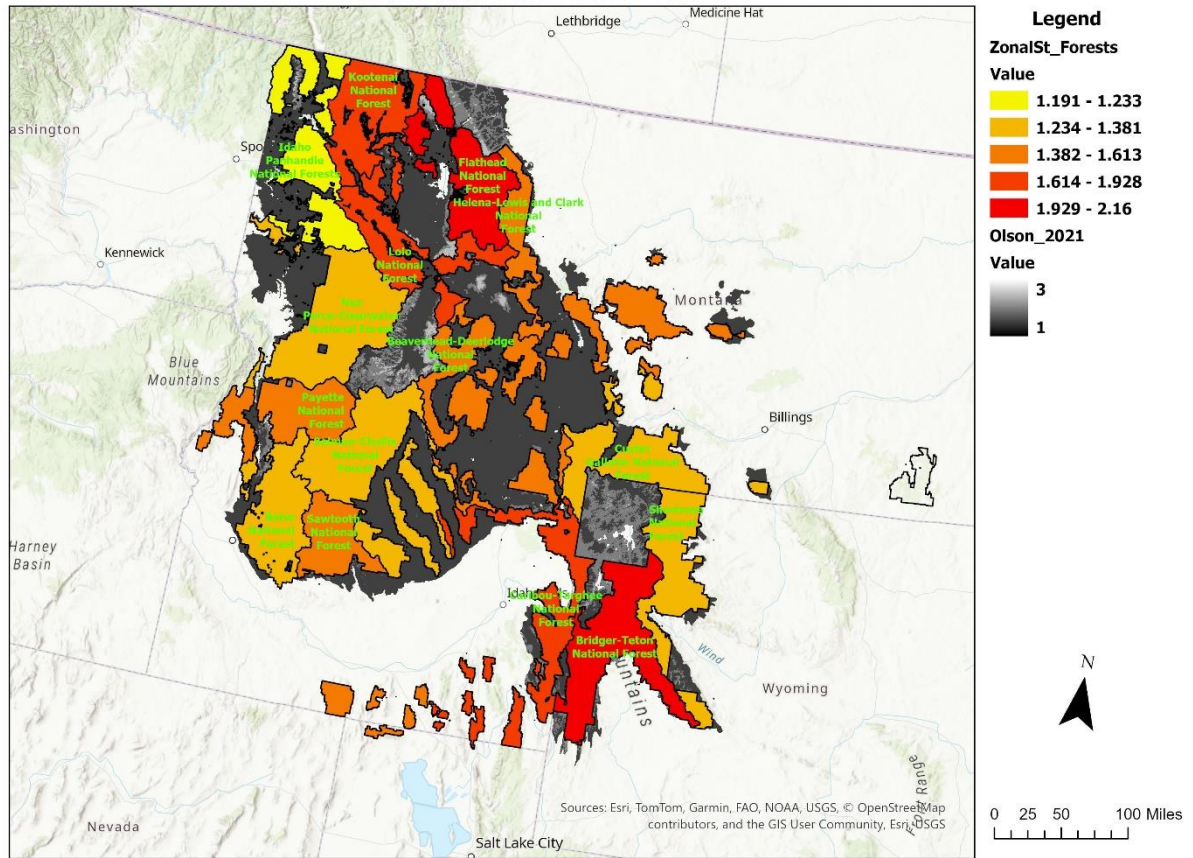
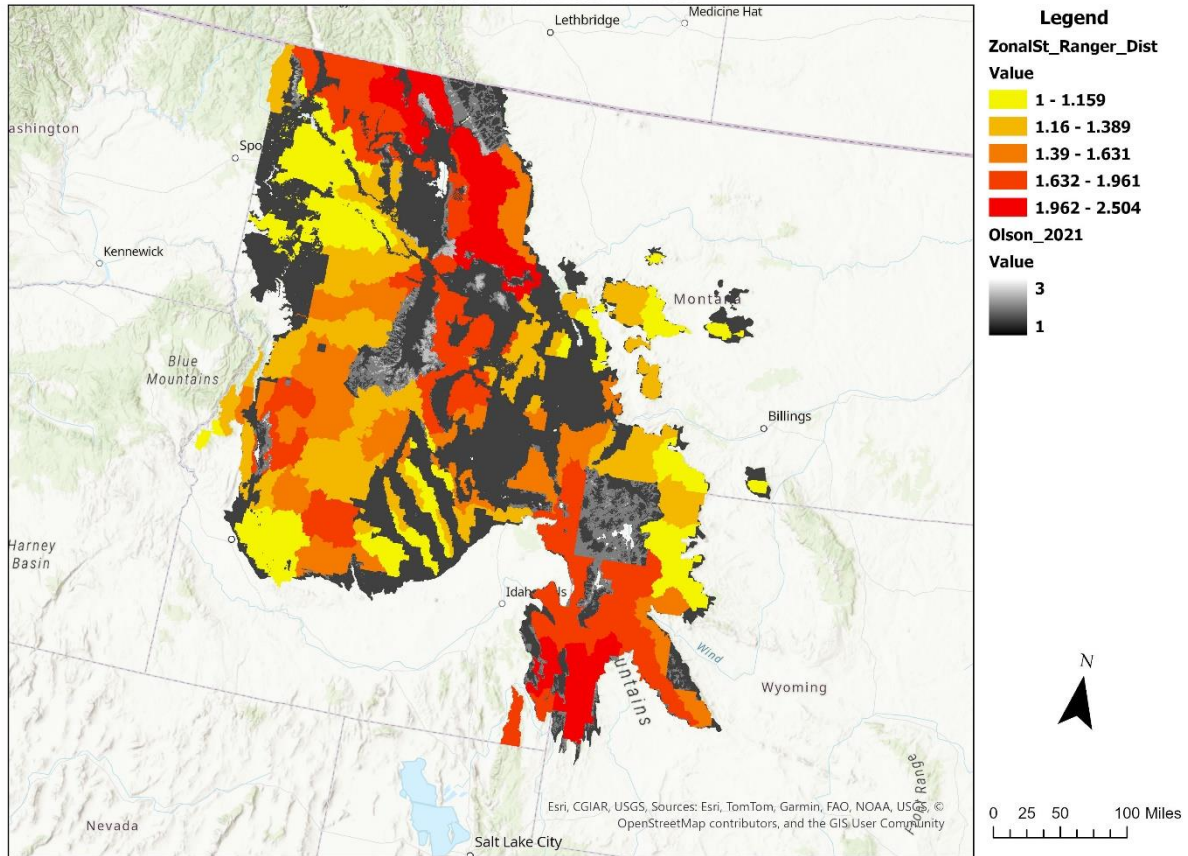


Figure 25. Ranger Districts Olson Probability Northern Rockies and Greater Yellowstone Area



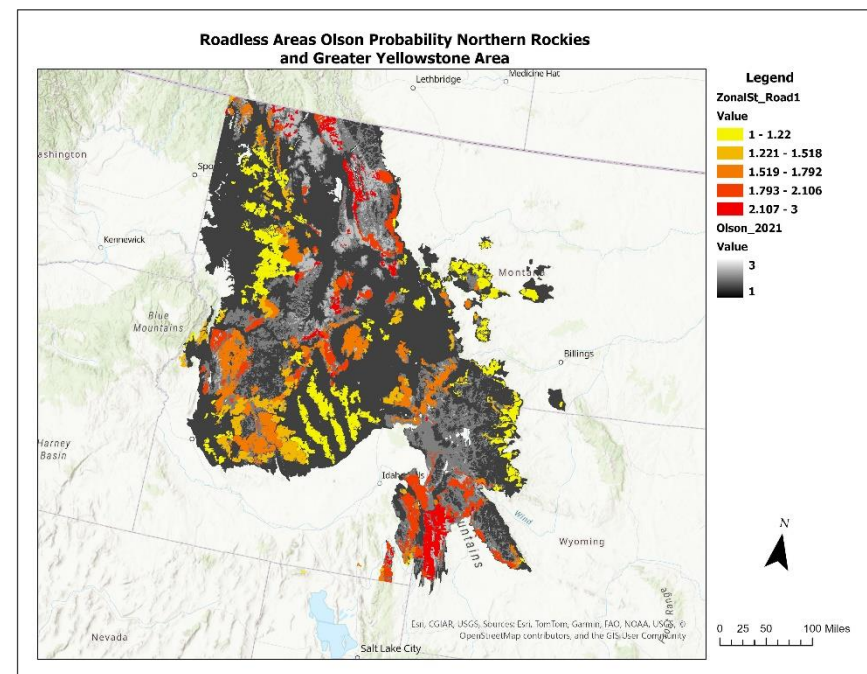
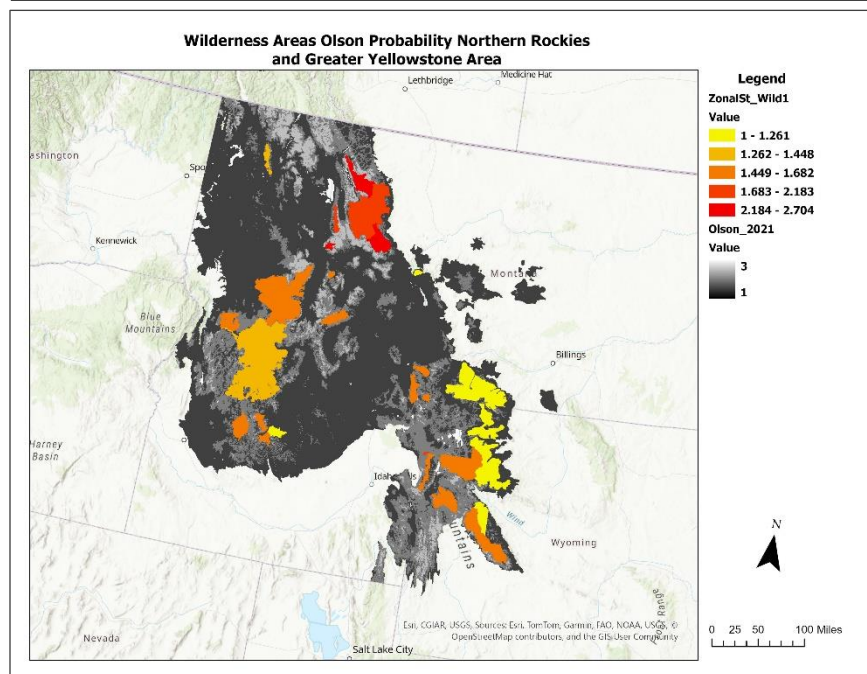
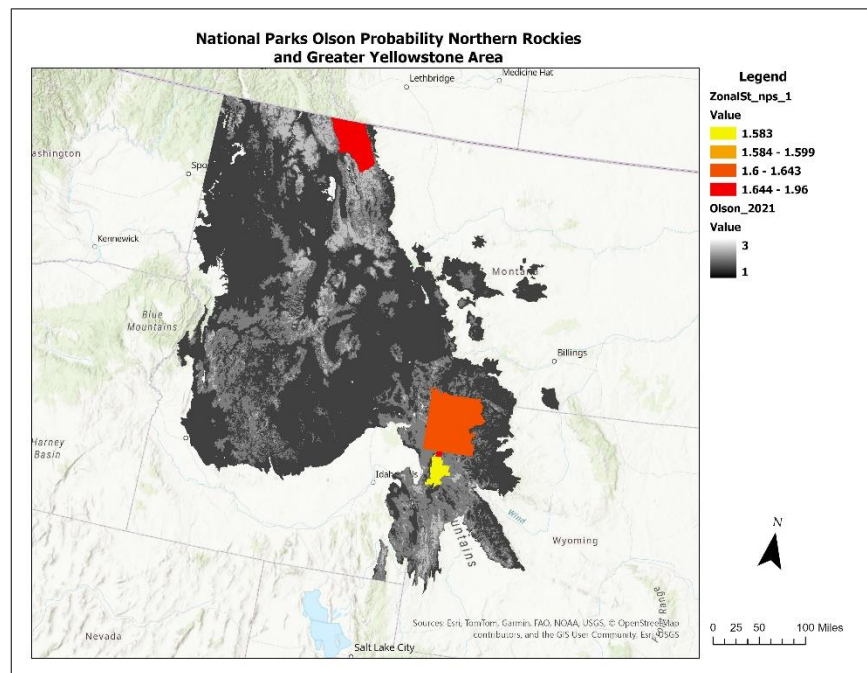
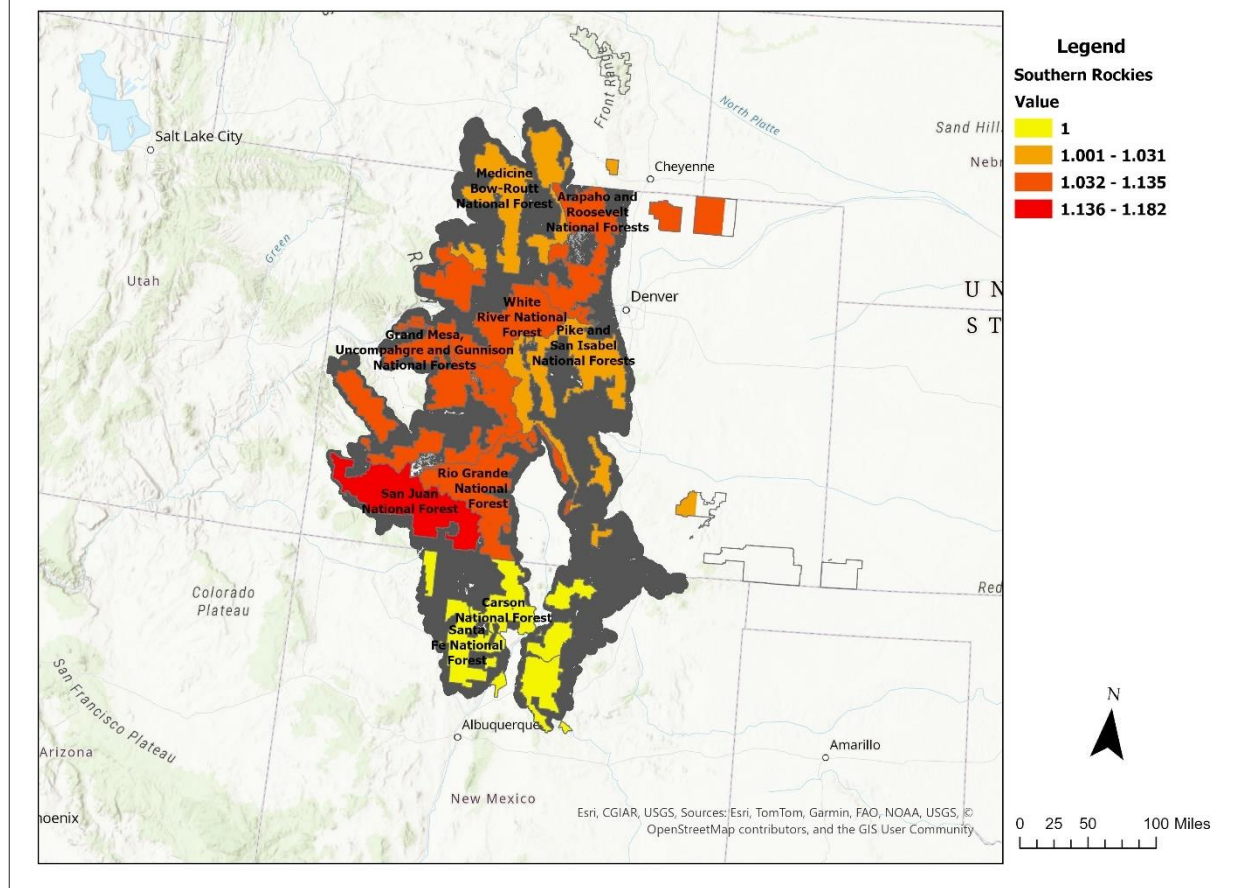


Figure 26. National Parks, Wilderness Areas, and IRAs within the Northern Rockies and Greater Yellowstone Area and Olson 2021

Figure 27. National Forests Squires Probability for the Southern Rockies

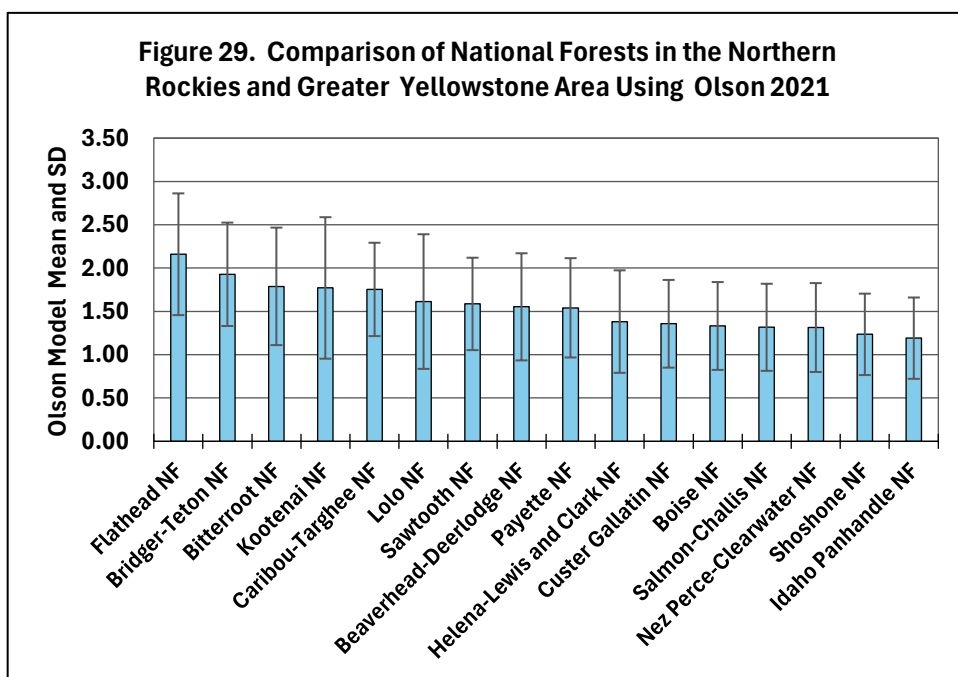
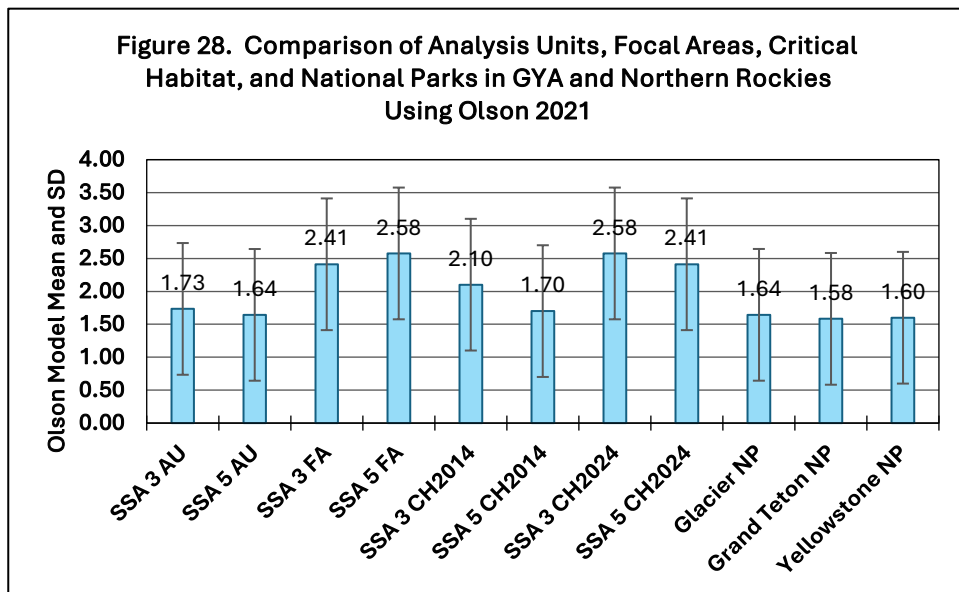


Anderson et al (2023) estimated a population of 52 lynx for Glacier National Park. When we analyzed Olson et al (2021) model data using ArcGIS Pro Zonal Statistics, we determine the mean habitat probability for Glacier NP was (1.64 ± 0.59). In Figure 28, the Analysis Units, Focal Areas, 2014 Critical Habitat and 2024 Proposed Critical Habitat were plotted. The Focal Areas and Critical Habitats had the highest habitat probabilities, but as we discussed before, they are fragmented and disconnected.

We can see that the standard deviations in Figure 28 indicate through their overlap, that the National Parks, the Unit 3 and 5 Analysis Units, and 2014 Critical Habitats have almost identical habitat probabilities to Glacier NP. Note that Unit 3 2014 Critical Habitat more closely compares to the Focal Area habitat probability. This analysis suggests that a broader critical habitat, that lowers the threshold to that of the Glacier NP level allows protection of habitats that should support lynx. We pursue that further in identifying management areas for focus and protection.

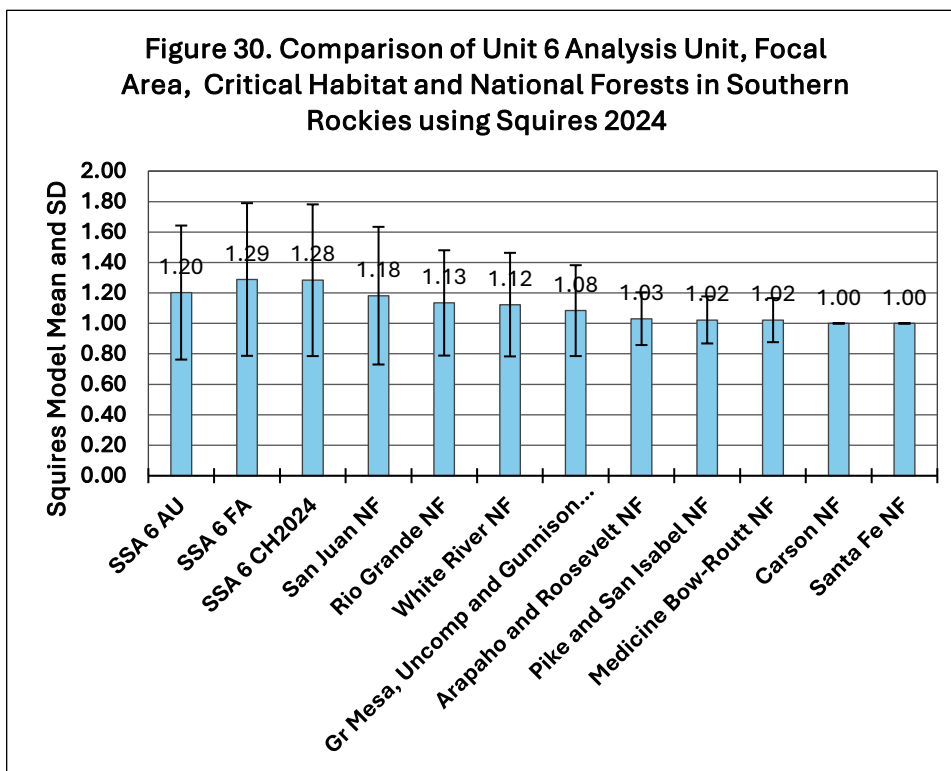
National Forests in the Northern Rockies and Greater Yellowstone Area are shown in Figure 29. They are ranked in order from highest to lowest Olson Model probabilities. The standard

deviations show much overlap between these Forests and do not disqualify any of them as important or critical habitat. Several National Forests in Unit 5 have higher mean habitat probabilities than those in Unit 3, for example, the Bridger-Teton and Caribou-Targhee. Yet, the Notice downplays these Unit 5 NFs.



We generated a similar chart for the Southern Rockies Unit 6, which also has its proposed Critical Habitat fragmented. (Figure 30). In this case, we looked at the nine National Forests overlain by the Squires et al (2024) model. We note that the raster values in Squires range up to 3 as they did for the Olson (2021) model. Yet, the mean values in Olson (2021) range above 1.6

for all management areas. In the Southern Rockies, none approached this value, with the highest being the Unit 6 Focal Area at 1.29. Both models operate over a range from 1 to 3, representing the pixel values withing the model images. This indicates that Unit 5 should be more suitable than Unit 6 for supporting Canada lynx as the mean within the range of values is higher.



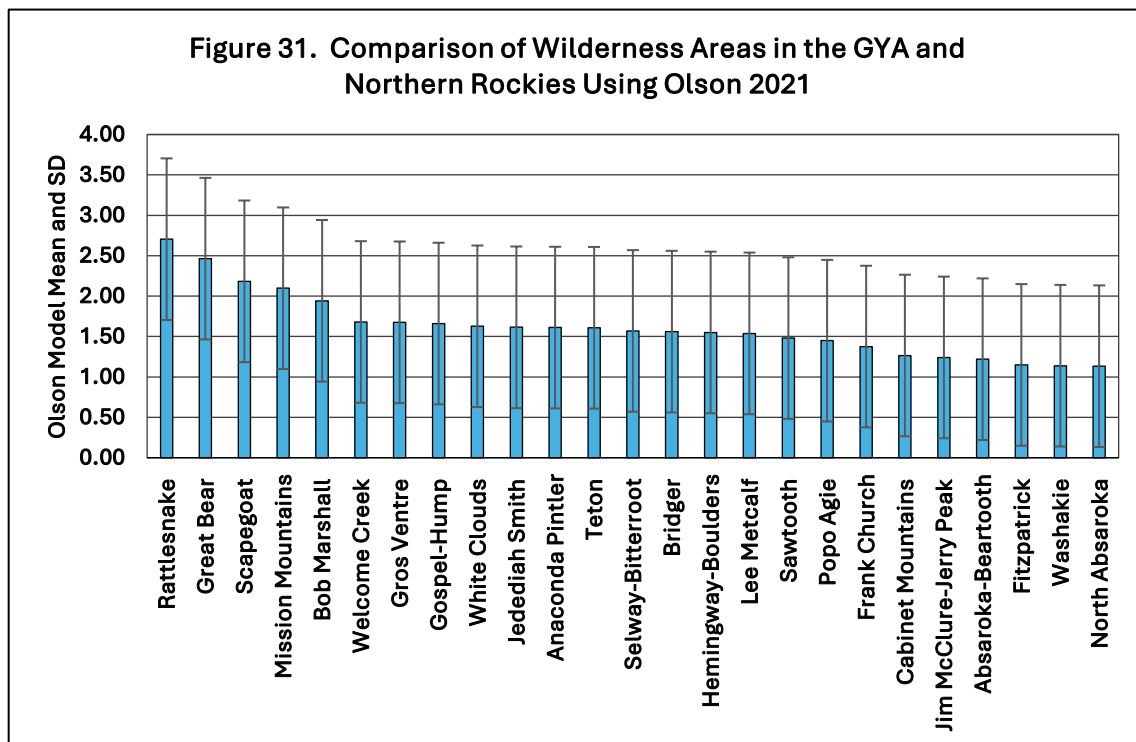
Whether the models are comparable is a question for the authors of those models. However, as habitat becomes less productive for lynx as one moves south away from the Canadian Boreal Forest, it makes sense that the Northern Rockies might have the highest values, followed by the Greater Yellowstone Area, then the Southern Rockies. This then becomes an important issue in that Colorado, with its much lower habitat probability is deemed suitable habitat and an introduced population is now considered as occupied habitat and given a much larger critical habitat than the Greater Yellowstone Area even though it has higher habitat probability.

The Federal Register Notice made several points regarding designation of critical habitat for Units 3, 5, and 6. Unit 3 was occupied at the time of listing and is currently occupied and directly connected to the habitat and population in Canada. Unit 5 has small pockets of habitat on the Bridger-Teton NF and recent modeling (Olson et al 2021) shows this area does not contain the physical and biological features necessary to support lynx residency and is not directly connected to lynx habitats elsewhere. In Unit 6 it is uncertain whether this unit historically supported a resident population or if present, it was ephemeral. It is

not connected to lynx habitats elsewhere. It now supports a resident population as the result of the State of Colorado reintroductions.

So, here we have what appears to be bias. Unit 5 (GYA) is claimed to not contain the physical and biological features needed and is not directly connected to habitats elsewhere. Yet, our analysis demonstrates that it has higher habitat probability than Unit 6 (Southern Rockies). The claim that it is not connected to habitats elsewhere is equally applicable to Unit 6 (Southern Rockies). They are not directly connected as well. The fault lies not in the landscape, but the failure to provide the needed connections. It is also a failure of the agencies that they have failed to explain why lynx are largely absent from the landscape in Unit 5 when it has high habitat probability across large areas.

In a similar manner we used Zonal Statistics on the Wilderness Areas in the GYA and Northern Rockies. These are ranked in Figure 31. Ranking such as this will help in prioritizing land management units for designation as critical habitat or other protections. When it comes to Wilderness Areas, they have the highest level of protection against human disturbance, so can function as primary habitat or connections depending on their location and habitat probabilities. We also calculated the habitat probability for Inventoried Roadless Area, but there are too many polygons to represent in a chart. This data can be accessed in our spreadsheet which contains all the calculations and charts.⁵⁰



⁵⁰ <https://app.box.com/s/p50ujoi6b9rixcg17e872ne6uqwd24k6>

We mapped the Wilderness, IRA, and Parks. (Figure 26). This provides a visual of the areas with higher habitat probability that could be used to identify connections. However, not all higher probability habitat is included in these designations. For example, in the Northern Rockies, three NFs (Flathead, Kootenai, and Lolo) with high habitat probability do not have these designations in sufficient areas to capture the highest probability habitat. (Figure 32). The Kootenai NF has a large area of higher probability habitat that is not in wilderness or roadless categories. For this reason, we recommend using the National Forests and Ranger Districts to help identify core and connecting habitat for management purposes.

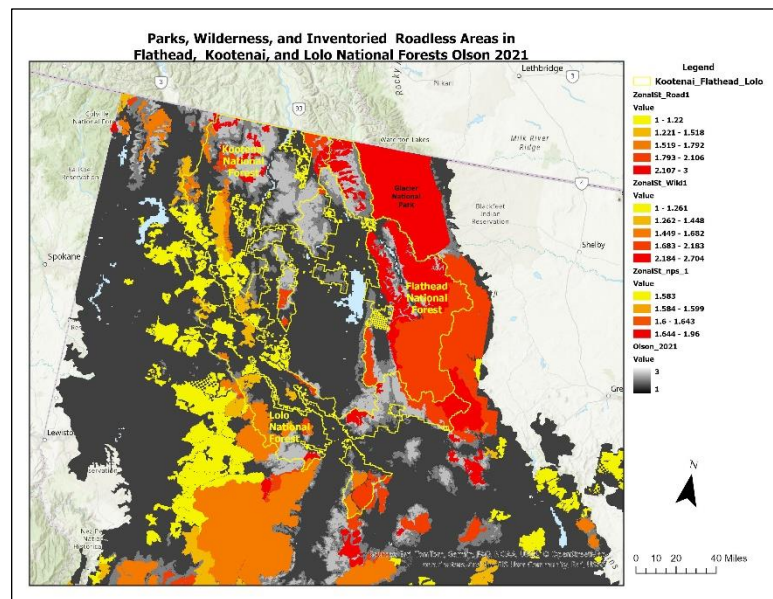
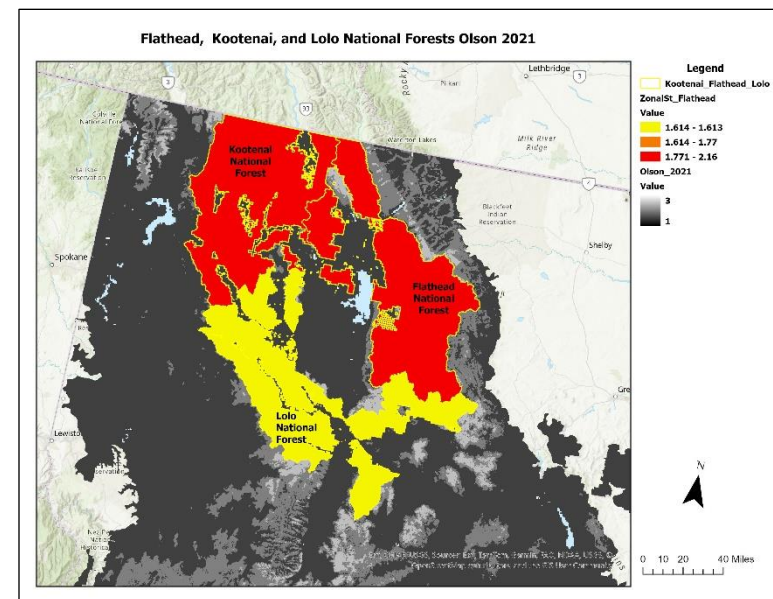
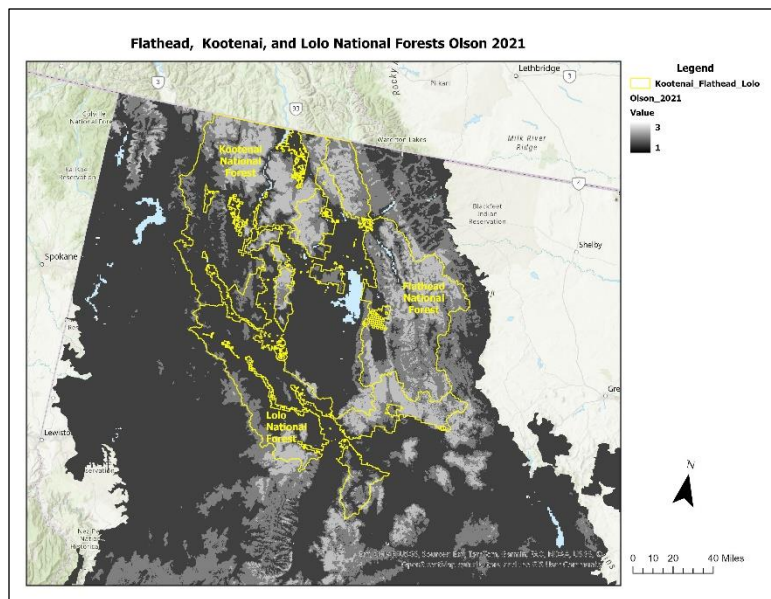


Figure 32. Flathead, Kootenai, and Lolo National Forests with Olson probability, and Protected Areas

6. Prioritizing Landscapes and Promoting Connectivity

Colorado Parks and Wildlife summarized lynx movements from the reintroductions in Colorado to Wyoming.⁵¹ Locations from 16 male and 15 female lynx that were released in Colorado between 1999 - 2006 were in Wyoming between 1999 – 2010. It is interesting to note that the reintroduced lynx came from Canadian populations to the north. Inspection of the maps in the report gives the impression that these lynx were attempting to find their way directly back north. As the report describes, *“Most of these individuals entered and exited Wyoming via the Medicine Bow Mountains or the Park Range and traveled no farther into the state than the northern extent of these ranges... . At least 8 lynx made it to the Greater Yellowstone Area and beyond. A few entered/exited via the Uinta Mountains in Utah... .”* The report notes that there were likely other individuals that made the trip, but there has been no documentation since that time. (p3). Inspection of the figures in the report shows that some lynx apparently did cross the wide lower elevation valleys between the Medicine Bow Mountains and GYA, but there was no consistent path being followed and there were few conifer or high elevation areas present.

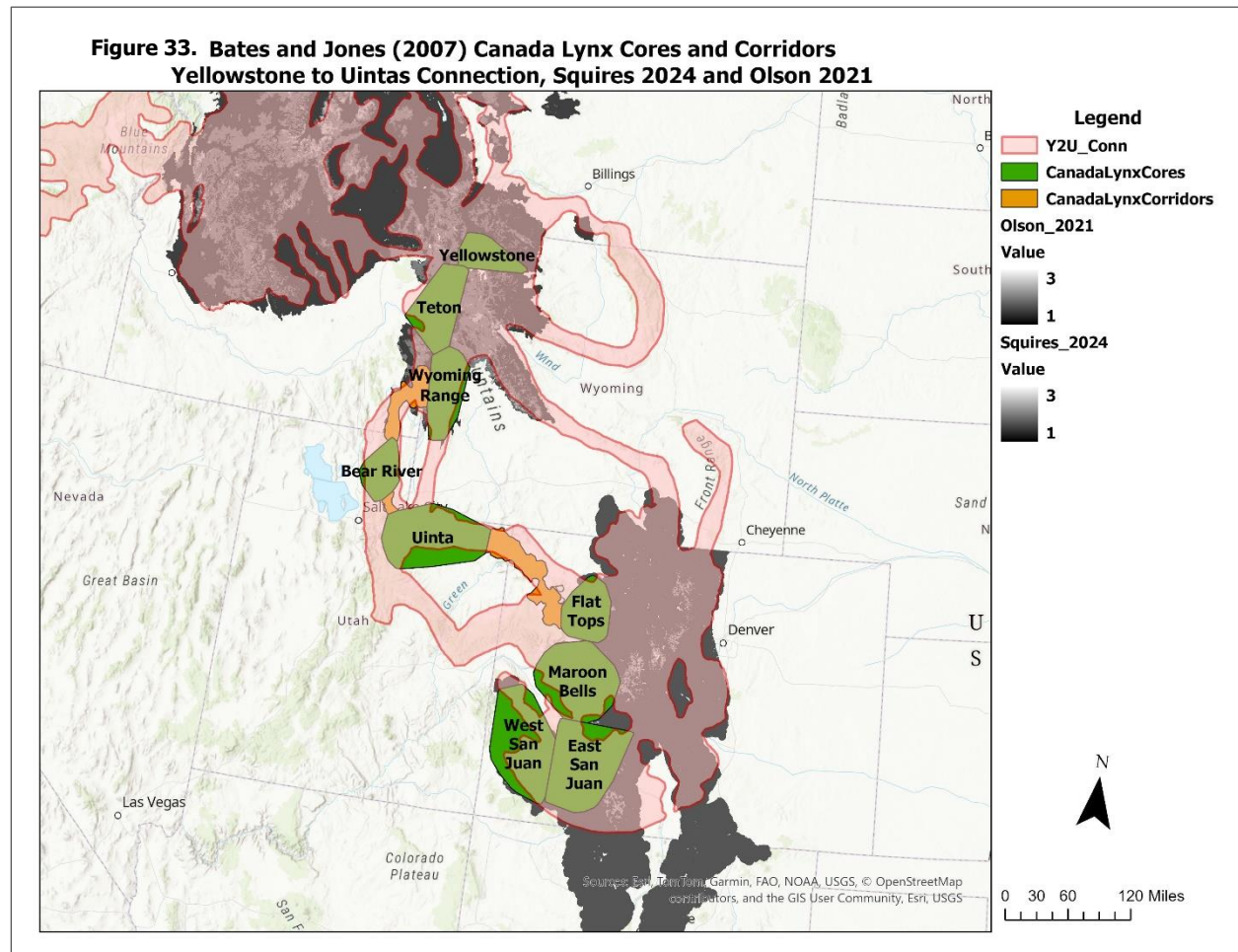
In our January 25, 2023 comments on the 2017 Canada Lynx Species Status Assessment, we reviewed the lynx least-cost path corridors and cores mapped by Bates and Jones (2007).⁵² (Figure 33). These connect the Greater Yellowstone Area, passing through the Wyoming Range into SE Idaho and NE Utah through the Wasatch Range (Bear River and Monte Christo Ranges) to the Uinta Mountains and Southern Rockies. Their path followed the Yellowstone to Uintas Connection leg through the Uinta Mountains to Colorado. A slightly longer leg of the Y2U Connection passes to the south and through the East Tavaputs Plateau and Book Cliffs with elevations of 9,000 to 10,000 feet. Lynx from the Colorado reintroductions used these paths as described. The higher elevation areas are visible in Figure 34.

Bates and Jones (2007) least-cost path analysis of lynx connectivity between the San Juan Mountains in Colorado and the Greater Yellowstone Area reviewed the negative effects of habitat loss and fragmentation on wildlife populations and the resulting isolation of those populations. The role of landscape linkages in providing connections and gene flow was addressed. Using GIS, current spatial data for habitats, human factors affecting lynx movement, and potential travel corridors between core patches of lynx habitat in the southern and northern Rockies were identified. Habitat suitability analysis identified the best core areas for lynx based on vegetation type and road density. Habitat types suitable for lynx were identified and scored. These core and corridor areas of the least cost path overlaid with the Yellowstone to Uintas Connection leg of the Regional Corridor show they aligned with each other. Detailed maps of vegetation classes, road densities, core areas, housing density, slope, habitat permeability, and least cost corridors are provided in Bates and Jones (2007). Their

⁵¹ Ivan, J. 2017. Summary of movements of Colorado lynx in Wyoming. Colorado Parks and Wildlife.

⁵² Bates, W. and Jones, A. 2007. Least-Cost Corridor Analysis for Evaluation of Lynx Habitat Connectivity in the Middle Rockies. Report to the Nature Conservancy by the Wild Utah Project, Salt Lake City.
<https://app.box.com/s/0g8b1ryqg1iz6r1fd61rdkc8fso97oh5>

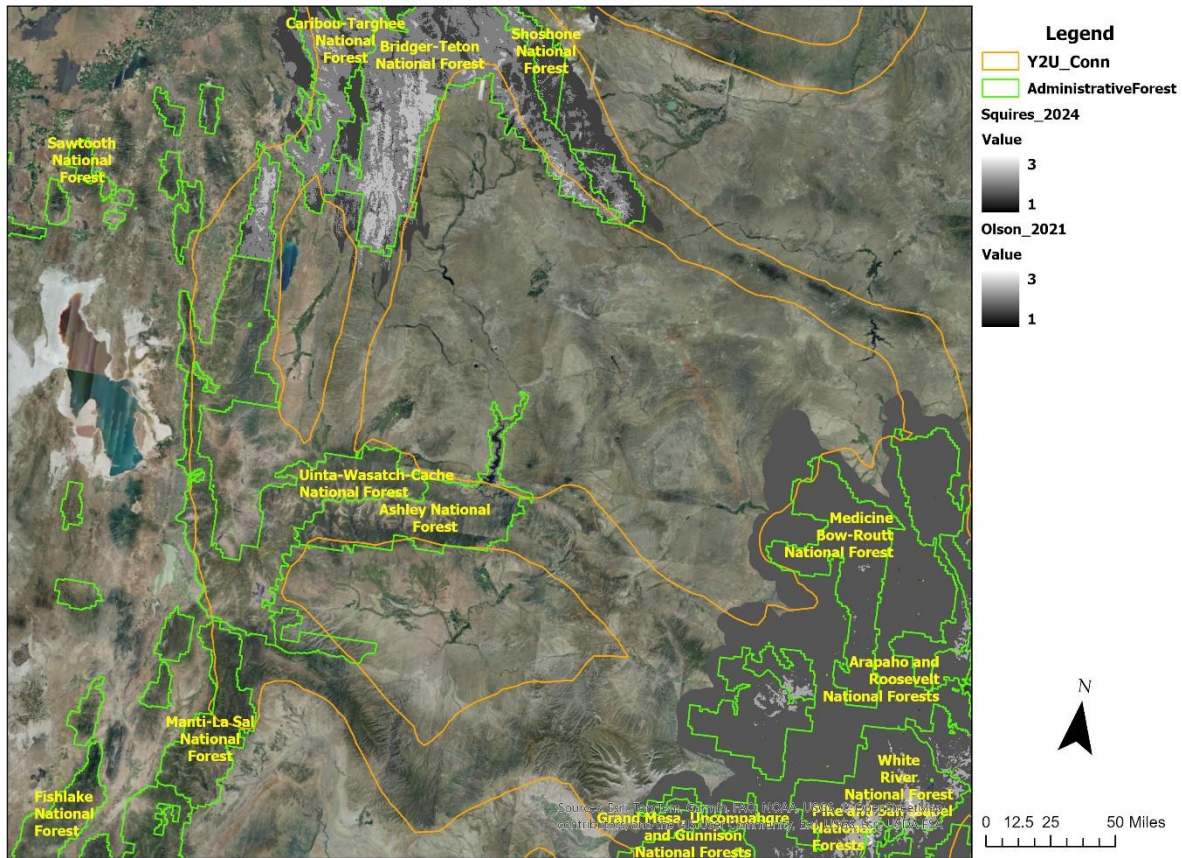
analysis provides an assessment of the probability of successful dispersal for lynx as it assessed the entire landscape, while “an animal traveling on the ground may not have prior knowledge of the territory it is crossing or obstacles it may come upon.” (p21). The model is suitable for making conservation and management decisions.



Colorado Parks and Wildlife engaged in a similar effort to map predicted use areas in Colorado.⁵³ They used location data from reintroduced lynx fitted with transmitters, filtered those data to remove locations for the first six months to account for habituation, considered elevations above 8,000 feet, and included factors for housing and road density, slope, distance to forest patches and vegetation types. Summer and winter data were used to generate models for both seasons. We note that Squires et al (2024) includes one of the authors of the CPW analysis and report. What is needed is a review of these two analyses and extending the Squires and Olson Models to cover this Model Gap and the Yellowstone to Uintas Connection.

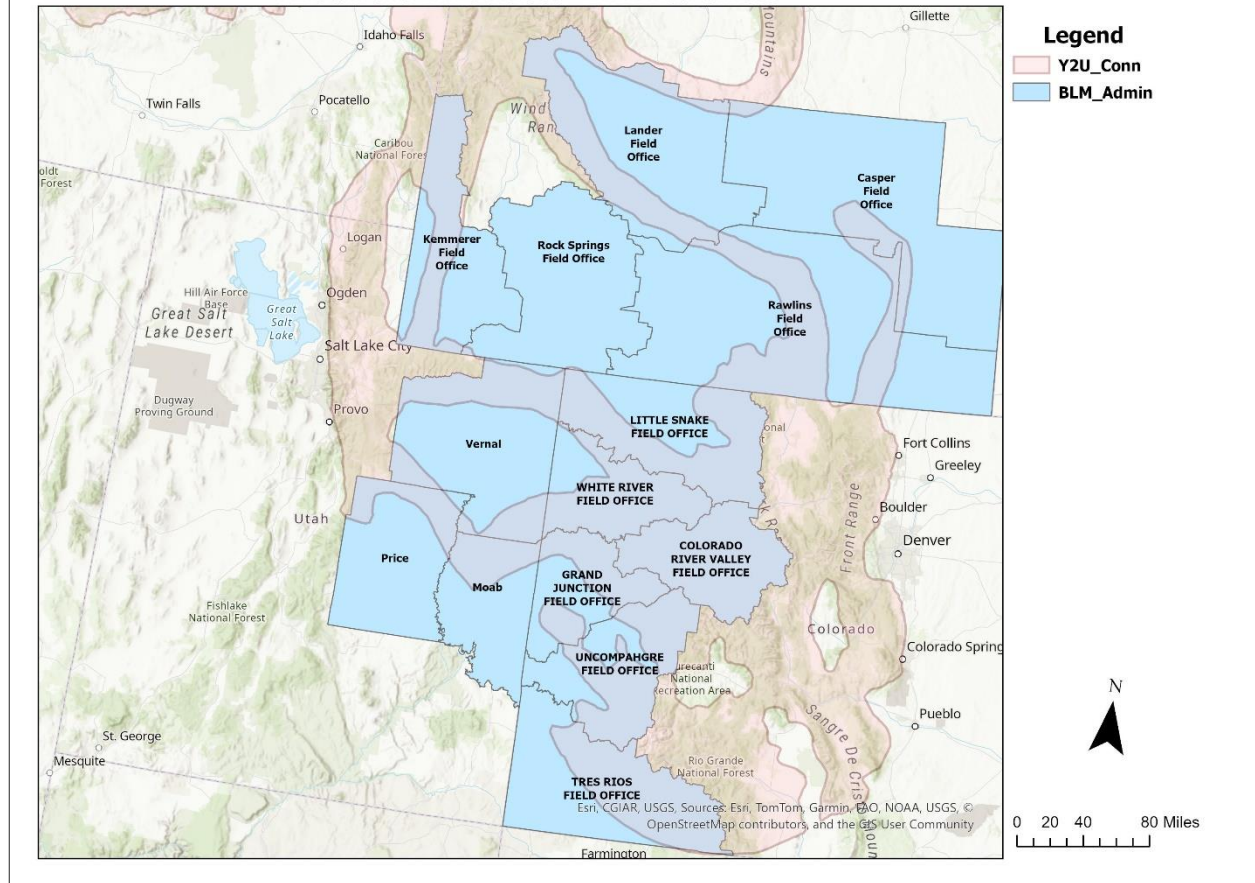
⁵³ Ivan, J., Rice, M., Shenk, T., Theobald, D., and Odell, E. Undated. Predictive Map of Canada Lynx Habitat Use in Colorado. Colorado Parks and Wildlife. Accessed on January 20, 2023. <https://cpw.state.co.us/Documents/Research/Mammals/Publications/CPWPredictiveLynxMapReport.pdf>

**Figure 34. The Model Gap in the Yellowstone to Uintas Connection
NE Utah and NW Colorado**



We then took a closer look at land management in this Model Gap and the Yellowstone to Uintas Connection. Figures 35 and 36 show BLM Field Offices and National Forests within this gap are responsible for management of most of these public lands. This provides an opportunity to work with these two land managers to identify a continuous core and corridor system connecting the Southern Rockies and Greater Yellowstone Area and through land use plan amendments remove genetic barriers for lynx and provide standards to make these cores and corridors functional for lynx.

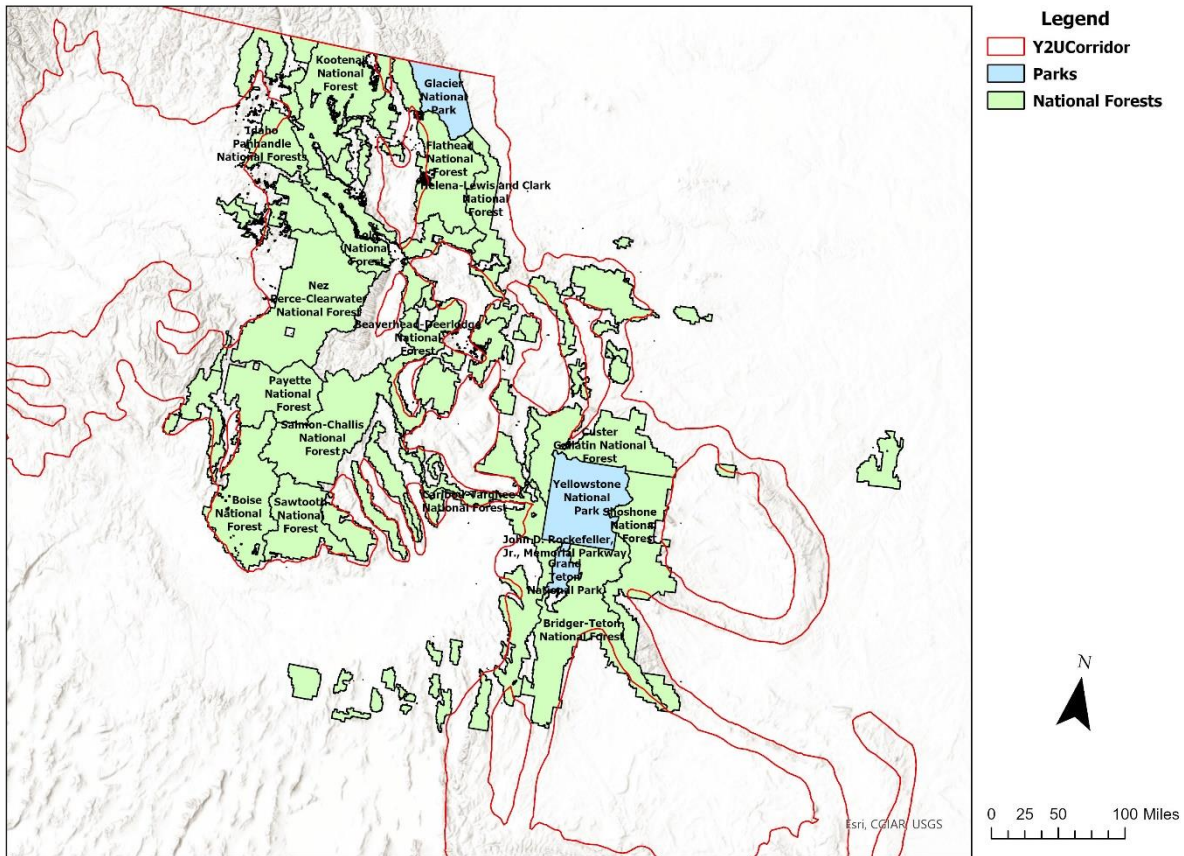
**Figure 35. The Model Gap in the Yellowstone to Uintas Connection
NE Utah and NW Colorado - BLM Field Offices**

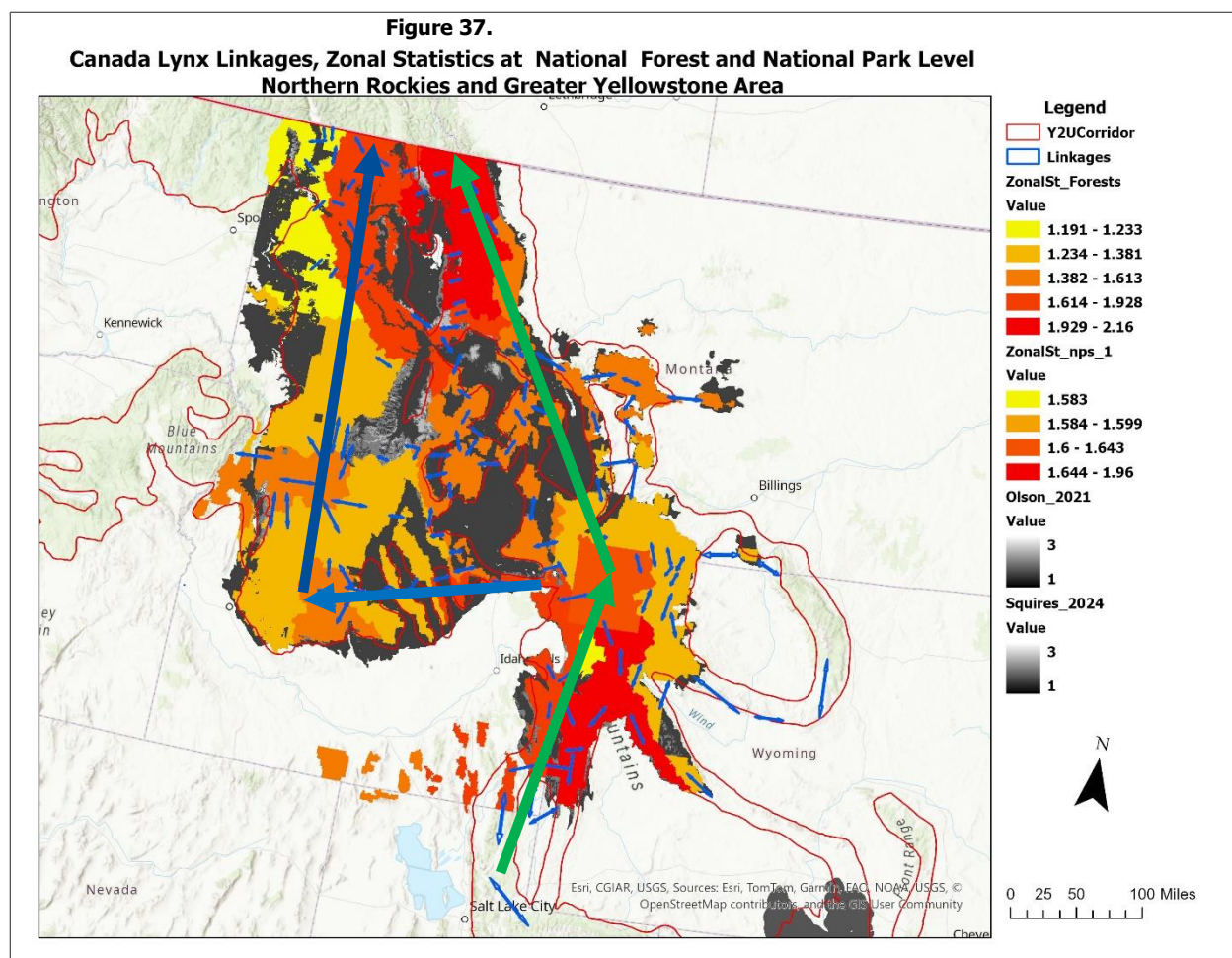


We looked closely at the linkages identified by the Forest Service⁵⁴ and the National Parks and National Forests within the Northern Rockies and Greater Yellowstone Area. (Figure 36 and 37). A more detailed analysis by the FWS team can identify specific areas for connecting these areas. Figure 37 shows the major vectors of movement within areas of high habitat probability or suitability. National Parks (Yellowstone and Grand Teton) and National Forests south to north (Unita-Wasatch-Cache, Caribou-Targhee, Bridger-Teton, Shoshone, Custer-Gallatin, Beaverhead-Deerlodge, Helena-Lewis and Clark, Lolo, Kootenai, and Flathead) combine to form a direct path (green arrows) from south of the GYA through the NR to Canada. A secondary leg (blue arrows) passes to the west and then north through National Forests (Sawtooth, Boise, Salmon-Challis, Payette, Nez Perce-Clearwater, Lolo, and Kootenai NFs).

⁵⁴ USDA Forest Service. 2007. FEIS Northern Rockies Lynx Management Direction. <https://app.box.com/s/smz8ucyfq4d07i27of3ot2tli89va9gx> and Figure 1 map: <https://app.box.com/s/eaeekj1gdznfx2ja7d3xh14bex3i83t>

Figure 36. Major Pathways for Canada Lynx in the GYA and Northern Rockies





1. Conclusions

The Federal Register Notice asked for input on:

the amount and distribution of lynx habitat; any additional areas that should be included; special management considerations and managing for climate change; land use designations and current or planned activities in the subject areas and their possible impacts on proposed critical habitat; areas for exclusion; and improving the approach to designating critical habitat.

In these comments, we have provided analysis and rationale for expanded critical habitat for Canada lynx based on historic occupancy records and modeling by Olson et al (2021) and Squires et al (2024) and shown through mapping the management areas that should be given the highest priorities for Canada lynx protections. This also includes defining and protecting

migration corridors, particularly the Yellowstone to Uintas Connection between the Greater Yellowstone Area and Southern Rockies, and the Greater Yellowstone Area to the Northern Rockies. These currently isolated populations in these units may be doomed to extinction if protected corridors that can support lynx home ranges and migrations are not identified and protected. We found no areas for exclusion, instead major expansion is needed.

We have provided our previous detailed comments on the 2017 Species Status Assessment, Draft Recovery Plan, and Supplemental Draft Recovery Plan. These lay out the science and chronology of agency analyses with our interpretations as to those factors affecting lynx occupancy, historical lynx occupancy, factors that are dismissed as affecting lynx due to “lack of evidence” and our own analyses of lynx habitat.

We have noted that factors of human disturbance and development such as mines, road, recreation, trapping were all dismissed even though science at the time implicated these as well as timber manipulations. In those reviews, we also pointed out that the lack of regulatory mechanisms that were the reason for the original listing remain lacking. No evidence has been provided that the Northern Rockies Lynx Management Direction and amended Forest Plans have made a difference as inspection of the standards and guidelines reveals they have no teeth and, like logging in Lynx Analysis Units, have apparently made no difference. We regularly see LAUs exposed to high amounts of historical and currently proposed disturbance in new projects offered by the Forest Service. In these comments, we now see that human disturbance is admitted to displace lynx from preferred areas. What is missing is accounting for these and providing for lynx core and corridor habitat.

- Using historical lynx observations, we have shown that Unit 3 had the highest mean habitat probability or suitability, followed by Unit 5, with Unit 6 being lowest.
- Using the Olson et al (2021) and Squires et al (2024) models, we also quantitatively showed that habitat suitability or probability was highest in Unit 3, next highest in Unit 5 and lowest in Unit 6 as reflected in the zonal statistics from these models.

In spite of this, Critical Habitat was reduced by 11% in Unit 3 and reduced by 88% in Unit 5, while Unit 6 had no Critical Habitat at the 2014 time of designation due to no occupancy, and now has millions of acres due to reintroductions made at the time of listing. The Federal Register Notice made the following claims to justify these changes.

Unit 3 was occupied at the time of listing and is currently occupied and directly connected to the habitat and population in Canada. Unit 5 has small pockets of habitat on the Bridger-Teton NF and recent modeling (Olson et al 2021) shows this area does not contain the physical and biological features necessary to support lynx residency and is not directly connected to lynx habitats elsewhere. In Unit 6 it is uncertain whether this unit historically supported a resident population or if present, it was ephemeral. It is not connected to lynx habitats

elsewhere. It now supports a resident population as the result of the State of Colorado reintroductions

In these comments we have shown that snow levels and snowshoe hare populations are sufficient to support lynx in both Units 5 and 6. The Olson et al (2021) Model clearly shows a large area of habitat in Unit 5, but has excluded all but the most narrowly drawn areas as proposed critical habitat, which in themselves are disconnected from each other. The claim in the Notice that physical and biological features are lacking in Unit 5 are clearly wrong.

We demonstrated that many areas left out of critical habitat have habitat probabilities matching and exceeding that of Glacier National Park, where a recent effort has estimated a lynx population of 52 individuals and a population of 1.28/100 km². We demonstrated that to capture a majority of historic observations required including the high and moderate probability habitats as modeled by Olson et al (2021). To only include the highest probability further fragments critical habitat. Using the Flathead NF as an example, we found these two categories captured 86% of observations included in the Montana Natural Heritage Program database and this threshold should be the minimum used in defining critical habitat.

We illustrated recent and historical observations using the McElvey and Wyoming observations. Observations from 1990 to present were made throughout the Bridger-Teton NF, Yellowstone NP, Grand-Teton NP, and Caribou-Targhee NF. The absence of observations in the Caribou NF other than a female and two kittens in 2005 appears to be due to heavy human disturbance in the linkages through the Soda Springs and Montpelier Ranger Districts where phosphate mining goes on 24/7, and roads fragment the landscape along with universal snowmobile access. We also used the Tally Lake Ranger District as an example from the Flathead NF. Timber projects increased to a maximum in the period up to the listing of lynx, while lynx observations declined thereafter. High numbers of recorded observations resulting from intensive tracking efforts may bias such an analysis, but there appears to be causation rather than correlation in this case.

We summarized road densities in the Northern Rockies and Greater Yellowstone Area National Forests while adjusting for protected areas. These ranged widely and we did not take the analysis further. They provide food for thought and further analysis of whether it's the road density or the human uses during the different seasons that matter. We posit it is the level of human activity, and limiting this in is of high priority in restoring and maintaining lynx populations.

This late assignment of critical habitat to Unit 6 based on reintroductions at the time of listing has ignored that lynx from those reintroductions were moving within the corridor and remaining for more than half a year in the Uinta Mountains. In the Caribou NF, a female and two kittens were observed in 2005 indicating continued use of, or attempts to occupy, this leg of the corridor. This corridor and the CNF need to be added to critical habitat to provide regulatory constraint on disturbance and for restoration of the corridor. Reintroduction of

additional lynx in the Uinta Mountains seems a very practical approach in the face of the Colorado program.

In Section 4 of these comments, we focused on fragmentation of critical habitat and lack of connectivity. The science cited indicates that the metapopulations in Units 5 and 6 will blink out if not connected and their habitats are protected to be functional. We cited the Glacier NP study by Anderson et al (2023) in which they discussed lynx and other carnivores' avoidance of humans. We presented maps of each Analysis Unit showing the evolution of critical habitat and the depth of fragmentation we are presented with. The losses in critical habitat in Units 3 and 5 were major, while Colorado gained millions of acres. Yet, there were no designated corridors to maintain connections between these. We recommend that the Analysis Units themselves become critical habitat with added connections which should also be critical habitat.

We mapped example areas including the Bridger-Teton NF and its proposed critical habitat showing these were compromised by past logging and roads. Extending into the Caribou-Targhee NF, the linkage habitat is fragmented by phosphate mines which form a very likely barrier in the Soda Springs and Montpelier Ranger Districts. Inventoried Roadless Areas are compromised by roads, mining and timber harvest and therefore have their habitat security and connectivity compromised as well.

What is clear is that so-called protected areas such as IRAs cannot function for lynx unless they are given specific protection from roads, mines, and recreational vehicles as well as trapping and dog pursuit of predators. This should be part of the management going forward in designated critical habitat and connecting corridors.

In our last section, we provided an analysis and illustration of applying the Olson et al (2021) and Squires et al (2024) models to identify core and corridor habitat for lynx. We mapped the Bates and Jones (2007) model that took into account human infrastructure and genetics to identify a least-cost path for lynx through the Yellowstone to Uintas Connection that connects the Colorado lynx habitat in Unit 6 to the Uinta Mountains in NE Utah and the Wasatch Mountains north to the Bear River Range and SE Idaho, then connecting to the Greater Yellowstone Area in Unit 5.

We recommended that the Olson et al (2021) model be updated to incorporate a similar analysis as Squires et al (2024) that took into account disturbance. This and the Model Gap we identify between Unit 6 and Unit 5, which includes both Forest Service and BLM managed lands be modeled to complete the picture.

Using ArcGIS Zonal Statistics, we mapped the Forests and other land management areas showing the extent of IRA, National Parks, National Forests and their mean Olson Model probabilities for the Northern Rockies and Greater Yellowstone Area. We also mapped this same picture for the National Forests in Unit 6 using the Squires Model. These paint a clear picture of the relative importance of these land management units for lynx habitat and

connections. Charts of these rankings were provided with their standard deviations so they can be visually compared.

The differences between Model means across all three Analysis Units were compared. The Northern Rockies were highest with the Greater Yellowstone Area next and Southern Rockies well below the others. This comports with the idea that habitat quality declines as one moves south from the Boreal Forest in Canada. Using the Glacier National Park study showing its lynx estimated population with its Olson Model mean of 1.64 ± 0.59 , we noted the National Forests and other management areas that are not significantly different from this should be managed as lynx habitat.

The idea that areas such as IRAs are protected is challenged with examples. One is that the Northern Rockies NFs do have high habitat probabilities, but there is a lack of protected areas, particularly in the Kootenai NF. What is clear is that so-called protected areas such as IRAs cannot function for lynx unless they are given specific protection from roads, mines, and recreational vehicles as well as trapping and dog pursuit of predators. This should be part of the management going forward in designated critical habitat and connecting corridors.

Finally, we presented a conceptual map using these higher rated Forests with a major link through the major vectors of movement within areas of high and moderate habitat probability or suitability. National Parks (Yellowstone and Grand Teton) and National Forests south to north (Unita-Wasatch-Cache, Caribou-Targhee, Bridger-Teton, Shoshone, Custer-Gallatin, Beaverhead-Deerlodge, Helena-Lewis and Clark, Lolo, Kootenai, and Flathead) combine to form a direct path (green arrows) from south of the GYA through the NR to Canada. A secondary leg (blue arrows) passes to the west and then north through National Forests including (Sawtooth, Boise, Salmon-Challis, Payette, Nez Perce-Clearwater, Lolo, and Kootenai).

All suitable habitats and connections for Canada lynx require land management that sustains currently functioning habitat. The current status of minimal analysis of impacts of roads, recreation, mines, trapping, and timber manipulations must be changed with science-based standards for each land management unit. The current concept of Lynx Analysis Units needs updating to account for science that was omitted when they were established. For example, we pointed out that work such as the 1989 Britell recommendations that included denning, travel, and stalking habitats as 60% of each square mile of lynx habitat were not used in the NRLMD which lacked defined characteristics for many elements of lynx habitat and connectivity. Other works such as Holbrook, Squires, Kosterman and others gave well defined habitat characteristics that should be incorporated into revised standards.

Current regulatory guidance is not taking these more quantitative measures into account in setting standards and for managing. All conifer forests need to be mapped with their current and potential stand characteristics and an analysis following that outlined in the FEIS for the

2003 Caribou National Forest Revised Forest Plan section on corridors in [Volume IV](#). In that section (pages D-4 to D-8), a basic process for assessing connectivity is suggested. This includes:

- Assess historic patterns in vegetation and relative connectivity.
- Assess current patterns in vegetation and relative connectivity, including the impacts of human disturbance or physical barriers.
- Compare historic and current patterns of relative connectivity to determine if animal movement opportunities have been significantly interrupted.
- Consider ecologically based measures to restore historic animal movement

The [2013 LCAS](#) provided the following conservation measures. These should be codified in quantitative terms that identifies and, through standards provides secure habitat and corridors for Canada lynx.

1. Vegetation management (includes several measures including landscape evaluation to identify opportunities for adaptation to climate change).
2. Wildland fire management
3. Habitat fragmentation (promote or retain large contiguous blocks of lynx habitat, identify linkage areas to maintain connectivity, minimize large scale development, and others
4. Recreation management (direct recreational activities away from identified linkage areas
5. Minerals and energy (locate facilities and roads outside of lynx habitat and linkage areas where possible)
6. Backcountry roads and trails (avoid road reconstruction and upgrades that substantially increase speeds) .
7. Livestock grazing (manage in riparian areas to maintain snowshoe hares)

For areas already disturbed, the stage of regeneration or restoration must be determined to evaluate when (and if) those areas may return to lynx habitat or connectivity so those areas can be included in a defined recovery effort. Mature and Old Growth Forests must be protected. Designating Critical Habitat with these recommended constraints provides Canada lynx the needed protections.

Note: While we have used the Olson and Squires Models for our analysis, we have questions remaining about some of the parameters used and the omission of a major corridor. There are other models but none across the broader landscape such as Olson and Squires. Others include the Montana National Heritage Program, Beaverhead-Deerlodge NF, and the ones we cited herein. There is more we could include such as our analysis of historic lynx observations in relation to slope, aspect and elevation showing a wide range of use across these parameters; analysis of the various National Forests and their models; analysis of the Montana Natural

Heritage Program models, and others but given time constraints, we were unable to further refine our analysis. However, these comments should provide sufficient input to increase critical habitat, set protective standards, and begin to focus management on entire Forests, Ranger Districts, other agencies such as BLM, tribes, states, and so on.

ATTACHMENT K

Northwest Science Notes

The purpose of Notes is to publish papers typically less than five pages long. No specific format or content is required for articles published as Notes, but all will be peer-reviewed and must be scientifically credible. Authors may contact the Editor about the suitability of manuscripts for this section.

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Movements of a Male Canada Lynx Crossing the Greater Yellowstone Area, Including Highways

Abstract

From 1999–2001, a male Canada lynx engaged in yearly exploratory movements across the greater Yellowstone area including the Teton Wilderness Area and Yellowstone National Park. For three consecutive summers, the lynx traversed a similar path in a northwesterly direction from the animal's home range in the Wyoming Range near Big Piney, Wyoming, to as far as the Henry's Lake Mountains, west of West Yellowstone, Montana. The longest travel distance was a minimum of 728 km during the summer of 2001. The male crossed several two-lane highways during his movements, including one highway that was crossed at least four times using the same general corridor between the Wyoming and Wind River Mountain Ranges.

Introduction

Canada lynx (*Lynx canadensis*) in the contiguous U. S. reside in small, widely distributed patches of boreal and western montane forests (Aubry et al. 2000, McKelvey et al. 2000). Small and geographically distinct populations are susceptible to demographic risks and stochastic environmental perturbations (Shaffer 1981, Gilpin and Soulé 1986). This may be especially true for lynx at the southern extent of the species' range as the patchiness of moist boreal forests increases (Agee 2000, Aubry et al. 2000, McKelvey et al. 2000). Given the distribution of lynx in the contiguous U.S., we assume that persistent populations at the southern extent of the species' range, such as the animals in Wyoming and Montana, depend on the movements of individuals across large geographic areas for demographic and genetic

rescue (Levins 1969, MacArthur and Wilson 1967). Therefore, improving our understanding of broad-scale movements has important conservation implications. In this note, we discuss the exploratory movements of 2 lynx within the greater Yellowstone area (GYA).

Methods

During the winter of 1996–1997, biologists from the Wyoming Game and Fish Department radio-collared two lynx (1 male, 1 female) in the Wyoming Range, near Big Piney, Wyoming. The Wyoming Range appeared to support a persistent lynx population as evidenced by harvest records from the 1970s and track observations throughout the 1990s. These animals were originally collared to increase our general understanding of lynx habitat use in GYA and to help biologists locate others individuals in the region. In October 2000, we replaced the male's VHF collar with a satellite

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transmitter (*Service ARGOS*, Inc.TM) to calculate locations. The satellite collar was programmed to obtain a location every other day, and the animal's movement path was delineated by plotting the best quality location for each day. Although the specific accuracy of ARGOS relocations was unknown, we believe that most locations were within 1 km (Keating et al. 1991).

Travel Routes

In 1998, we lost contact with the male on 5 June and he was not relocated until 4 September when he returned to his previous home range in the Wyoming Range. We also lost contact with the female until 10 August when she too returned to the Wyoming Range. We used aircraft to search for both animals in the Wyoming Range, but we did not expand our efforts to include the broader GYA. Thus, we concluded that both individuals engaged in exploratory movements outside their usual home ranges during 1998, but the extent of these movements was unknown. The female remained in the Wyoming Range until she died in March 2000.

In 1999, the male crossed State Highway 189/191, a two-lane highway, approximately 16 km east of Bondurant, Wyoming, between 7–11 May (Figures 1, 2) as he traveled north about 40 km to the Wind River mountain range. Between 13–24 June, he returned to his core home range in the Wyoming Range crossing state Highway 189/191 in the same general area as he did in May (Figure 2). Between 24 June and 1 July, the male crossed Highway 189/191 a third time as he traveled approximately 80 km north into the Wind River Range, before returning to his home range between 5–11 August. We could not document the location of the highway crossing on his return trip, but we assume it was in same area as previous crossings based on the last relocation. The sum of straight-line distances between relocation points that defined the 1999 movement from 6 May–5 August was 194 km.

During the summers of 2000 and 2001, the male made two “exploratory” movements that were similar each year. The two movements generally extended from the male's home range in the Wyoming Range to the Idaho/Montana border, as he traversed the Wind River Mountain Range, the Teton Wilderness Area, and Yellowstone National Park (Figure 1). In April 2000, the male first trav-

eled 95 km south before returning to his home range. He then left his home range on 18 June as he traveled in a northwesterly direction as far as Island Park, Idaho. On 1 August, he began the south leg of his journey back to his home range in the Wyoming Range following the same general route he used during early summer. The minimum straight-line distance between relocation points from late June through mid-September, 2000, was 421 km.

During summer 2001, the male left his home range on 21 May as he traveled to the Henry's Lake Mountains near West Yellowstone, Montana, following the same general route he did the previous year (Figure 1). Near West Yellowstone, the male crossed State Highway 20 near Macks Inn, Idaho, before continuing in a northwest direction to the Henry's Lake Mountains where he remained for approximately one week. On 8 August, he began his return trip to the Wyoming Range following the same general path he used in previous years. The minimum straight-line distance from 25 May–29 September 2001 was 728 km. The male died in January 2002.

Corridors and Movement Pattern

From 1999–2001, the male appeared to use the same Bondurant “corridor” when traveling to the Wind River Range from the Wyoming Range in the spring/early summer and when returning in the fall. During 2000 and 2001, the male also appeared to cross State Highway 287 on Togwotee Pass in the same general area (Figure 2). However, the precise location where the male crossed highways could not be determined given the crudely defined movement path as delineated by aerial and ARGOS-based satellite telemetry. The male's general movement pattern was characterized by periods of steady movement punctuated by times when he remained in the same area for several days. For example, the male traveled to Heart Lake in Yellowstone National Park on 19 August, 2000, and remained in the same general area until 27 August before he continued across Yellowstone National Park. In 2001, the male centralized his movements near Togwotee Pass from 6–14 June before heading north into the Absaroka Range. He then localized in an area approximately 30 km south of Yellowstone Lake from 27 June–10 July before traveling across the southern portion of Yellowstone National Park to Heart Lake that he had visited the previous summer.

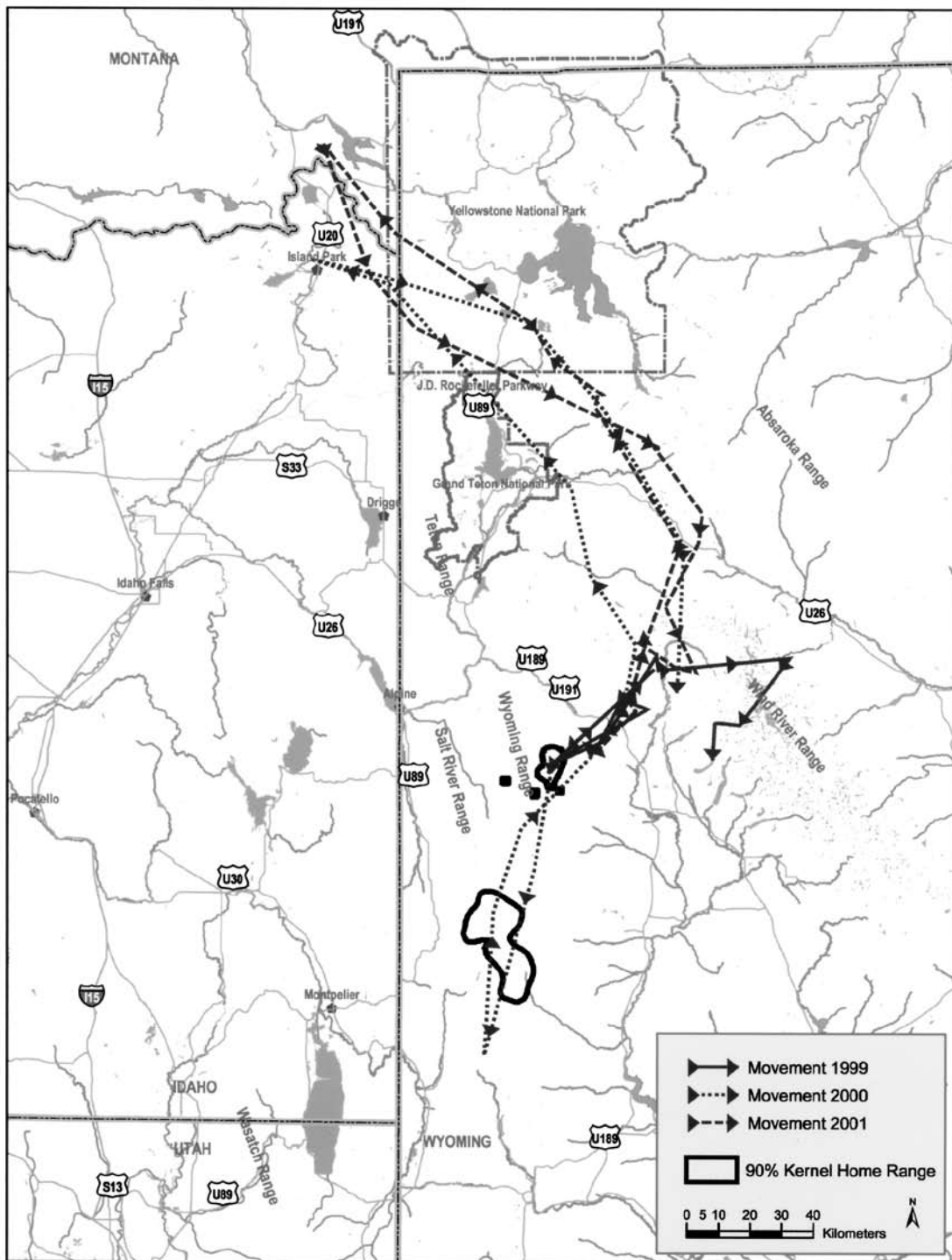


Figure 1. Exploratory movements of a male lynx in the Greater Yellowstone area during the summers of 1999–2001.

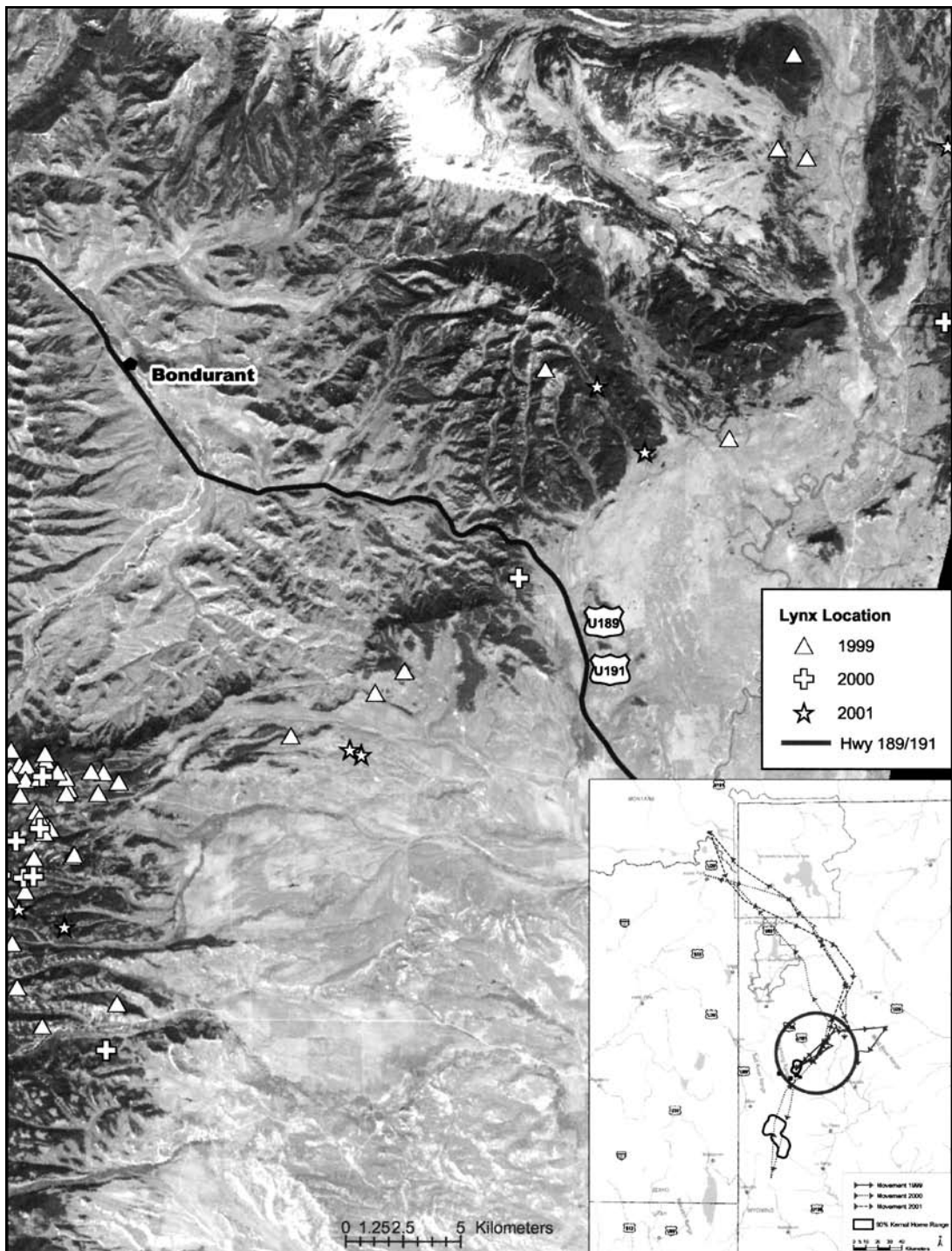


Figure 2. A “corridor” near Bondurant, Wyoming, used repeatedly by a male lynx as he traveled between the Wyoming and Wind River mountain ranges.

Discussion

It is well documented that lynx are capable of long-range exploratory movements, some over a 1000 km (Mech 1977, Brainerd 1985, Brittell et al. 1989, Slough and Mowat 1996, Squires and Laurion 2000, Mowat et al. 2000). However, the Wyoming male's movements were unique because he followed the same general movement path during consecutive summers. We can only speculate regarding the reason for his long-range movements. The Wyoming male did not begin these movements until late spring, well past the February-through-March breeding season. Although breeding was not a possibility, the male may have used these movements to assess the distribution of females throughout the region. It is also possible that he left his winter home range in response to a food shortage. For example, lynx from northern populations became nomadic when food availability was low (Ward and Krebs 1985, Slough and Mowat 1996). However, this explanation seems unlikely given the seasonal abundance of potential prey such as ground squirrels and snowshoe hare (*Lepus americanus*) leverets that appeared abundant on the study area during summer.

The male's exploratory movements during the summer were not random wanderings; rather, he appeared to "pilot" a route that included the same corridors and stop-over areas used in previous years. For example, the lynx used the same Bondurant corridor on at least four occasions to cross the two-lane highway (State Highway 189/191) that separated the Wyoming Range from the Wind River Mountain Range. This corridor consisted of small

islands of lodgepole pine *Pinus contorta* within a sagebrush *Artemisia* spp./wheatgrass *Agropyron* spp. matrix. We speculate the animal may have traveled from island to island as he crossed the Bondurant corridor, but our location data lacked the necessary precision to test this notion. The corridor used by the Wyoming male to cross the two-lane highways on Togwotee Pass and near Mack's Inn, Idaho had more contiguous forested cover compared to that near Bondurant.

We recognize that anecdotal observations of corridor use by a single individual have limited utility. However, these observations do illustrate the importance of gaining empirically-derived understandings of how lynx respond to landscape pattern, including highways and putative corridors. These understandings are especially important for lynx in the contiguous United States where habitat connectivity could be a major factor in the long-term persistence of geographically distinct populations.

Acknowledgements

We acknowledge J. Kolbe, S. Patla, and T. Ulizio for assisting with lynx captures and fieldwork. We especially thank T. Laurion for his many years of assisting lynx studies in the Wyoming Range. We thank R. Peterson for providing hounds for recollaring lynx. Also, a special thanks to G. Lust, Western Air Research, for aerial telemetry and his own efforts to follow lynx movements. Finally, we acknowledge the Big Piney Ranger District, Bridger-Teton National Forest, for their logistical help throughout the project.

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Received 10 March 2005

Accepted for publication 17 June 2005