WILD MONTANA

Region One, Objection Review Officer
U.S. Forest Service, Northern Regional Office
26 Fort Missoula Road
Missoula, MT
59804

Re: Nez Perce-Clearwater Land Management Plan Objection

Submitted electronically via:
https://cara.fs2c.usda.gov/Public/CommentInput?Project=44089.

January 29, 2024

Pursuant to 36 C.F.R. 219 Subpart B, Wild Montana (formerly Montana Wilderness Association) submits this objection to portions of the Draft Record of Decision (DROD), 2023 Draft Final Forest Plan, and the Final Environmental Impact Statement (FEIS) for the Nez Perce-Clearwater National Forest.

I. Description of Objecting Party and Standing

Since 1958, Wild Montana has been uniting and mobilizing people across Montana, creating and growing a conservation movement around a shared love of wild public lands and waters. We work at the local level, building trust, fostering collaboration, and forging agreements for protecting the wild, enhancing public land access, and helping communities thrive. Wild Montana routinely engages in public land-use planning processes, as well as local projects such as habitat restoration and timber harvest proposals, recreational infrastructure planning, oil and gas lease sales, and land acquisitions. Wild Montana and our thousands of members and tens of thousands of supporters are invested in the ecological integrity and quiet recreation opportunities on public lands across Montana, as well as the impact of climate change on Montana's wild places.

Our members also have a vested interest in the adjacent wildlands of the Nez Perce-Clearwater National Forest in Idaho. We travel over the border to visit the Nez Perce-Clearwater to spend time with our loved ones; pass down skills and knowledge to the next generation; harvest game through fair chase backcountry hunting and fishing; and find solace, recreation, refuge, and spiritual connection. Our membership in Mineral, Missoula, and Ravalli Counties consider the Nez Perce-Clearwater as much a part of our wildland backyards as the Lolo and Bitterroot National Forests, and the wild

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character of roadless areas and designated Wilderness on the Nez Perce-Clearwater attract our members from more distant counties, as well as Americans from all over the country. Wild Montana and our members are also committed to advocating for the important habitat found in the Hoodoo Roadless Areas that wildlife use without consideration for state boundaries.

Wild Montana has participated in the Nez Perce-Clearwater forest planning process since it began in 2012. We have provided written comments at multiple stages of the planning process, including the Assessment, Chapter 70 Wilderness Inventory and Evaluation, Proposed Action/Scoping, and the Draft Plan and Draft Environmental Impact Statement. The issues raised in our objections herein are based on these previously submitted comments because we believe that the Forest Service has not adequately addressed the concerns we raised in the previous stages of the forest plan revision process. Our objections address landscape-wide standards and processes and site-specific concerns primarily for the Hoodoo Roadless Area.

II. Lead Objector

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III. Summary of Objections

Wild Montana raises the following objections to the Draft Final Plan, Preferred Alternative.

- **Objection 01:** *By improperly excluding critical areas of the Hoodoo Roadless Area from Wilderness recommendation, the Forest Services acted arbitrarily, capriciously, and contrary to law and agency policy.*

- **Objection 02:** *The Forest Service needs to include clear and durable forest-wide standards for recommended wilderness management.*

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- **Objection 03:** *The Forest Service must include stronger wildlife standards to provide for habitat preservation and species viability.*

- **Objection 04:** *The Forest Service improperly applied the Wild & Scenic Rivers suitability evaluation.*

- **Objection 05:** *The Forest Service should add additional forest-wide standards for recreation management.*

IV. Objection 01: By improperly excluding critical areas of the Hoodoo Roadless Area from Wilderness recommendation, the Forest Services acted arbitrarily, capriciously, and contrary to law and agency policy.

Wild Montana strongly objects to the Forest Service's exclusion of key areas of the Hoodoo Roadless Area, including areas previously recommended, from its recommended wilderness designation. We have consistently raised the recommended wilderness issues contained in this objection in our extensive comments on the Draft Plan and DEIS, Proposed Action, and the Wilderness Evaluation.[1] However, due to the fact that the DEIS did not contain a Preferred Alternative, the DROD, Draft Final Plan, and FEIS have presented new information and rationales related to recommended wilderness, which has required us to newly address the issues in this objection.

While we appreciate that the preferred alternative would expand the Mallard-Larkins Recommended Wilderness Area and add the East Meadow Creek Recommended Wilderness Area, our objection is focused on the Hoodoo Roadless Area and the rationale for changing the recommended wilderness management boundaries.

The 252,000-acre Hoodoo Roadless Area is jointly managed by the Nez Perce-Clearwater (Idaho) and Lolo (Montana) National Forests. Both forests currently manage this roadless area largely as recommended wilderness. These recommended wilderness areas are contiguous, and there are 47 shared miles of boundary between the Montana and Idaho Hoodoo Roadless Areas. The Hoodoo Roadless Area (also

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[1] Wild Montana (formerly the Montana Wilderness Association), *Draft Environmental Impact Statement and Draft Revised Forest Plan Comments*, Apr. 17 2020 (*see* Appendix A) [hereinafter *DEIS Comments*]; Wild Montana (formerly the Montana Wilderness Association), *Proposed Action Comments*, Nov. 14, 2014 (*see* Appendix B) [hereinafter *Scoping Comments*].

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known as the Great Burn) is not only superlative in size, but it also contains exceptionally wild country that provides outstanding opportunities for both wildlife and quiet recreation. The Hoodoo Roadless Area received one of the highest wilderness ratings of any area managed by the Forest Service during the RARE Analysis processes, and the Forest Service has been recommending that Congress designate the area as Wilderness since the 1970s. Portions of the Great Burn Proposed Wilderness have been included in more than twenty legislative proposals, including one that went to President Reagan's desk in 1988 and was pocket-vetoed.

The vastness, wilderness character quality, and wildlife habitat values are critical elements that make the Hoodoo area one of the most outstanding examples of deserving recommended wilderness in our region. As we have held since our 2014 scoping comments, "[a]ny reduction to existing Recommended Wilderness Boundaries will result in the *irretrievable* loss of long-standing administratively protected areas…"[2]

In a January 2024 Facebook post, the official Nez Perce-Clearwater National Forest account posted about the proposed recommended wilderness boundaries for the Hoodoo Roadless Area. The post stated, "[t]he revised boundary was designed to improve manageability of the recommended area, provide connection to and consistency with the adjacent recommended wilderness area on the Lolo National Forest, increase protection of undisturbed wildlife habitat and connectivity for long-ranging species, and provide ecological diversity within the recommended area."[3] We contend the proposed change in boundaries is in direct opposition to each of these stated goals. In making the decision to change the recommended wilderness boundaries in the Hoodoo Roadless Area, the Forest Service fails to provide sufficient rationale and analysis of the impacts in violation of the National Environmental Policy Act (NEPA) and the 2012 Planning Rule. The Nez Perce-Clearwater National Forest is required to take a "hard look" at environmental consequences of the proposed action and the analysis must be based on best available science.[4]

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[2] *Scoping Comments* at 1.
[3] U.S. Forest Service - Nez Perce-Clearwater National Forests, *Creating the Hoodoo Recommended Wilderness Boundary*, Jan. 25, 2024 at 2:57 pm, https://www.facebook.com/NPClwNFs.
[4] 42 U.S.C. § 4332(2)(C); 40 C.F.R. § 1502.16, 1508.7, 1508.8; *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 348 (1989); 26 C.F.R. § 219.3.

A. The Wilderness Evaluation does not support this decision in violation of Forest Service policy.

The Forest Service must base the decision to recommend areas as Wilderness on the Wilderness Inventory and Evaluation Process. The Draft Final Plan and the decision to change the boundaries of the Hoodoo Roadless Area is contrary to the findings of the Wilderness Evaluation and is not supported by best available science.

The Wilderness Evaluation criteria are: (1) apparent naturalness, or the degree to which the area generally appears to be affected primarily by the forces of nature, with the imprints of man's work substantially unnoticeable; (2) outstanding opportunities for solitude *or* for a primitive and unconfined type of recreation in at least some portion of the unit; (3) whether an area less than 5,000 acres is of sufficient size to make practicable its preservation and use in an unimpaired condition; and (4) the degree to which the area may contain ecological, geological, or other features of scientific, educational, scenic, or historical value.[5] The Chapter 70 directives add a fifth evaluation criterion: the degree to which the area may be managed to preserve its wilderness characteristics, based on the geographic shape and configuration of the area and any governing legal requirements.[6] Because the wilderness recommendations must be "based on the analysis disclosed in the applicable NEPA document and input received during public participation opportunities," and the analysis must be based in part on the evaluation, it is critical that the evaluation criteria are properly applied.[7]

As we pointed to in our DEIS comments, the Recommended Wilderness Inventory, Evaluation, and Analysis performed as part of the Forest Planning process found for the Hoodoo Roadless Area that: the area retains a high degree of natural integrity and appearance; human activities have resulted in relatively minor and isolated impacts; vegetation in 73% of the roadless area is within the natural range of variation; the vastness of the area...along with its rectangular shape extending approximately 40 miles north-south provides excellent opportunity for solitude; external influences of sight and sound are minimal; the size and diversity of the area, the variety of vegetative types and landforms, the abundance of wildlife, streams, and lakes all contribute to virtually unlimited primitive settings for recreation; approximately 42% of the area consists of ecological types that are currently underrepresented; the Hoodoo is one of the three roadless areas on the Nez Perce-Clearwater where mountain goats are known to exist. These are unusual in the area and are scenic and wild to view; the water quality in the

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[5] 16 U.S.C. § 1131(c); FSH 1909.12, ch. 70, § 72.1.
[6] FSH 1909.12, ch. 70 § 72.1(5).
[7] FSH 1909.12, ch. 70 § 73, 74.

Hoodoo Roadless Area is generally high; the area shares boundaries with mostly other roadless areas (58%) and front country (42%); there are no adjacent private lands; the management of boundaries shared by other roadless areas is generally not challenging, since management is similar; and there are no grazing allotments overlap with the area.[8]

All of these findings, as well as other points that will be raised throughout this objection, suggest that the Hoodoo Roadless Area meets and exceeds requirements deserving of recommended wilderness management. In the final recommendation for the area moving forward in analysis, the Forest Service states that "snowmobiling and summer motorized use occurs either within the recommended area or adjacent to it. This use would reduce the opportunity for solitude for visitors in proximity to the activity" even though the analysis goes on to state that "[n]atural integrity, apparent naturalness and opportunity for solitude and primitive and unconfined recreation *are high in a majority of the area*."[9]

The portion of the Hoodoo Roadless Area that was recommended wilderness in the 1987 Forest Plan, was legally closed to motorized and mechanized use during the subsequent travel planning processes (with the exception of the Fish Lake Trail).[10] Therefore, in the Preferred Alternative, the Forest Service appears to be excluding recommended wilderness areas in the Hoodoo due to illegal snowmobile trespass and the improper consideration of outside sights and sounds.

The Forest Service may only consider "[l]egally established… uses within the area" in the Wilderness Evaluation process.[11] In this evaluation and the FEIS, the Nez Perce-Clearwater cannot consider current illegal over-snow vehicle use occurring because the Forest Service refused to enforce the 2012 Travel Plan.

Also, outside sights and sounds are relevant to the evaluation of opportunities for solitude only to the extent they are "pervasive and influence a visitor's opportunity for

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[8] *DEIS Comments* at 18; Nez Perce-Clearwater National Forests, *Final Environmental Impact Statement for the Land Management Plan*, Nov. 2023, App'x E: *Recommended Wilderness Inventory, Evaluation, and Analysis* at 65–74 [hereinafter *FEIS*].
[9] *FEIS* App'x E at 215 (emphasis added).
[10] Clearwater National Forest, *Travel Planning: Record of Decision*, Nov. 2011 [hereinafter *2012 Travel Plan ROD*]; Nez Perce-Clearwater National Forests, *Travel Planning: Final Record of Decision for Recommended Wilderness Areas*, Oct. 2017 [hereinafter *2017 Recommended Wilderness Travel Plan ROD*].
[11] FSH 1909.12, ch. 70 § 72.1(5)(b).

solitude" throughout the unit.[12] The assertion that outside snowmobile use would reduce the opportunity for solitude is an assertion not supported by empirical data or models of noise attenuation. Many designated wilderness areas are closely boarded by high-traffic roads. If Congress saw it fit to use highways as Wilderness boundaries, we do not see how, in the absence of data, the Forest Service can justify the claim that adjacent motorized use can create a pervasive loss of wilderness values across a large, rugged, roadless area. The Forest Service bears a high burden to show that outside sights or sounds are in fact pervasive and limit a visitor's opportunity to experience solitude *throughout* the unit. Even where the Forest Service can meet that high burden, the area may still merit wilderness recommendation if it possesses outstanding opportunities for primitive and unconfined recreation. The Forest Service must demonstrate how or why the presence of motorized uses degrades both opportunities for solitude and primitive and unconfined recreation types throughout the entire unit. The analysis in the Wilderness Inventory and Evaluation does not make the requisite showing how existing motorized uses would affect a visitor's ability to experience solitude throughout the unit, taking into account factors such as topography, presence of screening, and distance from impacts.[13]

For the Hoodoo Roadless Area, the Forest Service improperly disqualified parts of the unit due to the consideration of illegally established uses and outside sights and sounds concerns. Therefore, the justification for not carrying forward the area to continued recommended wilderness designation is flawed.

B. The analysis relied on improper measurement indicators.

During the DEIS phase, we provided additional examples of measurement indicators the Nez Perce-Clearwater should include in their analysis of recommended wilderness.[14] None of these were incorporated into the FEIS, and the FEIS still does not adequately address or measure the benefits associated with recommended wilderness. Thus, the FEIS analysis appears to be heavily biased toward alternatives with recommended wilderness areas that minimize conflicts with motorized and mechanized recreation, rather than alternatives with recommended wilderness areas that maximize wilderness character and protection. The measurement indicators used in the FEIS are as follows:[15]

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[12] FSH 1909.12, ch. 70 § 72.1(2)(a).
[13] *See id*.
[14] *DEIS Comments* at 16–17.
[15] *FEIS* at 1651.

1. Changes in wheeled motorized opportunities compared with the existing condition.
2. Changes in motorized over-snow vehicle opportunities compared with the existing condition.
3. Changes in trail miles that allow mechanized transport compared with the existing condition.
4. Changes in the amount of commercial use of permanent structures.
5. Acres of underrepresented ecological groups of the National Wilderness Preservation System.

Four out of the five indicators are weighted towards non-wilderness values. The analysis should be equalized by including a robust set of indicators that consider changes to wilderness values. This should include indicators that measure impacts to naturalness and outstanding opportunities for solitude or primitive recreation. The indicators should measure the negative effects on wilderness values and wilderness character if an area is not recommended or if certain management actions or uses are allowed.

The Forest Service's failure to take a "hard look" at the ecological benefits of recommended wilderness is in violation of NEPA.[16] The Forest Service must meaningfully analyze all impacts, including the ecological benefits of recommended wilderness areas. The required hard look encompasses effects that are "ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative."[17] The recommended wilderness section of the FEIS says very little about the wilderness characteristics of any of the considered areas.[18] That data is only located in the Wilderness Inventory, Evaluation, and Analysis in Appendix E instead of incorporating the analysis into the FEIS and discussion of each alternative. The Forest Service must incorporate best available science into their analysis regarding the benefits of wilderness and wilderness recommendation.[19]

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[16] 42 U.S.C. § 4332(2)(C); 40 C.F.R. § 1502.16, 1508.7, 1508.8; *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 348 (1989).
[17] 40 C.F.R. § 1508.8.
[18] *See FEIS 3.6.2 Recommended Areas* at 1648–85.
[19] 36 C.F.R. § 219.3.

C. The Preferred Alternative is inconsistent with the Forest Service analysis conducted for the Forest Plan Assessment and Travel Plan.

The Draft Final Plan, DROD, and FEIS are in contradiction to the analysis and conclusion made in the recent Clearwater Travel Plan decision and the Forest Plan's Need for Change.

The 2012 Clearwater Travel plan and subsequent 2017 Record of Decision (ROD) regarding recommended wilderness management, made it clear that the Nez Perce-Clearwater was committed to preserving wilderness character and prohibiting nonconforming uses in the 1987 Hoodoo Roadless Area Recommended Wilderness.

The Need for Change in the Nez Perce-Clearwater Forest Plan DROD vaguely states that there is a need to revise the 1987 Forest Plans to "provide for ecological, social, and economic sustainability in an integrated manner. Additionally, the plans need to be revised to better consider multiple uses and ecosystem services desired by local, regional, and national publics."[20] The DROD, FEIS, and Draft Final Plan do not enumerate the reasoning why there was a need for the Forest Service to change their management of the Hoodoo Roadless Area since the recent 2012 Clearwater Travel Plan decision and subsequent 2017 ROD for the Clearwater National Forest Travel Planning for Recommended Wilderness Areas. There is insufficient analysis and discussion as to why the conditions of the forest and on the ground management have changed since these decisions were signed so the forest plan needed to take a drastically different management approach. The 2017 decision made it clear that opening up parts of the 1987 recommended wilderness in the Hoodoo Roadless Area would make it difficult for the Forest Service to regulate the amount and areas of use effectively.[21]

The 2012 Clearwater Travel Plan stated that the non-recommended wilderness areas of the Inventoried Roadless Areas on the forest would "remain open to snowmobiling so there will continue to be opportunities for over-snow motorized recreation in back-country areas."[22] As we referred to in our DEIS comments, a 2018 study used in the Forest Service's analysis for this forest plan revision shows that 2.6% of the forests'

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[20] Nez Perce-Clearwater National Forests, Draft Record of Decision: Revised Land Management Plan, Nov. 2023, at 3 [hereinafter *DROD*].
[21] *2017 Recommended Wilderness Travel Plan ROD* at 10–11.
[22] *2012 Travel Plan ROD* at 42.

users engage in snowmobiling, that the activity was expected to show low growth, and that only 6% of locals and 11% of rural locals indicated there are too few opportunities for snow machine use.[23]

This local survey conducted by USFS Region 1 to determine the preferences for motorized and mechanized access to federal public lands showed that 61% of local respondents indicated there are adequate or too many accessible sites for snow machine use; additionally, 32% of respondents indicated they didn't know whether there were too many or too few sites available. 51% of local respondents indicated there are adequate or too many accessible sites for mountain biking, and 40% indicated they didn't know whether there were adequate sites.[24] Although the survey reflected data from across the entire footprint of the Nez Perce-Clearwater National Forest, and not just the communities adjacent to the Hoodoo Roadless Area, the high numbers indicating that there is currently adequate winter motorized and mountain biking suggests that there is not a high demand or need to reduce recommended wilderness acreage for the Hoodoo Roadless Area. This begs the question of what data the Forest Service is relying on to justify the proposed Preferred Alternative's management of the Hoodoo Roadless Area.

Furthermore, the FEIS analysis inadequately represents the needs and interest in quiet recreation opportunities and instead provides inflated analysis discussing the benefits of motorized recreation based upon speculation, not best available science. In January 2021, Missoula County provided a letter to Supervisor Probert sharing that, "[n]on-motorized recreation significantly contributes to Missoula County's tourism economy, which accounted for more than $284 million in expenditures from nonresidents in our county last year. The popularity and value of the Great Burn and nearby Wild and Scenic River resources benefit local businesses such as river outfitters, fishing guides, recreation gear shops and public lands cartography businesses."[25] While the economic benefits of outfitting and guiding in recommended wilderness was referenced in the FEIS, the Forest Service does not discuss the economic benefits of nonmotorized recreation. Instead, the Forest Service acknowledges that the "plan and Preferred Alternative favor more access for recreational and economic purposes."[26]

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[23] *DEIS Comments* at 21; *FEIS* at 1788–1790 (discussing the Region 1 Social Survey, BBER 2018; and Region 1 Social Survey Year 2 only, BBER, 2019).
[24] *Id*.
[25] Missoula Board of County Commissioners BCC 2021-009, Jan. 14, 2021, re: Nez Perce-Clearwater National Forest (*see* Appendix C).
[26] *FEIS* at 1266.

Part of the rationale in the Clearwater National Forest's Travel Plan for Recommended Wilderness Areas for closing areas to motorized use was impacts to wilderness character and manageability.[27] The ROD, which was signed by Forest Supervisor Cheryl Probert, stated that "[c]ontinuing to allow unregulated motorized recreation in RWAs [recommended wilderness areas] would negatively impact naturalness, primitive character, opportunities for solitude, and wolverine… As motorized use continues to grow, such impacts would become more pronounced and the wilderness character of the areas as existed in 1987, when they were recommended for designation, would not be protected and the potential for future wilderness designation would be reduced. Impacts of such uses to wildlife (particularly wolverine) and trail resources would also be expected to increase. *Because these areas are large and remote, the Forest Service does not have the ability to effectively regulate the amount of use if they remained open…*"[28]

Illegal over-snow vehicle use has persisted since the Clearwater's travel planning decisions, and the Forest Service has not properly managed the 1987 recommended wilderness or provided enforcement. Subsequently, in this planning process, the Forest Service has decided to simply open up the areas where they were not enforcing their previous decisions. As the Forest Service acknowledged in the 2017 decision, the area is large and rugged, and if snowmobiling is allowed, it would be difficult and cost-prohibitive for the Forest Service to control and enforce. The decision to change the recommended wilderness boundaries in the Hoodoo Roadless Areas provides no assurances that the Forest Service will enforce the new boundaries since there is no track record of effective enforcement. Or if the Forest Service continues to allow further and further illegal encroachment into the recommended wilderness, this process sets the precedent that the next time this plan is revised, the Forest Service could use the fact that they created unenforceable boundaries as a reason to open more of the Hoodoo Roadless Area to further nonconforming uses. Conversations with Nez Perce-Clearwater staff at the public meetings held for this planning process suggest that law enforcement availability in this area is inadequate to manage illegal trespass, especially given that boundaries will not be marked and will not be entirely clear to users. By rewarding those who have illegally trespassed despite clear direction from the Clearwater Forest Plan, this planning process is not setting up the Forest Service to effectively manage future difficult management challenges.

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[27] *2017 Recommended Wilderness Travel Plan ROD.*
[28] *Id*. at 10–11 (emphasis added).

Furthermore, regarding mechanized use, the Travel Plan asserted that there "is little mountain bike use within the areas recommended for wilderness by the forest's plan… the remaining areas of the forest will provide a *wide variety of bicycle opportunities* of varying challenge and in a variety of settings."[29]

The Forest Plan FEIS and DROD do not provide any justification for why the Nez Perce-Clearwater must change the recommended wilderness boundaries in the Hoodoo Roadless Area to provide for more winter motorized and mechanized use opportunities, in contrary to their previous findings. This forest plan revision process kicked off in 2014, and there is no evidence showing that between when the 2017 Recommended Wilderness Travel Plan was released and when this 2023 Draft Final Plan came out there were substantial changes on the ground justifying the Forest Service reversing their position.

D. The Preferred Alternative presents manageability and cross-boundary issues.

The Lolo National Forest Plan and Travel Plan provide clear guidance regarding motorized use and wilderness characteristic management on the Montana-side of the Hoodoo Roadless Area, which is managed as MA12 (recommended Wilderness). The Nez Perce-Clearwater Preferred Alternative would allow for winter motorized use and mechanized use along the Lolo-Nez Perce-Clearwater forest boundary. These effects could include, but are not limited to, impacts on soundscape caused by winter motorized use, inability to enforce boundaries, as well as ecological impacts to wildlife populations that freely move from the Idaho to Montana portions of this roadless area and back. For example, sensitive mountain goat populations in the Hoodoo Roadless Area frequent both the Montana and Idaho sides of this roadless area. Idaho-side nonconforming uses are likely to have implications for the health of this trans-state population of mountain goats.

The Nez Perce-Clearwater has a non-discretionary duty, per the USFS Planning Handbook and 2012 Planning Rule, to assess the broader landscape in which this plan will be implemented, which we also discussed extensively in our DEIS comments.[30]

USFS Planning Handbook:

[29] *2012 Travel Plan ROD* at 41–42 (emphasis added).
[30] *DEIS Comments* at 19–20.

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> The intent behind identifying designated areas in plans and recommending additional areas for designation is to … Recommend areas where doing so would help carry out the distinctive role and contributions of the plan area **in the broader landscape** or contribute to achieving desired conditions for the plan area.[31]
>
> *2012 Planning Rule*
>
> Ensure planning takes place in the context of the larger landscape by taking an 'all-lands approach.'[32]
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> "Ecological and social systems are not confined within NFS unit boundaries... the responsible official will consider the landscape-scale context for management and will look across boundaries throughout the assessment, plan development/revision, and monitoring phases of the planning process.[33]
>
> The plan must include plan components, including standards or guidelines, to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity, taking into account: …(ii) Contributions of the plan area to ecological conditions within the broader landscape influenced by the plan area.[34]

The released FEIS does not fulfill the Nez Perce-Clearwater's substantive duty to comply with these aspects of the 2012 Planning Rule and Planning Handbook.

In the Clearwater's recent travel planning decision, the Forest Service stated that their reasoning in prohibiting nonconforming uses in recommended wilderness is to create *consistency* across forest boundaries.[35] Regarding over-snow vehicle use, the travel planning ROD stated that "[u]nlike summer use, winter use is an area-based, rather than route-based, opportunity for motorized vehicles; therefore, expanding the evaluation area beyond the Forest boundary is prudent. The results of this evaluation show that on the Lolo National Forest, the adjacent portion of the Great Burn roadless

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[31] FSH 1909.12, Chap. 20 § 24.0 (emphasis added).
[32] 36 CFR § 219.4.
[33] 77 Fed. Reg. 21,178 (Apr. 9, 2012), *Response to the Issue of Coordination and Cooperation Beyond NFS Boundaries*.
[34] 36 CFR § 219.8 (a)(ii).
[35] *2012 Travel Plan ROD* at 37 (emphasis added).

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area has been restricted for many years to over-snow vehicles. Eliminating over-snow vehicle use in the Great Burn area will result in consistent management practices across the boundary between these National Forests."[36]

Part of the rationale in the FEIS provided for not carrying forward areas of the Hoodoo Roadless Area as recommended wilderness, is that the established motorized use will "present boundary management challenges to prevent trespass into the recommended area."[37] The FEIS Recommended Wilderness Inventory, Evaluation, and Analysis for the Hoodoo Roadless explicitly states that the "management of boundaries shared by other roadless areas is generally not challenging, since management is similar."[38] This forest plan, however, undermines this entire assumption for the Nez Perce-Clearwater and Lolo National Forests. The Lolo National Forest is initiating scoping for their forest planning process on January 31, 2024, which will include the draft wilderness inventory and evaluation. By changing the management for one half of the contiguous Hoodoo Roadless Area, the Nez Perce-Clearwater National Forest is potentially hamstringing the Lolo National Forest in their management. Continuing to manage the Nez Perce-Clearwater side of the Hoodoo Roadless Area as recommended wilderness would allow boundary consistency to remain "not challenging, since management is similar."

Furthermore, the Draft Final Plan would provide for a 150-foot corridor excluded from recommended wilderness for the Stateline (Divide) Trail #738. The Forest Service must clarify how the 150 feet will be calculated to ensure this does not include a portion of the Lolo National Forest. The Nez Perce-Clearwater must not authorize decisions that would occur on the Lolo National Forest. This corridor would effectively sever the Nez Perce-Clearwater's Recommended Wilderness Area and the Lolo's Recommended Wilderness Area, and would invite illegal mountain bike use incursions into connective trails that remain in recommended wilderness areas. This can create manageability issues, even if we assume the Nez Perce-Clearwater will make the necessary effort to educate the public about recommended wilderness boundaries and management prescriptions, post restrictions on connecting trails, and enforce travel restrictions. Moreover, the Stateline Trail has been maintained for stock and foot-users, and the FEIS does not address how this trail would need to be rebuilt to be safe for mountain

[36] *2012 Travel Plan ROD* at 42.
[37] *FEIS* App'x E at 215.
[38] *FEIS* App'x E at 74.

bike use. A recent Missoulian article stated that the trail is in “deteriorating condition.”[39] As Wild Montana has raised with the Lolo National Forest, the current trail contains dangerous corners and poor site lines that increase the chances of a fast-moving bike running into a mountain goat or a slow-moving backpacker.[40] This is especially notable given that the Stateline above the Heart Lake trail is a popular destination for families with children. The Nez Perce-Clearwater FEIS also does not acknowledge or address that the most common use of the Stateline Trail by mountain bikers currently is as a loop route that descends into the Heart Lake basin on the Lolo National Forest or from the Hoodoo trailhead out to the Clearwater Crossing trailhead.

E. This decision impacts plant and animal species in violation of the National Environmental Policy Act, Endangered Species Act, and the 2012 Planning Rule.

The decision to change the recommended wilderness boundaries for the Hoodoo Roadless Area will negatively impact plant and animal species, including the sensitive mountain goat and threatened wolverine and whitebark pine. The Forest Service’s FEIS and DROD do not adequately analyze the direct, indirect, and cumulative impacts on species from human disturbance, specifically winter recreational opportunities. The FEIS fails to take a hard look at, and carefully consider, the overall cumulative effect on each species. Cumulative impacts are “the impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.”[41] Cumulative impacts can result from “individually minor but collectively significant actions taking place over a period of time.”[42] Moreover, the rationale the Forest Service provides for the Preferred Alternative is not consistent with the scientific analysis regarding these potential impacts, and therefore, the decision is not based on best available science.

In our DEIS comments, we raised concerns regarding mountain goats and wolverine, however, we are also objecting based on new information regarding mountain goats,

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[39] Joshua Murdock, *Wilderness advocates worry as Stateline Trail may reopen to bikes*, Jan. 24, 2024, https://missoulian.com/news/local/wilderness-great-burn-mountain-bikes-nez-perce-cle[…]rest-hoodoo/article_788736ec-ba3c-11ee-8308-eb3e728d4978.html.
[40] Wild Montana (formerly the Montana Wilderness Association) Letter to Forest Supervisor Carolyn Upton, *Re: Visit to the Great Burn and Closure Order Request*, Aug. 20, 2020 (Appendix D).
[41] 40 C.F.R. § 1508.7.
[42] 40 C.F.R. § 1508.7.

given their addition to the Lolo National Forest's Species of Conservation Concern list and the recent Endangered Species Act listing of the wolverine and whitebark pine.[43]

The DROD states that a key element of the plan is the "[d]eliberate identification of motorized vehicle suitability to provide for habitat connectivity of wide-ranging species and *species sensitive to winter motorized use*, including grizzly bear, wolverine, elk, fisher and more, while considering how critical those uses are to rural community social and economic sustainability."[44] In the FEIS, the Forest Service more explicitly states that the Preferred Alternative would "favor more access for recreational and economic purposes. The wildlife species that are sensitive to motorized uses or are accessed more easily by motorized access *will not do as well* relatively speaking than if the motorized system favored fewer roads and less human access."[45] We would contend that the Forest Service has illegally prioritized motorized vehicle suitability over the habitat needs of the species.

1. Mountain Goats

The Hoodoo Roadless Area is one of three roadless areas on the Nez Perce-Clearwater National Forest where mountain goats are known to exist. Idaho recognizes mountain goats as a Species of Greatest Conservation Need, Priority Tier 3, in the Idaho State Wildlife Action Plan of 2017.[46] Tier 3 species are considered "rare or uncommon, but not yet imperiled," and may face emerging threats or declining trends range-wide.[47] The Forest Service asserts that the plan's Preferred Alternative "strikes a balance between the protection of mountain goat populations and winter motorized use."[48] We strongly disagree with this statement and would argue that the Forest Service is instead legitimizing illegal over-snow vehicle use that has been occurring in the existing Hoodoo Recommended Wilderness Area without protecting necessary mountain goat habitat.

In October 2023, the Regional Forester added mountain goats (*Oreamnos americanus*) to the Lolo National Forest's Species of Conservation Concern (SCC) list. SCC are defined as "…a species, other than federally recognized threatened, endangered, proposed, or candidate species, that is known to occur in the plan area and for which

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[43] *DEIS Comments* at 24–33.
[44] *DROD* at 12.
[45] *FEIS* at 1266 (emphasis added).
[46] Idaho Fish and Game, *State Wildlife Action Plan*, Jan. 2017, at 883.
[47] *Id*. at 34; Idaho Department of Fish and Game, *Species Ranks*, https://idfg.idaho.gov/species/taxa/ranks.
[48] *FEIS* at 1250.

the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area."[49] In our DEIS comments, we explained extensively why scientific evidence shows there is substantial concern for the mountain goat species' ability to persist in the long term in the plan area, especially the Hoodoo Roadless Area.[50] We did not explicitly request that mountain goats be added to the SCC list, however, the recent listing of the mountain goat as an SCC for the Lolo National Forest constitutes new information we did not have in 2020.

The Blacklead and Stateline mountain goat herds utilize habitat on both the Idaho and Montana sides of the roadless area. This is frequently observed by recreationists, and has been observed by Wild Montana staff during field visits to the area. The FEIS depicts mountain goat observations from overflights conducted by Idaho Fish & Game biologists.[51] Although this data ends at the Montana border, observation dots are distinctly clustered at the border, indicating Blacklead goats are utilizing habitat on the Montana and Idaho border without regard for state boundaries.

The rationale provided for adding mountain goats as a Lolo SCC is as follows, "[a]ll herds within the plan area have demonstrated or are suspected to have population declines. Populations within the plan area are small and isolated and likely have limited connectivity to other populations due to habitat arrangements within the larger landscape. Although the specific cause of the population decline is unknown, multiple threats to the species exist within the plan area, and when coupled with the inherently small populations within the plan area indicate there is substantial concern for the species."[52] This SCC decision was made by the Regional Forester, Leanne Marten.

On the adjacent forest, the Nez Perce-Clearwater, this Draft Final Plan does not consider mountain goats as an SCC and furthermore does not contain plan components to ensure the viability of the species into the future.[53] For the Nez Perce-Clearwater's SCC decision, the Regional decisionmaker determined that SCC status was not warranted for mountain goats because "[m]ost habitat is in designated wilderness or *Idaho roadless areas, removed from stressors associated with motorized use* and

[49] 36 C.F.R. § 219.9(c).
[50] *DEIS Comments* at 25–30.
[51] *FEIS* at 1209.
[52] Northern Region/Lolo National Forest, *Lolo National Forest Evaluations and Rationales for Identifying Species of Conservation Concern: Animals*, Oct. 2023, https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd1149533.pdf, at 104.
[53] Species' specific plan components are discussed in more detail below in Objection 03.

vegetation management."[54] Additionally, the FEIS states that "[f]ew plan components are directed towards mountain goats, as most habitats are inaccessible to anthropogenic threats and are protected in many ways by restrictions in wilderness, recommended wilderness, or roadless areas."[55] This rationale does not take into account the reality of the plan decision which is proposing to change the underlying assumption about habitat removed from areas with motorized use. Although the Hoodoo Roadless Area is an inventoried roadless area parcel, the change of recommended wilderness boundaries would mean that the stressor of winter motorized use *would be allowed* into mountain goat habitat areas.

The Forest Service Handbook explicitly states that SCC should be considered for "species identified as species of conservation concern in adjoining National Forest System plan areas (including plan areas across regional boundaries)."[56] The Nez Perce-Clearwater and Lolo National Forests are not only within the same region, but the species at issue exists in one contiguous roadless area spanning the two forests.

As we raised in our DEIS comments, several of the Hoodoo mountain goat herds have experienced significant declines in recent decades, and this includes the Hoodoo Roadless Area Blacklead Herd.[57] The FEIS states that for all of the mountain goat populations across the Nez Perce-Clearwater National Forest, the "most acute decline based on limited survey efforts is within the Blacklead subpopulation within the Hoodoo Recommended Wilderness Area, where the Idaho Department of Fish and Game has documented *sharp declines* in mountain goat numbers."[58] Illegal over-snow vehicle use regularly occurs near Blacklead Mountain and Williams Peak, which is within the identified Blacklead herd winter range.[59] The FEIS describes that in 2017, Clay Hickey flew over the Hoodoo Roadless Area and reported snowmobile tracks near historic mountain goat areas and counted "less than twenty individuals where past winter counts were in the low hundreds."[60] This evidence is highly suggestive that illegal winter motorized use in the Hoodoo Roadless Area has had significant negative impacts on

[54] Northern Region, *Species of Conservation Concern: Nez Perce-Clearwater National Forests*, animal xlsx, https://www.fs.usda.gov/detail/r1/landmanagement/planning/?cid=fseprd500402 (emphasis added).
[55] *FEIS* at 1234.
[56] FSH 1909.12, ch. 10 § 12.52(d).
[57] *DEIS Comments* at 25–30.
[58] *FEIS* at 1208.
[59] *See* Great Burn - Idaho Roadless Boundaries (2008) Nez Perce-Clearwater Forest Plan Mountain Goat Habitats and Locations (Appendix E).
[60] *FEIS* at 1209.

the Blacklead mountain goat herd, which may be pushing that herd very quickly towards extirpation primarily due to human disturbance.

Mountain goat habitat is broadly characterized by steep, rugged, and high-elevation terrain within subalpine to alpine regions.[61] The species prefers habitat close to "escape terrain," such as cliffs, which allow individuals to avoid predation and disturbance.[62] Habitat is also selected based on heat load, which accounts for incoming sunlight, and influences both forage productivity and snow depth.[63] Given the limited availability of suitable habitat, mountain goat populations undergo short altitudinal migrations to accommodate seasonal resource variation.[64] Habitat becomes even more limited in the winter when snow accumulation and harsh weather conditions concentrate mountain goat populations into ranges 2-50% the size of those occupied in the summer.[65] In the Rocky Mountains, preferred mountain goat winter habitat and feeding areas are located within 200m-wide ridgetop corridors that provide access to escape terrain.[66] Mountain goats face increased energy expenditures and physiological stress in the winter, making their winter habitat critical to population success. Preferred winter habitat is limited and isolated, leaving mountain goats vulnerable to direct threats as well as indirect threats that cause them to abandon high-quality habitat.[67] Changes in spatial distribution, such as avoiding and/or fleeing areas of natural or anthropogenic disturbance, lead to increased energy expenditures at a time when forage resources are limited. Limited resource availability and harsh winter conditions result in nutritional deficiencies, increased starvation risk, and high juvenile mortality.[68] Vulnerability to direct and indirect threats also occurs as a result of the small size and reproductive isolation of many populations. Undisturbed, high-quality winter habitat is critical to mitigating these threats

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[61] Bruce L. Smith & Nicholas J. DeCesare, *Status of Montana's mountain goats: A synthesis of management data (1960–2015) and field biologists' perspectives,* May 2017, Montana Fish Wildlife and Parks (Appendix F); Idaho Department of Fish and Game, *Idaho Mountain Goat Management Plan 2019-2024*.
[62] Clifford G. Rice, *Seasonal altitudinal movements of mountain goats*, 72 Journal of Wildlife Management 1706 (2008) (Appendix G).
[63] Aaron Shafer et al., *Habitat selection predicts genetic relatedness in an alpine ungulate*, 93 Ecology 6 (2019).
[64] Clifford Rice, *supra* note 62.
[65] Kim Poole et al., *Wintering strategies by mountain goats in interior mountains*, 87 Canadian Journal of Zoology 273 (2009).
[66] Steeve Côté and Marco Festa-Bianchet, *Mountain Goat, Wild Mammals of North America: Biology, Management, Conservation*, The John Hopkins University Press (2003), 1061–75.
[67] Idaho Department of Fish and Game, *supra* note 61.
[68] *Id.*; *see also* Kim Poole et al., *supra* note 65.

and maintaining over-winter survival rates and population size.[69] The Nez Perce-Clearwater FEIS acknowledges the importance of protecting mountain goat winter habitat, "winter range is important to the long-term survival of mountain goats and should be identified and managed to reduce disturbance to mountain goats," yet the decision to allow winter motorized use in the Hoodoo Roadless Area is in direct contradiction with this acknowledgment.[70]

Mountain goats are highly sensitive to both motorized and nonmotorized recreational disturbance and demonstrate behavioral changes (increased vigilance and decreased foraging time), reduced reproductive success, and changes in spatial distribution (reducing presence in or abandoning desired habitat).[71] These impacts are particularly acute in the winter, when resources and expendable energy are limited, as well as when disturbance occurs near nursery groups.[72] Unpredictable disturbances that occur at high-intensity, like that of motorized vehicles, are most detrimental to mountain goats and elicit moderate-to-strong negative physiological and functional responses in exposed animals.[73]

Historically, mountain goat populations faced limited disturbance from winter motorized recreation such as snowmobiling, as until the 1990s machines lacked the capability to access remote areas frequented by mountain goats. Technological advances, the introduction of snow bike technology, and decreased snowpack availability are now leading to increased competition between mountain goats and motorized recreationists for the same areas, particularly along ridge-tops used by mountain goats for winter feeding and also favored by snowmobilers and snowbikers for the access to highline views.[74] Studies on general ungulate populations demonstrate that snowmobiles can cause increased flight response, habitat loss, and mortality.[75] Several studies have

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[69] Steeve Côté and Marco Festa-Bianchet, *supra* note 66; Kylie Paul, K., *Potential Conflicts Between Wildlife and Over-snow Recreation in the Scotchman Peaks/Savage Peak Area* (2017) (Appendix H).
[70] *FEIS* at 1207.
[71] Gayle Joslin, *Mountain goat population changes in relation to energy exploration along Montana's Rocky Mountain front*, Biennial Symposium of the Northern Wild Sheep and Goat Council 5:253–269 (1986) (Appendix I); Kevin Hurley, *Northern Wild Sheep and Goat Council position statement on helicopter-supported recreation and mountain goats*, July 9 2004, Biennial Symposium of the Northern Wild Sheep and Goat Council 14:131–136 (Appendix J); Kylie Paul, *supra* note 66 (Appendix H).
[72] Kevin Hurley, *supra* note 71 (Appendix J); Grant Harris et al., *Effects of winter recreation on northern ungulates with focus on moose (Alces alces) and snowmobiles,* 60 European Journal of Wildlife Resources 45 (2014) (Appendix K).
[73] Kylie Paul, *supra* note 69 (Appendix H).
[74] *Id*.
[75] *Id*.

documented the negative impacts of helicopter disturbance on mountain goat populations, as well as that of non-aircraft disturbance. Both aircraft and non-aircraft disturbance can reduce effective habitat, lower forage and resting rates, and impact seasonal habitat use.[76]

Mountain goats are particularly vulnerable to the potential negative impacts of snowmobile disturbance, as research indicates that ungulates become increasingly sensitive, rather than habituated, to long-term and repeated disturbance. Given the accessibility of snowmobiles to rugged terrain and the frequent unpredictable, high-intensity disturbance resulting from this access, expansion of snowmobiling activity into critical mountain goat winter range is likely to reduce habitat availability and quality, produce increased energy expenditures, and reduce reproductive success.[77] Mountain goat populations are small and isolated, making them vulnerable to and often unable to recover from population declines.[78]

To reduce the impacts of winter motorized recreation on mountain goat populations, existing management plans recommend maintaining at least a 500-meter line-of-sight setback from the animals while in open areas and maintaining a distance large enough to prevent disturbance.[79] Given the relatively narrow ridgeline corridors occupied by mountain goat populations during winter months, difficulties arise in enforcing these guidelines. In British Columbia, land management administrators use both visual surveys and habitat modeling to define three habitat categories - “occupied”, “high relative probability of occupation”, and “low suitability”. Recreation in areas identified as occupied or highly likely occupied by mountain goats, particularly during the winter, are placed under use-restrictions to limit disturbance and its potential negative impacts. This process is adaptive and responsive to both changes in mountain goat distribution and recreation type.[80] Adopting management principles of this kind in the Hoodoo Roadless Area is not possible, both from implementation, education, and enforcement standpoints. At the February 2020 St. Regis DEIS public meeting, Nez Perce-Clearwater recreation staffer, Kearsten Edwards shared that in recent years winter law enforcement in the Hoodoo Pass area has consisted of one to two days on

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[76] Idaho Department of Fish and Game, *supra* note 61.
[77] *Id.*
[78] Bruce L. Smith & Nicholas J. DeCesare, *supra* note 58 (Appendix F).
[79] Steve Gordon & Steven Wilson, *Effect of helicopter logging on mountain goat behavior in coastal British Columbia*, Biennial Symposium of the Northern Wild Sheep and Goat Council 14:49–63 (2004).
[80] British Columbia: Ministry of Environment, *Management Plan for the Mountain Goat (Oreamnos americanus) in British Columbia*, May 2010 (Appendix L).

the ground and possibly one overflight.[81] This level of oversight is not adequate to implement the type of management described above, nor is it currently adequate to enforce illegal use and boundaries, as evidenced by tracks seen by Idaho Fish & Game on overflights, the level of snowmobile use our staff have seen while visiting the area in winter, as well as the observations of Great Burn Conservation Alliance members on winter overflights they have financed for a number of years.

The modeling and analysis provided by the FEIS regarding mountain goats and winter recreation is woefully deficient and does not account for the skill levels of riders using this area, nor the new capabilities of snow bikes.[82] Even though the FEIS's model for the overlap between potential snowmobile use and winter mountain goat habitat is insufficient, the Preferred Alternative's boundaries for recommended wilderness in the Hoodoo Roadless Area were changed to allow for snowmobiling in sensitive areas around Blacklead Mountain and Williams Peak. The FEIS explicitly states that "..the boundaries were altered to accommodate recreation."[83] The Forest Service attempts to rationalize the decision by incorrectly stating that "areas of concentrated use by mountain goats were included in recommended wilderness and would not be suitable for summer nor winter motorized use. This strikes a balance in providing for both desires of winter recreation users and protection of mountain goat populations."[84] We strongly disagree. The Forest Service further attempts to justify the Preferred Alternative by stating that the authorization of over-snow vehicle use in any portion of the Hoodoo Roadless Area will require a subsequent travel planning environmental analysis and decision document, even though the Forest Service has repeatedly stated its intention to open these areas to over-snow vehicle use.[85] The fact that there must be subsequent travel planning does not undercut the Forest Service's obligations in this forest planning

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[81] Conversation between Erin Clark, Wild Montana Organizing Director, and Kearsten Edwards, Nez Perce-Clearwater Recreation Staff, St. Regis Nez Perce-Clearwater public meeting, February 21, 2020.
[82] *FEIS* at 1235 ("Model results suggest low amounts of overlap between snowmobile use and known mountain goat population areas. This makes sense because most mountain goat habitat is too steep for comfortable snowmobile use. However, some areas predicted to have high probability values in the snowmobile model are in proximity and adjacent to known mountain goat herds, particularly the herd on Blacklead Mountain, which may leave them susceptible to access by highly skilled snowmobilers. Highly skilled snowmobilers can access steeper terrain and more rugged conditions than average snowmobilers. The model did not perform well at predicting use by highly skilled snowmobilers because it shows areas known to be used by advanced snowmobile users as not preferred by typical snowmobilers. The model only predicts snowmobiler preferences and does not predict snow bike use, which may have different use patterns than snowmobiles.").
[83] *FEIS* at 1208.
[84] *FEIS* at 1235.
[85] *FEIS* at 1250.

effort. The FEIS does not adequately consider any of the potential impacts on mountain goats from this decision in direct violation of their NEPA analysis requirements. The FEIS is also in conflict with management direction provided by the Regional Forester to manage these same herds, i.e. the same individual animals, on the Lolo National Forest as an SCC.

2. Wolverine

Over-snow vehicle use around Blacklead Mountain and Hoodoo Pass will overlap with wolverine habitat as well. As we explained in our DEIS comments, wolverine habitat is present across the forest, but the Hoodoo Roadless Area provides unique, high-quality habitat worthy of special consideration.[86]

The day after this phase of the Nez Perce-Clearwater Forest Plan was released, wolverines were listed as threatened under the Endangered Species Act (ESA). Since this is new information since 2020, we did not previously directly raise the issue of ESA compliance, however, we did discuss at length the impacts of the decision on wolverine. This listing means that the Forest Service must aid in the conservation of the wolverine and ensure that all activities, like revision of this forest plan, are not likely to jeopardize the continued existence of the wolverine or destroy or adversely modify designated critical habitat.[87]

The Forest Service in conjunction with U.S. Fish and Wildlife Service, must ensure this forest plan decision, which would open modeled wolverine habitat up to over-snow vehicle use, would not jeopardize the wolverine. Under the ESA, "conservation" means "to use and the use of all methods and procedures which are necessary to bring any endangered species . . . to the point at which the measures provided pursuant to [the ESA] are no longer necessary."[88] Thus, "the ESA was enacted not merely to forestall the extinction of species[], but to allow a species to recover to the point where it may be delisted."[89] This federal agency obligation is an affirmative duty. The Forest Service

[86] *DEIS Comments* at 31–33.
[87] 16 U.S.C. §§ 1531 et seq.
[88] 16 U.S.C. § 1532(3).
[89] *Gifford Pinchot Task Force v. U.S. Fish & Wildlife Serv.*, 378 F.3d 1059, 1070 (9th Cir.), amended, 387 F.3d 968 (9th Cir. 2004). It is also worth noting that legal claims under the Endangered Species Act do not need to be included in this objection since many such claims are not foreseeable and do not become clear until U.S. Fish and Wildlife Service issues the final biological opinion. Here we do not even have a draft biological opinion and the current analysis is based on an underlying assumption that the wolverine

must show that opening up areas of the Hoodoo Roadless Area to snowmobile use would not jeopardize the existence of wolverine. Wolverine habitat is present across the forest, but the Great Burn provides unique, high-quality habitat. The FEIS stated that, "[a]reas that had a higher probability of use in modeled wolverine habitat include the area near Lolo Pass."[90]

Habitat needs and constraints become even narrower when assessing wolverine maternal denning needs. Heinemeyer et al. showed that female wolverines exhibited stronger avoidance of off-road motorized winter recreation, and wolverines of both sexes avoided areas of both motorized and nonmotorized winter recreation.[91] The FEIS acknowledges this body of scientific research stating the study "suggested stronger negative responses to winter recreation than previous publications suggested."[92] Furthermore, the FEIS acknowledged research that has shown that forest roads used by snow machines in Canada were strongly negatively correlated with wolverine distribution.[93]

The FEIS analyzes that the Preferred Alternative change in recommended wilderness boundaries for the Hoodoo Roadless Area would result in a loss of approximately 13,747 acres in primary wolverine habitat and 12,131 fewer acres of maternal habitat compared to the No Action Alternative.[94] The Forest Service justifies this decision by stating that "[w]hile they will no longer be recommended wilderness, they will be managed as Idaho Roadless Rule Wildland Recreation theme, the most restrictive theme of the Idaho Roadless Rule."[95] This analysis, however, does not take into account that under the Preferred Alternative, motorized use and mechanized use would expand into these wolverine habitat areas. The Idaho Roadless Rule does not provide adequate protections for species negatively affected by winter motorized use.

The plan also does not adequately discuss the significance of wolverine habitat loss attributable to climate change. It has been predicted that between 2030 and 2059 suitable habitat in the contiguous U.S. for wolverine will decrease by 31%, and that for

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hasn't been officially listed under the Endangered Species Act. *See* 16 U.S.C. § 1540(g)(2); *Darby v. Cisneros*, 509 U.S. 137, 154 (1993).

[90] *FEIS* at 977.

[91] Kimberly Heinemeyer et al., *Wolverines in winter: indirect habitat loss and functional responses to backcountry recreation*, Ecosphere 10(2) (2019) (Appendix M).

[92] *FEIS* at 961.

[93] *FEIS* at 956–57.

[94] *FEIS* at 971.

[95] *Id*.

Idaho specifically, habitat will decrease by 43%. These estimates further predict that habitat in the contiguous U.S. and Idaho will decrease by 63% and 78% respectively.[96] Climate change will reduce wolverine habitat, while simultaneously restricting winter recreationists to these areas that maintain persistent snowpack. This overlap will impact maternal denning success and lead to habitat loss and population declines.

In the Great Burn, protecting wolverine habitat and populations will only be productive if this area is also designated off-limits to over-snow motorized and mechanized use. We look forward to seeing the biological opinion for this forest plan revision once the Forest Service has completed consultation with the U.S. Fish and Wildlife Service. Although the U.S. Fish & Wildlife Service has one year to designate critical habitat, the Nez Perce-Clearwater should not be designating areas as suitable for over-snow vehicle use that will likely be critical habitat due to the presence of maternal and primary habitat. The Forest Service and U.S. Fish and Wildlife Service have conducted enough analysis and modeling to know where these high importance areas on the forest may occur, and the data brought forward in the DEIS suggests that these areas are in the Hoodoo Roadless Area, and quite specifically overlap with the areas the FEIS would open to over-snow motorized use.

FEIS also discusses that connectivity of wolverine habitat is “highest in the plan area along the Idaho-Montana border” and is essential for linking habitats in “central Idaho to those in the Bob Marshall Wilderness and Glacier National Park in Montana and through them on to Canada.”[97] The FEIS continues by stating that “[s]pecific effects of this change are that future travel planning projects might open these areas to winter motorized uses, and if so, wolverines could experience disturbance and displacement because of winter motorized uses.”[98] Even with this ample evidence in front of the agency and analysis in the FEIS, the Forest Service is proposing to open this critical maternal denning habitat and connectivity corridor to over-snow motorized use.

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[96] K.S. McKelvey et al., *Climate change predicted to shift wolverine distributions, connectivity, and dispersal corridors*, 21 Ecological Applications 2882 (2011).
[97] *FEIS* at 965.
[98] *FEIS* at 975.

3. Whitebark Pine

Since our DEIS comments in 2020, whitebark pine has been officially listed as a threatened species under the Endangered Species.[99] In the Forest Service's Biological Assessment for the Nez Perce-Clearwater Forest Plan, the Forest Service discusses that in "some areas winter recreation also provides a threat to existing trees as a portion of the trees that protrude above the snow may be damaged by motorized vehicles."[100] The Biological Assessment also discusses the threat of climate change to whitebark pine and encourages adaptation strategies and establishing refugia.[101]

Data collected by Winter Wildlands Alliance showed that between 1983 and 1995, snowmobiles damaged between 12 and 720 trees per acre across approximately 72,393 surveyed acres on the Hebgen Ranger District of the Gallatin National Forest.[102] On the Kootenai National Forest, north of the Great Burn in Montana, the Over-Snow Motorized Use Travel Plan scoping documentation extensively acknowledged that adverse effects to whitebark pine may result from running over tree parts present above the snow layer, breaking limbs, abrasion of branches, and leader growth.[103]

In the Final Forest Plan and FEIS, the Forest Service must acknowledge that climate change will negatively affect whitebark pine, and evaluate the compounded negative effect caused by the concentration of over-snow vehicle use at higher elevations as climate change progresses. The Hoodoo Roadless Area warrants consideration as a whitebark pine refugia as contemplated in the Biological Assessment, and at minimum, this plan needs to contain measurement indicators and minimization measures for whitebark pine.

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[99] U.S. Fish & Wildlife Service, 87 FR 76,882, Dec. 15, 2022, https://www.fws.gov/species-publication-action/endangered-and-threatened-wildlife-and-plants-threatened-species-70.

[100] Nez Perce-Clearwater National Forests, *Biological Assessment for Threatened, Endangered, Proposed Species, and Essential Fish Habitat Assessment*, June 2023, at 452 [hereinafter *Biological Assessment*].

[101] *Biological Assessment* at 456.

[102] Winter Wildlands Alliance, *Seeing the forest and the trees: assessing snowmobile tree damage in national forests: A report by Winter Wildlands Alliance*, 2009 (Appendix N).

[103] Kootenai National Forest Over-snow Motorized Use Travel Plan, *Draft Minimization Criteria Screening*, July 2023, at 6.

Remedy Requested for Objection 01:

The Forest Service must revise the FEIS and Forest Plan so that the final decision is based on best available scientific information. The FEIS and measurement indicators should incorporate the benefits of wilderness and wilderness character, and the Forest Service must limit winter over-snow vehicle suitability in areas with known stands of whitebark pine, maternal and primary wolverine denning habitat, and sensitive mountain goat herds. In order to comply with Forest Service policy, the ESA, NFMA, and the agency's own NEPA analysis, the Nez Perce-Clearwater should recommend the entire 151,874 acre Hoodoo Roadless Area as Wilderness.

V. Objection 02: The Forest Service needs to include clear and durable forest-wide standards for recommended wilderness management.

Wild Montana objects to the lack of sufficient forest-wide standards for recommended wilderness management that would effectively preclude nonconforming uses. As we have raised since scoping, recommended wilderness areas must be managed for social and ecological characteristics that preserve and enhance wilderness character over time, as required by the 2012 Planning Rule, Forest Service guidance, and caselaw.[104] Furthermore, the final plan must adopt clear standards for the proper management of recommended wilderness areas and mechanisms by which those standards can be immediately implemented. Public land managers are responsible for managing recommended wilderness areas to preserve wilderness character and their potential for future inclusion into the National Wilderness Preservation System.

The 2015 Forest Service Manual planning directives address the management of recommended wilderness areas.[105] Those directives state:

> *Any area recommended for wilderness or wilderness study designation is not available for any use or activity that may reduce the wilderness potential of an area.*

It is important to note that this Manual direction replaced the previous 1923.03 direction, which stated that:

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104 *DEIS Comments* at 4–17.
105 FSM 1923.03(3).

"Any inventoried roadless area recommended for wilderness or designated wilderness study is not available for any use or activity that may reduce the wilderness potential of the area. Activities currently permitted may continue pending designation, if the activities do not compromise the wilderness values of the area."

Furthermore, the Forest Service Handbook[106] states:

When developing plan components for recommended wilderness areas, the responsible official has discretion to implement a range of management options. All plan components applicable to a recommended area must protect and maintain the social and ecological characteristics that provide the basis for wilderness recommendation. In addition, the plan may include one or more plan components for recommended wilderness areas that:

> *1. Enhance the ecological and social characteristics that provide the basis for wilderness designations;*
> *2. Continue existing uses, only if such uses do not prevent the protection and maintenance of the social and ecological characteristics that provide the basis for wilderness designation;*
> *3. Alter existing uses, subject to valid existing rights; or*
> *4. Eliminate existing uses, except those uses subject to valid existing rights."*

The Handbook reiterates the direction given in the 2012 Planning Rule by stating all plan components "must", *not may*, "protect and maintain the social and ecological characteristics that provide the basis for wilderness designation". The Handbook also restates the Forest Service's authority to "alter" or "eliminate existing uses" in the maintenance of those characteristics.

A. The Draft Final Plan's recommended wilderness standards are insufficient.

While we support the Final Plan's suitability components designating recommended wilderness as unsuitable for motorized and mechanized transport, we object to the ambiguous and insufficient standards for recommended wilderness that exclusively rely on the Recreation Opportunity Spectrum (ROS). The Draft Final Plan currently contains

[106] FSH 1909.12, ch. 70 § 74.1.

two forest-wide plan standards regarding recommended wilderness management which are:

- **MA2-STD-RWILD-01:** Summer recreation opportunities shall be compatible with the appropriate recreation opportunity spectrum classification of primitive or semi-primitive non-motorized.
- **MA2-STD-RWILD-02:** Winter recreation opportunities shall be compatible with the appropriate recreation opportunity spectrum classification of primitive or semi-primitive non-motorized.

These proposed standards fail to adequately create a future condition that allows recommended wilderness areas to retain their social wilderness characteristics and opportunity for future inclusion in the National Wilderness Preservation System. By tiering the recommended wilderness standard to the ROS classifications, the Forest Service is not putting into place clear and enforceable standards. The standards need to address an adequate range of issues to guide future managers on how to approach projects and activities that may affect wilderness character. For example, in addition to recreation opportunities, the standards should address development activities like commercial utility corridors, energy or utility structures, recreation events, developed recreation sites, road construction, timber harvest, and communication sites, as in other recently revised forest plans in Region 1. The 2012 Planning Rule specifically provides, "[t]he plan must include plan components, *including standards and guidelines*, to provide for ... management of areas recommended for wilderness designation to protect and maintain the ecological and social characteristics that provide the basis for their suitability for wilderness designation."[107] The suitability components summarized in the table should be included as standards to ensure enforceability since those components are not referenced in a plan standards.

Additionally, the proposed recommended wilderness standards include references to both "semi-primitive nonmotorized" and "primitive" ROS classifications. The ROS classification of semi-primitive nonmotorized is silent on mechanized use and could create confusion if the standards are not clarified.

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[107] 36 CFR § 219.10(1)(iv).

B. The Forest Service should should ensure nonconforming uses are prohibited in recommended wilderness areas

Without explicit recommended wilderness management standards to back up the suitability table components, there are no assurances that motorized and mechanized uses will, in fact, be banned in recommended wilderness areas. As we mentioned in our DEIS comments, the Forest Service should not consider allowing nonconforming uses in recommended wilderness, as this is contrary to regional policy and precedent.[108] The direction in the 2012 Planning Rule instructs the USFS to “protect and maintain the ecological *and social characteristics* … for wilderness designation” and we strongly urge the Nez Perce-Clearwater to manage both the ecological and social characteristics of recommended wilderness areas in a manner that is consistent with the Forest Service’s recommendations and prohibits uses that are nonconforming to the Wilderness Act. Forest Service policy clearly expresses that mechanized and motorized uses are not compatible with recommended wilderness areas, and urges managers not to include such recreation in these areas.

As discussed at length in our DEIS comments, motorized and mechanized transport can diminish an area’s “primeval character”, its “outstanding opportunities for solitude or a primitive and unconfined type of recreation”, as well as its ecological values, and it is essential that FEIS adequately address and analyze these potential diminishments.[109] Visitors to wilderness, whether designated or recommended, expect to find high levels of naturalness, solitude, and access to remote experiences via primitive recreation. Uses that do not conform to the intent and purpose of wilderness affect this experience. The diminishment of social and ecological characteristics can lead future decision-makers to reduce, or even eliminate, recommended wilderness areas in future planning processes.

The Nez Perce-Clearwater National Forest recently addressed the issue of nonconforming uses in recommended wilderness in the Clearwater National Forest Travel Planning for Recommended Wilderness Areas ROD.[110] The findings of this ROD lead to the conclusion that the Forest Service could not allow nonconforming uses within the recommended wilderness because of the obligation to protect and maintain the wilderness suitability of recommended wilderness areas. Indeed, the ROD which was signed by Forest Supervisor Cheryl Probert stated that “[c]ontinuing to allow

[108] *DEIS Comments* at 6–7.
[109] *DEIS Comments* at 4–17.
[110] *2017 Recommended Wilderness Travel Plan ROD.*

unregulated motorized recreation in RWAs [recommended wilderness areas] would negatively impact naturalness, primitive character, opportunities for solitude, and wolverine… As motorized use continues to grow, such impacts would become more pronounced and the wilderness character of the areas as existed in 1987, when they were recommended for designation, would not be protected and potential for future wilderness designation would be reduced. Impacts of such uses to wildlife (particularly wolverine) and trail resources would also be expected to increase. Because these areas are large and remote, the Forest Service does not have the ability to effectively regulate the amount of use if they remained open…"[111]

Every National Forest in Region 1 includes recommended wilderness standards that prohibit nonconforming uses. We strongly encourage the Nez Perce-Clearwater to follow the lead of these other Region 1 Forests. We previously provided these examples that illustrate how management decisions to allow nonconforming uses in recommended wilderness areas have led to losses in acreage in subsequent forest planning processes, reducing the potential for future Wilderness designation for those areas.[112] We want to provide these examples again to demonstrate why strong standards for recommended wilderness that do not allow nonconforming uses are essential. By allowing nonconforming uses to persist and establish, and by failing to manage these areas in a manner consistent with National Forest policy, these decisions failed to protect and maintain ecological and social characteristics for wilderness designation.

1. *Beaverhead Deerlodge National Forest, Mt. Jefferson Recommended Wilderness:*

   In 1990, the Beaverhead Deerlodge National Forest created the 4,474 acre Mt. Jefferson Recommended Wilderness Area in the Hellroaring Creek drainage, the ultimate headwaters of the Missouri River. Although small, the Mt. Jefferson Recommended Wilderness Area was adjacent to the 23,054 acre Centennials Recommended Wilderness Area, managed by the Bureau of Land Management (BLM), for a combined total of approximately 28,000 acres. The previous Beaverhead Deerlodge National Forest Plan allowed snowmobiling in Recommended Wilderness Areas. When snowmobiling technology improved in the 1990s, Mt. Jefferson became a publicized snowmobile destination, accessed primarily from the Idaho side. Attempts by the Madison District Ranger to close

[111] *Id*. at 10–11.
[112] *DEIS Comments* at 11–14.

the Recommended Wilderness Areas to snowmobiles were overruled by the Forest Supervisor. In contrast, snowmobiling was prohibited in the adjacent BLM Centennials Recommended Wilderness Area. In 2002, the responsible BLM field manager wrote a letter to the Beaverhead Deerlodge National Forest requesting the closure of the Forest Service portion of the Recommended Wilderness Area in order to curtail illegal trespass. His request was ignored. When the Beaverhead Deerlodge National Forest revised its Forest Plan in 2009, the already small Mt. Jefferson Recommended Wilderness Area was cleaved in half: 2,000 acres in the upper reaches of the Hellroaring Creek drainage were stripped of Recommended Wilderness Area status, leaving only a 2,000 acre Recommended Wilderness Area in the lower reaches of the valley.

This example addresses the issue of illegal trespass in adjacent public lands when nonconforming uses are allowed. This is very relevant to decision-making for the Nez Perce-Clearwater given the adjacent Hoodoo Roadless Area acres managed by the Lolo National Forest as recommended wilderness. Illegal trespass by nonconforming uses on the Lolo is expected to be an issue if management of the Nez Perce-Clearwater National Forest goes forward with the Preferred Alternative as discussed in Objection 1.

2. *Beaverhead Deerlodge National Forest, West Big Hole Recommended Wilderness:*

Approximately 56,000 acres of the 130,000 acre West Big Hole Inventoried Roadless Area, on the east slope of the Beaverhead Range was an recommended wilderness area in the Beaverhead Deerlodge National Forest’s 1980s-era Forest Plan. Crowned by 10,620ft Homer Youngs Peak, the West Big Hole is a key link in the chain of wild areas that connect the Greater Yellowstone Ecosystem with central Idaho wildlands, including the Frank Church-River of No Return and Selway-Bitterroot Wildernesses. The previous Beaverhead Deerlodge National Forest Forest Plan allowed snowmobiling in Recommended Wilderness Areas, and when snowmobile technology improved in the 1990s, the West Big Hole became a popular high-marking playground. As a result, when the Beaverhead Deerlodge National Forest released its revised Forest Plan in 2009, the West Big Hole Recommended Wilderness Area was eliminated.

Winter motorized technology continues to improve. In recent decades snow bikes have become a readily available and popular technology. Snow bike riders can access more densely forested and steeper terrain than snowmobiles. These capabilities have potential impacts on winter habitat security for sensitive species such as wolverines and mountain goats as discussed elsewhere in this objection.

3. *Beaverhead Deerlodge National Forest, Anaconda-Pintler Wilderness Recommended Inclusions (Sullivan and Tenmile Creek):*

The 1980s Beaverhead Deerlodge National Forest Plan included Sullivan and Tenmile Creeks as Recommended Wilderness Area additions to the Anaconda-Pintler Wilderness. At the southeastern end of the Anaconda Range, these drainages harbor ancient, gnarled, 800-year-old subalpine larches that are among the oldest trees in Montana. Just like the West Big Hole and Mt. Jefferson, snowmobiles were allowed in this recommended wilderness area. When technology improved enough to allow access into this rugged high country, recreation became popular enough that the Beaverhead Deerlodge National Forest removed the Recommended Wilderness Area when it revised its Forest Plan in 2009.

4. Flathead National Forest, Jewel Basin:

The aptly-named Jewel Basin is a beloved gem in the Crown of the Continent ecosystem and the crown jewel of the Swan Range. The spectacular alpine lakes of the Jewel Basin are not unlike some of the incredible alpine lakes in the Hoodoo Roadless Area. In the 1987 Flathead National Forest plan, the Jewel Basin Recommended Wilderness Area encompassed over 32,000 acres. Like all 1980s forest plans, the 1987 plan, did not address mechanized transport. In subsequent years, the Alpine No. 7 trail that traverses the Swan Crest and bisects the Jewel Basin caught the interest of mechanized users, and became a popular mountain and dirt biking destination. Images of mountain bikers riding the Alpine No. 7 trail are used on local mountain biking websites and promotional materials. These mechanized users actively advocated for use of additional portions of Alpine No. 7 in Jewel Basin, as well as other trails in the Jewel Basin Recommended Wilderness Area.

The 2018 Flathead ROD ultimately eliminated 14,000 acres of Recommended Wilderness Area in Jewel Basin, shrinking it nearly by half. The plan attributed this loss specifically to recreational use pressure: “Jewel Basin recommended wilderness area excluded a portion in the south end where mechanized transport occurs.” The Flathead FEIS also specifically stated that the acreage of the Jewel Basin Recommended Wilderness Area was, “reduced … to minimize effects on mechanized transport." In this case, the establishment of mountain biking in a recommended wilderness area directly precluded that part of the recommended wilderness area from continued protection and the possibility of future designation.

5. *Custer Gallatin National Forest, Lionhead:*

The Lionhead Recommended Wilderness Area in the Custer Gallatin National Forest was managed as recommended wilderness between 1987 and 2022. The 2006 travel plan prohibited snowmobiles in the area and acknowledged that mountain biking was inconsistent with managing for wilderness character, but deferred a specific decision regarding mechanized use. No decision was ever issued and mechanized use became more established in the area on the Continental Divide National Scenic Trail (CDNST). Because of this, in the 2021 Final Forest Plan, the Forest Service eliminated recommended wilderness protections to transform the entire CDNST section as a mountain bike trail even though mechanized use was not listed as a "compatible" use of the trail in the CDNST Comprehensive Plan that was created under the National Trails System Act.

As demonstrated by the case studies above, failing to close recommended wilderness areas to burgeoning nonconforming uses precipitates a rapid decline in their potential for future inclusion in the National Wilderness Preservation System. In the end, wilderness character, quality of wildlife habitat, quiet recreation opportunities, recommended wilderness areas, and the potential for future designations have been significantly degraded.

We urge the Nez Perce-Clearwater to follow through on its responsibility to wilderness-quality lands and include robust plan components that are consistent with its own administrative recommendations to manage these landscapes for social and ecological characteristics that preserve wilderness character over time, allowing maximum potential for Wilderness designation in the future. The Forest's own commitment to wilderness character sets the baseline for visitor's expectations and resulting actions. The Nez Perce-Clearwater must support its own recommendations by prohibiting all nonconforming uses in recommended wilderness areas and specifically declaring that these areas are not suitable for mechanized and motorized transport through clear standards and guidelines.

Remedy Requested for Objection 02:

From the case studies above and our work across National Forests, Wild Montana has learned that clear, unambiguous plan components that fully retain wilderness character and the potential of recommended wilderness areas while waiting on Congress to act are a necessity. The currently proposed recommended wilderness standards include references to both “semi-primitive nonmotorized” and “primitive” ROS classifications. The ROS classification for recommended wilderness should be changed to Primitive to ensure clear future management direction. The semi-primitive nonmotorized ROS setting states that “[m]echanized transport such as mountain biking are often present.”[113] This creates conflicting plan direction which will create future management uncertainty. Additionally, we encourage the Nez Perce-Clearwater National Forest to consider the following recommendations for forest-wide recommended wilderness area plan components.

The Final Plan must add an additional plan standard or clarify in the existing plan standards that nonconforming uses are prohibited in recommended wilderness. Wild Montana proposes the following standard:

- **Standard**: All motorized and mechanized forms of transportation and equipment are not allowed in recommended Wilderness, including snowmobiles, snow bikes, hang gliders, bicycles, carts and wagons, except for administrative purposes. Landing aircrafts is also prohibited except for administrative purposes.

As suggested above, the suitability table is not sufficient to provide enforceable plan components. We recommend the final plan add the information in the suitability table as the following plan components:

- **Standard**: Timber cutting, sale, or removal may only be allowed to the extent permitted by the Idaho Roadless Rule, 36 CFR 294.24.
- **Standard:** Mineral activities may only be allowed to the extent permitted by the Idaho Roadless Rule, 36 CFR 294.25.
- **Standard:** Road construction and reconstruction may only be allowed to the extent permitted by the Idaho Roadless Rule, 36 CFR 294.23.
- **Standard:** Bicycles and other mechanical forms of transportation are not allowed.

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113 Nez Perce-Clearwater National Forests, *2023 Land Management Plan*, Nov. 2023, at 73.

- **Standard:** Wheeled carts (including game carts) are not allowed.
- **Standard:** Construction of new buildings or structures is not allowed.
- **Guideline:** Maintenance of existing buildings and structures is allowed.

The Forest Service should consider adding additional components that contemplate other developments and infrastructure such as commercial utility corridors, energy and utility structures, recreation events, and developed recreation sites. Limiting trail density will also help ensure that areas retain their ecological and social wilderness characteristics and the possibility for inclusion in the National Wilderness Preservation System. As the populations of Missoula and Ravalli Counties continue to grow it will be increasingly important to protect recommended wilderness from trail proliferation. We recommend the following guideline for recommended wilderness areas:

- **Guideline**: To maintain areas of undeveloped wilderness character, there should be no net increase in miles of system trails within recommended wilderness. Trail reroutes for resource protection or after natural occurrences, such as fire, floods, windstorms, and avalanches, should utilize the best long-term sustainable routes with minimal trail infrastructure.

VI. Objection 03: The Forest Service must include stronger wildlife standards to provide for habitat preservation and species viability.

Wild Montana objects to the Draft Final Plan's lack of wildlife standards, especially for the wolverine, mountain goat, and grizzly bear. In our DEIS comments, we discussed sustaining and protecting wildlife populations in the Nez Perce-Clearwater National Forest, especially for these sensitive species found in the Hoodoo Roadless Area.[114]

In addition to the Forest Service obligations under the Endangered Species Act discussed in Objection 1, under the National Forest Management Act (NFMA), the Forest Service must "provide for diversity of plant and animal communities" on units of the National Forest System.[115] To implement this requirement, the revised 2012 Planning Rule directs the agency to "provide the ecological conditions necessary" to "contribute to the recovery of federally listed endangered and threatened species… and maintain a viable population of each species of conservation concern within the plan

[114] *DEIS Comments* at 24–33.
[115] 16 U.S.C. § 1604(g)(3)(B).

area."[116] This requirement includes "standards and guidelines, to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds in the plan area, including plan components to maintain or restore their structure, function, composition, and connectivity."[117]

The Draft Final Plan relies almost exclusively on insufficient coarse-filter plan components that do not provide for individual species. By failing to enact the proper plan standards that are necessary to conserve species, the Forest Service is in violation of the 2012 Planning Rule, NFMA, and the ESA.

In Objection 1, we extensively discussed the plan's analysis of mountain goats and wolverines and the species' threats, which is relevant to this objection as well.

A. Mountain Goats

As discussed in Objection 1, the Regional Forester recently designated mountain goats as an SCC for the adjacent Lolo Forest Planning process. The Nez Perce-Clearwater FEIS states that no plan standards are needed for the species since "most habitats are inaccessible to anthropogenic threats and are protected in many ways by restrictions in wilderness, recommended wilderness, or roadless areas."[118] In Objection 1 we demonstrate how this assertion is in conflict with the draft plan's intention to allow nonconforming winter motorized access in areas that overlap with known mountain goat herd use.

B. Wolverine

Regarding wolverine, the FEIS considers some of the best available science on the ecology of wolverines and the key stressors facing the species.[119] The Draft Final Plan's management decision arbitrarily flies in the face of this analysis. Not only is the Forest Service proposing to open critical habitat areas to over-snow winter motorized use, but the plan also dismisses the need for wolverine plan components. As discussed above, the day after the Draft Final Plan and FEIS were published, U.S. Fish and Wildlife Service announced a final decision to list the wolverine in the contiguous U.S. as a threatened species. Therefore, under the 2012 Planning Rule, the Forest Service is

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[116] 36 C.F.R. § 219.9(b)(1).
[117] 36 C.F.R. § 219.9(a).
[118] *FEIS* at 1234.
[119] *See FEIS* at 949–91.

required to determine if coarse-filter plan components contribute to the recovery of wolverine, and if not, there must be species-specific plan components.[120]

The U.S. Fish and Wildlife Service's Species Status Assessment Addendum asserted that 96% of modeled wolverine habitat is located on federal lands primarily managed by the Forest Service.[121] In the addendum, U.S. Fish and Wildlife Service states that coarse-filter plan components will "undoubtedly provide some conservation benefits to wolverines… [h]owever, quantifying these benefits outside of wilderness areas is challenging given the variability in Forest Plan standards and conservation measures across the range of the wolverine."[122]

We do not believe coarse-filter plan components on their own will properly protect habitat and that site-specific plan components are necessary to provide for the conservation of wolverine in the planning area.

C. Grizzly Bear

While the Hoodoo Roadless Area does not currently support a resident population of grizzly bears, this area is important for habitat connectivity between the Bitterroot Ecosystem and Northern Continental Divide Ecosystem grizzly bear recovery units. In the fall of 2007, a grizzly bear was shot by a black bear hunter in the Kelly Creek area of the Hoodoo Roadless Area. The bear was genetically identified as having originated in the Selkirk Mountain population of North Idaho. It is only a matter of time, likely within the scope of this plan, that grizzly bears will again reside in the Hoodoo Roadless Area. It is already highly probable that they are regularly passing through the Hoodoo Roadless Area. During this objection period, U.S. Fish and Wildlife Service initiated a process to consider the establishment of a grizzly bear population in the Bitterroot ecosystem across Idaho and Montana. One of the stated purposes for this action is to restore a grizzly bear population to be "well distributed throughout the [Bitterroot Ecosystem]."[123] It is therefore reasonably foreseeable that grizzly bears will be in the planning area during the life of the revised forest plan.

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[120] 36 C.F.R. § 219.9(b).
[121] U.S. Fish and Wildlife Service, *Species Status Assessment Addendum for North American Wolverine (Gulo gulo luscus)*, Sept. 2023, at 42.
[122] *Id*. at 43.
[123] U.S. Fish and Wildlife Service, 89 Fed. Reg 3413 (Jan. 18, 2024), https://www.govinfo.gov/content/pkg/FR-2024-01-18/pdf/2024-00873.pdf?utm_campaign=subscription+mailing+list&utm_medium=email&utm_source=federalregister.gov.

We appreciate the species-specific desired conditions for grizzly bear, however reliance on the general ecosystem plan components is not sufficient to provide for grizzly bear habitat, and site-specific plan components are needed to address the effects of motor vehicle access and grizzly bears.[124] The Nez Perce-Clearwater National Forest is in a key area to facilitate genetic exchange between recovery zones and help this species recover.

Remedy Requested for Objection 03:

The Regional forester must add mountain goats to the SCC list for the Nez-Perce Clearwater National Forest and the Final Plan must contain additional specific wildlife standards for wolverines, mountain goats, and grizzly bears to ensure the species' viability in the landscape for the long term. The Forest Service should also analyze and adopt minimum standards for core grizzly bear habitat for areas that provide connectivity between the Bitterroot Recovery Zone and the Northern Continental Divide, Cabinet Yaak, and Selkirk Recovery Zones. We also recommend the Nez Perce-Clearwater incorporate the following plan components:

- **Desired Condition**: Human-caused disturbances do not affect species such as mountain goat, wolverine, and grizzly bear at a frequency or scale that prevents wildlife populations from attaining desired distribution and abundance in the planning area.
- **Standard:** Over-snow vehicle use is prohibited in mountain goat winter range.
- **Desired Condition:** Mountain goats are not harassed or displaced from known winter concentration or kidding areas due to human activities.
- **Guideline:** To limit the risk of cumulative impacts to female wolverines with dependent young, there should be no net increase in percentage of modeled wolverine maternal denning habitat where motorized over-snow vehicle use is identified as suitable on NFS lands at a forestwide scale.[125]
- **Standard:** Over-snow vehicle use is prohibited in wolverine primary and maternal denning habitat from December 1st to May 31st.[126]

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[124] 36 C.F.R. § 219.9(b).
[125] *See* Flathead National Forest*, Land Management Plan*, Nov. 2018, at 61.
[126] Kootenai National Forest Over-snow Motorized Use Travel Plan, *Draft Minimization Criteria Screening*, July 2023, at 57. ("Wolverine nay respond negatively to increased winter recreation from over-snow vehicle use causing dispersal from important maternal and primary habitat components… Modeled habitat would be closed to all over-snow vehicle use from December 1 to May 31.").

- **Guideline:** The Nez Perce-Clearwater National Forest will adopt a forest-wide order that describes acceptable methods for storing food and other wildlife attractants on public lands administered by the Forest.

VII. Objection 04: The Forest Service improperly applied the Wild & Scenic Rivers suitability evaluation.

We appreciate that the Nez Perce-Clearwater Draft Final plan found Cayuse Creek, Fish Creek, Hungary Creek, Kelly Creek, North Fork Kelly Creek, Middle Fork Kelly Creek, and South Fork Kelly Creek as eligible and suitable for inclusion in the Wild and Scenic Rivers System. Wild Montana, however, objects to the process used for Wild and Scenic River suitability as discussed in our DEIS comments.[127]

In the Wild and Scenic Rivers Act, Congress declares up front that it is "the policy of the United States that certain selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations."[128] To be eligible for inclusion in the Wild and Scenic River System, a river or segment thereof must be "free-flowing" and it or its related land area must possess at least one outstandingly remarkable value.[129] Free-flowing, as applied to any river or section of a river, means "existing or flowing in a natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway." Outstandingly remarkable values are the "scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values" listed in section 1 of the Wild and Scenic Rivers Act.[130] Once the eligibility criteria are met, there are two ways for a river to be included in the National Wild and Scenic Rivers System: (1) by an Act of Congress; or (2) upon application of a state governor and approval by the Secretary of the Interior as outlined in section 2 (a)(ii) of the Wild and Scenic Rivers Act.[131]

Specifically, under Section 5 (d)(1) of the Wild and Scenic River Act, the "Secretary of

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[127] *DEIS Comments* at 33–37.
[128] 16 U.S.C. § 1271.
[129] 16 U.S.C. § 1273(b).
[130] 16 U.S.C. § 1271.
[131] 16 U.S.C. § 1273(a); *see also* Wilderness Society v. Tyrell, 918 F.2d 813, 815 (9th Cir. 1990) (discussing the Wild and Scenic Rivers Act designation process).

the Interior and the Secretary of Agriculture shall make specific studies and investigations to determine which additional wild, scenic and recreational river areas within the United States" qualify for inclusion in the National Wild and Scenic Rivers System.[132] This section "requires the Secretaries of Agriculture and the Interior to conduct 'specific studies and investigations' to discover rivers eligible for inclusion in the National Wild and Scenic River System."[133] This identification process is carried out at the field office level, by local federal agents, as part of a planning process.

Once identified, such potential additions to the National Wild and Scenic River System or eligible rivers are to be taken into account by Federal agencies in all planning activities (at either the plan or site-specific level). The Nez Perce-Clearwater began a review of the waterways in the planning area in 2017 and completed a non-required suitability report in 2018. 89 river segments on the Nez Perce-Clearwater are currently managed as eligible segments, and all 89 deserve to continue being managed as eligible segments. After recognizing 89 rivers and streams to be eligible for designation under the Wild and Scenic Rivers Act, only 11 were found to be "suitable" for continued protection. This is unacceptable and a threat to waterways that feed the forests that support local timber industries, while simultaneously providing world-class recreation opportunities for individuals and jobs for local river guides and outfitters. These rivers and streams are also steeped in rich cultural history and are home to a number of cultural sites.

Correspondence obtained by American Rivers and American Whitewater through a January 2020 FOIA request demonstrates that staff of the Nez Perce-Clearwater National Forest received significant pressure from Idaho County Commissioners to conduct a suitability report prior to the Forest Planning process with the express purpose of finding most eligible river segments unsuitable. A July 25, 2017 letter from the Board of Idaho County Commissioners to Forest Supervisor Cheryl Probert included the following statements, "[w]e have concerns with the number of river segments (approximately 100) currently being proposed as eligible under the Wild and Scenic River Eligibility process… We believe that it is important that the Forest completes the Suitability Evaluation during the current Forest Planning process. We believe the Suitability process would eliminate most of these rivers, thus eliminating unnecessary and burdensome regulations on the land."[134]

[132] 16 U.S.C. § 1276(d)(1).
[133] *Id.*
[134] Board of Idaho County Commissioners letter to Cheryl Probert, July 25, 2017 (Appendix O).

Consistent with Section 5(d)(1) of the Wild and Scenic Rivers Act, the Forest Service's 2012 Planning Rule imposes obligations on the agency to consider the eligibility of rivers for inclusion and does not authorize nonsuitability determinations during the forest planning process.[135] Instead, the focus of both the Wild and Scenic Rivers Act and the 2012 Planning Rule is on the identification of eligible rivers, and the planning rule is silent on suitability determinations.[136] The Forest Planning process does not authorize the use of suitability studies and instead must be used to identify the eligible rivers so as to "protect the values that provide the basis for their suitability for inclusion in the system."[137]

Remedy Requested for Objection 04:

We request that the Nez Perce-Clearwater National Forest provide interim protections for all rivers found to be eligible for inclusion in the Wild and Scenic Rivers system, regardless of their suitability determination.

VIII. Objection 05: The Forest Service should add additional forest-wide standards for recreation management.

Rapidly evolving, and advancing, recreation technology demands both unambiguous plan components that clearly define what types of recreational uses are permitted in certain areas, as well as forward-thinking policies that anticipate the increased use and associated impacts of certain activities over the life of the new plan.[138] For example, in the 1980s, it was barely conceivable that mountain bikes would be able to traverse most trails. Today mountain biking is a growing and popular recreation activity in our region. This plan must be able to withstand advances in motorized and mechanized technology for the next 15-30 years that, like advancements made since the 1980s, will undoubtedly make further and faster backcountry access earlier and therefore more desirable in all seasons.

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[135] 36 C.F.R. § 219.7(c)(2)(vi) ("Identify the eligibility of rivers for inclusion in the National Wild and Scenic Rivers System, unless a systematic inventory has been previously completed and documented and there are no changed circumstances that warrant additional review.").
[136] This is in contrast to the preceding rule provision which instructs the Forest Service to "[i]dentify and evaluate lands that may be *suitable* for inclusion in the National Wilderness Preservation System and determine whether to recommend any such lands for wilderness designation." *Id*. (emphasis added).
[137] *Id*.
[138] *See DEIS Comments* at 23–24.

Snow bikes are a relevant example to the Hoodoo Roadless Area. Timbersled, a snow bike manufacturer that is now owned by Polaris, claims it has doubled the number of sleds it has sold every year since 2010. The industry suggests that snow bikes are on pace to outsell snowmobiles in the next few years. The nimbleness of a snow bike far exceeds that of snowmobiles, allowing riders to access more heavily forested terrain and steeper aspects than on a snowmobile. Winter visits to the Hoodoo Roadless Area vicinity by our staff and members in recent years have demonstrated that snow bike use is prevalent in the area. The capabilities of these machines, and their likely increased presence, must be considered by the Nez Perce-Clearwater in evaluating the impacts of designating new winter motorized access areas.

Motorized (or electric-powered or electric-assisted) mountain bikes are another example of an emerging recreational technology that presents a challenge in the management of quiet trails. New electric bikes weigh as little as 43 pounds, and are visually nearly indistinguishable from a nonmotorized mountain bike. Bike manufacturer Santa Cruz has been investing heavily in this type of electronic mountain bike and they are advertising their latest model using this tagline, “For riders looking for something that doesn’t scream EBIKE until they need it to.”[139] This technology will not only allow e-bike riders to access all terrain a standard mountain bike could ride, but it will also present a legal enforcement challenge given that close inspection is now necessary to discern whether a bike is motor-assisted or not. Worldwide, the 2022 e-bike market was estimated at $19.05 billion. The market is expected to grow at a compound annual growth rate of 14.5% to reach $52.37 billion a year by 2030.[140]

Wild Montana strongly supports the existing Forest Service management policy that classifies all types of e-bikes as motorized vehicles that are exclusively permitted on motorized trails and roads.[141] While this management decision is not specific to the Nez Perce-Clearwater National Forest, it is important for the Nez Perce-Clearwater National Forest to adopt and articulate this policy within recreational plan components. While the

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[139] *See* Heckler SL at https://www.santacruzbicycles.com/en-US/bikes/heckler-sl#details.
[140] Grand View Research, *E-bikes Market Size, Share & Trends Analysis Report By Propulsion Type (Pedal-assisted, Throttle-assisted), by Battery Type, By Power, By Application, And Segment Forecasts, 2023 - 2030*, https://www.grandviewresearch.com/industry-analysis/e-bikes-market-report#:~:text=The%20global%20e%2Dbikes%20market%20size%20was%20estimated%20at%20USD,USD%2052.37%20billion%20by%202030.
[141] FSM 7700 *Travel Management* § 7702, amended Mar. 31, 2022.

FEIS mentions e-bikes in passing, the Draft Final Plan does not explicitly reference e-bikes in any discussions regarding mechanized or motorized use.[142]

Snow bikes and e-bikes are just two examples, and there are many emergent technologies that could change use on our national forest lands. The use of hovercrafts and flying vehicles is increasingly popular, and recreational use could pose new challenges for how to integrate them into Nez Perce-Clearwater National Forest management direction. Aircrafts specifically pose a danger to the integrity of Wilderness and recommended Wilderness, as well as wildlife populations such as mountain goats. No matter how advanced aircraft technology becomes, such transportation or recreation is not appropriate in any type of wilderness.[143]

Remedy Requested for Objection 05:

Wild Montana suggests the following plan standards regarding emerging recreation technologies:

- **Standard:** Use of emerging recreational technologies that are not specifically addressed by current direction is prohibited unless explicitly integrated through a public planning process.

- **Standard:** Electric bikes ("e-bikes") are defined as motorized travel and are not suitable on non-motorized routes.

Furthermore, the Forest Service should amend the definition of the Semi-Primitive Non-Motorized ROS classification to expressly prohibit e-bike use in those ROS setting areas.

If the Stateline Trail is opened to mechanized access, this plan should also indicate how the Nez Perce-Clearwater National Forest intends to increase law enforcement in this trail corridor to prevent e-bike use, as well as how the Nez Perce-Clearwater will prevent mountain bike users from descending off the Stateline into the Heart Lake basin or to the Clearwater Crossing trailhead on the Lolo National Forest.

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[142] *See FEIS* at 1161, 1652.
[143] Montana Wilderness Association v. McAllister, 666 F.3rd 549, 566 (9th Cir. 2011).

IX. The Forest Service should explicitly contemplate implementation and the need for subsequent travel planning.

The Final Revised Plan should clarify that ROS suitability is not the same as a travel management designation and that site-specific travel planning in compliance with the Travel Management Rule is required to designate routes and areas for motorized use. The revised plan should also include a timeline for when site-specific travel planning will occur, especially for the parts of the forest currently lacking an over-snow vehicle winter travel plan. We want to ensure once this forest plan decision is signed, the Nez Perce-Clearwater National Forest will continue enforcing the 2012 Travel Plan until a subsequent travel planning decision is finalized using the appropriate minimization criteria and NEPA analysis.

We recommend the Nez Perce-Clearwater follow the precedent set by other forests and include a plan component that states the forest will initiate site-specific winter travel planning in compliance with Subpart C of the Travel Management Rule within three years of completion of the revised forest plan.[144]

X. Meeting Request

Pursuant to 36 C.F.R. Section 219.57(a), Wild Montana requests to meet with the reviewing officer to discuss and resolve these objections.

XI. Conclusion

Thank you for your time and consideration. As outlined above, Wild Montana has remaining substantive concerns with the Draft Final Forest Plan, DROD, and FEIS that we previously raised in our comments. We look forward to discussing these issues further and hope that our concerns will be adequately resolved through an objection resolution meeting.

The Nez Perce-Clearwater National Forest contains some of the highest quality Wilderness, recommended Wilderness, and Inventoried Roadless Areas in the Lower

[144] The Flathead and Helena-Lewis & Clark Forest Plans in Montana committed to initiate site-specific planning to implement their plans' recommended wilderness suitability direction for motorized and mechanized transport within three years of signing the final RODs.

48. This plan revision is a critical nexus in forest management to protect these incredible landscapes for the plants, animals, and people who depend on them.

We look forward to continued work with the planning team moving forward. Please do not hesitate to contact us if you have any questions.

Sincerely,

Maddy Munson
Public Lands Director
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Email: mmunson@wildmontana.org

Appendix A

MONTANA WILDERNESS ASSOCIATION | Helena Office 80 S. Warren St., Helena, MT 59601 | (406) 443-7350 wildmontana.org

April 17, 2020

USDA Forest Service
Nez Perce-Clearwater National Forest
Attn. Zach Peterson, forest planner and Cheryl Probert, forest supervisor
909 3rd Street
Kamiah, Idaho 83536

Submitted via Nez Perce-Clearwater NF Cara webform, as well as email to zachary.peterson@usda.gov

Dear Ms. Probert, Mr. Peterson, and Nez Perce-Clearwater National Forest Planning Team,

Please accept this letter on behalf of Montana Wilderness Association (MWA) and our thousands of members and supporters in response to the public comment period of the draft environmental impact statement (DEIS) and draft revised forest plan (FP) for the Nez Perce-Clearwater National Forest. MWA is pleased to have the opportunity to contribute to this important step in the forest planning process.

I. ORGANIZATIONAL BACKGROUND

For more than 60 years, MWA, a 501(c)(3) organization, has worked with communities to protect Montana's wilderness heritage, quiet beauty, and outdoor traditions, now and for future generations. Our work began in 1958 when our founders sent a letter to 100 friends, inviting them to join a citizen-led effort to protect the Madison and Gallatin Ranges. Our commitment to grassroots conservation was instrumental in the passage of the 1964 Wilderness Act and the designation of all 15 Wilderness areas in Montana. Through our staff in Missoula, and on behalf of tens of thousands of supporters across the state and across the country, we are committed to protecting the wilderness values, preserving the cultural significance, and maintaining opportunities for quiet recreation in the planning area through the RMP process.

MWA has participated in this forest planning process since it began in 2012. Our members have a vested interest in the adjacent wildlands of the Nez Perce-Clearwater National Forest in Idaho. We travel over the border to visit the Nez Perce-Clearwater to spend time with our loved ones; pass down skills and knowledge to the next generation; harvest game through fair chase backcountry hunting and fishing; and find solace, recreation, refuge, and spiritual connection. Our membership in Mineral, Missoula, and Ravalli Counties consider the Nez Perce-Clearwater as much a part of our wildland backyards as the Lolo and Bitterroot National Forests, and the wild character of roadless areas and designated Wilderness on the Nez Perce-Clearwater attract our members from more distant counties, as well as Americans from all over the country.

Our comments address landscape and site-specific conservation primarily for the Hoodoo Roadless Area (a.k.a Great Burn). Our comments highlight elements of the draft plan and associated analysis in the DEIS that we support, areas we explicitly oppose, and areas that need to be improved, as well as support and rationale for our recommendations.

II. SUMMARY OF ORGANIZATIONAL COMMENTS

MWA supports the following management recommendations for the Hoodoo Roadless Area. Detailed rationale for these recommendations is found in part III.

- Manage all 151,874 acres of the Hoodoo Roadless Area as recommended wilderness, recognizing the area's outstanding wilderness characteristics (consistent with Alternative W).

- Prohibit all non-confirming uses across these 151,874 acres other than administrative use of chainsaws by USFS and partners, maximally protecting wilderness characteristics, as well as wildlife habitat for sensitive species that include, but are not limited to, wolverine and mountain goats (consistent with Alternative W).

- Continue to allow motorized access for 4.1 miles of the Fish Lake trail (consistent with Alternative Z).

- Manage the Hoodoo Roadless Area as unsuitable for timber production and harvest, including unsuitability for both permanent and temporary road construction.

- Manage the following river segments as suitable for Wild and Scenic River designation:
    - Kelly Creek (26.2 miles)
    - North Fork Kelly Creek (5.9 miles)
    - Middle Fork Kelly Creek (4.9 miles)
    - South Fork Kelly Creek (6.2 miles)
    - Cayuse Creek (35.9 miles)

- Continue to manage Rhodes Peak for recommendation as a Research Natural Area (consistent with all Alternatives).

In addition, MWA supports the following plan components that are outside of, or not specific to, the Hoodoo Roadless Area:

a. *Proposed Designated Special Areas*
   In recognition of the botanical values and cultural significance of the Packer Meadows area, MWA supports the designation of this special area.

b. *Designated Wilderness*
   MWA supports and would like to contribute to planning and implementing "a wilderness symposium for all agency personnel, non-government organizations, academia and private citizens on the wilderness areas managed by the Nez Perce-Clearwater and

adjoining national forests" (DEIS A4-73). We further encourage this symposium to address management of recommended, as well as, designated wilderness.

c. *Management of Mallard-Larkins Roadless Area*
Manage 90,855 acres of the Mallard-Larkins Roadless Area as recommended wilderness, recognizing the area's outstanding wilderness characteristics (consistent with Alternative Y).

III. <u>COMMENTS</u>

Montana Wilderness Association's comments cover these topics:

1. Range of alternatives
2. Management of Recommended Wilderness
3. Hoodoo Roadless Area (Great Burn)
    a. Recommended wilderness
    b. Non-conforming uses
    c. Trans-boundary issues
    d. Recreation
    e. Wildlife
        i. Grizzly bears
        ii. Mountain goats
        iii. Wolverine
    f. Wild and Scenic Rivers
    g. Research Natural Areas
4. Other management areas
    a. Proposed designated special areas
    b. Designated wilderness

1. Range of alternatives

Montana Wilderness Association cannot support any of the Alternatives as proposed in the DEIS and Draft Forest Plan. Throughout these comments we will clarify our objections to components of each alternative, as well as the elements we support.

MWA would also like to call particular attention to the fact that the DEIS indicates that Alternative Z reflects "a proposal for recommended wilderness that was brought forward by a group of national and state wilderness advocacy groups". Alternative Z, however, would allow non-conforming uses in the Hoodoo Recommended Wilderness, including mechanized travel and winter over-snow motorized travel. Montana Wilderness Association does not support allowances for recreational non-conforming uses as explained in *Section 2* of these comments. It is unlikely that the proposal provided to the Forest Service included this provision for non-conforming uses and it is misleading of the Nez Perce-Clearwater to suggest that this alternative reflects the management direction proposed and supported by the wilderness advocacy community.

2. Management of Recommended Wilderness

Recommended wilderness areas (RWAs) must be managed for social and ecological characteristics that preserve and enhance wilderness character over time, as required by the 2012 Planning Rule, US Forest Service guidance, and case law. Furthermore, the draft plan must adopt clear standards for the proper management of RWAs and mechanisms by which those standards can be immediately implemented.

a. RWAs must be managed for social characteristics that preserve wilderness character over time

Public land managers are responsible for managing recommended wilderness areas (RWAs) to preserve wilderness character and their potential for future inclusion into the National Wilderness Preservation System (NWPS). Motorized and mechanized transport can diminish an area's "primeval character", its "outstanding opportunities for solitude or a primitive and confined type of recreation", as well as its ecological values, and it is essential that the DEIS adequately address and analyze these potential diminishments. Visitors to wilderness, whether designated or recommended, expect to find high levels of naturalness, solitude, and access to remove experiences via primitive recreation. Uses that do not conform to the intent and purpose of wilderness affect this experience. The diminishment of social and ecological characteristics can lead future decision makers to reduce, or even eliminate, RWAs in future planning processes: this loss of potential future wilderness character by allowing non-conforming uses must be addressed in the DEIS. For this reason, we urge the Planning Team to select an alternative, or combination of alternatives that prohibit mechanized transport, motorized use, and other non-conforming uses in RWAs, so as to properly protect these lands, maintain their potential for designation to the NWPS, and minimize future difficulties inherent in no longer allowing non-conforming uses if these areas were to become designated Wilderness.

The following comments focus on wilderness-related issues in the DEIS, specifically, the management directives for RWs, and their inconsistency with the direction provided in the 2012 planning rule to "protect and maintain the ecological and social characteristics that provide the basis for their suitability for wilderness designation".

The Wilderness Act defines Wilderness by its unique qualities, including solitude and primitive recreation, and by defining activities that detract from the characteristics[1]. Section 4 of The Wilderness Act prohibits roads, motorized uses, and mechanized transport to protect wilderness characteristics, stating:

[1] 16 USC 1131 §2(c).

PROHIBITION OF CERTAIN USES
(c) "...there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area."[2]

Congress reserves the right to make final decisions regarding Wilderness designations. In the intervening time before Congress acts, it is the managing agency's responsibility to "preserve [the] wilderness attributes until such time as Congress makes the decision regarding wilderness designation…"[3]

In December 2018, the Flathead National Forest concluded in its final, revised Forest Plan that nonconforming uses are not suitable in RWAs. Forest Supervisor Chip Weber described his reasoning in the final Record of Decision (emphasis added):

> "I have included plan components to protect and maintain the ecological and social characteristics that provide the basis for each area's suitability for wilderness recommendation. One of these plan components indicates mechanized transport and motorized use are not suitable (MA1b-SUIT-06) in recommended wilderness areas. I have included this plan component in my final decision because **I believe it is necessary to protect and maintain the ecological and social characteristics that provide the basis for their wilderness recommendation** (described in Appendix G of the land management plan). Although a number of commenters and objectors expressed concern that the management of recommended wilderness creates "de facto wilderness" in lieu of action by Congress, the land management plan does not create wilderness. **The Forest Service has an affirmative obligation to manage recommended wilderness areas for the social and ecological characteristics that provide the basis for their recommendation until Congress acts.** The land management plan does not allow for continued uses that would affect the wilderness characteristics of these areas and possibly jeopardize their designation as wilderness in the future."[4]

It is important to manage RWAs "in a manner consistent with the Forest's recommendation [for wilderness]."[5] Managing RWAs in a way that can negatively affect their ultimate inclusion into the NWPS, as Alternative Z would, is out-of-step with: 1) USFS 2012 Planning Rule, 2) 2015 Forest Service Manual, 3) Forest Service Handbook, and 4) Region 1 Guidance.

<u>2012 Planning Rule</u>

[2] 16 USC 1131 §4(c).
[3] Bitterroot NF Travel Management Planning, Final Record of Decision (2016), p 25-27.
[4] Flathead National Forest, Forest Plan Record of Decision (2018), p. 26.
[5] Bitterroot Travel Management, Final Record of Decision (2016), p. 25-27.

The 2012 planning rule[6] provides important regulatory guidance for the management of RWAs, as well as plan components like suitability and standards that create the framework to carry out that RWA guidance. The 2012 Rule states:

> *"The plan must provide for … protection of Congressionally designated wilderness areas as well as management of areas recommended for wilderness designation to protect and maintain the ecological and social characteristics that provide the basis for their suitability for wilderness designation."*

This direction was acknowledged by Julie King, former Bitterroot National Forest Supervisor, in her decision in the 2016 Travel Management Plan Record of Decision to prohibit non-conforming uses in RWAs (emphasis added):

> "Additionally, **allowing uses that do not conform to wilderness character creates a constituency that will have a strong propensity to oppose recommendation and any subsequent designation legislation**. Management actions that create this operating environment will complicate the decision process for Forest Service managers and members of Congress. It is important that when the wilderness recommendations are made to Congress that they be unencumbered with issues that are exclusive to the wilderness allocation decision."[7]

Supervisor King's decision follows Forest Service direction clearly and further adheres to the 2015 Forest Service Manual which states, "Any area recommended for wilderness or wilderness study designation is not available for any use or activity that may reduce the wilderness potential of an area."[8] It is not appropriate to manage RWAs for anything other than their wilderness character. Activities such as winter motorized use and mountain biking impair both the social and ecological characteristics of wilderness and cannot be permitted in RWAs.

Allowing uses that do not conform to wilderness character, particularly winter motorized use, has complicated management of the Nez Perce-Clearwater's Hoodoo Roadless Area significantly over the last two decades, and allowed for creation of a "constituency" similar to that described by Julie King's Travel Management Plan ROD. With the completion of the Clearwater Travel Plan in 2012, winter motorized use in the Hoodoo Roadless Area was no longer allowed. Illegal winter motorized trespass since this 2012 decision, however, has been a recurring issue that has been documented by Idaho Fish and Game[9], Great Burn Conservation Alliance (formerly the Great Burn Study Group), and others. I personally was passed by three

[6] 36 CFR 219.10(b)(1)(iv).
[7] Bitterroot Travel Management, Final Record of Decision, p 25-27. The Federal District Court in Missoula upheld the 2016 this Record of Decision, including restrictions on mechanized use.
[8] FSM 1923.03(3).
[9] Nez Perce-Clearwater National Forest, DEIS, personal communication with Clay Hickey, July 2017, p 3.2.3.4-31.

snowmobilers near Granite Peak in the Crooked Fork drainage of the Hoodoo Roadless Area in March 2019, and the presence of old snowmobile and snow bike tracks in the area through which I traveled during that trip indicated that illegal trespass had frequently occurred throughout the month prior. Alternative Z's allowance of non-conforming uses would continue to create this "constituency", further increasing tensions between user groups, necessitating law enforcement efforts to ensure trespass does not occur on the Lolo National Forest side of the Hoodoo Roadless area, and encumbering the Service with user issues if Congress were to designate this area as Wilderness.

The direction in the 2012 Planning Rule instructs the USFS to "protect and maintain the ecological <u>and social characteristics</u> … for wilderness designation" (emphasis added) and we strongly urge the Nez Perce-Clearwater NF to manage both the ecological and social characteristics of RWs in a manner that is consistent with the USFS's recommendations and prohibits uses that are non-conforming to the Wilderness Act.

Forest plans revised under the 2012 Rule are required to include desired conditions (DCs), and for the suitability requirements to uphold the DCs.[10] Concerning suitability, the rule states that "specific lands within a plan area will be identified as suitable for various multiple uses or activities *based on the desired conditions applicable to those lands*."[11] (emphasis added)

The Nez Perce-Clearwater has identified five critical desired conditions for RWA management, and it will be imperative for the objectives, goals, standards, and suitability requirements of the plan to support those DCs. Under Alternative Z, that will not be the case. The draft plan includes the following DCs for RWAs, which will require consistent suitability requirements for recreation management:

> MA2-DC-RWILD-01: Recommended wilderness areas maintain their existing wilderness characteristics to preserve opportunities for inclusion in the National Wilderness Preservation System.
>
> MA2-DC-RWILD-03: Recommended wilderness areas facilitate the connectivity and movement of wildlife species across the Nez Perce-Clearwater by remaining large areas with little human activity.
>
> MA2-DC-RWILD-04: Recommended wilderness areas provide opportunities for solitude or a primitive and unconfined type of recreation. Impacts from visitor use do not detract from the natural setting.

[10] CFR 36 § 219.7 (e)(1).
[11] CFR 36 § 219.7 (e)(1)(v).

> MA2-DC-RWILD-05: Outfitter guide recreation special uses support identified public need to provide services aligned with the natural setting and recreational purposes of the recommended wilderness areas.

Alternatives W and Y uphold these DCs by finding nonconforming recreational uses not suitable in RWAs per suitability language in MA2-SUIT-RWILD-12, MA2-SUIT-RWILD-13, and MA2-SUIT-RWILD-14. The proposed suitability language in Alternative Z, however, will fail to create a future condition that allows the Hoodoo RWA to retain its social wilderness characteristics and opportunity for future inclusion. Furthermore, ecological values will be degraded should winter motorized travel be allowed to occur in the Hoodoo RWA. We urge the Planning Team to adopt the proposed suitability language offered for Alternatives W and Y, as it conforms with the stated DCs.

Case studies from across Region 1 show that authorizing or allowing non-conforming uses have directly precluded previously recommended RWA acreage from the possibility of inclusion in the NWPS in the future; thus failing to upload a desired condition where RWAs maintain their potential for future Wilderness designation (see below for discussion on case studies).

<u>2015 Forest Service Manual</u>
The 2015 Forest Service Manual[12] planning directives address the management of RWAs. Those directives state:

> *Any area recommended for wilderness or wilderness study designation is not available for any use or activity that may reduce the wilderness potential of an area.*

It is important to note that this Manual direction replaced the previous 1923.03 direction, which stated that:

> *"Any inventoried roadless area recommended for wilderness or designated wilderness study is not available for any use or activity that may reduce the wilderness potential of the area. Activities currently permitted may continue pending designation, if the activities do not compromise the wilderness values of the area."*

Discussed below are several case studies from Region 1 where uses and activities that occurred in areas recommended for Wilderness directly reduced the wilderness potential of the area. We urge the Nez Perce-Clearwater NF to follow this new direction in the Manual and prohibit any non-conforming uses, such as mountain biking and winter motorized travel, in areas recommended for wilderness, as in Alternative Z. Failure to follow the agency's own policy would be arbitrary and capricious.

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[12] FSM 1923.03(3).

Forest Service Handbook

The Forest Service Handbook[13] states:

> *When developing plan components for RWAs, the responsible official has discretion to implement a range of management options. All plan components applicable to a recommended area must protect and maintain the social and ecological characteristics that provide the basis for wilderness recommendation. In addition, the plan may include one or more plan components for an RWA that:*
>
> 1. *Enhance the ecological and social characteristics that provide the basis for wilderness designations;*
> 2. *Continue existing uses, only if such uses do not prevent the protection and maintenance of the social and ecological characteristics that provide the basis for wilderness designation;*
> 3. *Alter existing uses, subject to valid existing rights; or*
> 4. *Eliminate existing uses, expect those uses subject to valid existing rights."*

The Handbook reiterates the direction given in the 2012 Planning Rule by stating all plan components "must", not may, "protect and maintain the social and ecological characteristics that provide the basis for wilderness designation". The Handbook also restates the Forest Service's authority to "alter" or "eliminate existing uses" in the prevention and maintenance of those characteristics.

Region 1 Guidance

Region 1 Guidance[14] states:

> *If it is determined that the area is best suited to motorized or mechanized recreation, the area should not be recommended for wilderness. If it is determined that the best future use is inclusion in the NWPS, the desired condition should reflect that. If there are established uses that are incompatible with that desired condition, such as motorized or mechanized recreation, forests should choose to implement one of the following actions:*
> 1. *Pursue a non-motorized, non-mechanized approach to the management of the area through travel planning.*
> 2. *Adjust management area boundary to eliminate the area with established uses.*
> 3. *Not recommend the area for wilderness designation.*
>
> *Administrative use of motorized equipment for maintenance (chain saws, rock drills, limited use of helicopters) will continue to be allowed.*

[13] FSH 1909.12, Chp 70, Sec 74.1.

[14] Consistency in Land and Resource Management Plans, 9/24/2007.

Region 1 Guidance clearly expresses that non-mechanized and non-motorized uses are not compatible with RWAs, and urges managers not to include such recreation in RWAs.

Pertinent Case Law - RWA Management

Opportunities for solitude and primitive and unconfined recreation, as well as secure wildlife habitat (particularly for at-risk or species of focus like the wolverine or mountain goat) decline in places where motorized and mechanized use is allowed. Areas that were once considered remote and inaccessible are made more accessible by improved technology available for motorized vehicles and mechanical transport, as well as increased recreation pressures from a growing number of forest users. These are two things that can change dramatically over the life of a Forest Plan, and were not considered in the analyzed effects of this DEIS.

This can limit the opportunities for quiet recreationists to experience the solitude offered by primitive recreation in the once-quiet backcountry of RWAs. The increased access and accompanying noise from machines compromises the underlying area's suitability for wilderness protection by degrading the social characteristics of wilderness. The noise, in particular, can even travel over forest boundaries to affect adjacent wild lands. In this case, this is important to note given the shared boundary between the Lolo and Nez Perce-Clearwater National Forests in the Hoodoo Roadless Area. These impacts all must be appropriately accounted for in the DEIS. The cases discussed below provide a legal basis for determining what management actions are appropriate for maintaining and enhancing wilderness character and opportunities for future inclusion in the NWPS.

A 2011 9th Circuit court ruling[15] held that the Gallatin National Forest erred in its travel management, and helped further define wilderness character of the Hyalite-Porcupine-Buffalo Horn WSA.[16] That ruling, along with *Citizens for Balanced Use v. Erickson*[17] and *Russell Country Sportsmen v. USFS*,[18] established that the Forest Service is obligated to consider the social characteristics in its management decisions:

> *The Wilderness Act does not define "wilderness" solely according to "physical, inherent characteristics." Instead, it states that, in addition to having physical characteristics such as large acreage, a wilderness "has outstanding opportunities for solitude".*

[15] *Montana Wilderness Association v. McAllister,* 666 F.3d 549 (9th Cir. 2011).

[16] While Wilderness Study Areas are managed under a different scheme than the 2012 Rule, the application of the Rule's language regarding social characteristics should be consistent with these 2011 judicial interpretations. WSAs must be managed to preserve their wilderness character, and RWAs likewise must be managed to preserve their wilderness character. The resources being protected in RWAs and WSAs are therefore the same, and these judicial rulings provide important guidance as to how the Forest Service can preserve the opportunity for future Wilderness designation.

[17] *Citizens for Balanced Use v. Erickson,* No. 10-35823 (9th Cir. 2011).

[18] *Russell Country Sportsmen v. USFS*, 668 F.3d 1037 (9th Cir. 2011).

> *If the [Wilderness Act and Montana Wilderness Study Act] allowed the Service to focus on physical characteristics alone, even a massive escalation in noisy, disruptive motorized use would trigger no management response so long as there was no resulting physical degradation. For example, the Service could allow sightseeing helicopters to fly over the study areas in unlimited numbers, filling the study areas with loud and intrusive noise. Because the helicopters would likely never touch the ground, however, their presence from a common-sense perspective would plainly degrade the areas' wilderness character.*[19]

In another case[20] that impacts national forests across the country, U.S. District Court for the District to Montana upheld the Forest Service's authority to restrict non-conforming uses, such as dirt bikes, four-wheelers, snowmobiles, and mountain bikes in RWAs in the Beaverhead-Deerlodge National Forest (BDNF).

At 3.35 million acres, the BDNF is Montana's largest national forest. It also encompasses 1.8 million acres of unprotected roadless lands, the most unprotected lands of any national forest in Montana. The revised Forest Plan allocated a small minority (18%) of these roadless lands to Recommended Wilderness management where mechanized and motorized vehicle use is prohibited. Though it banned motorized vehicles in RWAs, the BDNF's revised plan opened up the majority of the forest for motorized vehicle use (55% in summer, 60% in winter). Nevertheless, a coalition of off-road vehicle groups, county commissioners, and landowners sued the BDNF in December 2010 in an effort to overturn all of the RWA protections.

All of the Plaintiff's claims were either dismissed for lack of subject matter or, more importantly, denied on the merits. This case showed that national forests have the ability to protect the wilderness characteristics of some of our nation's most spectacular wilderness-quality areas and roadless habitat, where wildlife can thrive safe from modern human activities and interference, and backcountry travelers can enjoy hiking and horseback riding without the noise and disturbance of non-conforming uses.

<u>Region 1 examples - Loss of wilderness character</u>

In Region 1, there are several examples that illustrate how management decisions to allow non-conforming uses in RWAs have led to losses of RWA acres in subsequent forest planning processes, reducing the potential for future Wilderness designation for those areas. Below are four examples (three on the BDNF and one on the Flathead NF) where RWAs have decreased in size following RW management decisions that allowed non-conforming uses in RWAs. By allowing non-conforming uses to persist and establish, and by failing to manage these areas in a manner consistent with the Forest's recommendation, these decisions failed to protect and maintain ecological and social characteristics for wilderness designation.

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[19] *McAllister,* 666 F.3rd at 566.

[20] *Beaverhead County Comm'rs v U.S. Forest Serv.,* No. 2:10-cv-00068-SEH (D. Mont. July 22, 2013).

1. BDNF: Mt. Jefferson Recommended Wilderness
   In 1990, the BDNF created the 4,474 acre Mt. Jefferson RWA in the Hellroaring Creek drainage, the ultimate headwaters of the Missouri River. Although small, the Mt. Jefferson RWA was adjacent to the 23,054 acre Centennials RWA, managed by the BLM, for a combined total of approximately 28,000 acres. The previous BDNF Forest Plan allowed snowmobiling in RWAs. When snowmobiling technology improved in the 1990s, Mt. Jefferson became a publicized snowmobile destination, accessed primarily from the Idaho side. Attempts by the Madison District Ranger to close the RWA to snowmobiles were overruled by the Forest Supervisor. In contrast, snowmobiling was prohibited in the adjacent BLM Centennials RWA. In 2002, the responsible BLM field manager wrote a letter to the BDNF requesting the closure of the USFS portion of the RWA in order to curtail illegal trespass. His request was ignored. When the BDNF revised its Forest Plan in 2009, the already small Mt. Jefferson RWA was cleaved in half: 2,000 acres in the upper reaches of the Hellroaring Creek drainage were stripped of RWA status, leaving only a 2,000 acre RWA in the lower reaches of the valley.

   This example addresses the issue of illegal trespass in adjacent public lands when non-conforming uses are allowed. This is very relevant to decision-making for the Nez Perce-Clearwater given the adjacent Hoodoo Roadless Area acres managed by the Lolo National Forest as recommended Wilderness. Illegal trespass by non-conforming uses on the Lolo is expected to be an issue if management of the Nez Perce-Clearwater NF follows Alternatives X, Y, and Z. Conversations with Nez Perce-Clearwater staff at the public meetings held for this planning process suggest that law enforcement availability in this area is not adequate to manage illegal trespass, especially given that boundaries will not be marked and will not be entirely clear to users.[21]

2. BDNF: West Big Hole Recommended Wilderness
   Approximately 56,000 acres of the approximately 130,000 acre West Big Hole Inventoried Roadless Area, on the east slope of the Beaverhead Range was an RWA in the BDNF's 1980s-era Forest Plan. Crowned by 10,620ft Homer Youngs Peak, the West Big Hole is a key link in the chain of wild areas that connect the Greater Yellowstone Ecosystem with central Idaho wildlands, including the Frank Church-River of No Return and Selway-Bitterroot Wildernesses. The previous BDNF Forest Plan allowed snowmobiling in RWAs, and when snowmobile technology improved in the 1990s, the West Big Hole became a popular high-marking playground. As a result, when the BDNF released its revised Forest Plan in 2009, the West Big Hole RWA was eliminated.

[21] At the St. Regis public meeting on February 21, 2020, Kearsten Edwards indicated in conversation with Erin Clark of MWA that in the last few years law enforcement availability for the Hoodoo Pass area was 1-2 times per winter on the ground and zero to one overflight.

Winter motorized technology continues to improve. In recent decades snow bikes have become a readily available and popular technology. Snow bike riders can access more densely forested and steeper terrain than snowmobiles. These capabilities have potential impacts on winter habitat security for sensitive species such as wolverines and mountain goats. This issue will be further explored later in these comments.

3. BDNF: Anaconda-Pintler Wilderness Recommended Inclusions (Sullivan and Tenmile Creek)
   The 1980s BDNF Forest Plan included Sullivan and Tenmile Creeks as RWA additions to the Anaconda-Pintler Wilderness. At the southeastern end of the Anaconda Range, these drainages harbor ancient, gnarled, 800-year-old subalpine larches that are among the oldest trees in Montana. Just like the West Big Hole and Mt. Jefferson, snowmobiles were allowed in this RWA. When technology improved enough to allow access into this rugged high country, recreation became popular enough that the BDNF removed the RWA when it revised its Forest Plan in 2009.

4. Flathead NF: Jewel Basin
   The aptly-named Jewel Basin is a beloved gem in the Crown of the Continent ecosystem and the crown jewel of the Swan Range. The spectacular alpine lakes of the Jewel Basin are not unlike some of the incredible alpine lakes in the Hoodoo Roadless Area. In the 1987 Flathead National Forest plan, the Jewel Basin RWA encompassed over 32,000 acres. Like all 1980s forest plans, the 1987 plan, however, did not address mechanized transport. In subsequent years, the Alpine No. 7 trail that traverses the Swan Crest and bisects the Jewel Basin caught the interest of mechanized users, and became a popular mountain and dirt biking destination. Images of mountain bikers riding the Alpine No. 7 trail are used on local mountain biking websites and promotional materials.[22] These mechanized users actively advocated for use of additional portions of Alpine No. 7 in Jewel Basin, as well as other trails in the Jewel Basin RWA.

   The 2018 Flathead ROD ultimately eliminated 14,000 acres of RWA in Jewel Basin, shrinking it nearly by half. The plan attributed this loss specifically to recreational use pressure: "Jewel Basin recommended wilderness area excluded a portion in the south end where mechanized transport occurs."[23] The final environmental impact statement also specifically states that the acreage of the Jewel Basin RWA was, "reduced … to minimize effects on mechanized transport."[24] In this case, the establishment of mountain biking in a RWA directly precluded that part of the RWA from continued protection and the possibility of future designation.

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[22] See http://www.whitefishbikeretreat.com/flathead-valley.html, http://www.flatheadamb.org/news/flathead-national-forest-plan-revision, and https://www.trailforks.com/trails/alpine-trail-7/.
[23] Flathead National Forest, FEIS, vol 1, p 27.
[24] Flathead National Forest, FEIS, vol 2, p 26.

As demonstrated by the case studies above, failing to close RWAs to burgeoning non-conforming uses preciptates a rapid decline in their potential for future inclusion in the NWPS. In the end, wilderness character, quality of wildlife habitat, quiet recreation opportunities, RWAs, and the potential for future designations have been significantly degraded.

We urge the Nez Perce-Clearwater NF to follow through on its responsibility to wilderness-quality lands and include only plan components that are consistent with its own administrative recommendations to manage these landscapes for social and ecological characteristics that preserve wilderness character over time, allowing maximum potential for Wilderness designation in the future. The Forest's own commitment to wilderness character sets the baseline for visitor's expectations and resulting actions.

Montana Wilderness Association strongly opposes Alternative Z of this draft plan, which would allow mechanized transport and winter motorized use in all recommended Wilderness areas, including the Hoodoo Roadless Area. For the reasons mentioned in this section, we believe Alternative Z's RWA management direction conflicts with the Forest's own recommendations and will fail to uphold the Nez Perce-Clearwater NF's legal responsibilities for managing RWAs.

The effects analysis of Alternatives Y and Z regarding mechanized and motorized use in RWAs is inadequate. It does not meaningfully address the degradation and potential loss of wilderness character in areas that are meant to be managed for potential inclusion in the NWPS. It also fails to fully analyze the ecological impacts of motorized and mechanized recreation in RWAs (i.e. the impacts on animals that rely on secure habitat in these areas). While it analyzes some of the potential impacts to wolverines, it does not adequately evaluate impacts to other species, such as mountain goats. It also fails to analyze the Service's ability to enforce boundaries for mechanized and motorized use, as well as the effectiveness of the natural features on these boundaries to contain use. The effects of Alternative Z focus on the "displacement" of motorized and mechanized recreators from RWAs, but there is no corollary analysis for how wilderness character will be displaced or lost, including the displacement of quiet recreators and wildlife by motorized and mechanized use.[25]

The Nez Perce-Clearwater must support its own recommendations by prohibiting all non-conforming uses in RWAs, specifically declaring that these areas are not suitable for mechanized and motorized transport through clear standards, guidelines, and suitability language.

Plan components for RWA management

From the case studies above, and from our work across National Forests, MWA has learned that clear, unambiguous plan components that fully retain wilderness character and potential of

[25] Nez Perce-Clearwater DEIS, p. 3.6.2-11-12.

RWAs while waiting on Congress to act are a necessity. We encourage the Nez Perce-Clearwater NF to consider the following recommendations for forest-wide RWA plan components.

Non-conforming uses

Eliminating non-conforming uses and creating strong enforcement mechanisms to support those decisions is the norm in Montana's national forests, and equally applicable to Idaho national forests. Strong suitability language should be utilized that clearly states, "Recommended wilderness areas are not suitable for motorized or mechanized recreation." The final plan should also include standards, as standards are the only plan components that the Forest Service *must* (versus should) adhere to.

Inevitable changing technology and increasing recreation pressures over the life of a Forest Plan emphasize the need for standards that maintain the desired condition of RWAs. Standards are the legal constraints on activities, whereas suitability is a slightly more flexible tool, and it is important that those two elements of the final Forest Plan are congruent and supportive of each other. Consistent standards and suitability language will also make it much easier for the Forest to enforce its own plan during the monitoring and enforcement phases of forest planning. We encourage the Nez Perce-Clearwater NF to adopt a standard, in addition to the clear suitability language, when it comes to non-conforming uses in RWAs.

Both the BDNF and Kootenai National Forests in Region 1 include RWA standards that prohibit non-conforming uses. We strongly encourage the Nez Perce-Clearwater NF to follow the lead of these other Region 1 forests. Here is a proposed standard:

> **Standard**: All motorized and mechanized forms of transportation and equipment are not allowed in recommended Wilderness, including snowmobiles, snow bikes, hang gliders, bicycles, carts and wagons, except for administrative purposes. Landing aircraft is prohibited except for administrative purposes.

Trail Development

Limiting trail density and managing RWAs like designated Wilderness will help ensure that areas retain their ecological and social wilderness characteristics and the possibility for inclusion in the NWPS. As the populations of Missoula and Ravalli Counties continue to grow[26] it will be increasingly important to protect recommended wilderness from trail proliferation. We urge you to consider applying the following guideline to recommended wilderness areas:

> **Guideline**: To maintain areas of undeveloped wilderness character, there should be no net increase in miles of system trails within recommended wilderness. Trail reroutes for resource protection or after natural occurrences, such as fire, floods, windstorms, and

[26] Nez Perce-Clearwater DEIS, p 3.6.2.14.

avalanches, should utilize the best long-term sustainable routes with minimal trail infrastructure.

<u>Implementation of RWA suitability</u>
The DEIS contains an objective designed to provide a mechanism to implement prohibitions on motorized and mechanized transport:

> **MA2-OBJ-RWILD-01**: Initiate site-specific planning within five years to remove all activities or uses that are not allowed in the Forest Plan's record of decision.

Rather than a five year process of removal, the Nez Perce-Clearwater NF could issue an order, concurrently with the final forest plan and ROD to close areas to non-conforming uses. Issuing such a closure order concurrently with the plan revision is authorized by the planning rule directives[27] and would be the most efficient way to implement the suitability plan components prohibiting non-conforming uses. This would ensure that allowable use is not in immediate conflict with the revised Forest Plan. If a multi-year process is determined to be necessary, in keeping with the Flathead NF plan that was also developed under the 2012 Planning Rule in Region 1, a three-year deadline to commence planning would be more appropriate.[28]

<u>Indicators and Effects Analysis</u>
The measurement indicators used in the DEIS for recommended Wilderness, as listed below, do not adequately address or measure the benefits associated with recommended Wilderness:

1. Impacts on wheeled motorized opportunities,
2. Impacts on motorized over-snow vehicle opportunities,
3. Impacts on trails that allows mechanized transport,
4. Impacts on commercial use of permanent structures, and
5. Amount of underrepresented ecosystems in the wilderness system.

Four out of five indicators are weighted towards non-wilderness values. The analysis should be equalized by including a robust set of indicators weighted towards wilderness values. This can include indicators that measure impacts to naturalness and outstanding opportunities for solitude or primitive recreation. They should measure the negative effects to wilderness values and wilderness character if an area is not recommended or if certain management actions or uses are allowed. The DEIS indicates that recommended wilderness provides for "species diversity, protection of threatened and endangered species, protection of watersheds, scientific

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[27] FSH 1909.12, section 21.8.
[28] The Flathead ROD states, "The Forest will initiate site-specific planning per the land management plan's suitability direction within three years from the date of this decision where an existing order may need to be changed (e.g., changes to snowmobile use per the current oversnow vehicle motor vehicle use map or where an order may need to be issued, e.g. to prohibit mechanized transport).", p 54.

research and other ecological processes, and social values,"[29] yet the indicators and analysis do not measure impacts to these values.

A improved set of indicators might include the below options, although this is not an exhaustive list:

- Impacts on naturalness,
- Impacts on opportunities for solitude and/or primitive recreation,
- Impacts on opportunities for semi-primitive, non-motorized recreation,
- Impacts on wolverine habitat,
- Impacts on mountain goat populations,
- Impacts on Idaho Roadless Areas providing high and medium-high capability for providing wilderness character as assessed using wilderness character attributes.

These indicators should be incorporated, analyzed, and reported on in the FEIS.

3. Hoodoo Roadless Area (Great Burn)

a. Recommended wilderness

The 252,000 acre Hoodoo Roadless Area is jointly managed by the Nez Perce-Clearwater (Idaho) and Lolo (Montana) National Forests. Both forests currently manage this roadless area as recommended wilderness (Nez Perce-Clearwater: 111,988 acres; Lolo: 98,100 acres). These areas are contiguous and there are 47 shared miles of boundary between the Montana and Idaho Hoodoo Roadless Areas. This 210,088 acre RWA represents an area larger than the state of Delaware.

The Hoodoo Roadless Area (a.k.a. Great Burn) is not superlative only in size, it also contains exceptionally wild country that provides for both wildlife and quiet recreation in outstanding ways. Montana Wilderness Association's web page describing the Great Burn shares that, "The Great Burn has received one of the highest wilderness ratings of any area managed by the Forest Service, which has been recommending that Congress designate the area as Wilderness since the 1970s. Portions of all of the Great Burn Proposed Wilderness have been included in more than twenty legislative proposals, including one that went to President Reagan's desk in 1988 and was pocket vetoed." Appendix E of the Nez Perce-Clearwater DEIS acknowledges that, "the outstanding scenery, the variety and abundance of wildlife species (elk, black bears, mountain goats, and moose) and the high quality westslope cutthroat trout fishery in Idaho are major attractions."[30]

[29] Nez Perce-Clearwater DEIS, Chapter 3.
[30] Nez Perce-Clearwater DEIS, p E-70.

The vastness, wilderness character quality, and wildlife habitat values are critical elements that make the Hoodoo area one of the most outstanding examples of deserving recommended wilderness in our region. The Recommended Wilderness Evaluation performed as part of the Forest Planning process found that:

- The area retains a high degree of natural integrity and appearance (p. E-72).
- Human activities have resulted in relatively minor and isolated impacts (p. E-72).
- Vegetation in 73% of the roadless area is within the natural range of variation (p. E-72).
- The vastness of the area...along with its rectangular shape extending approximately 40 miles north-south provides excellent opportunity for solitude (p. E-74).
- External influences of sight and sound are minimal (p. E-74).
- The size and diversity of the area, the variety of vegetative types and landforms, the abundance of wildlife, streams, and lakes all contribute to virtually unlimited primitive settings for recreation (p. E-74).
- Approximately 42% of the area consists of ecological types that are currently underrepresented in the NWPS (p. E-75).
- Hoodoo is one of the three roadless areas on the Nez Perce-Clearwater where mountain goats are known to exist. These are unusual in the area and are scenic and wild to view (p. E-76).
- Water quality in the Hoodoo Roadless Area is generally high (p. E-76).
- The area shares boundaries with mostly other roadless areas (58%) and front country (42%). There are no adjacent private lands. The management of boundaries shared by other roadless areas is generally not challenging, since management is similar (p. E-78).
- No grazing allotments overlap with the area (p. E-78).

All of these findings, as well as other points that will be raised throughout these comments, suggest that the Hoodoo Roadless Area meets and exceeds requirements deserving of recommended wilderness management. Montana Wilderness Association, therefore, requests that the Nez Perce-Clearwater manage all 151,874 acres of the Hoodoo Roadless Area as recommended wilderness, utilizing the boundaries present in DEIS Alternative W.

b. Non-conforming uses

As described in *Section 2. Management of recommended wilderness*, the 151,874 Hoodoo recommended wilderness should prohibit non-conforming uses in order to preserve wilderness character and maintain potential for this area's future inclusion into the NWPS.

c. Trans-boundary issues

The Lolo National Forest Plan and Travel Plan provide clear guidance regarding motorized use and wilderness characteristic management on the Montana-side of the Hoodoo Roadless Area, which is managed as MA12 (recommended Wilderness). Alternatives Y and Z would allow uses on the boundary of the Nez Perce-Clearwater and Lolo National Forest that are highly likely to result in spillover use onto the adjacent Hoodoo Roadless Area acres managed by the Lolo National Forest. The Lolo Forest Plan contains two clear MA12 standards, that are enforceable and have been tested and upheld by litigation.[31] These two standards are:

1. No motorized use.
2. Proposed wilderness will be managed to "protect their wilderness characteristics" pending a decision on Wilderness classification.

The DEIS neglects to acknowledge and analyze the effects on Lolo National Forest recommended Wilderness by allowing non-conforming uses per Alternative Z or altering recommended Wilderness boundaries in the Hoodoo Roadless Area per Alternative Y to allow for winter motorized use on this boundary in the Hoodoo Pass area. These effects could include, but are not limited to, impacts on soundscape caused by winter motorized use, ability to enforce boundaries, as well as ecological impacts to wildlife populations that freely move from the Idaho to Montana portions of this roadless area and back. One of the sensitive mountain goat populations in the Hoodoo Roadless Area frequents both the Montana and Idaho-side of this roadless area. Idaho-side non-conforming uses are likely to have implications for the health of this trans-state population of mountain goats.

The Nez Perce-Clearwater has a non-discretionary duty, per the USFS Planning Handbook and 2012 Planning Rule, to assess the broader landscape in which this plan will be implemented:

> USFS Planning Handbook
> *The intent behind identifying designated areas in plans and recommending additional areas for designation is to: … b. Recommend areas where doing so would help carry out the distinctive role and contributions of the plan area* ***in the broader landscape*** *or contribute to achieving desired conditions for the plan area.*[32] (emphasis added)

[31] *Montana Snowmobile Association v. Wildes,* 103 F. Supp. 2d 1239 (D. Mont. 2000).
[32] FSH 1909.12, Chap. 20, Sec. 24.0, p 124.

2012 Planning Rule
Ensure planning takes place in the context of the larger landscape by taking an 'all-lands approach.'[33]

...Consider the landscape-scale context for management and will look across boundaries throughout the assessment, plan development/revision, and monitoring phases of the planning process.[34]

The plan must include plan components, including standards or guidelines, to maintain or restore the ecological integrity of terrestrial and aquatic ecosystems and watersheds in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity, taking into account: …(ii) Contributions of the plan area to ecological conditions within the broader landscape influenced by the plan area.[35]

The released DEIS does not fulfill the Nez Perce-Clearwater's substantive duty to comply with these aspects of the 2012 Planning Rule and Planning Handbook. We encourage the Nez Perce-Clearwater to execute effects analysis that addresses how Nez Perce-Clearwater NF management of the Hoodoo Roadless Area will affect wilderness characteristics and recommended Wilderness management of the Lolo National Forest.

d. Recreation

Recreational use of the Nez Perce-Clearwater NF's designated Wilderness areas has grown tremendously in recent decades. In 2006, the Forest estimated 30,000 designated Wilderness visits, whereas in 2016, it estimated yearly Wilderness visitation at 76,000 visits (253% growth).[36] It is not unlikely that use of recommended Wilderness areas, such as the Great Burn, have seen similar growth in use.

We know that our Montana Wilderness Association members and supporters value the Great Burn for the extremely high-quality quiet recreation opportunities this area provides. Hiking, backpacking, trail running, horsebacking riding, horsepacking, wildlife viewing, and photography are frequently cited by our members as their reasons for recreating in this area. The DEIS indicates that 44.5% of the forest's users engage in hiking/walking, 43.4% view natural features, 7% engage in primitive camping, and 2.7%

[33] CFR 36 p 21164.
[34] CFR 36, Response to the Issue of Coordination and Cooperation Beyond NFS Boundaries, p 21178.
[35] CFR 36 § 219.8 (a)(ii).
[36] Nez Perce-Clearwater DEIS, p 3.4.2-6.

backpack[37]. This large population represents our membership and other Great Burn users. It is important to note that only 2.6% of Nez Perce-Clearwater users engage in snowmobiling and other winter motorized use. The DEIS indicates that motorized off-road activities and motorized snow activities are expected to show low growth over the lifespan of this Forest Plan.[38]

A local survey conducted by USFS Region 1 to determine the preferences for motorized and mechanized access to federal public lands showed that 61% of local respondents indicated there are adequate or too many accessible sites for snow machine use, additionally 32% of respondents indicated they didn't know whether there were too many or two few sites available. 51% of local respondents indicated there are adequate or two many accessible sites for mountain biking and 40% indicated they didn't know whether there were adequate sites.[39] Although the survey reflected data from across the entire footprint of the Nez Perce-Clearwater National Forest, and not just the communities adjacent to the Hoodoo Roadless Area, the high numbers indicating that there is currently adequate winter motorized and mountain biking suggests that there is not adequate demand or need to reduce recommended wilderness acreage for the Hoodoo Roadless Area as proposed in Alternatives X and Y.

The DEIS suggests that "The Nez Perce-Clearwater is one of a few remaining areas in the western United States that has the terrain to provide the opportunity for high level risk and high level skill-based winter motorized access in remote areas"[40]. While the Nez Perce-Clearwater does offer terrain that meets this description, high quality snowmobiling opportunities in Montana and Idaho remain robust. In Montana, high risk, high skill playgrounds for winter motorized use are available in Cooke City and in the Beaverhead Deerlodge National Forest (as shared through case studies in *Section 2. Management of Recommended Wilderness*), as well as in the Lookout Pass area on the Montana-Idaho border north of the Hoodoo Roadless Area. This is a small sample of a variety of areas providing this unique set of experiences within a day's drive from our Montana-side Nez Perce-Clearwater communities, as well as a plentitude of lower risk, less remote snowmobiling terrain. On the Nez Perce-Clearwater NF 15.6% of the forest provides opportunities for semi-primitive motorized winter recreation, in addition to 23.4% of the forest providing roaded natural winter recreation.[41] In total, over 39% of the forest is open for use by the 2.6% of Nez Perce-Clearwater NF users who engage in snowmobiling.[42]

[37] Nez Perce-Clearwater DEIS, p 3.4.2-11.
[38] Nez Perce-Clearwater DEIS, p 3.4.2-9.
[39] Region 1 Social Survey, BBER, 2018; Region 1 Social Survey Year 2 only, BBER, 2019.
[40] Nez Perce-Clearwater DEIS, p 3.4.2-21.
[41] Nez Perce-Clearwater DEIS, p 3.4.2-11.
[42] Nez Perce-Clearwater DEIS, p I-30 and 3.4.2-9.

We are disappointed to see the DEIS make little mention of the health and medical benefits to people from spending time in nature, engaging in human-powered activities like walking and hiking. There is a rapidly growing body of science documenting the health and medical benefits that people can derive from spending time in quiet nature. These values are certainly among the most important direct benefits the Nez Perce-Clearwater NF provides for people of every age and background, in addition to indirect ecosystem services providing clear air and water.

Access to nature can result in lower levels of stress, reduced illness and mortality, accelerated healing times, reduced obesity, improved cardiac and overall health, and a greater sense of well-being.[43] These benefits have been clinically proven to apply to people of all ages, income levels, genetic backgrounds, health conditions, and abilities.[44] Numerous papers on this subject have been written by USDA scientists and researchers. Linda Kruger, a research scientist with the Juneau Forestry Sciences Lab and author of the USDA publication The Forest as Nature's Health Service states:

> *...caring for the land and serving people includes the provision of health benefits. One of the guiding principles of sustainability is to contribute to a healthy population… [A]n economic return on nature and wild places through wellness and increased quality of life will reduce healthcare costs and help create wellness… [D]elivering health benefits contributes to a healthy future for both people and the natural landscape. The most important emerging area of public health is the zone of interaction between the human and the natural environment.*[45]

National forests and wild public lands provide some of the cleanest and healthiest environments in our region. These are some of the best areas for Idahoans and Montanans to exercise constitutional rights to a healthful environment because they are available to people regardless of income. In Idaho and Montana there are no fees for traveling in Wilderness or enjoying national forest trails.

Growing evidence suggests national forest lands with values including the opportunity for solitude and the opportunity to immerse oneself in natural landscapes hold immense long-term values for human wellness and recovery.

Wild, natural landscapes with outstanding natural and human health values, such as the Hoodoo Roadless Area, are present on the Nez Perce-Clearwater NF. Choices in the

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[43] Improving Health and Wellness through Access to Nature, American Public Health Association.
[44] Outside Magazine, https://www.outsideonline.com/2393660/science-newest-miracle-drug-free.
[45] The Forest as Nature's Health Service. Linda E. Kruger, Research Social Scientist, Juneau Forestry Sciences Lab.

final plan directly affect future access to the human health values of the Forest. Plan decisions may have long term effects on the availability of areas for natural quiet, primitive wildland settings, and solitude. RWAs hold and maintain very high natural and human health values. Choosing to no longer manage the Hoodoo Roadless Area as recommended wilderness (Alternative X) or reducing the portion of the Hoodoo Roadless Area managed as recommended wilderness (Alternative Y) will directly reduce future access to human health values.

Montana Wilderness Association recommends that the final plan and FEIS carefully and critically include references to the best available science surrounding medical benefits of undeveloped and natural appearing forest lands as an important benefit to people, especially opportunities for quiet and human-powered recreation through maximizing management across the forest for recommended wilderness, such as in Alternative W.

Emerging Recreational Technologies

Rapidly evolving, and advancing, recreation technology demands both unambiguous plan components that clearly define what types of recreational uses are permitted in certain areas, as well as forward thinking policies that anticipate the increased use and associated impacts of certain activities over the life of the new plan. For example, in the 1980s it was barely conceivable that mountain bikes would be able to traverse most trails. Today mountain biking is a growing and popular recreation activity in our region. This plan must be able to withstand advances in motorized and mechanized technology for the next 15-30 years that, like advancements made since the 1980s, will undoubtedly make further and faster backcountry access earlier and therefore more desirable in all seasons.

Snow bikes are a relevant example to the Hoodoo Roadless Area. Timbersled, a snow bike manufactured that is now owned by Polaris, claims it has doubled the number of sleds it has sold every year since 2010.[46] The industry suggests that snow bikes are on pace to outsell snowmobiles in the next few years. The nimbleness of a snow bike far exceeds that of snowmobiles, allowing riders to access more heavily forested terrain and steeper aspects than on a snowmobile. Winter visits to the Hoodoo Roadless Area vicinity by our staff and members in recent years have demonstrated that snow bike use is prevalent in the area. The capabilities of these machines, and their likely increased presence, must be considered by the Nez Perce-Clearwater in evaluating the impacts of designating new winter motorized access areas.

Motorized (or electric-powered or electric-assisted) mountain bikes are another example of an emerging recreational technology that presents a challenge in the management of quiet trails. New electric bikes weigh as little as 65 pounds and have fat tires just like

[46] https://www.timbersled.com/en-us/news/the-snow-bikes-are-coming/.

regular mountain bikes. Riders can pick the desired level of pedal assistance or use the throttle that removes pedaling altogether. Worldwide, e-bike sales have skyrocketed with 35 million sold in 2016. Some economists predict the industry will account for more than $34 billion in sales by 2025.

MWA strongly supports existing Forest Service management policy 13 that classifies all types of e-bikes as motorized vehicles that are exclusively permitted on motorized trails and roads.[47] While this management decision is not specific to the Nez Perce-Clearwater NF, it is important for the Nez Perce-Clearwater NF to adopt and articulate this policy within recreational plan components.

Snow bikes and e-bikes are just two examples and there are many emergent technologies that could change use on our national forest lands. Use of hovercrafts and flying vehicles are increasingly popular, and recreational use could pose new challenges for how to integrate them into Nez Perce-Clearwater NF management direction. Aircrafts specifically pose a danger to the integrity of Wilderness and recommended Wilderness, as well as wildlife populations such as mountain goats. No matter how advanced aircraft technology becomes, such transportation or recreation is not appropriate in any type of wilderness.[48]

Montana Wilderness Association suggests this plan include the following standards regarding emerging recreation technologies:

- Use of emerging recreational technologies that are not specifically addressed by current direction are prohibited unless explicitly integrated through a public planning process.

- Electric bikes are defined as motorized travel and are not suitable on non-motorized routes.

e. Wildlife

Managing the Hoodoo Roadless Area as recommended Wilderness has numerous positive ecological impacts. In this section, Montana Wilderness Association enumerates some of the critical reasons recommended Wilderness management is needed to sustain and protect wildlife populations.

i. Grizzly bears

[47] USFS National Forest Briefing Paper, Managing E-Bikes on National Forest System Trails (2015).
[48] *McAllister,* 666 F.3rd at 566.

While the Hoodoo Roadless Area does not currently support a resident population of grizzly bears, this area is currently important for habitat connectivity between the Bitterroot Ecosystem and Northern Continental Divide Ecosystem grizzly bear recovery units.[49] In the fall of 2007, a grizzly bear was shot by a black bear hunter in the Kelly Creek area of the Hoodoo Roadless Area. The bear was genetically identified as having originated in the Selkirk Mountain population of North Idaho.[50] It is likely only a matter of time, probably within the scope of this plan, that grizzly bears will again reside in or regularly pass through the Hoodoo Roadless Area. The draft Forest Plan contains no plan components for grizzly bears. Montana Wilderness Association recommends including plan components for grizzly bears. Management of the Hoodoo as recommended Wilderness will provide habitat security and meet habitat and management requirements as outlined for Bear Management Units (BMUs) by the Interagency Grizzly Bear Management Team.

ii. Mountain goats

The Hoodoo Roadless Area is one of three roadless areas on the Nez Perce-Clearwater NF where mountain goats are known to exist. Idaho recognizes mountain goats as a Species of Greatest Conservation Need, priority Tier 3, in the Idaho State Wildlife Action Plan of 2017. Tier 3 species are considered "rare or uncommon, but not yet imperiled"[51], and may face emerging threats or declining trends range wide.[52] Several of the Hoodoo mountain goat herds have experienced significant declines in recent decades, and this includes the Hoodoo Roadless Area's Blacklead herd.[53] Declines in this herd may be as high as 80%.[54] The Stateline/Heart Lake herd uses habitat on both Idaho and Montana sides of the Hoodoo Roadless Area. This herd may not have experienced declines as significant as the Blacklead herd, yet their habitat needs and sensitivities are the same.

Mountain goat habitat is broadly characterized by steep, rugged, and high-elevation terrain within subalpine to alpine regions.[55] The species prefers habitat close to 'escape terrain', such as cliffs, which allow individuals to avoid predation and disturbance.[56] Habitat is also selected based on heat load, which accounts for incoming sunlight, and

[49] Nez Perce-Clearwater DEIS, p. 3.2.3.3-87.
[50] Servheen, et al, *A Sampling of Wildlife Use in Relation to Structure Variables for Bridges and Culverts Under I-90 between Alberton and St. Regis, Montana,* 2004.
[51] Idaho Department of Fish and Game, 2020. "Species Ranks". https://idfg.idaho.gov/species/taxa/ranks.
[52] Idaho Department of Fish and Game, 2017. Idaho State Wildlife Action Plan, p 34.
[53] Boyd, K. *Literature Review: Impacts of Human Recreational Land Use on Mountain Goats.* The Wilderness Society. 2020.
[54] Nez Perce-Clearwater DEIS, p 3.2.3.4-31.
[55] Smith, B. and DeCesare, N., 2017. Status of Montana's mountain goats: A synthesis of management data (1960–2015) and field biologists' perspectives, Montana Fish Wildlife and Parks; Idaho Department of Fish and Game, 2019. Idaho Mountain Goat Management Plan 2019-2024.
[56] Rice, C., 2008. Seasonal altitudinal movements of mountain goats. Journal of Wildlife Management 72(8).

influences both forage productivity and snow depth.[57] Given the limited availability of suitable habitat, mountain goat populations undergo short altitudinal migrations to accommodate seasonal resource variation.[58]

Habitat becomes even more limited in the winter, when snow accumulation and harsh weather conditions concentrate mountain goat populations into ranges 2-50% the size of those occupied in the summer.[59] In the Rocky Mountains, preferred mountain goat winter habitat and feeding areas are located within 200m-wide ridgetop corridors that provide access to escape terrain.[60] Mountain goats face increased energy expenditures and physiological stress in the winter, making their winter habitat critical to population success. Preferred winter habitat is limited and isolated, leaving mountain goats vulnerable to direct threats as well as indirect threats that cause them to abandon high-quality habitat.[61] Changes in spatial distribution, such as avoiding and/or fleeing areas of natural or anthropogenic disturbance, leads to increased energy expenditures at a time when forage resources are limited. Limited resource availability and harsh winter conditions result in nutritional deficiencies, increased starvation risk, and high juvenile mortality.[62] Vulnerability to direct and indirect threats also occurs as a result of the small size and reproductive isolation of many populations. Undisturbed, high-quality winter habitat is critical to mitigating these threats and maintaining over-winter survival rates and population size.[63] The Nez Perce-Clearwater DEIS acknowledges the importance of protecting mountain goat winter habitat, "winter range is important to the long-term survival of mountain goats and should be identified and managed to reduce disturbance to mountain goats".[64]

Mountain goats are highly sensitive to both motorized and non-motorized recreational disturbance and demonstrate behavioral changes (increased vigilance and decreased foraging time), reduced reproductive success, and changes in spatial distribution (reducing presence in or abandoning desired habitat).[65] These impacts are particularly

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[57] Shafer et al., 2012. Habitat selection predicts genetic relatedness in an alpine ungulate.Ecology 93(6).
[58] Rice, *Seasonal altitudinal movements of mountain goats*.
[59] Poole et al., 2009. *Wintering strategies by mountain goats in interior mountains*. Canadian Journal of Zoology, 87(3).
[60] Côté, S. and Festa-Bianchet, M., 2003. *Mountain Goat, Wild Mammals of North America: Biology, Management, Conservation*, p 1061–1075.
[61] IDFG, Idaho Mountain Goat Management Plan 2019-2024.
[62] IDFG, Idaho Mountain Goat Management Plan 2019-2024; Poole et al., *Wintering strategies by mountain goats in interior mountains*.
[63] Côté, S. and Festa-Bianchet, M., *Mountain Goat, Wild Mammals of North America: Biology, Management, Conservation;* Paul, K., 2017. *Potential Conflicts Between Wildlife and Over-snow Recreation in the Scotchman Peaks/Savage Peak Area.*
[64] Nez Perce-Clearwater DEIS, p 3.2.3.4-30.
[65] Joslin, G., 1986. *Mountain goat population changes in relation to energy exploration along Montana's Rocky Mountain front*. Biennial Symposium of the Northern Wild Sheep and Goat Council 5:253–269; Hurley, K. 2004. *Northern Wild Sheep and Goat Council position statement on helicopter supported*

acute in the winter, when resources and expendable energy are limited, as well as when disturbance occurs near nursery groups.[66] Unpredictable disturbances that occur at high-intensity, like that of motorized vehicles, are most detrimental to mountain goats and elicit moderate-to-strong negative physiological and functional responses in exposed animals.[67]

Historically, mountain goat populations faced limited disturbance from winter motorized recreation such as snowmobiling, as until the 1990s machines lacked the capability to access remote areas frequented by mountain goats. Technological advances, the introduction of snow bike technology, and decreased snowpack availability are now leading to increased competition between mountain goats and motorized recreationists for the same areas, particularly along ridge-tops used by mountain goats for winter feeding and also favored by snowmobilers and snow bikers for the access to highline views.[68]Studies on general ungulate populations demonstrate that snowmobiles can cause increased flight response, habitat loss, and mortality.[69] Several studies have documented the negative impacts of helicopter disturbance on mountain goat populations, as well as that of non-aircraft disturbance. Both aircraft and non-aircraft disturbance can reduce effective habitat, lower forage and resting rates, and impact seasonal habitat use.[70]

Mountain goats are particularly vulnerable to the potential negative impacts of snowmobile disturbance, as research indicates that ungulates become increasingly sensitive, rather than habituated, to long-term and repeated disturbance (Frid 2003). Given the accessibility of snowmobiles to rugged terrain and the frequent unpredictable, high-intensity disturbance resulting from this access, expansion of snowmobiling activity into critical mountain goat winter range is likely to reduce habitat availability and quality, produce increased energy expenditures, and reduce reproductive success.[71] Mountain goat populations are small and isolated, making them vulnerable to and often unable to recover from population declines.[72]

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recreation and mountain goats, July 2004. Biennial Symposium of the Northern Wild Sheep and Goat Council 14:131–136; Paul, K., 2017. *Potential Conflicts Between Wildlife and Over-snow Recreation in the Scotchman Peaks/Savage Peak Area.*

[66] Hurley, K., 2004. Northern Wild Sheep and Goat Council position statement on helicopter supported recreation and mountain goats, July 2004. Biennial Symposium of the Northern Wild Sheep and Goat Council 14:131–136; Harris et al. 2014, *Effects of winter recreation on northern ungulates with focus on moose (Alces alces) and snowmobiles,* European Journal of Wildlife Resources (60).

[67] Paul, *Potential Conflicts Between Wildlife and Over-snow Recreation in the Scotchman Peaks/Savage Peak Area*.

[68] Ibid.

[69] Ibid.

[70] IDFG, Idaho Mountain Goat Management Plan 2019-2024.

[71] IDFG, Idaho Mountain Goat Management Plan 2019-2024.

[72] Smith, B. and DeCesare, N., 2017, Status of Montana's mountain goats: A synthesis of management data (1960–2015) and field biologists' perspectives.

Looking specifically at the Hoodoo Roadless Area, recent flight counts by the Idaho Department of Fish and Game in areas occupied by goats documented snowmobile tracks near historic mountain goat areas and counted below 20 individuals where past winter counts were in the low 100s.[73] This evidence is highly suggestive that illegal winter motorized use in the Hoodoo Roadless Area (in areas that would become legally accessible for winter motorized use under Alternative X, Y and Z) has had significant negative impacts on the Blacklead mountain goat herd, which may be pushing that herd very quickly towards extirpation primarily due to human disturbance. This evidence also suggests that the models the Nez Perce-Clearwater NF used to estimate overlap between snowmobile use and known mountain goat population areas did not account for the skill levels of riders using this area, nor the new capabilities of snow bikes.[74] Overflights conducted by the Great Burn Conservation Alliance during winter months over the last decade have demonstrated high levels of snowmobile trespass throughout the Hoodoo Roadless Area, including in the Blacklead area, as well as the ability of these riders to access terrain that would not have been available to them even two decades ago.

To reduce the impacts of winter motorized recreation on mountain goat populations, existing management plans recommend maintaining at least a 500 meter line-of-sight setback from the animals while in open areas and maintaining a distance large enough to prevent disturbance.[75] Given the relatively narrow ridgeline corridors occupied by mountain goat populations during winter months, difficulties arise in enforcing these guidelines. In British Columbia, land management administrators use both visual surveys and habitat modelling to define three habitat categories - “occupied”, “high relative probability of occupation”, and “low suitability”. Recreation in areas identified as occupied or highly likely occupied by mountain goats, particularly during the winter, are placed under use-restrictions to limit disturbance and its potential negative impacts. This process is adaptive and responsive to both changes in mountain goat distribution and recreation type.[76] Adopting management principles of this kind in the Hoodoo Roadless Area is not possible, both from implementation, education, and enforcement standpoints. At the February St. Regis DEIS public meeting, Nez Perce-Clearwater NF team member Kearsten Edwards shared that in recent years winter law enforcement in the Hoodoo

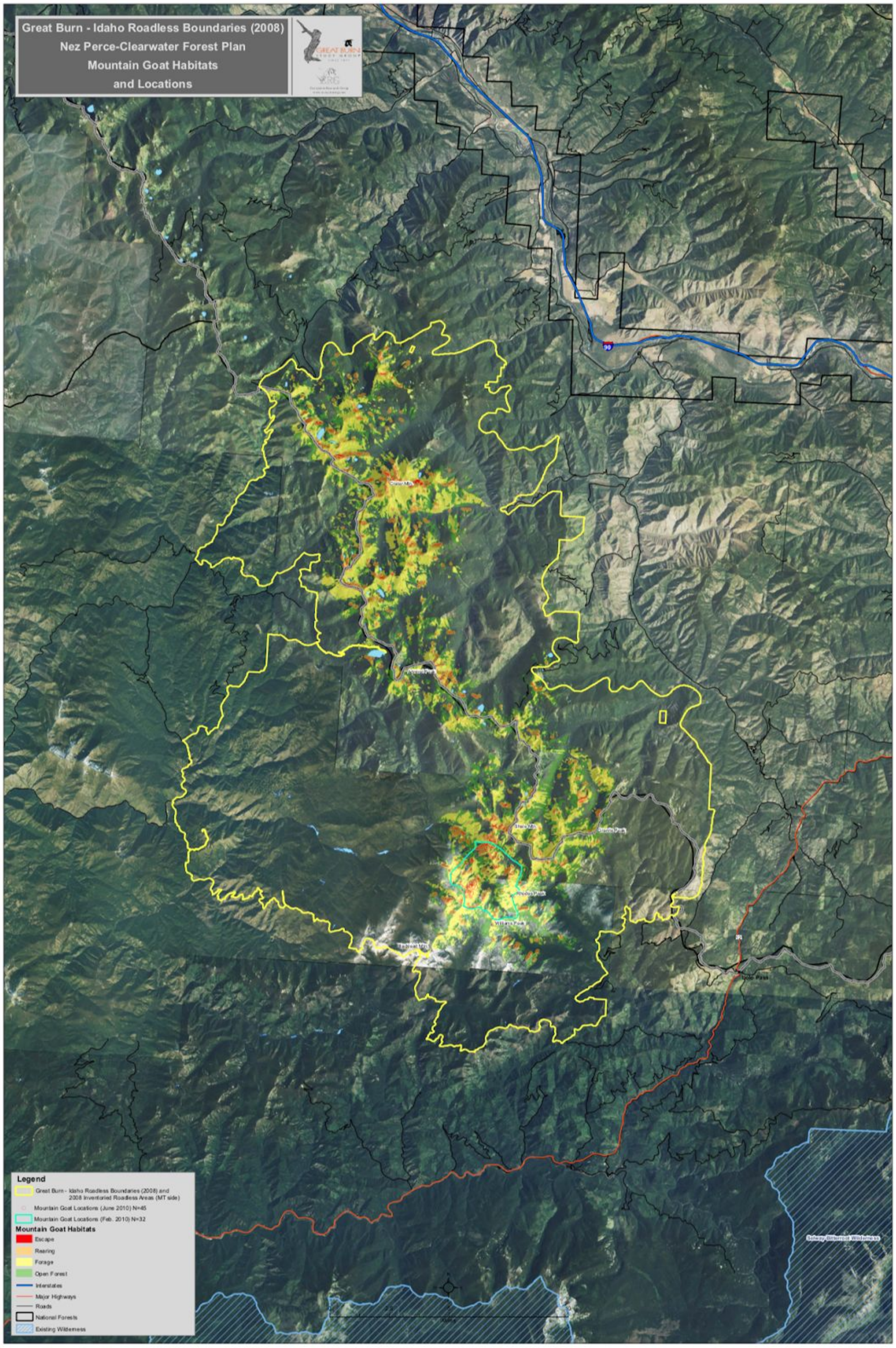
[73] Nez Perce-Clearwater DEIS, p 3.2.3.4-31.
[74] “Preliminary model results suggest low amounts of overlap between snowmobile use and known mountain goat population areas. This makes sense because most mountain goat habitat is too steep for comfortable snowmobile use.” Nez Perce-Clearwater DEIS, p 3.2.3.4-44.
[75] Gordon, S.M. and S.F. Wilson. 2004. Effect of helicopter logging on mountain goat behavior in coastal British Columbia. Biennial Symposium of the Northern Wild Sheep and Goat Council 14:49–63.
[76] British Columbia Ministry of Environment, 2010. Management Plan for the Mountain Goat (Oreamnos americanus) in British Columbia.

Pass area has consisted of one to two days on the ground and possibly one overflight.[77] This level of oversight is not adequate to implement the type of management described above, nor is it currently adequate to enforce illegal use and boundaries, as evidenced by tracks seen by Idaho Fish & Game on overflights, the level of snowmobile use I have seen while visiting the area in winter, as well as the observations of Great Burn Conservation Alliance members on winter overflights they have financed for a number of years.

Protecting the entire Hoodoo Roadless Area as recommended Wilderness with no allowance for non-conforming uses, particularly winter motorized use, as well as summer mechanized use, is critical to providing winter habitat security for the existing Hoodoo Roadless Area mountain goat populations.

The below map depicts a one-year snapshot of mountain goat presence from February and June 2010 counts, compiled by the Great Burn Study Group (now the Great Burn Conservation Alliance) and Ecosystem Research Group. A high resolution copy of this map will be provided as an attachment with these comments. The presence data on this map overlaps with areas that would be opened to winter oversnow use by Alternatives X, Y, and Z.

[77] Conversation between Erin Clark, MWA western Montana field director, and Kearsten Edwards, St. Regis Nez Perce-Clearwater public meeting, February 21, 2020.


Great Burn - Idaho Roadless Boundaries (2008)
Nez Perce-Clearwater Forest Plan
Mountain Goat Habitats
and Locations
Legend
Great Burn - Idaho Roadless Boundaries (2008) and 2008 Inventoried Roadless Areas (MT side)
Mountain Goat Locations (June 2010) N=45
Mountain Goat Locations (Feb. 2010) N=32
Mountain Goat Habitats
Escape
Rearing
Forage
Open Forest
Interstates
Major Highways
Roads
National Forests
Existing Wilderness

iii. Wolverine

The wolverine is listed as a proposed threatened or endangered species for the Nez Perce-Clearwater National Forest, pending a status review by the U.S. Fish and Wildlife Service. Wolverine habitat is present across the forest, but the Great Burn provides unique, high-quality habitat worthy of special consideration. The DEIS indicated that, "areas that had a higher probability of use in modeled wolverine habitat include the Great Burn area near Lolo Pass."[78] The DEIS also indicated that recommended wilderness areas, including the Great Burn, also appear to be an important connectivity area for lynx, fisher, and wolverine.[79]

Wolverine have particularly narrow habitat needs, especially in winter and for females of reproductive age. The presence of persistent spring snowpack is a necessary component of wolverine habitat. The Copeland et al. model utilized by the Nez Perce-Clearwater in their analysis identified areas having persistent snowpack in at least five years out of seven, which isolated only three areas on the forest: the highest elevations along the Idaho-Montana border (within the Hoodoo Roadless Area), the Gospel-Hump Wilderness, and the Selway-Bitterroot Wilderness. Of identified habitat from the composite Copeland-Inman model, 42.3% occurs in Idaho Roadless Areas, including 127,267 acres in the Hoodoo Roadless Area.

Habitat needs and constraints become even narrower when assessing maternal denning needs. Heinemeyer et al. showed that female wolverines exhibited stronger avoidance of off-road motorized winter recreation, and wolverines of both sexes avoided areas of both motorized and non-motorized winter recreation.[80] While the Bighorn-Weitas Roadless Area contains the most overall wolverine habitat, the Hoodoo Roadless Area contains the most maternal denning habitat on the forest.[81] The Hoodoo recommended wilderness area would contribute 35,727 acres of female wolverine habitat under Alternative W, only 18,455 acres in Alternative Y, zero acres in Alternative X, and although the amount of recommended wilderness under Alternative Z is intermediate to Alternatives W and X, the effects on wolverine conservation are equivalent to Alternative X (zero acres) because over-snow motorized travel would be permissible on these recommended wilderness acres. No single area on the entire forest other than the Hoodoo Roadless Area contains more than 6,800 acres of maternal denning habitat.

The Hoodoo Roadless Area also contains more acres having high importance for wolverine habitat connectivity than any other area on the Nez Perce-Clearwater. The plan demonstrates that the most important areas for connectivity on the forest are along

[78] Nez Perce-Clearwater DEIS, p 3.2.3.3-62.
[79] Nez Perce-Clearwater DEIS, p 3.2.3.3-70.
[80] Heinemeyer et al., 2019. Wolverines in winter: indirect habitat loss and functional responses to backcountry recreation. Ecosphere 10(2)e:02611. 10.1002/ecs2.2611.
[81] Nez Perce-Clearwater DEIS, p 3.2.3.3-66, Table 18 and p 3.2.3.3-72, Table 22.

the Idaho-Montana border, in the Hoodoo Roadless Area (127,267 acres).[82] This represents 60% of the high importance connectivity acres on the entire forest.

To protect wolverine habitat the Nez Perce-Clearwater has a responsibility to heed the data provided by the models utilized (Inman et al. 2012, Copeland et al. 2010), as well as the maternal denning habitat data[83], and data about range importance for habitat connectivity and gene flow[84], which all suggest that recommended wilderness management for the Hoodoo Roadless Area will significantly contribute to wolverine conservation on this forest. The draft Forest Plan does not include plan components for wolverine, in spite of the wolverines' candidacy for listing under the Endangered Species Act. The following reasoning is provided, "Most of the wolverine habitat already falls within either designated wilderness or Idaho Roadless Rule area." Given that the Idaho Roadless Rule does not preclude recreation that is known to have negative impacts on wolverine (see above), this rationale is not defensible.

The draft plan also does not adequately discuss the significance of wolverine habitat loss attributable to climate change. It has been predicted that between 2030 and 2059 suitable habitat in the contiguous U.S. for wolverine will decrease by 31%, and that for Idaho specifically habitat will decrease by 43%. These estimates further predict that habitat in the contiguous U.S. and Idaho will decrease by 63% and 78% respectively.[85] Climate change will reduce wolverine habitat, while simultaneously restricting winter recreationists to these waning areas that maintain persistent snowpack. This overlap will impact maternal denning success and lead to habitat loss and population declines.

In order to protect wolverine habitat and populations in the Great Burn, recommending this area for recommended wilderness management will only be productive if these areas are also designated off-limits to over-snow motorized and mechanized use.

Wild and Scenic River designations will also provide a level of protection for wolverines in the Hoodoo Roadless Area. Recognizing the following river segments as suitable Wild and Scenic Rivers will provide the associated acreages of protection for wolverine habitat:

Cayuse Creek: 4,138 acres
North Fork Kelly Creek: 1,746 acres
Middle Fork Kelly Creek: 1,423 acres
South Fork Kelly Creek: 1,549 acres

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[82] Nez Perce-Clearwater DEIS, p 3.2.3.3-70.
[83] Nez Perce-Clearwater DEIS, p 3.2.3.3-70.
[84] Idaho FIsh and Game State Wildlife Action Plan, 2014 and Schwartz et al. 2009.
[85] McKelvey et al., 2011. Climate change predicted to shift wolverine distributions, connectivity, and dispersal corridors, Ecological Applications, Vol 21:8.

Kelly Creek: 637 acres
Crooked Fork Creek: 2,704 acres

Montana Wilderness Association recommends all of these river segments be found WSR suitable, not only to afford wolverine habitat protections, but also for the reasons enumerated in the following section of comments.

f. Wild and Scenic Rivers (WSR)

Congress passed the Wild and Scenic Rivers Act (WSRA)[86] to: (1) initiate a national wild and scenic rivers system (NWSRS); (2) designate the first components of the NWSRS (known as the "instant" rivers); and (3) prescribe the methods by which additional rivers may be added to the NWSRS from time to time.[87]

The idea of creating a NWSRS emerged from Congress' recognition (as far back as 1960) that "special attention should be given to the dwindling number of American streams that are still in a relatively natural state."[88] America's "unspoiled and free-flowing streams, or their segments, that symbolize [the] vanishing heritage of our original landscape" need to be "preserv[ed] and protect[ed]."[89] Many of "our remaining free-flowing rivers are under threat of dams, pollution, and other destructive assault. If some of them are to be saved or restored to their natural state, legislative action is urgent."[90]

In the WSRA, Congress declares up front that it is "the policy of the United States that certain selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations."[91] The "established national policy of dam and other construction . . . needs to be complemented by a policy that would preserve . . . selected rivers or sections thereof in their free-flowing condition."[92] Just "as the Nation has set aside some of its land areas in national parks, national monuments, and national historic sites, and the like, so some of its streams which have exceptional values of the sorts . . .scenic, recreational, aesthetic, and scientific – ought to be preserved for public use and enjoyment."[93]

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[86] 16 U.S.C. §§ 1271-1287.
[87] 16 U.S.C. § 1272; H.R. Rep. No. 90-1623, *reprinted in* 1968 U.S.C.C.A.N. 3801 (hereinafter, page references are to the U.S.C.C.A.N. cite).
[88] H.R. Rep. 90-1623 at 3802.
[89] S. Rep. No. 90-491.
[90] Id.
[91] 16 U.S.C. § 1271.
[92] Id.
[93] H. R. Rep. No. 90-1623 at 3802.

To be eligible for inclusion in the NWSRS, a river or segment thereof must be "free-flowing" and it or its related land area must possess at least one outstandingly remarkable value.[94] Free-flowing, as applied to any river or section of a river, means "existing or flowing in a natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway." Outstandingly remarkable values are the "scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values" listed in section 1 of the WSRA.[95] Once the eligibility criteria is met, there are two ways for a river to be included in the NWSRS: (1) by an Act of Congress; or (2) upon application of a state governor and approval by the Secretary of the Interior as outlined in section 2 (a)(ii) of the WSRA.[96]

Under the WSRA, there are three separate means by which a river is authorized for inclusion in the NWSRS via an Act of Congress. First, Congress can automatically designate the river, on its own, as a component of the NWSRS.[97] Second, Congress can designate the river as a "potential addition" to the NWSRS, require further study (the preparation of a suitability study report), and upon completion of this process designate the river as a component of the NWSRS.[98] Third, pursuant to Section 5 (d)(1) of the WSRA, Federal land management agencies such as the U.S. Forest Service, National Park Service (NPS), and BLM can (and must) conduct their own "specific studies and investigations" to determine if any additional rivers within their jurisdiction qualify for inclusion in the NWSRS and, if so, submit such rivers to Congress (via the President) for inclusion in the NWSRS.[99]

Specifically, under Section 5 (d)(1) of the WSRA, the "Secretary of the Interior and the Secretary of Agriculture shall make specific studies and investigations to determine which additional wild, scenic and recreational river areas within the United States" qualify for inclusion in the NWSRS.[100] This section "requires the Secretaries of Agriculture and the Interior to conduct 'specific studies and investigations' to discover rivers eligible for inclusion in the [NWSRS]."[101] This identification process is carried out at the field office level, by local federal agents, as part of a planning process.

Once identified, such potential additions to the NWSRA or eligible rivers are to be taken

[94] 16 U.S.C. § 1273 (b); *see also Center for Biological Diversity (CBD) v. Veneman*, 394 F. 3d 1108, 1109 (9th Cir. 2005) (defining eligibility).
[95] 16 U.S.C. § 1271. The reference to "other similar values" includes "ecological" values. 47 Fed. Reg. 39457 (1982 Interagency Guidelines).
[96] 16 U.S.C. § 1273 (a); *see also Wilderness Society v. Tyrrel*, 918 F. 2d 813, 815 (9th Cir. 1990) (discussing the WSRA's designation process).
[97] *See* 16 U.S.C. § 1274 (a) (list of designated rivers).
[98] *See* 16 U.S.C. §1275 (a) (river study reports); § 1276 (a) (list of Congress' potential additions requiring a report).
[99] *See* 16 U.S.C. § 1276 (d)(1).
[100] Id.
[101] *CBD,* 394 F. 3d at 1110; *see also Washington County, Utah, et. al.*, 147 IBLA 373, 377 (March 4, 1999) (discussion of section 5 (d) mandate); *SUWA*, 132 IBLA 255 (April 19, 1995) (rejecting groups challenge to section 5 (d) inventory as pre-decisional).

into account by Federal agencies in all planning activities (at either the plan or site specific level). In “all planning for the use and development of water and related land resources, consideration shall be given by all Federal agencies involved to potential national wild, scenic and recreational river areas.”[102] In sum, section 5 (d)(1) “requires all [Federal agencies] to take into account potential scenic river areas in their planning activities and directs the Secretary of the Interior and the Secretary of Agriculture to determine what scenic river areas there are that should be taken into account by such agencies.”[103]

The Nez Perce-Clearwater began review of the waterways in the planning area in 2017 and completed a non-required suitability report in 2018. 89 river segments on the Nez Perce-Clearwater are currently managed as eligible segments, and all 89 deserve to continue being managed as eligible segments. After recognizing 89 rivers and streams to be eligible for designation under the Wild and Scenic Rivers Act, the Forest’s 2018 Wild and Scenic Rivers Suitability Report finds only 42% of those rivers and streams to be “suitable” for continued protections. This is unacceptable and a threat to waterways that feed the forests that support local timber industries, while simultaneously providing world-class recreation opportunities for individuals and jobs for local river guides and outfitters. These rivers and streams are also steeped in rich cultural history and are home to a number of cultural sites.

Correspondence obtained by American Rivers and American Whitewater through a January 2020 FOIA request[104] demonstrates that staff of the Nez Perce-Clearwater National Forest received significant pressure from Idaho County Commissioners to conduct a suitability report prior to the Forest Planning process with the express purpose of finding most eligible river segments unsuitable. A July 25, 2017 letter from the Board of Idaho County Commissioners to Forest Supervisor Cheryl Probert included the following statements, “We have concerns with the number of river segments (approximately 100) currently being proposed as eligible under the Wild and Scenic River Eligibility process.” “We believe that it is important that the Forest completes the Suitability Evaluation during the current Forest Planning process. We believe the Suitability process would eliminate most of these rivers, thus eliminating unnecessary and burdensome regulations on the land.”[105]

In October 2018, American Whitewater notified the Nez Perce-Clearwater National Forest of critical flaws found in the Draft Suitability Report. “First and foremost, conducting suitability determinations to remove eligibility protections as part of the planning process is not a legal practice. Even if it were, the Draft Report was inappropriately released before public comment was solicited - except for the forest-wide opinions of select local groups and political leaders which fill the pages. The

[102] 16 U.S.C. § 1276 (d)(1).
[103] H.R. Report 90-1623 at 3811.
[104] American Rivers FOIA request 2020-FS-R1-02171-F W&S Suitability, submitted January 21, 2020.
[105] Board of Idaho County Commissioners letter to Cheryl Probert, July 25, 2017. Included in attachments submitted with these comments.

Draft Report fails to connect the dots between the facts and opinions therein, and the differing conclusions represented by various alternatives… We ask that the Forest Service cease the suitability process entirely. If not, we ask that the Draft Report be withdrawn and resubmitted after public comment is solicited and considered. If neither of these steps are taken, we ask that all eligible streams be found suitable and ORVs expanded."[106]

Montana Wilderness Association has taken a close look at the river segments found in the Hoodoo Roadless Area: Kelly Creek, N Fork Kelly Creek, M Fork Kelly Creek, S Fork Kelly Creek, Cayuse Creek, Crooked Fork Creek, and Hopeful Creek. Reviews of these segments by the Forest found values significant and in keeping with those necessary for Wild and Scenic River eligibility. In keeping with the American Whitewater recommendation and the merits and values possessed, all of these Hoodoo Roadless Area river segments should be managed as eligible and suitable WSR river segments. Here is a brief summary of these river segments:

Kelly Creek (26.2 miles) - recognized in Alternatives W, Y, and Z
Recreational values: These values derive from Kelly Creek's exceptional trout fishing. This creek supports important populations of steelhead trout and native cutthroat trout, and is one of three extremely important fluvial westslope cutthroat trout populations in the North Fork Clearwater River Basin, one of only a half dozen in the region. Fluvial bull trout are also present and the creek is also designated critical habitat for Columbia River bull trout. Kelly Creek supports Blue Ribbon equivalent trout fishing. Outstanding values recognized by the State Water Plan include species of concern, salmonid spawning, recreational use, and scenery. Kelly Creek notably offers a high-quality trail-based fishing opportunity in a natural setting.
Wild values: The suitability report describes Kelly Creek as "a harmonious relationship of rock, water, and a variety of vegetation...flowing through a variety of terrain, including high country meadows, forests, and rocky canyons."[107] This creek provides important Harlequin duck habitat. Kelly Creek meets water quality standards. Areas along the creek provide winter habitat for big game, particularly elk and mountain goat.
Cultural values: It is important to note that Nez Perce tribal staff identified Kelly Creek as having cultural and historic importance to the Nez Perce tribe.

Cayuse Creek (35.9 miles) - recognized in Alternatives W and Y
Recreational values: Like Kelly Creek, Cayuse Creek's recreational values derive from Kelly Creek's exceptional trout fishing. This creek supports important populations of steelhead trout and native cutthroat trout, and provides Blue Ribbon equivalent trout fishing. Also like Kelly Creek, it is one of three extremely important fluvial westslope cutthroat trout populations in the North Fork Clearwater River Basin.
Wild values: Cayuse Creek contains some of the largest stands of old growth forest left in the Clearwater River Basin. Water quality standards have not been established for

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[106] American Whitewater letter to Nez Perce-Clearwater National Forest, October 2, 2018. Included in attachments submitted with these comments.
[107] P 65.

Cayuse Creek. Areas along Cayuse Creek, like Kelly Creek, provide winter habitat for big game, particularly elk and mountain goats. The entire Cayuse corridor also provides lynx habitat.

N Fork, M Fork, and S Fork Kelly Creek (5.9, 4.9, and 6.2 miles respectively) - recognized in Alternatives W, Y, and Z
Wild values: The upper reaches of these forks include distinctive cliffs. All three forks meet water quality standards. Beneficial uses for these streams are aesthetic, cold water aquatic life, secondary contact recreation, wildlife habitat, and agricultural/industrial water supply. Protection of these headwaters obviously serves to protect water quality values for the downstream portions of Kelly Creek.

Crooked Fork Creek and Hopeful Creek (23.2 and 4.7 miles respectively) - Crooked Fork Creek recognized in Alternative Z
The Nez Perce-Clearwater National Forest needs to address why there is no suitability in any alternative for Hopeful Creek.

Fish-based values include diversity and abundance, habitat quality, and natural reproduction. Modeled to provide westslope cutthroat and bull trout habitat refugia. Bull trout spawning and early rearing occurs in this segment. This creek also supports Snake River steelhead and Chinook salmon spawning. Crooked Fork Creek supports a population of Harlequin ducks. The stream is free of non-native aquatic species. Areas along these creeks provide summer and winter habitat for big game, particularly elk.

MWA requests a final plan that offers full protection of the amazing river resources in the Hoodoo Roadless Area by recommending all seven of these eligible river segments as Wild and Scenic River suitable and establishing management to protect the outstandingly remarkable values of all seven segments, a total of 107 river miles. MWA also requests the suitability report be amended to address the “critical flaws” that have been identified.

g. *Research Natural Areas*
Montana Wilderness Association supports retaining Rhodes Peak as a proposed research natural area and to continue to encourage the Regional Forester to recommend this area for establishment.

4. Other Management Areas

Proposed Designated Special Areas
In recognition of the botanical values and cultural significance of the Packer Meadows area, MWA supports the designation of this special area.

Designated Wilderness

MWA supports and would like to contribute to planning and implementing “a wilderness symposium for all agency personnel, non-government organizations, academia and private citizens on the wilderness areas managed by the Nez Perce-Clearwater and adjoining national forests.”[108] We further encourage this symposium to address management of recommended, as well as, designated wilderness.

Management of other Recommended Wilderness
Manage 90,855 acres of the Mallard-Larkins Roadless Area as recommended wilderness, recognizing the area’s outstanding wilderness characteristics (consistent with Alternative Y).

IV. Conclusion

Thank you for the opportunity to comment during this important process. We appreciate the hard work of the Forest Plan Revision Team and other Nez Perce-Clearwater NF staff during this Forest Plan revision process. We are also particularly appreciative of the Forest’s efforts to include Montana communities in this process. The public meetings that you have offered in St. Regis, Missoula, and Hamilton during the last two phases of this process acknowledge the importance of this landscape to western Montanans, as well as Idahoans.

The Nez Perce-Clearwater National Forest contains some of the highest quality Wilderness, recommended Wilderness, and roadless areas in the Lower 48. This plan revision is a critical nexus in forest management to protect these incredible landscapes for the plants, animals, and people who depend on these areas.

We look forward to continued work with the Nez Perce-Clearwater NF team moving forward.

Sincerely,

Erin Clark
Western Montana field director
837 Woody Street, Suite 101
Missoula, MT 59802
eclark@wildmontana.org
406.823.0477

[108] Nez Perce-Clearwater DEIS, p A4-73.

Appendix B

MONTANA WILDERNESS ASSOCIATION | Helena Office 80 S. Warren St., Helena, MT 59601 | 406-443-7350 fax: 406-443-0750 www.wildmontana.org

November 14, 2014

Forest Plan Revision
Nez Perce-Clearwater National Forests
903 3rd Street
Kamiah, ID 83536

Dear Forest Plan Revision Team,

The Montana Wilderness Association (MWA) thanks you for this opportunity to provide feedback on the Proposed Action dated July 2014. The Montana Wilderness Association is proud to work collaboratively with the US Forest Service and a wide variety of partners towards mutual goals of forest stewardship and the protection of locally, regionally, and nationally-significant roadless landscapes across our mission area, which includes all of Montana and areas immediately adjacent. Our volunteers have participated in every Nez Perce-Clearwater Forest Plan Revision pre-scoping collaborative meeting to date. The revision of a Forest Plan on a Forest as ecologically and culturally significant as the Nez-Clear, is a welcome opportunity to prepare for a future where intact wild landscapes are more valuable than they are, today, given accelerating changes in climate, increasing pressures from human settlement, and ongoing attempts to re-establish native wildlife populations.

In the following pages, we will make clear that the Nez Perce-Clearwater National Forest's 153,900-acre Hoodoo (Great Burn) Inventoried Roadless Area (IRA), as well as surrounding wildlands, *must be protected as Recommended Wilderness* at the conclusion of the Forest Plan Revision. Proposed "Special" Management Areas as described in Proposed Action Recommended Wilderness Option B are anything but "Special." Indeed, high quality snowmobile recreation opportunities abound on the Nez-Clear as well as the adjacent Lolo National Forest in areas that are *not* qualified for Wilderness Recommendation. We see no reason to allow an incompatible use to further degrade and derail some of the nation's premier Wilderness candidate landscapes.

Put simply, the Montana Wilderness Association believes:

a) Any reduction to existing Recommended Wilderness boundaries will result in the *irretrievable* loss of long-standing administratively protected areas and would severely diminish chances for future Wilderness designation by Congress;
b) Any creation of Special Management Areas in the Hoodoo (Great Burn) IRA for over-snow or other motorized use will create a recreation management nightmare for both the Nez-Clear and Lolo National Forests, result in significant degradation of all four qualities of Wilderness Character within Recommended Wilderness, and lead to major impacts on wildlife winter range and denning habitat;
c) Any Special Management Areas in the Hoodoo (Great Burn) IRA will undermine existing Recommended Wilderness on the Lolo National Forest;
d) Proposed Action Recommended Wilderness Option A represents the minimum amount of Recommended Wilderness that should be established in the Northern Bitterroot Mountains. We support the *addition* of Recommended Wilderness for the Rawhide, Meadow Creek-Upper North Fork, Bighorn Weitas, and Moose Mountain Inventoried Roadless Areas.

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Overview:

Founded in 1958, The Montana Wilderness Association is the nation's oldest state-based Wilderness-advocacy organization. For more than fifty years, we have worked with communities to protect Montana's wilderness heritage, quiet beauty, and outdoor traditions, now and for future generations. Our five thousand dues-paying members in Montana, Idaho, and beyond, care deeply for the unique, wildlife-rich, roadless landscapes that we are fortunate to still possess here in the USFS Northern Region. The outcome of the Nez Perce-Clearwater National Forest Plan Revision directly impacts Recommended Wilderness and roadless landscapes in Montana.

The Northern Bitterroots are home to some of the last large, intact, and connected blocks of wild, roadless country in the lower-48. The beating heart of this million-acre network of premier Wilderness-worthy landscapes is the 252,000-acre Great Burn or Hoodoo Inventoried Roadless Area. Surrounding that immense core lie other critical wildlands, including Rawhide, Meadow Creek-Upper North Fork, Bighorn Weitas, and Moose Mountain. The Montana Wilderness Association believes all of these critical areas should remain or become Recommended Wilderness at the conclusion of this Forest Plan Revision, guaranteeing outstanding wildlife habitat and connectivity between the Northern Continental Divide and Cabinet-Yaak Ecosystems to the north, and Central Idaho protected areas to the south.

Along with our partners at the Great Burn Study Group, the Montana Wilderness Association has been a part of every Forest Planning effort and legislative solution for the Great Burn over the past several decades. The Great Burn/Hoodoo IRA has been administratively designated Recommended Wilderness on both the Nez-Clear and Lolo National Forests since their first Forest Plans were completed in the 1980s. Either all or portions of the Great Burn have been highlights of no fewer than 16 Wilderness bills introduced to Congress by Idaho and Montana legislators. One of those, Montana's 1988 statewide Wilderness bill, passed both houses of Congress but was pocket vetoed by President Reagan over petty partisan politics, the only example of a Wilderness veto in the history of the Wilderness Act. It is only a matter of time before the Great Burn will be reintroduced and designated as Wilderness.

Highlighted Concerns with Proposed Action Recommended Wilderness Option B:

Boundary Enforcement and Nez-Clear NF-Lolo NF Joint Management Challenges

Concerns over the three Great Burn winter-motorized Special Management Areas portrayed in Proposed Action Recommended Wilderness Option B, stem from the already-existing nightmare management scenario that it would cement in place. For the last decade, the Great Burn Study Group has documented frequent illegal snowmobile incursion into the Great Burn Recommended Wilderness on the Lolo National Forest, where motors are illegal, year-round. The open, rolling landscape of the Idaho-Montana border throughout the Great Burn Recommended Wilderness invites illegal trespass. The area is costly and difficult to patrol, with little-to-no access from Idaho during the winter months and lengthy approaches from Montana. Based on conversations with Forest Service staff on both the Lolo and Nez-Clear, it is evident that little-to-no coordination or consultation occurred between the Forests during the pre-scoping period, despite obvious impacts across Forest boundaries.

Lessons from recent Forest Planning Efforts: the Mt. Jefferson Rec. Wilderness Case Study

The devastating results of poor Forest Planning on the Beaverhead-Deerlodge and Targhee National Forests in the Mt. Jefferson IRA should be of particular interest to Forest Planners on the Nez-Clear as they study possible management options for the Hoodoo/Great Burn. The following timeline of events describes how the Mount Jefferson (Hell-Roaring Creek) Recommended Wilderness/Centennial Mountains Wilderness Study Area went from a lightly used and little-known snowmobile recreation area to one with intensive use, significant impacts, and costly management challenges.

1989: 89,000-acre Centennials Wilderness Study completed with BLM and BDNF recommending adjacent areas totaling approximately 28,000 acres for Wilderness designation.

The BDNF recommended (only) 4, 474 acres of the Hell-Roaring Creek drainage, a U-shaped drainage wrapped by the Continental Divide containing the most distant headwaters of the Missouri-Mississippi River.

2001: Madison District Ranger Mark Petroni proposes to close USFS Recommended Wilderness in Hell-Roaring Creek to all motorized use including snowmobiles in order to protect Wilderness Character and potential and winter use by wolverines (see attached letter from Mark Petroni dated 9/4/2001). Ranger Petroni warns national snowmobile publications are publicizing this Recommended Wilderness to encourage increased snowmobile use.

2002: BLM also writes USFS to urge this closure of Recommended Wilderness citing the fact that leaving it open to snowmobiles had become the source of new snowmobile trespass into the adjoining BLM Centennials Recommended Wilderness (see attached letter from Jon Raby dated 8/15/2002). BDNF Supervisor Janette Kaiser blocks action by BDNF Madison District Ranger, saying it needed further study.

2004: Madison District Ranger again proposes closure of the 4, 474-acre Recommended Wilderness. Supervisor Tom Reilly decides to allow snowmobile use in the upper 2,000 acres of the RW, allowing District Ranger Petroni to close mid-drainage only as a first step.

2005: Forest Plan revision is initiated on Beaverhead-Deerlodge NF. The preferred alternative continues to recommend 4,474-acre Hell-Roaring Wilderness.

2009: Final Record of Decision drops the 2,000-acre area that was left open to snowmobiling from the Hell-Roaring Recommended Wilderness.

The BDNF's 2009 Forest Plan Record of Decision stated that monitoring would occur and if there were incursions into the adjacent closed area, the Forest would re-evaluate the decision. According to a letter dated January 15, 2013 and signed by Forest Supervisor David Myers, "Despite clear boundary marking, intentional trespass is common, as evidenced by tracks, and direct observations of riders entering the closure in close proximity to signs." The Forest is now in a situation of having to re-evaluate the decision to allow snowmobiling on Mt. Jefferson. In the meantime, Montana Sen. Jon Tester was forced to remove the Mt. Jefferson Proposed Wilderness from his Forest Jobs and Recreation Act.

In summation, The establishment of SMA's within the Hoodoo/Great Burn IRA would create an impossible law enforcement scenario for the Nez-Clear and Lolo NF, would represent a huge mistake for the Clearwater NF planning team, and would be devastating to the potential for Wilderness designation, as has played out on the Beaverhead-Deerlodge NF. Based on all available evidence, it seems impossible for the Nez-Clear to prove that SMA's would have no impact on adjacent Recommended Wilderness on the Nez-Clear and on the Lolo.

Impacts to Wilderness Character

The Hoodoo/Great Burn IRA is one of the region's – and the nation's – premier areas to experience an untrammeled, undeveloped, and natural area, and one with outstanding opportunities for solitude and primitive/unconfined recreation. From a quiet recreation standpoint, few if any areas in northern Idaho provide a comparable experience to the Great Burn, where hikers, horse-packers, skiers, and snowshoers can enjoy unique high-elevation access to miles of open, uninterrupted ridgelines, scenic lake basins, old-growth forests, and more.

Snowmobile use in cherry-stem "Special" Management Areas is entirely inconsistent with managing for Wilderness Character in adjacent Recommended Wilderness. The noise and air-pollution impacts from snowmobiles will have a significant negative impact on skiers and snowshoers in the Recommended Wilderness, resulting in visitor conflicts. Visitors have expectations based on the agency management scheme for an area. When people visit areas that are recommended for Wilderness by an agency, they expect to have a wilderness-type experience. The noise and air pollution from snowmobiles will ruin their wilderness experience.

DC-SMA-01 states that the Desired Condition for the four SMA's will "preserve opportunities to experience some qualities of wilderness character while allowing low levels of oversnow motor vehicle use." Two questions; 1) what qualities of Wilderness Character will be preserved? Based on MWA's knowledge of the qualities of wilderness character, oversnow motor vehicle use is, by definition, antithetical to maintaining the qualities of Wilderness Character. 2) How do you propose to limit snowmobile use to "low levels"? What is considered "low levels"? Will a permit system be required to maintain "low levels" of use?

Based on the very low current levels of snowmobiling on the Nez-Clear portion of the Hoodoo/Great Burn Recommended Wilderness and its associated negative impacts, as well as the availability of high-quality snowmobile recreation in other parts of the Nez-Clear and Lolo NF's, there is no compelling reason to allow snowmobiling to establish itself by creating the SMA's in Option B.

Even with no snowmobiling allowed within the Hoodoo/Great Burn IRA, motorized access to high-elevation areas will remain exceptional, with entry possible from Hoodoo Pass, Schley Saddle, and Blacklead Mountain. Just as the public must park their cars at the trailhead and walk or ride horses into the IRA during the summer, so too should snowmobilers park at the trailhead and ski or snowshoe into the IRA during the winter months.

Impacts to Wildlife

Modern snowmobile technology and user-habits are significantly different from those of the 1980s when the current Nez-Clear Forest Plan was released. Today, snowmobiles are capable of traversing sensitive terrain that was previously inaccessible, and they concentrate use in alpine bowls where they compact snow, damage whitebark pines and other high-elevation species, and displace wildlife.

High-marking in places such as the Blacklead, Hoodoo, and Surveyor areas threatens critical mountain goat winter range and winter denning habitat for species including wolverines. Mountain goats have the highest natural mortality and lowest reproductive rate of any ungulate in North America. Disturbance can stress entire herds – especially in deep snow areas where goats survive long periods off their reserves. Stress can effect herd reproduction and result in extirpation of mountain goats in the Great Burn.

The wildlife suitability component of the draft plan said: "Motorized over-snow travel is not suitable in mountain goat winter range." Based on MWA member and volunteer Bert Lindler's e-mail communications with Ray Hennekey of Idaho Fish and Game, the occupied mountain goat winter range is being mapped, but the map has not yet been completed. How can an option be presented carving SMA's for snowmobiling out of Recommended Wilderness in areas that may include potential and occupied mountain goat winter habitat?

Wolverines were recently announced as unwarranted for threatened species listing by the U.S. Fish and Wildlife Service even though their population in the contiguous United States is estimated to be less than 300. Recently, wolverines in the Great Burn Recommended Wilderness were caught on camera by Montana Fish Wildlife and Parks. Wolverines den in large boulder or talus fields in high elevation cirques which very likely would be threatened by snowmobile use. According to *The Idaho Comprehensive Wildlife Conservation Strategy*, "Human disturbance is among the most important causes of habitat fragmentation and degradation in wolverine habitat. Areas of disturbance create barriers to movement, reduce winter foraging opportunities, and may affect reproductive success (Copeland and Whitman 2004). Increased winter recreation may displace wolverines from potential habitat (Copeland and Whitman 2004). Snowmobiles should be excluded from potential wolverine denning areas to minimize these threats to wolverines."

How does establishing these snowmobile special management areas further the proposed action's Desired Future Condition FW-DC-WL-03? "Nests, den sites, other important birthing, rearing, and wintering areas for at-risk species are relatively free of human disturbance during the period at-risk species are active at these sites. Individual animals that establish nests or den sites near areas of pre-existing human use (e.g., developed recreation sites, open roads) are assumed to be accepting of that existing level of human use at the time animals establish occupancy."

The Great Burn Recommended Wilderness lies in a key wildlife travel corridor between the Northern Continental Divide Ecosystem, Cabinet-Yaak Ecosystem, and Central Idaho. Species such as the grizzly bear are using the Great Burn Recommended Wilderness and surrounding wildlands when expanding their range. Evidence is provided by a hunter's accidentally killing a grizzly bear in Kelly Creek in 2007 and by the travels of Ethel, a collared female grizzly that found her way into the Great Burn during the summer of 2014. Many believe it is only a matter of time before grizzly bears once again become established in the Bitterroot Ecosystem. Grizzly bears should be protected and included in the list of species in FW-DC-WL-06 (page 42). Grizzly bears den in high elevation areas and snowmobile use there could threaten denning or emerging grizzly bears. Many forests have adopted food and attractant storage orders to proactively prevent human-bear conflicts. A good model adjacent to the planning area is on the Lolo National Forest. A similar food and attractant storage order standard should be developed to minimize conflicts with both grizzly and black bears.

How does carving snowmobile SMA's from the Great Burn Recommended Wilderness further the proposed action's desired future condition FW-DC-WL-05? "Forest management contributes to wildlife movement within and between disparate National Forest System (NFS) land parcels. Movement between NFS parcels separated by other ownerships is facilitated by managing the NFS portions of linkage areas identified through interagency cooperation. Federal ownership is consolidated when opportunities arise to improve habitat connectivity and facilitate wildlife movement."

How does carving snowmobile SMA's from the Great Burn Recommended Wilderness further the proposed action's desired future condition FW-DC-WL-04? "Habitat conditions on the Forest support the recovery of threatened and endangered species through cooperation and coordination with the U.S. Fish and Wildlife Service, State agencies, other federal agencies, tribes, and interested groups."

Impacts to cultural and historical resources

We encourage the Nez-Clear NF to consider specific plan components designed to protect the significant resources that include, but are not limited to: the Lolo Trail, Lewis and Clark Trail, Nez Perce Trail, and Southern Nez Perce Trail. Additional plan components are clearly warranted to protect the outstandingly remarkable prehistoric, historical and cultural values associated with these resources. How will winter motorized use affect these resources in the Great Burn Recommended Wilderness?

Value of the Great Burn Recommended Wilderness to Spokane/Coeur d'Alene Metropolitan Area

The Great Burn Recommended Wilderness is heavily used by recreationists from the Spokane, WA-Coeur d'Alene, ID metropolitan area (population 609,000 in 2011) as evidenced by observation of Washington and Idaho license plates at trailheads in Montana, which often equal or outnumber local plates. No collaborative or informational meetings were held in the Spokane/Coeur d'Alene area, and to the best of our knowledge, no one from that area participated, in person, in the forest planning revision collaborative. The absence of folks from this area in the formative stage of the planning process is serious, particularly given the paucity of wilderness nearby (just 100,148 acres of designated wilderness is within 100 miles of the Spokane, WA-Coeur d'Alene, ID metropolitan area).

Conclusion

The Montana Wilderness Association sees no room for negotiation over the boundaries of the Great Burn/Hoodoo Recommended Wilderness on the Nez-Clear. We stand with the Clearwater Basin Collaborative and our partners at the Great Burn Study Group in recommending the selection of Proposed Action Option A *as a minimum*. The Montana Wilderness Association's preference is to extend the Recommended Wilderness boundaries to those of the Hoodoo IRA and the 1987 Clearwater Forest Plan, with the addition of Recommended Wilderness for the Rawhide, Meadow Creek-Upper North Fork, Bighorn Weitas, and Moose Mountain Inventoried Roadless Areas.

Given the long history of agency and non-profit commitment to managing the Great Burn as a landscape that will inevitably receive Congressional Wilderness designation, MWA trusts that the Nez-Perce Clearwater National Forest will continue to ensure a wild future for the Great Burn. In the words of the Forest Service's founding father, Gifford Pinchot, the public is counting on the Nez-Clear to do "the greatest good of the greatest number for the longest time."

Thank you again for the opportunity to comment on the Proposed Action. We look forward to continuing to participate in this process through all possible channels. Please don't hesitate to contact us with questions at any time.

Sincerely,

Zack Porter

Western Montana Field Director
Montana Wilderness Association
127 N. Higgins, Ste 301
Missoula, MT 59802
406-823-0695
zporter@wildmontana.org

cc: Joyce Thompson, Planning and Public Affairs Staff Officer
Nez Perce-Clearwater National Forest

Carol Hennessey, Forest Plan Revision Collaboration Coordinator
Nez Perce-Clearwater National Forest

Appendix C

Missoula County Commissioners
Mailing Address: 200 West Broadway
Physical Address: 199 West Pine
Missoula, MT 59802-4292

P: 406.258.4877 | F: 406.258.3943
E: bcc@missoulacounty.us

Missoula COUNTY

BCC 2021-009
Jan. 14, 2021

Nez Perce-Clearwater National Forest
Attn.: Cheryl Probert, Forest Supervisor
903 3rd St.
Kamiah, ID 83536

Cc: Leanne Marten, Northern Region Regional Forester
Zach Peterson, Nez Perce-Clearwater Forest Planner

Dear Supervisor Probert,

Thank you for the number of public meetings you have held in Missoula County to gain input during the Nez Perce-Clearwater National Forest (NPCNF) Forest Plan revision process. We appreciate your recognition of the importance of the Great Burn/Hoodoo Roadless Area and other portions of the NPCNF to our county and residents. Recently, we have had conversations with constituents regarding changes proposed in the NPCNF Forest Plan revision and would like to share our perspective.

The presence of and accessibility to wildlands near our county (such as those contained in the Great Burn/Hoodoo Roadless Area) are very important to Missoula County residents and visitors alike. These lands significantly contribute to our quality of life and provide benefits including ecosystem services, wildlife habitat and recreational opportunities, while also supporting public health and our local economy. Given the importance of these lands, we have concerns about some of the proposed management changes to the Idaho portion of the Great Burn/Hoodoo Roadless Area.

As a primary concern, we believe that allowing motorized winter access, as proposed in the NPCNF Draft Environmental Impact Statement, would negatively impact the unique and important character of these lands, which is comprised of quality fish and wildlife habitat as well as high-quality recreational opportunities for wilderness-like recreation and solitude. We are aware of the interest some have in expanding motorized winter recreation opportunities, but do not feel this is an appropriate location for that use. We believe there are more suitable locations for motorized winter use and would be interested in working together to address the needs of recreation communities in ways that do not negatively impact wildlife populations that are already subject to increasing habitat fragmentation, the stressors of climate change and increasing recreation pressure on our wild areas.

The Great Burn is important to the conservation of native fish and wildlife species, as well as maintaining valuable ecosystem services. The Great Burn connects wildlife habitats in both a north-south and east-west axis. Grizzly bears move through the Great Burn, which provides connectivity between populations. Other notable wildlife species using the area include wolverine, mountain goat, elk, deer, lynx and fisher. The Great Burn's fisheries are also significant. Salmon spawning habitat is found in the headwaters of the Crooked Fork in the southern part of the Great Burn. Kelly Creek is a source of cold, clean water that sustains a blue-ribbon cutthroat trout fishery and Cayuse Creek functions similarly.

Outdoor recreation is an important component of Missoula County's quality of life and economy. The Montana and Idaho portions of the Great Burn offer Missoula County residents and visitors high-quality recreational opportunities such as hiking, backpacking, wildlife watching, nature photography and fly-fishing. Non-motorized recreation significantly contributes to Missoula County's tourism economy, which accounted for more than $284 million in expenditures from nonresidents in our county last year. The popularity and value of the Great Burn and nearby Wild and Scenic River resources benefit local businesses such as river outfitters, fishing guides, recreation gear shops and public lands cartography businesses.

As a result, we support continued management of the Great Burn/Hoodoo Roadless Area for inclusion in the National Wilderness Preservation System as recommended wilderness, and we encourage management of all segments of Kelly Creek and Cayuse Creek as suitable for inclusion in the Wild and Scenic Rivers System.

Thank you for considering the preferences expressed here alongside comments you have received from other Montana and Idaho county commissions. The value of wild places such as the Great Burn transcends state boundaries, for wildlife and humans alike.

Sincerely,

BOARD OF COUNTY COMMISSIONERS

DocuSigned by:
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David Strohmaier, Chair

Not Available

Josh Slotnick, Commissioner

DocuSigned by:
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Juanita Vero, Commissioner

BCC/ac

Appendix D

MONTANA WILDERNESS ASSOCIATION | Helena Office
80 S. warren St., Helena, MT 59601 | (406) 443-7350
wildmontana.org

August 20, 2020

Carolyn Upton, Forest Supervisor
Lolo National Forest
24 Fort Missoula Road
Missoula, Montana 59804

cc: Cheryl Probert, Forest Supervisor, Nez Perce-Clearwater National Forest
Leanne Marten, Regional Forester, Northern Region
Jimmy Gaudry, Wilderness and Wild & Scenic River Program Manager, Northern Region
Carole Johnson, Superior District Ranger, Lolo National Forest

Dear Supervisor Upton,

It was a pleasure to have the opportunity to discuss, as well as visit, the Great Burn (Hoodoo Roadless Area) with you at the end of July. As the largest recommended wilderness area (RWA), and largest roadless area, in Region 1, this landscape is a very important component of our regional wild public lands. The Great Burn is notable not only for its size, but also for the quality of its wilderness characteristics and the unique wildlife security and connectivity zones it contains. The Great Burn is superlatively suited for consideration for Wilderness designation. In addition, the area is, as we discussed, increasingly valued by local communities for the beauty of its landscapes, wildlife viewing opportunities, and hence the quality of the human-powered recreation opportunities it provides, which presents both opportunities and challenges.

The Lolo National Forest portion of the Hoodoo Roadless Area is currently managed as MA12, i.e. recommended wilderness. The Lolo National Forest Plan of 1986 states management of MA12 areas that are not yet designated as Wilderness should "protect wilderness characteristics pending a decision as to their classification." Furthermore, RWAs across the Forest Service system must be managed for social and ecological characteristics that preserve and enhance wilderness character over time, as required by the 2012 Planning Rule, US Forest Service guidance, and case law.

As forests across Region 1 engage in planning processes and release new plans, such as the 2018 Flathead National Forest Plan, these plans have acknowledged that allowing non-conforming uses in recommended wilderness would degrade wilderness characteristics[1], and therefore non-conforming uses should not be

[1] "I have included plan components to protect and maintain the ecological and social characteristics that provide the basis for each area's suitability for wilderness recommendation. One of these plan components indicates mechanized transport and motorized use are not suitable (MA1b-SUIT-06) in recommended wilderness areas. I have included this plan component in my final decision because **I believe it is necessary to protect and maintain the ecological and social characteristics that provide the basis for their wilderness recommendation . . . The Forest Service has an**

allowed in RWAs. In addition to the Flathead plan, the plans released for the Helena-Lewis & Clark and Custer-Gallatin National Forests in the last six months also prohibit mechanized use in RWAs. Comments Montana Wilderness Association submitted on the Nez Perce-Clearwater National Forest Plan DEIS in April 2020 encourage the same approach to RWA management for the Nez Perce-Clearwater portion of the Great Burn, and we encourage that approach for the portion of the Great Burn managed by the Lolo National Forest in Montana as well.

The 2012 Clearwater National Forest travel management plan prohibits motorized and mechanized use within the Great Burn recommended wilderness. A Nez Perce-Clearwater Forest Plan outcome that prohibits non-conforming recreational uses in RWAs would be consistent with this current travel management plan.

Increasingly, however, there is evidence that mechanized use, mountain biking in particular, is becoming common in the Great Burn. Mountain bike users are violating the 2012 Clearwater Travel Plan by biking the Stateline Trail from Hoodoo Pass. The Stateline Trail, particularly from Hoodoo Pass to the Heart/Pearl Basin overlooks, passes in and out of Montana, into Idaho, numerous times, as we discussed while on the trail together. Each time a rider enters Idaho, they are in violation of the 2012 Clearwater Travel Plan. These mechanized users frequently drop off of the Stateline Trail to complete loop or point-to-point rides, exiting the Great Burn via the Heart Lake Trailhead or the Clearwater Crossing Trailhead, in the Lolo National Forest.

Case studies from across Region 1 (Beaverhead-Deerlodge and Flathead National Forests in particular) show that allowing non-conforming uses has directly precluded previously recommended RWA acreage from the possibility of inclusion in the National Wilderness Preservation System in the future; failing to uphold a desired condition where RWAs maintain their potential for future Wilderness designation. Details about these case studies are not included here, but I will be happy to provide them if requested.

To maintain the wilderness characteristics of the Great Burn and uphold MA12 management standards, the Montana Wilderness Association requests that a special closure order be issued for mechanized uses on the portion of the Hoodoo Roadless Area managed by the Lolo National Forest.

At minimum, this closure would ensure consistency with the Clearwater Travel Plan, by helping to address mechanized trespass on the Stateline Trail, which contains segments in both Idaho and Montana. At maximum, this closure will ensure that

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affirmative obligation to manage recommended wilderness areas for the social and ecological characteristics that provide the basis for their recommendation until Congress acts. The land management plan does not allow for continued uses that would affect the wilderness characteristics of these areas and possibly jeopardize their designation as wilderness in the future." Flathead National Forest, Forest Plan Record of Decision (2018), p. 26.

wilderness characteristics are being upheld on the portion of the Hoodoo Roadless Area managed by the Lolo National Forest in keeping with the MA12 standard.

In addition to protecting wilderness character and the potential for future designation, this closure will protect public health and safety, as well as wildlife security, as anecdotal evidence from users in the Great Burn indicate that mechanized use, particularly in the Heart and Pearl Lake basins, is inconsistent with providing safe experiences for foot users, especially those with children. The Heart and Pearl Lake basin is widely known as an ideal area for family backpacking. The single-track nature of this trail system, as well as the presence of several sections of trail with thick vegetation and sharp drop offs (particularly as the trail ascends/descends from the lake basin to the Stateline Trail), creates hazard-prone areas where dangerous conflicts could occur between mechanized users and horseback or foot-based users.

Mechanized use may also have negative impacts on mountain goat populations that reside in this area. Native mountain goat herds in western Montana have declined in recent decades[2], and this has also been true for the Blacklead herd on the Idaho-side of the Great Burn. Idaho Fish & Game recently estimated that this Great Burn herd may have declined by up to 80% over the last decade alone.[3] Although the Montana-side Great Burn mountain goat herd has not yet shown such a trend, this population should be considered sensitive. Research has shown that mountain goats are highly sensitive to both motorized and non-motorized recreational disturbance and demonstrate behavioral changes (increased vigilance and decreased foraging time), reduced reproductive success, and changes in spatial distribution (reducing presence in or abandoning desired habitat) as a result of this use.[4]

USFS rules state that a Forest Supervisor may issue a special closure order to limit certain trail uses "for the protection of…public health or safety." Special closure orders on National Forest System trails may include prohibitions on "any type of vehicle" or "any type of traffic or mode of transport". We respectfully request that you use your authority to issue this Great Burn Recommended Wilderness special closure order, allowing MA12 management standards to be upheld and wilderness characteristics of this area to be protected and secured until Congress acts.

Montana Wilderness Association has worked closely with our partner organization, the Great Burn Conservation Alliance, in crafting this request. Together, we request that you consider this issue promptly. And together, we look forward to providing any support that would be helpful in issuing, upholding, and communicating about

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[2] Smith, B. and DeCesare, N., 2017, Status of Montana's mountain goats: A synthesis of management data (1960–2015) and field perspectives.
[3] Nez Perce-Clearwater DEIS, p 3.2.3.4-31.
[4] Joslin, G., 1986. *Mountain goat population changes in relation to energy exploration along Montana's Rocky Mountain front*. Biennial Symposium of the Northern Wild Sheep and Goat.
Council 5:253–269; Hurley, K. 2004.

MONTANA WILDERNESS ASSOCIATION
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this special closure, both with our memberships and with the larger communities that use and value the Great Burn Recommended Wilderness.

Thank you for your consideration. I look forward to discussing this request further with you and working together to address this matter.

Sincerely,

Erin Clark, western Montana field director

Amy Robinson, conservation director

Appendix E


Great Burn - Idaho Roadless Boundaries (2008)
Nez Perce-Clearwater Forest Plan
Mountain Goat Habitats
and Locations
GREAT BURN STUDY GROUP
SINCE 1971
ERG
Ecosystem Research Group
www.ecosystemrg.com
90
Crater Mtn
Admiral Peak
Shale Mtn
Granite Peak
Rhodes Peak
Williams Peak
Blacklead Mtn.
12
Lolo Pass
Selway-Bitterroot Wilderness
Legend
Great Burn - Idaho Roadless Boundaries (2008) and 2008 Inventoried Roadless Areas (MT side)
Mountain Goat Locations (June 2010) N=45
Mountain Goat Locations (Feb. 2010) N=32
Mountain Goat Habitats
Escape
Rearing
Forage
Open Forest
Interstates
Major Highways
Roads
National Forests
Existing Wilderness

Appendix F

Status of Montana's mountain goats: A synthesis of management data (1960–2015) and field biologists' perspectives

Final report: 1 May 2017

Bruce L. Smith
U. S. Fish and Wildlife Service (retired)

Nicholas J. DeCesare
Montana Fish, Wildlife and Parks

Montana Fish, Wildlife & Parks

Suggested citation: Smith, B. L., and N. J. DeCesare. 2017. Status of Montana's mountain goats: A synthesis of management data (1960–2015) and field biologists' perspectives. Final report, Montana Fish, Wildlife and Parks, Missoula.

EXECUTIVE SUMMARY

We synthesized population survey and harvest data collected by Montana Fish, Wildlife and Parks (MFWP) staff over the past 60 years for the state's mountain goat (*Oreamnos americanus*) populations. In addition, we surveyed 18 MFWP biologists who manage goats in Regions 1–5 to learn more about the populations for which they have management responsibility. We summarized their written questionnaire responses to evaluate the current status and management circumstances of Montana's mountain goats.

Mountain goats distributions in Montana include historic ranges as well as mountainous areas into which goats have expanded from introductions of animals to non-native habitat. In 2016 an estimated 3,685 mountain goats were managed by MFWP, 2,526 (69%) in introduced populations, and 1,159 (31%) in native populations. Another 2,225 goats inhabited the Montana portions of Glacier and Yellowstone National Parks. The most important finding of this work was the dichotomy between native and introduced mountain goats. Compared with population estimates from the 1940s and 1950s, numbers of goats across native ranges (outside Glacier National Park) are 3–4 times fewer today than the 4,100 estimated from surveys during the 1940s. Our survey of MFWP biologists confirmed this decline of native goats. Many of the populations are small and isolated demographically and genetically. Furthermore, both hunting licenses issued for and annual harvests of native populations have declined nearly 10-fold from the 1960s to present. On the other hand, the majority of introduced populations are prospering, with some notable exceptions. Introduced populations now provide the majority of Montana's hunting opportunity. Total goat harvest has declined from the 1960s when 300–500 animals were harvested annually to a relatively stable ≈210 goats annually over the past 30 years. Twelve of Montana's 52 hunting districts (9 with native populations) have been closed to hunting in recent years.

Area biologists provided insights into how they survey and establish harvest prescriptions for populations. They also identified a wide range of management and research needs from which they would benefit in managing and conserving mountain goats. We provide full details of the biologists' answers to a 25-item questionnaire in the attached Appendix.

We identified multiple avenues of management and research for MFWP to consider in future planning efforts: evaluation of statistical power associated with various monitoring protocols, continued maintenance of centralized databases, design of monitoring approaches for long-term consistency, potential development of a statewide species management plan, and research into habitat factors, population dynamics, and causes of mortality of mountain goats.

INTRODUCTION

Among North American native big game species, mountain goats (*Oreamnos americanus*) present many challenges for wildlife management and conservation. They live in remote and harsh environments where traditional monitoring techniques are challenging; they often occur in small isolated populations which are, by definition, more difficult to monitor and face increased risk of declines; and they exhibit life history characteristics that make them particularly susceptible to over-harvest and slow to recover from population declines (Toweill et al. 2004, Festa-Bianchet and Côté 2008). Potentially as a result of some of these challenges, mountain goats have suffered recent population declines across much of the southern portion of the species' native range over the past 50–70 years (Côté and Festa-Bianchet 2003, Festa-Bianchet and Côté 2008, Smith 2014). For example, goat populations in British Columbia have declined by half from an estimated 100,000 in 1960 to 39,000–63,000 in 2010 (Mountain Goat Management Team 2010). Abundance of mountain goats in Washington has declined by 60 percent since 1950 (Rice and Gay 2010). Due to concerns about declines in Alberta, wildlife officials closed the entire province to goat hunting in 1987. Only in 2001 were conservative harvest quotas reinstated there (Hamel et al. 2006).

In Montana, the status of mountain goats is complicated. The western portion of the state supports native populations. To the east, additional populations were established by translocating goats into prehistorically unoccupied habitat (Figure 1). License numbers to hunt native goats have generally been reduced over the past three or four decades, indicating population declines in some areas. Carlsen and Erickson (2008) concluded, "The decline in mountain goat populations is alarming and deserves investigation by Montana Fish, Wildlife and Parks [MFWP]. When goat populations decline, it appears they don't recover."

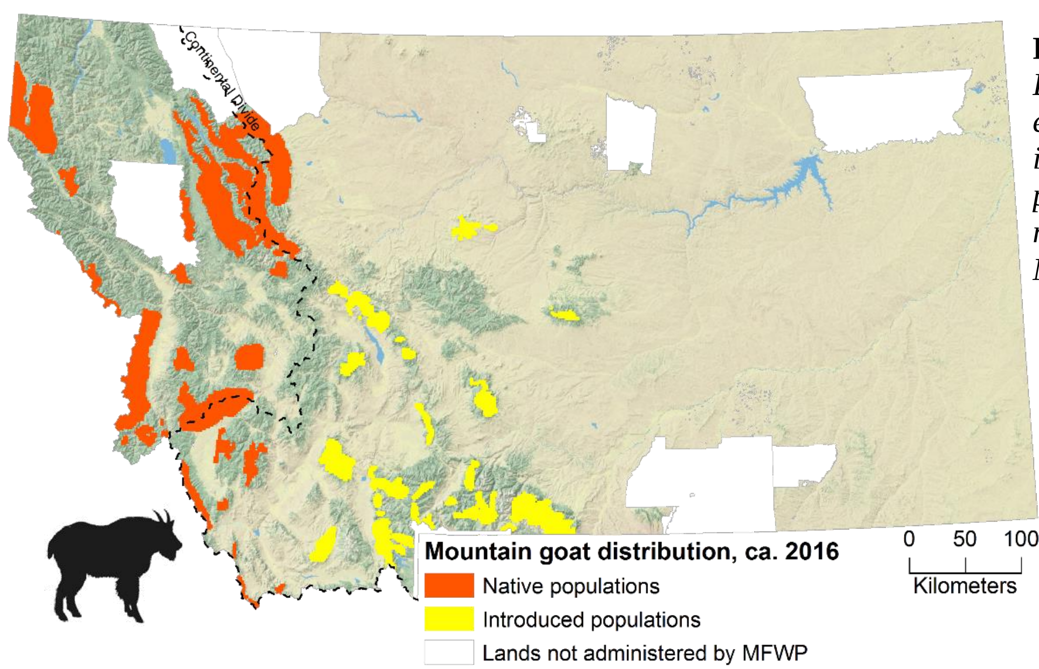


Figure 1. *Distribution of extant native and introduced populations of mountain goats in Montana, 2016.*

Concern over declines in native mountain goat populations are also supported by findings in Alberta, British Columbia, and Washington, which indicate that the mountain goat's natural history may make it particularly sensitive to harvest (and other factors, such as motorized vehicle disturbance) relative to other big game species (Gonzalez-Voyer et al. 2003, Hamel et al. 2006, Mountain Goat Management Team 2010, Rice and Gay 2010).

Contrary to the decline of Montana's native mountain goats, substantial increases have been observed in some introduced populations (Williams 1999, Lemke 2004, Flesch et al. 2016). The transplanting of goats into southwestern and central Montana began over 70 years ago. From 1941 to 2008, 495 animals were transplanted to 27 different sites, with some ranges receiving multiple introductions (Picton and Lonner 2008). Introduced herds in some locations have grown in both numbers and geographic range, while other introductions appeared to have failed, whether immediately or after a period of time.

Carlsen and Erickson (2008) reported that the statewide total goat harvest has been relatively stable over the past 30 years, although this summary may mask markedly different trends occurring among native and introduced populations. A synthesis of historic harvest and monitoring data from each hunting district (HD), and aggregated at larger scales, would elucidate potential shifts in population trends among native and introduced populations, with implications for future conservation of mountain goats and the recreational opportunities they afford.

Montana has a rich history of research into the biology, ecology, and conservation requirements of mountain goats, beginning with the work of Casebeer et al. (1950). Studies during the 1970s and '80s provided the most comprehensive biological information on Montana's native goat populations (Chadwick 1973, Rideout 1974, Smith 1976, Thompson 1980, Joslin 1986). Several studies in the Crazy Mountains provided information on that introduced population's ecology and growth during the 1950s and 1960s (Lentfer 1955, Saunders 1955, Foss 1962). Changes in numbers and distributions of other introduced populations were closely monitored in recent years by MFWP (Swenson 1985, Williams 1999, Lemke 2004). Most recently, Flesch et al. (2016) described range expansion and population growth of introduced goats in the Greater Yellowstone Area.

The aim of this study was to compile and synthesize mountain goat harvest and population information at a statewide scale across Montana over the past 50–60 years, with particular attention to comparing and contrasting dynamics of native and introduced mountain goat populations. We also developed and distributed an expert-opinion survey to solicit the insights and opinions of MFWP personnel (area biologists and/or regional wildlife managers whose jurisdictions include mountain goats) regarding population trends, limiting factors, monitoring practices, and future research and management needs. Summarized results from this survey of MFWP biologists represent the current state of knowledge about Montana's mountain goats, with potential to guide future research, monitoring, and planning efforts aimed at filling information gaps and sustaining or enhancing mountain goat populations and hunting opportunity.

Project Objectives

1. Compile and digitize historical harvest and population monitoring data from MFWP records and reports into a statewide database.

2. Assess trends in mountain goat populations and hunter harvest across Montana, with attention to differences in dynamics among native and introduced populations.

3. Use an expert-opinion questionnaire sent to MFWP personnel to assess the state of knowledge regarding population trends, monitoring practices, limiting factors, and management and research needs for Montana's mountain goats.

OBJECTIVE 1: COMPILE HISTORICAL DATA

We began this project by compiling as much historical data as we could find regarding mountain goat harvest and monitoring. Data sources included:

1. MFWP's internal website databases
    a. Wildlife Information System (WIS), aerial survey data
    b. Wildlife Information System (WIS), hunting and harvest survey data – per HD
    c. Mandatory Reporting Response Entry (MRRE), harvest data – per animal
2. Various electronic data files and reports from area biologists
3. Archived MFWP Survey & Inventory reports from regional office libraries or archives in:
    a. Kalispell
    b. Missoula
    c. Butte
    d. Bozeman
    e. Helena

We organized these data in an electronic database for our analyses. The database will be archived and/or distributed within FWP upon the project's completion. After completing the database, we sent data subsets to each area biologist for review and/or editing of hunting, harvest, and population survey data within their respective jurisdictions. Thus, nearly all of these data have been reviewed by FWP biologists with knowledge about each local area.

The compilation of mountain goat harvest data included >2,200 district-years of data concerning quantities of licenses issued, total numbers of goats harvested, and numbers harvested according to sex. Some data were available as far back in time as 1948 for some HDs. Data for most regions were more consistently available during the period of 1960–2015. Information on the sex, age, and horn measurements for >5,100 individuals was also available via mandatory checking of harvested goats, which began in 1982 and continued through 2015. Other harvest data, such as hunter-days, goats observed, and days per goat seen or harvested, were inconsistently collected over space and time and not deemed suitable for summary in this report.

Population survey data presented challenges to compile because they were not necessarily collected or summarized in reports every year in a way similar to harvest data. We were able to compile data from many population surveys by reading regional survey and inventory reports. Review of population survey data by current FWP area biologists allowed us to fill in many data gaps, although we may still be missing data for certain areas and time periods. To date, we have compiled >700 individual goat population surveys spanning 1942–2016.

OBJECTIVE 2: TRENDS IN HARVEST AND POPULATION SURVEY DATA

Hunter harvest data

We analyzed mountain goat hunter harvest data for the period spanning 1960–2015 (Figure 2). The availability of hunting licenses during this period peaked in 1963 at 1,371 licenses, primarily for hunting of native populations (Figure 2a). Unlimited licenses were available for several native populations in Region 1 at the beginning of the study period in 1960, although regulations for these HDs were gradually switched to limited-draw-based hunting during the subsequent decade. The last unlimited hunting occurred in 1971 in a portion of the Bob Marshall Wilderness, after which only limited licenses were offered in all HDs. In 2015, 16,643 hunters applied to the lottery for 241 goat licenses, with a 1.4% chance of successfully drawing.

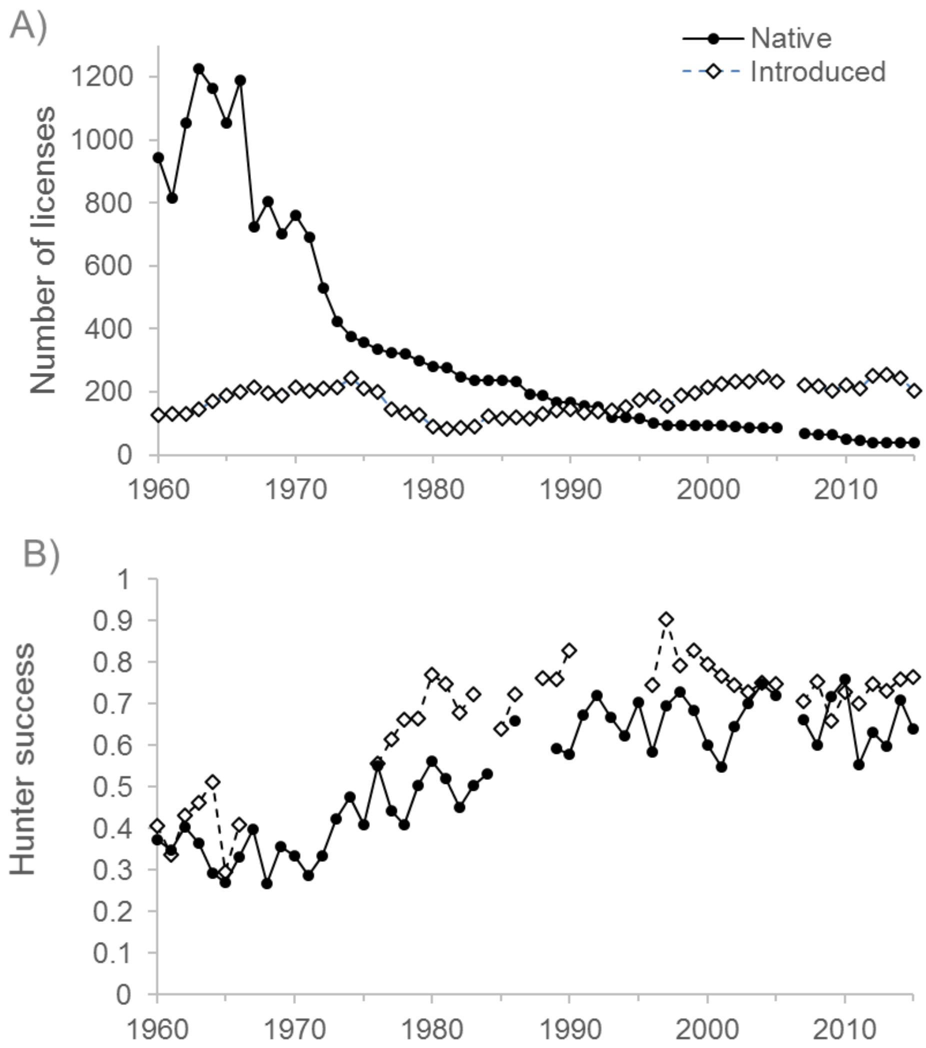


Figure 2. *Trends in A) the availability of hunting licenses and B) hunter success rates (kills per license) for native and introduced populations of mountain goats in Montana, 1960–2015.*

The success rates of hunters, measured as kills per license sold, were lowest during the beginning of this study period, averaging 34% for native populations and 41% for introduced populations during the 1960s (Figure 2b). During subsequent decades, as licenses were reduced in native ranges and increased in introduced ranges, success rates for both increased. Throughout this period, hunter success in introduced range has remained consistently higher than in native range. Thus far during the 21st century (2000–2015), success rates have averaged 65% for hunters of native populations and 74% for hunters of introduced populations. Hunter success rates are typically high and difficult to interpret for special big game species with low-odds license drawings. In such cases, we do not expect trends in hunter success to reflect those of abundance of mountain goats.

Mirroring trends in license availability, total harvest of mountain goats was highest during the early 1960s, peaking at 513 animals in 1963 (Figure 3). By the late 1970s and throughout the 1980s, total harvest became somewhat stable, averaging 216 goats per year during 1977–1989, and ranging from 170–242. Similar harvests have been achieved since, including during the 1990s (mean=212, range=197–228), the 2000s (mean=221, range=184–250), and most recently 2010–2015 (mean=198, range=174–214; Figure 3). Less visible during this 40-year period of stability in total harvest has been a dramatic shift in harvest from native to introduced populations (Figure 3). In the early 1960s, 87–88% of harvested animals were from native populations, averaging 377 native goats harvested per year compared to 55 introduced goats. Since that time, the proportionate harvest of native goats has declined substantially as a result of both reduced licenses in native populations and increased licenses in introduced populations (Figures 3, 4). In 2015, 25 goats were harvested from native ranges compared to 155 from introduced ranges.

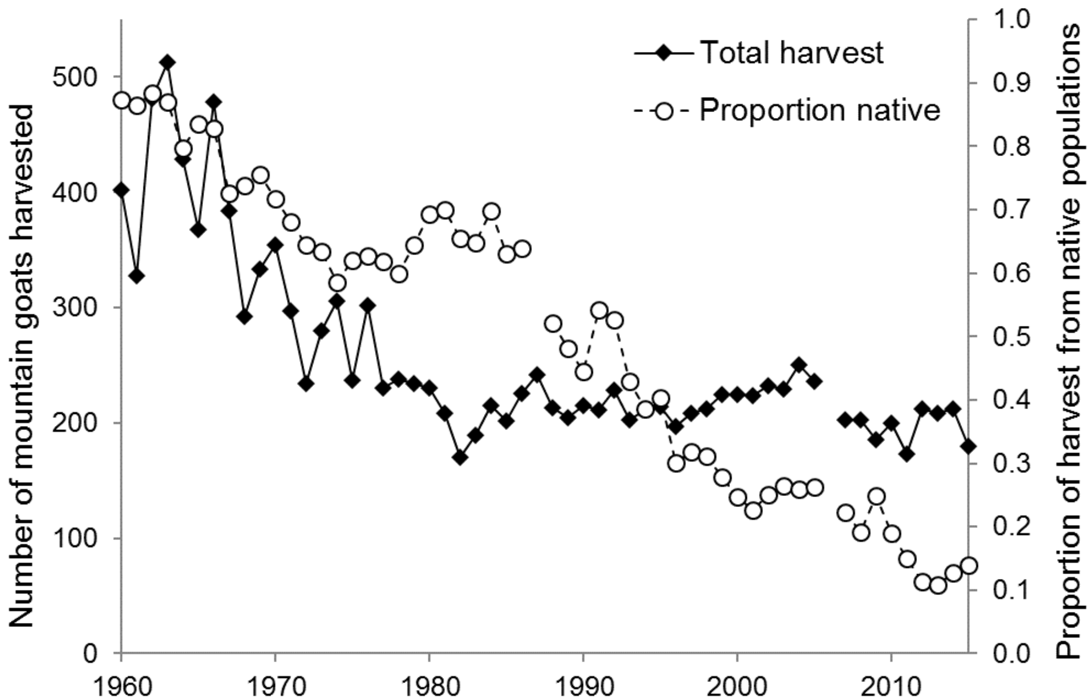


Figure 3. *Total harvest of mountain goats and the proportion of harvest coming from native populations in Montana, 1960–2015.*

When looking at trends in total harvest according to administrative region, large declines in native harvest are evident in Regions 1 and 2 of western Montana. To the contrary, substantial increases in harvest have occurred in introduced populations in Region 3 of southwestern Montana (Figure 4).

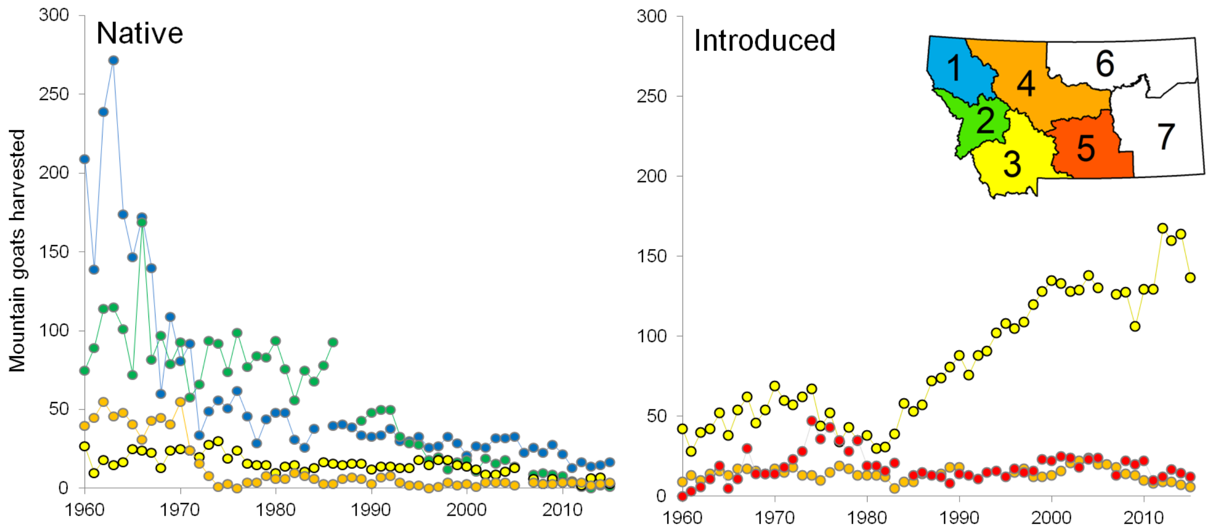


Figure 4. *Numbers of mountain goats harvested from native and introduced populations, by administrative region, in Montana, 1960–2015.*

Unlike other North American ungulates, mountain goats present a unique challenge to hunters and wildlife managers because the sexes are difficult to differentiate in the field. Male and female goats do, in fact, exhibit sexually dimorphic horn characteristics, but these and other subtle differences can be challenging for untrained observers to identify (Smith 1988a). Consequently, MFWP has consistently offered either-sex licenses that allow hunters to legally harvest either a male or female. Harvest of male goats is typically the goal for both wildlife managers (e.g., to harvest animals with lower reproductive value) and for hunters (e.g., to harvest animals with larger trophy scores). To support this goal, MFWP currently offers information and videos on their website as a voluntary educational opportunity for hunters. An exception to either-sex licenses was implemented in 2016 when 25 female-only licenses were issued in the Crazy Mountains HD313. Early indications are that hunters with these licenses were quite adept at successfully identifying and harvesting females during the 2016 season (e.g., preliminary data showed 14 of 14 harvested goats were females, K. Loveless, personal communication).

To assess how hunter education and/or selectivity may have changed in past years, we also summarized the proportion of females within the harvested sample of mountain goats during 1960–2015 (Figure 5). There was no statistical difference in proportionate harvest of females among native and introduced populations (t_{110}=0.543, P=0.588). A decreasing trend in the annual proportion of females in the harvest was evident among both native (β=-0.002, P=0.001) and introduced (β=-0.002, P=0.001) subsets of the statewide harvest, showing an average decrease of 0.2% per year. For example, an average of 42.2% of the annual harvest was females during the 1960s (excluding the outlier value of 18% from 1964), while an average of 30.7% of the harvest was females during 2010–2015.

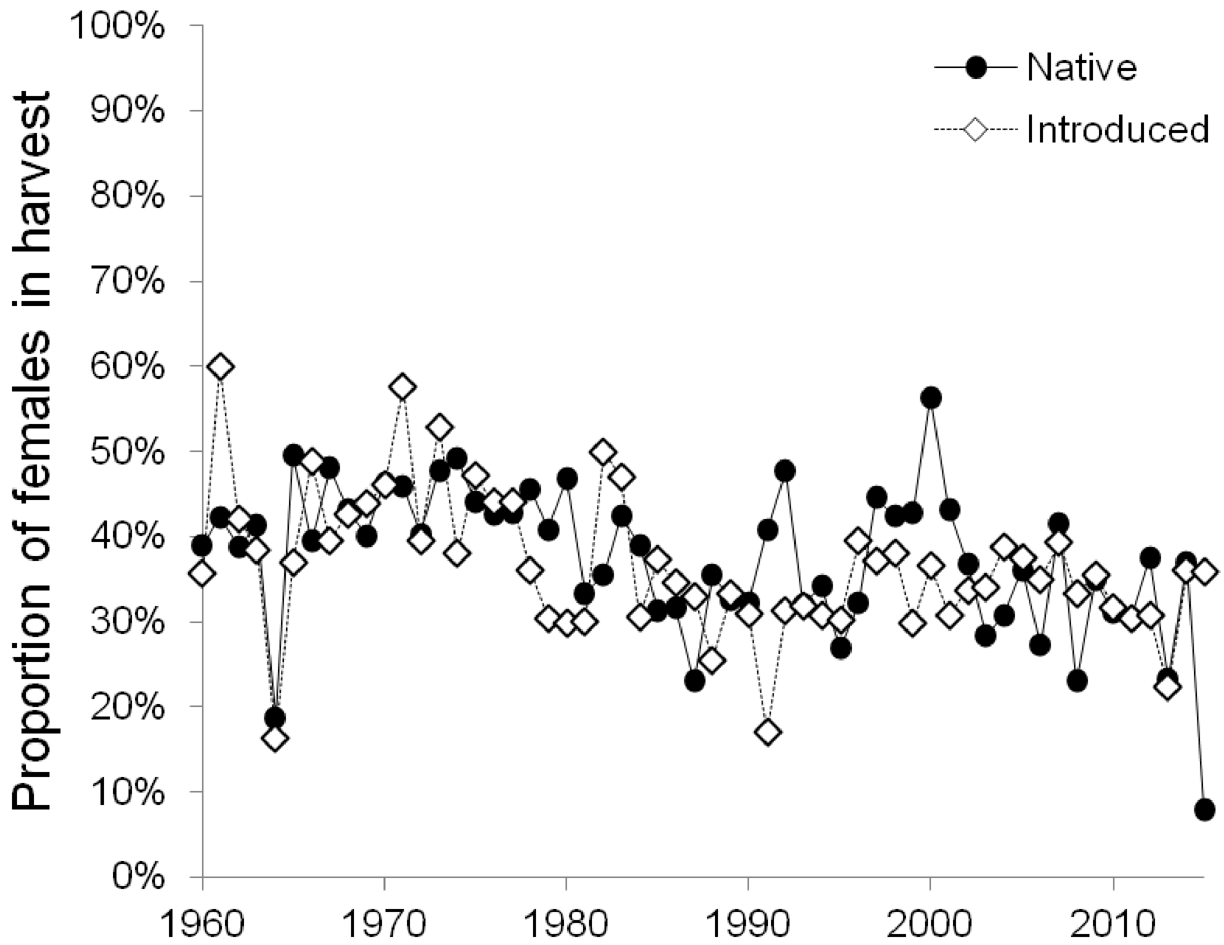


Figure 5. *Proportion of females within the annual harvest of mountain goats, among native and introduced populations, in Montana, 1960–2015.*

In order to compare trends in total harvest among regional populations, we grouped 69 different mountain goat HDs that have been used during various portions of the period 1960–2015 into 28 regional "populations" (Figure 6). The area and number of animals encompassed by each population were not consistent, although we attempted to delineate populations according to logical topographic or ecological boundaries. These groupings included 14 native populations and 14 introduced populations, and we plotted long-term trends in total mountain goat harvest for each (Figure 7). The native population in the Whitefish Range saw no harvest during this period and was eventually deemed as extirpated. Declines in harvest are evident for nearly all native populations (with the possible exception of the Cabinet Mountains) and some introduced populations, while other introduced populations show recent increases in harvest.

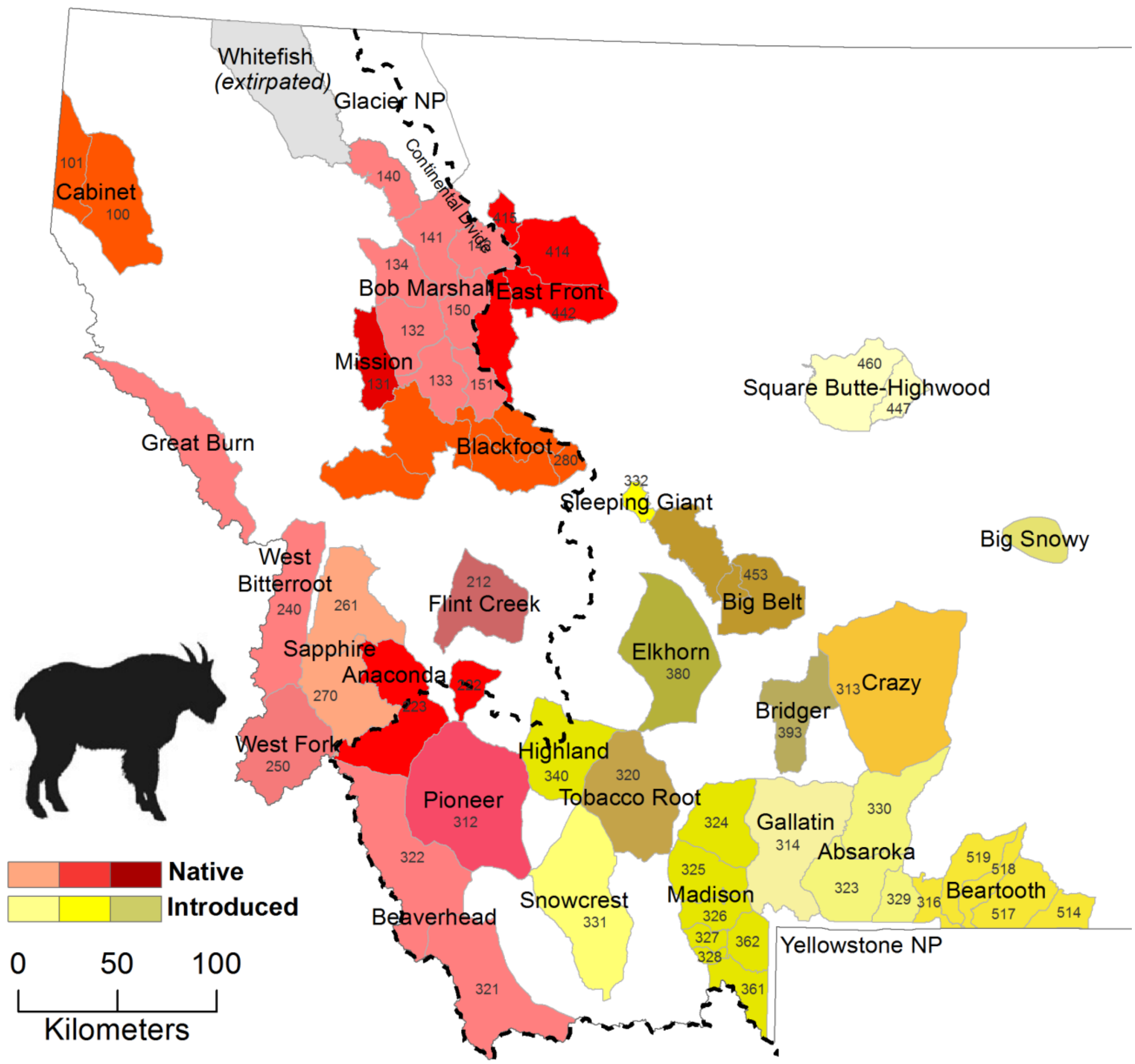
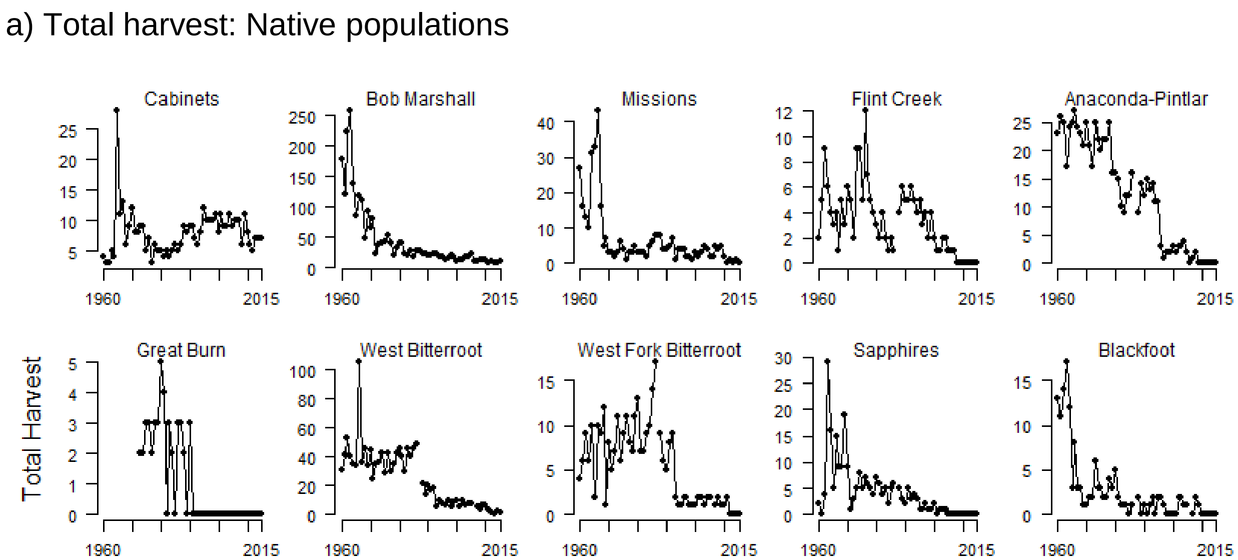


Figure 6. *Hunting districts and regional "populations" of mountain goats in Montana during 1960–2015, which were defined subjectively for purposes of summary within this report. Note: our summaries do not include popuations inside Glacier and Yellowstone National Parks.*



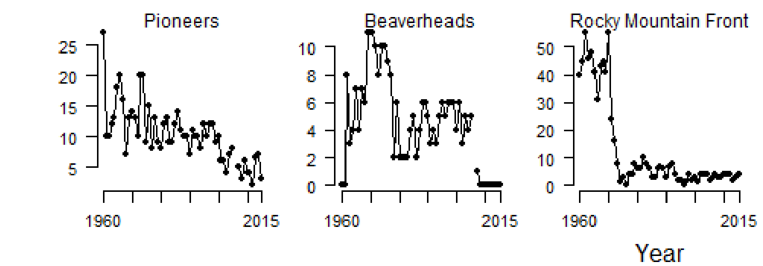
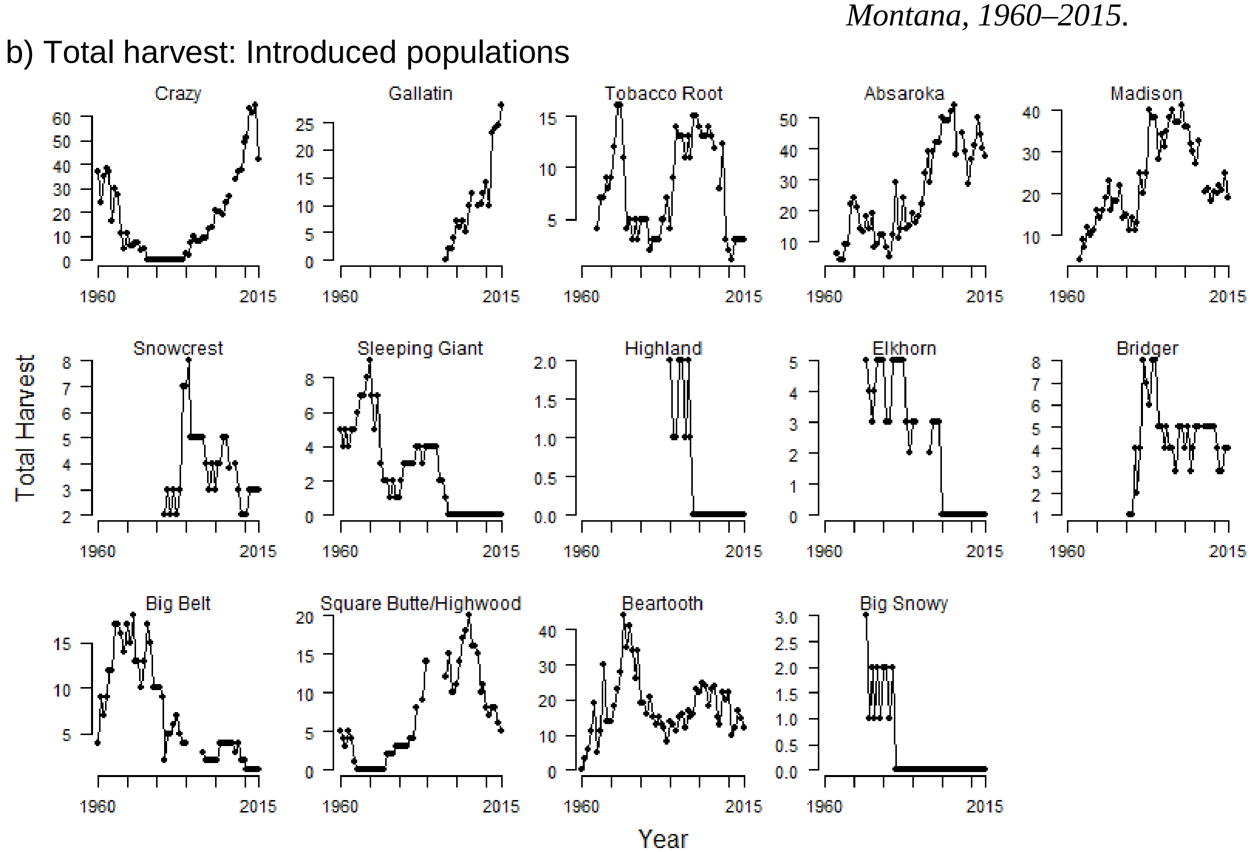


Figure 7. *Trends in total harvest of mountain goats within a) native populations and b) introduced populations (often combining results from multiple neighboring hunting districts, past and present) in Montana, 1960–2015.*



Harvest rates

We estimated contemporary harvest rates of mountain goats by combining hunter harvest data presented here with population estimates developed below via questionnaires to FWP area biologists (see Objective 3). We estimated the "license rate" in 2015 as the number of licenses issued divided by the estimated population size of mountain goats within a given jurisdiction. We estimated the "harvest rate" as the 2015 estimated total harvest of mountain goats divided by the estimated population size (Table 1).

Table 1. *Population estimates, hunting licenses offered, total harvest, and estimated license rate (licenses/population size) and harvest rate (harvest/population size) of mountain goats among regional populations in Montana, 2015. See "Objective 3-Population estimates" below for more information about population estimates.*

	Regional population	Population estimate (Range)	Licenses	Total harvest	License rate	Harvest rate
Native populations	Cabinet	135 (125-155)	8	7	5.9%	5.2%
	Bob Marshall	360 (322-367)	13	10	3.6%	2.8%
	Mission	17 (16-18)	2	0	11.8%	0%
	Whitefish (extirpated)	0	0	0	--	--
	Anaconda	20 (0-40)	0	0	0%	0%
	Blackfoot	40 (20-55)	0	0	0%	0%
	Flint Creek	25 (0-70)	0	0	0%	0%
	Great Burn	23 (20-25)	0	0	0%	0%
	West Bitterroot	100 (80-120)	2	1	2.0%	1.0%
	Sapphire	10 (0-40)	0	0	0%	0%
	West Fork	30 (10-100)	0	0	0%	0%
	Beaverhead	51 (36-66)	0	0	0%	0%
	Pioneer	125 (75-150)	9	3	7.2%	2.4%
	East Front	223 (165-315)	5	4	2.2%	1.8%
Introduced populations	Absaroka	470 (355-538)	58	38	12.3%	8.0%
	Bridger	78 (56-98)	5	4	6.4%	5.1%
	Crazy	450 (330-550)	50	42	11.1%	9.4%
	Elkhorn	20 (9-30)	0	0	0%	0%
	Gallatin	250 (140-275)	30	28	12.0%	11.2%
	Highland	10 (10-15)	0	0	0%	0%
	Madison	617 (447-760)	24	19	3.9%	3.1%
	Sleeping Giant	0 (0-1)	0	0	0%	0%
	Snowcrest	48 (22-48)	3	3	6.3%	6.3%
	Tobacco Root	27 (11-44)	3	3	11.1%	11.1%
	Big Belt	105 (81-130)	2	1	1.9%	1.0%
	Square Butte-Highwood	105 (90-135)	6	5	5.7%	4.8%
	Big Snowy	1 (1-2)	0	0	0%	0%
	Beartooth	345 (290-422)	21	12	6.1%	3.5%

In 2015, MFWP issued a total of 241 mountain goat hunting licenses (39 for native populations, 202 for introduced populations). License holders harvested an estimated 180 mountain goats (25 from native populations, 155 from introduced populations). MFWP biologists estimated a total population of 3,685 mountain goats (1,159 in native populations and 2,526 in introduced populations) on MFWP-administered lands (excluding National Parks and Indian Reservations; see Objective 3). When summing estimates of harvest and goat populations statewide, the estimated statewide license rates in 2015 were 6.5% overall, or 3.4% from native populations and 8.0% from introduced populations. The estimated statewide harvest rates were 4.8% overall, or 2.1% from native populations and 6.1% from introduced populations.

We also estimated license and harvest rates specific to each regional population of mountain goats by grouping data among HDs into populations as described above for harvest trends. Among the 13 extant native populations, 7 were closed to hunting and 6 provided hunting opportunity in 2015. The average license rate among the hunted native populations was 5.5%, and the harvest rate averaged 2.0% (Table 1). Among the 14 introduced populations, 4 were closed to hunting and 10 provided hunting opportunity in 2015. The average license rate among the hunted introduced populations was 7.7%, and the harvest rate averaged 6.3% (Table 1).

Population survey data

We conducted pilot trend analyses of aerial survey data spanning 1960–2015 but found the results difficult to interpret. The availability of data varied substantially among areas and among time periods. The survey areas did not always appear consistent given small populations of goats and often challenging flying conditions, and the timing of surveys also varied in many cases. While consistent and rigorous data were available for several populations, there were many populations for which a consistent stream of data at reasonably high frequency of once per 1–5 years were unavailable within this period. For all of these reasons, we felt formal trend analyses of the survey data would be difficult to synthesize at a statewide scale in a meaningful way.

We instead focused our analysis on survey data collected during the 21st century (2000–2015), and identified 52 survey areas (typically HDs) with at least one survey during this period, for a total of 171 surveys (Table 2). To estimate annual population growth rates, λ, from survey count data, we used exponential growth state-space models developed by Humbert et al. (2009). These models have been shown to more rigorously measure uncertainty surrounding estimates of trend by accounting for process variance (i.e., biological variation) in annual growth rates as well as observation error that induces additional sampling noise around annual count data. Flesch et al. (2016) also used these methods in a recent analysis of mountain goat population trends from survey count data in the Greater Yellowstone Area. Our analysis includes some of the same populations as those studied by Flesch et al. (2016), although we focus only on a recent time period, 2000–2016. This statistical approach has been shown to perform well with a minimum of 5 data points spanning a ten-year survey period (Humbert et al. 2009, Flesch et al. 2016). For our analyses we identified a set of 21 survey areas for which at least 5 surveys for 5 unique years had been conducted. In our case, this spanned a 16-year study period.

We estimated survey-based population growth rates for 5 native populations and 16 introduced populations during 2000–2015 (Figure 8). Survey data were more limited for native than introduced populations. For native populations, point estimates of λ were <1 for 4 of 5 populations, although 95% confidence intervals of λ overlapped 1 for all but one of these (HD 101, West Cabinet Mountains). The estimated population growth rate for the 5^{th} native population was λ=1.0. Among introduced populations, point estimates of λ were <1 for half (8 of 16) of populations and >1 for the other half. Confidence intervals of λ overlapped 1 for 14 of 16 introduced populations, while confidence intervals for the remaining 2 populations (HD 330, North Absaroka, and HD 514, Line Creek) indicated estimates of λ that were significantly <1.

Given the wide confidence intervals surrounding most estimates of λ, little can be said with statistical certainty about trends in survey data for many of these mountain goat populations using survey data alone. Plotting the precision of trend estimates relative to the number of individuals counted per survey area suggested a positive relationship between the magnitude of counts and precision (Figure 9). Thus, statistically rigorous estimates of trends are more difficult to attain under survey conditions of small populations and infrequent surveys.

Among all mountain goat survey areas, with at least one survey during 2000–2015, the average count was 39 animals. For the subset of 21 areas with >5 surveys the average count was 56 animals. When comparing the standard error of estimates of lambda by the magnitude of these counts per area, it appears that there is potential for a high amount of uncertainty (i.e., SE estimates >0.05 would lead to confidence intervals >0.2 units wide surrounding λ) when the average number of goats counted is <100 animals. This would apply to 48 of all 52 survey areas flown during 2000–2015, unless surveys were designed such that data could be pooled among multiple survey areas prior to interpretation. However, a formal power analysis of simulated mountain goat survey data would provide an improved depiction of the precision of trend estimates under various scenarios of monitoring goats with aerial surveys.

Table 2. Mountain goat survey areas and/or hunting districts (HD), the number of surveys conducted during 2000–2015, and the average total count per survey, Montana.

	Regional population	Survey area or HD	$N_{surveys}$	Average count
Native populations	Cabinet	100	7	80 (40-113)
		101	8	36 (7-57)
		121	9	8 (2-17)
		Montanore Mine	6	15 (3-43)
	Mission	131	1	38 (38-38)
	Mission – Bob Marshall	132	2	20 (15-24)
		133	3	27 (4-48)
		134	1	26 (26-26)
		140	1	47 (47-47)
		142	2	38 (20-56)
		150	2	39 (33-44)
		151	2	9 (2-16)
	Anaconda	222 223	2	25 (9-40)
	Blackfoot	283	2	10 (10-10)
		280 (Dunham)	3	27 (24-32)
		280 (Scapegoat)	4	31 (20-37)
	Flint Creek	212	2	19 (13-25)
		213	1	0 (0-0)
	Great Burn	220	2	4 (2-5)
	West Bitterroot	240	6	66 (19-119)
	West Fork Bitterroot	250 (portion)	2	41 (38-43)
	Beaverhead	321	1	7 (7-7)
		322	4	15 (10-19)
	Pioneer	312	4	11 (0-33)
	East Front	414	1	11 (11-11)
		415	3	26 (24-27)
		442 & Sun River Game Preserve	11	46 (22-71)
Introduced populations	Absaroka	323	7	167 (120-221)
		329	7	113 (75-147)
		330	7	27 (17-38)
	Bridger	393	5	54 (25-88)
	Crazy	313	8	288 (190-371)
	Elkhorn	380	2	5 (0-9)
	Gallatin	314	4	128 (34-180)
	Madison	324	3	60 (53-71)
		325	5	33 (25-41)
		326	4	20 (13-24)
		327	5	16 (6-22)
		328	3	4 (2-7)
		362	6	35 (6-74)
	Sleeping Giant	332	5	2 (0-4)
	Snowcrest	331	1	22 (22-22)
	Tobacco Root	320	3	49 (11-84)
	Big Belt	451	8	32 (17-53)
		453	10	30 (2-49)
	Square Butte-Highwood	447	3	53 (35-62)
		460	3	40 (26-50)
	Beartooth	316	10	43 (8-76)
		514 (winter trend area)	10	48 (12-94)
		517 (winter trend area)	10	24 (4-51)
		518 (winter trend area)	10	21 (2-49)
		519 (winter trend area)	5	8 (2-24)

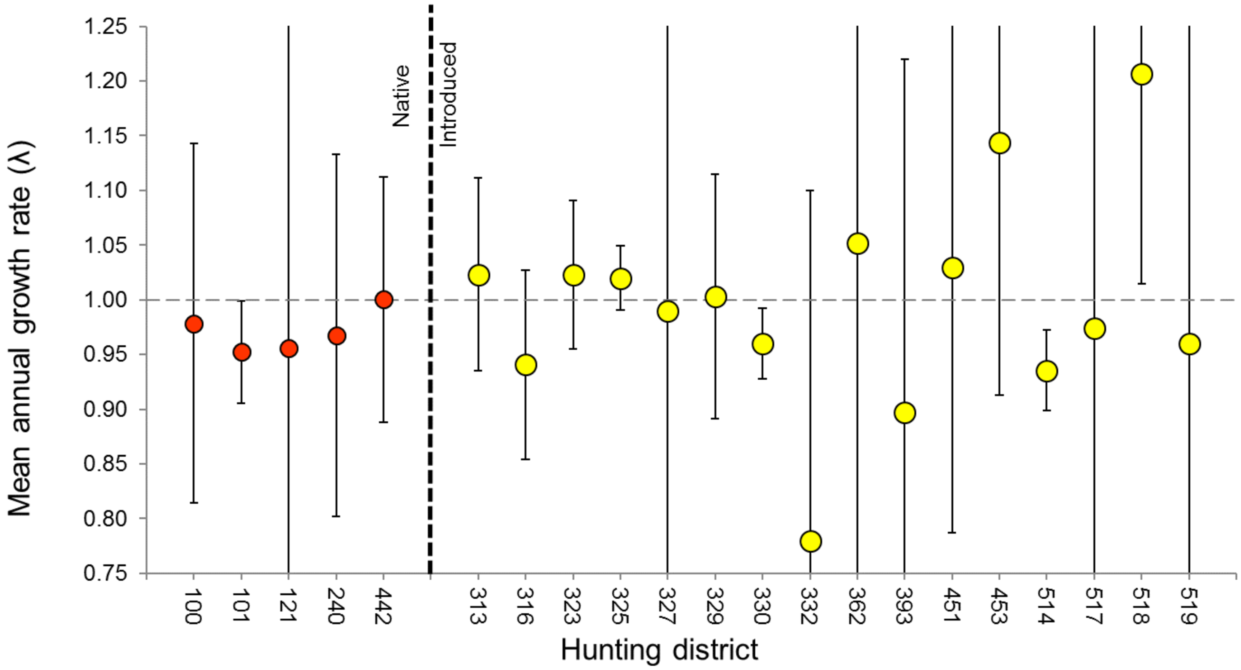


Figure 8. *Mean annual population growth rates and 95% confidence limits for 21 mountain goat survey areas in Montana, 2000–2016.*

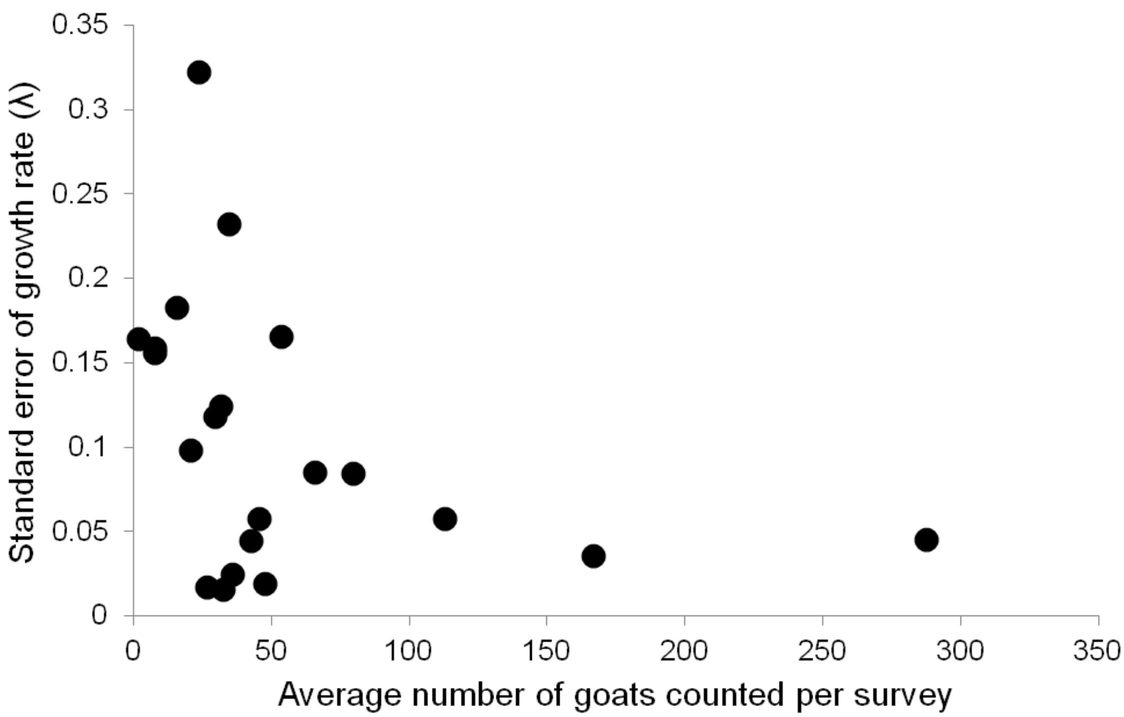


Figure 9. *The standard error of mountain goat population growth rate estimates as a function of the average number of individuals counted during trend surveys in 21 survey areas across Montana, 2000–2015.*

OBJECTIVE 3: SURVEY OF FIELD BIOLOGISTS

MFWP previously contracted a survey of population status, management practices, and research needs for another ungulate species, moose (*Alces alces*; Smucker et al. 2011). As in that project, we developed an original, standardized questionnaire for completion by MFWP area biologists whose jurisdictions include mountain goats. We emailed this 25-question survey to eighteen MFWP biologists in Regions 1–5 who have management responsibility for currently delineated mountain goat HDs. Responses were compiled and summarized separately for native and introduced mountain goat populations. We treated HDs as population sample units for summarizing results, and populations not currently within an administrative HD were included as independent samples. For a subset of questions (3, 7, 11, and 20), we asked respondents to rank a set of possible answers by their relative importance within each HD. In these cases, respondents were free to select and rank as many or as few options as were applicable, with their top choice receiving at rank of 1. We summarized answers to these questions in 2 ways: 1) first we recorded the number of times (the count) a given answer was selected, and 2) we scored rankings in reverse order such that ranks of 1 received the most points. For example, Question #3 included 7 possible answers, and a ranking of 1 received a score of 7, a ranking of 2 received a score of 6, and so on. Scores were then summed for each possible answer across all responses. Other questions were open-ended and received longer narrative responses. These responses are summarized in the following section, with complete details of responses from biologists presented in the Appendix.

Population estimates (Question 1)

We asked area biologists to provide population estimates for a total of 58 population units, including 26 HDs with native populations, 26 HDs with introduced populations, and 6 populations (4 native and 2 introduced) not currently within an HD (Appendix, Q1). These estimates were derived from the best available information from aerial and ground surveys, and applying sightability corrections and professional judgment. Several biologists provided narrative descriptions about individual HDs on their questionnaires. Along with population estimates, we also asked for a "range of confidence" of the estimate within each HD. This was not a statistical confidence interval. In some cases, a range of sightability values from the literature were used to estimate these ranges of confidence surrounding point estimates, and in other cases these were "best guesses" at the range of possible values of true abundance. When pooling estimates for summary purposes across multiple HDs, we used the sum of point estimates, low range of confidence boundaries, and high range of confidence boundaries to characterize total estimates and range of confidence boundaries for the pooled area.

The estimated total population (and range of confidence) of mountain goats in 2016 in native populations was 1,159 (885–1,537), and in introduced populations was 2,526 goats (1,842–2,958). The combined statewide population (excluding the 2 national parks) was 3,685 (2,727–4,495). An additional 2,000 (1,700–2,300) goats are estimated to live in native populations within Glacier National Park (Belt and Krausman 2012, J. Belt pers. comm.), and 225 (200–250) goats from introduced populations inhabiting northern Yellowstone National Park, either year-round or seasonally (Flesch et al. 2016). Including animals within national parks yields statewide estimates of 3,159 native goats and 2,751 introduced goats totaling 5,910 in all.

All introduced populations occur east of the Continental Divide in Regions 3–5. All native populations occur in Regions 1 and 2, west of the Continental Divide, plus three HDs in Region 3 and three HDs in Region 4 (Figure 1; Appendix Q1).

Past trends and limiting factors (Questions 2–5)

Area biologists estimated that 77% (23 of 30) of native mountain goat populations have declined over the past 50-year period of 1960–2010, including 1 extirpated population (Appendix, Q2). An additional 13% (4 of 30) were judged to be stable and 10% (3 of 30) had uncertain trends over this period. For introduced populations, biologists estimated that 43% (12 of 28) declined during this 50-year period, 11% (3 of 28) remained stable, and 43% (12 of 28) increased. Population trend was uncertain for the remaining herd of introduced goats.

The most commonly cited factors limiting goat numbers over the past 50 years were total hunter harvest followed by unknown reasons, harvest of female goats, habitat changes, and predation (Appendix, Qs 3, 4). That sequence was very similar for both native and introduced populations of goats, with ORV/snowmobile use a concern in several HDs of native goats, and predation a greater concern for introduced populations. Several respondents noted the uncertainty surrounding declines in native goat populations, sometimes as a consequence of insufficient population data needed to assess changes (Table 3).

Table 3. *Relative importance of factors limiting goat populations during past years (1960–2010) for native populations (26 HDs plus 3 populations not within current HDs) and for introduced populations (26 HDs plus 1 population not within a HD). Count data indicate the number of populations to which a limiting factor applies. Weighted scores reflect both the number of populations to which a factor applies and the relative rankings of that factor among others selected. See Appendix, Q3, 4 for detailed responses.*

		Disease	Predation	Hunter harvest (total # animals)	Hunter harvest (proportion of females)	Habitat changes (non-anthropogenic)	ORV/Snowmobile disturbance	Energy exploration	Logging and/or road construction	Non-motorized recreation	Climate change	Small population risks (inbreeding, …)	Other (describe in Q4)	Unknown
Native	Count	7	10	21	10	17	14			3	10	9		21
	Weighted score	23	49	126	70	78	79			15	13	52		123
Introduced	Count	4	12	11	10	10				1		4	5	8
	Weighted score	14	63	56	54	43				3		23	30	54
Total	Count	11	22	32	20	27	14			4	10	13	5	29
	Weighted score	37	112	182	124	121	79			18	33	75	30	177

From our compilation of hunting license records, we found that the total number of licenses issued to hunt native populations has declined over the study period (and 9 of 26 native HDs have been closed to hunting; Objective 2). When asked why licenses in their areas of management responsibility had declined, biologists most frequently indicated that licenses were reduced in response to observed declines in goat numbers (38%) and as precautionary actions until more reliable population data become available (25%; Appendix, Q5).

Current trends and liming factors (Questions 6–8)
We also asked about the status of goat populations in recent years: 2010–present. Biologists responded that 75% of native populations declined during this time or their status was uncertain; whereas introduced populations were largely stable (54%) with a few increasing and a few others decreasing (Appendix, Q6). The most commonly cited factors currently limiting goat numbers were habitat changes, followed by harvest of female goats, total goat harvest, predation, and ORV/snowmobile disturbance (Table 4, Appendix, Q7, 8).

There were marked differences between perceived factors limiting native versus introduced populations. For introduced populations, predation, harvest of females, total harvest, and habitat changes ranked similarly as most important. For native goats, habitat changes were most important, followed by ORV/snowmobile disturbance, small population risks, and climate change concerns.

Table 4. *Relative importance of factors limiting goat populations currently or into the future for native populations (26 HDs plus 3 populations not within current HDs) and for introduced populations (26 HDs plus 1 population not within a HD). Count data indicate the number of populations to which a limiting factor applies. Weighted scores reflect both the number of populations to which a factor applies and the relative rankings of that factor among others selected. See Appendix, Q7, 8 for detailed responses.*

		Disease	Predation	Hunter harvest (total # animals)	Hunter harvest (proportion of females)	Habitat changes (non-anthropogenic)	ORV/Snowmobile disturbance	Energy exploration	Logging and/or road construction	Non-motorized recreation	Climate change	Small population risks (inbreeding, …)	Other (please describe in Q4)	Ltd Available Habitat
Native	Count	10	14	14	13	18	21			4	20	16	4	
	Weighted score	50	66	74	81	101	95			20	91	99	15	
Introduced	Count	6	13	11	11	12	3			3		3		2
	Weighted score	41	69	62	67	60	17			11		17		14
Total	Count	16	27	25	24	30	24			7	20	19	4	2
	Weighted score	91	135	136	148	161	112			31	91	116	15	14

Compared to past limiting factors (1960–2010, see Table 3), there was less uncertainty about factors currently limiting populations. For introduced goat populations, concerns about effects of harvest levels on populations (total and females), habitat changes, and predation remained high. For native populations, there was a shift away from historical concerns about harvest levels to how populations are now being affected by habitat changes (see Habitat considerations section below), ORV/snowmobile disturbance, climate change, and small population risks. In part, this shift reflects a steep reduction in licenses issued for hunting of native populations over the years. As numbers of goats in native populations have decreased (see Questions 2–5 above), numbers of licenses and harvested goats have plummeted from an average 967 licenses and 329 harvested annually during the decade of the 1960s to an average of 50 licenses and 33 goats harvested during 2007–2015 (39 licenses and 25 goats harvested from native herds in 2015). Contrarily, introduced populations have generally prospered at most transplant sites since their introductions. Numbers of licenses and goats harvested from introduced populations have increased from an average 169 licenses and 71 goats harvested annually during the 1960s to an average of 225 licenses and 165 goats harvested during 2007–2015 (202 licenses and 155 goats harvested from introduced populations in 2015).

Regarding native goat populations, several biologists noted that the cumulative effects of specific factors listed in Table 4 may be perpetuating suppression of goat numbers that may have begun prior to 2010 (Appendix, Q8). Regarding introduced populations, biologists raised concerns about suspected predation on goats as well as the need for careful monitoring of harvest rates and potential overuse of available range by goats (Appendix, Q8).

Harvest and season setting (Questions 9–16)

Biologists managing HDs with native goats take an almost unanimously conservative approach to harvest, with the goal of minimizing impact on populations (Appendix, Q9). Nine of those 26 HDs are closed to hunting; and 8 of the 9 closed HDs are in Region 2. For HDs with introduced goats, objectives of harvest were more varied. Biologists have recommended harvest strategies to limit population growth in six HDs with introduced populations, whereas three of the 26 HDs with introduced populations have been closed to hunting.

Biologists varied in their assessment of the adequacy of survey and inventory information available to them for making management decisions (Table 5; Appendix Q10). The results suggest that, on average, more adequate survey data are collected in HDs with introduced goats. This corresponds to a greater proportion of statewide hunting opportunity being offered in HDs with introduced goats (84% in 2015), though there could be a variety of reasons for variations in survey frequency. When asked which factors were most limiting to population survey efforts, biologists identified aircraft/pilot unavailability, adverse weather conditions, and lack of funding as leading reasons (Appendix, Q12). Differences in population size may also play a role in the adequacy of information available, given our results show that larger populations yield more reliable, less variable, and thus more useful population survey data (Figure 9).

Survey minimum counts and survey recruitment ratios (e.g., kids per goat aged ≥1-year-old) are the two types of data on which biologists place the greatest reliance in setting harvest regulations (Table 6; Appendix Q11). This is true for both native and introduced populations, which underscores the importance of obtaining reliable population survey data to manage goat populations. The next two factors most relied on to set regulations were FWP harvest data (number of animals harvested relative to number of licenses issued) and hunter effort data (number of days/animal harvested). With mandatory reporting of mountain goat kills and consistent annual hunter harvest surveys, these may be the most consistently available data at biologists' disposal.

Table 5. *Tallied responses from 17 biologists regarding the quantity and quality of mountain goat survey and inventory information available for making management decisions, for those managing both native (N=10) and introduced (N=7) populations (see Appendix Question 10).*

	Adequate	Somewhat adequate	Somewhat inadequate	Inadequate
Native populations		2	4	4
Introduced populations	1	4	2	
Total	1	6	6	4

Table 6. *Relative importance of information that biologists use to set annual goat harvest regulations for native populations (26 HDs plus 3 populations not within current HDs) and for introduced populations (26 HDs plus 1 population not within a HD). Count data indicate the number of populations to which a limiting factor applies. Weighted scores reflect both the number of populations to which a factor applies and the relative rankings of that factor among others selected. See Appendix, Q11 for detailed responses.*

		FWP hunter harvest data	FWP hunter effort data (e.g., kills per unit effort)	FWP observations data (e.g., number seen/hunter)	Age and/or horn data	Anecdotal hunter reports (i.e., not in MRRE)	Survey minimum counts	Survey recruitment ratios	Other (please describe):
Native	Count	5	4	4	2	3	5	5	
	Weighted score	22	19	15	6	11	31	32	
Introduced	Count	7	6	4	6	5	8	10	1
	Weighted score	33	25	11	20	15	54	51	7
Total	Count	12	10	8	8	8	13	15	1
	Weighted Score	55	44	26	26	26	85	83	7

When asked if proposed quotas for other species, such as mountain lions, have been affected by population demographics of overlapping mountain goat populations, 16 of 17 respondents answered "no" (Appendix Q13).

We also asked biologists two questions regarding how considerations of the sex of animals entered into hunters' decisions when targeting a mountain goat. Responses indicated that an average of 55% of hunters intend to harvest a male rather than a female (Appendix, Q14); and biologists estimated that an average of 52% of hunters can correctly identify a mountain goat's sex under field hunting conditions (Appendix, Q15). These results suggest that over half of license-holders may be as likely to kill a female as a male, particularly with female-biased sex ratios being typical in the adult cohort of goat populations (Chadwick 1973, Rideout 1974, Gonzalez Voyer et al. 2003). In a simulated field test, 81% of attendees of a Northern Wild Sheep and Goat Council meeting accurately identified the sex of mountain goats after being shown a 20 minute presentation describing the diagnostic characteristics of each sex. However 77% of participants in that study had prior experience censusing or classifying goats (Smith 1988b). When asked if the educational information provided to license-holders was sufficient for hunters to make informed decisions about the age and sex of the animals they choose to harvest, three biologists answered yes, six no, and six were uncertain (Appendix, Q16).

Population surveys (Questions 17–19)
We asked biologists about the methodology used to conduct population trend counts, how often surveys are conducted and during which seasons. They reported using a combination of ground and aerial survey types during all seasons and at intervals ranging from annually to never (Appendix, Q17). When asked if standardized methods should be employed to monitor mountain goats across the state, the consensus was "no" (14 of 18 responses; Appendix, Q18).

When asked to compare native to introduced goat populations, 5 of 6 biologists who responded to this question felt that Montana's introduced populations were generally healthier or more productive with higher recruitment rates. The majority of biologists surveyed said they did not have enough experience or knowledge to make this assessment (Appendix, Q19).

Habitat considerations (Questions 20–21)
There was little consensus about which, if any, habitat management programs would benefit goat conservation or increase hunter opportunity (Table 7). Among the possible management scenarios suggested in the question, 3 recreational management categories had a combined weighted score (21), larger than any other category (Table 7; Appendix, Q20). Sixteen of 17 biologists had not completed any habitat-related projects alone or in cooperation with federal land managers to improve mountain goat habitat or conservation (Appendix, Q21).

Table 7. *Relative importance of habitat management programs that would promote mountain goat conservation and hunter opportunity. Count data indicate the number of populations to which a management program applies. Weighted scores reflect both the number of populations to which a factor applies and the relative rankings of that factor among others selected.*

	None; Habitat is not a limiting factor	More fire (natural or prescribed)	Less fire (suppression of wildfire)	Weed management	Road management (i.e., more restrictive)	ORV management	Snowmobile management	Non-motorized recreation management	Unknown	Other (please describe):
Count	3	5	2	1		2	4	3	6	
Weighted score	9	15	5	1		5	11	5	15	

Management and research needs (Questions 22–25)
Biologists expressed interest in translocating animals to sustain particular native and introduced mountain goat populations (Table 8). Several cautioned that introductions should be carefully evaluated on an area-by-area (herd-by-herd) basis (Appendix, Q22).

Biologists identified a wide array of research needs that would benefit their understanding and management of mountain goat populations (Appendix, Q23 details all topics). This question was open-ended (as was Question 24 about management needs) allowing respondents to offer any number of research topics that interested them. Of the 12 topics mentioned, 3 research themes or areas of study captured 62% of all topics respondents offered: assessments of habitat condition, use, and carrying capacity (9 responses); population demographics: productivity, recruitment, kid survival, and adult survival (7); and causes of mortality (5). The other 9 topics were each mentioned 3 times or less.

Biologists also identified 8 management or monitoring needs that would assist mountain goat management (Appendix Q24 details all topics). The 2 topics most often mentioned, and constituting 68% of all responses, were: better/more frequent monitoring of populations (10 responses); and sightability correction models and improved, standardized, survey methodology (5). Ten additional topics of relevance to mountain goat management and conservation in Montana were mentioned 1 or 2 times each by questionnaire respondents (Appendix, Q24–25).

Table 8. *Biologists' responses about whether there is a pressing need for translocation of mountain goats to sustain native and/or introduced populations.*

	Yes	No
Native	2	4
Introduced	3	7
Total	5	11

DISCUSSION

Population estimates and trends
The overall goals of this project were to synthesize population and harvest trends of mountain goats in Montana over the past 50–60 years and to summarize and evaluate their current status and management circumstances. Based on the responses of FWP biologists who manage Montana's goats, there were an estimated 2,526 animals (69% of total) in introduced populations and 1,159 animals (31%) in native populations in 2016 under MFWP jurisdiction. The combined statewide population managed by MFWP was 3,685 (2,726–4,493) mountain goats. Including another 2,225 goats estimated in the 2 national parks yielded an estimated 5,910 animals within Montana's borders.

To put current numbers in historical perspective, we reviewed previous statewide population estimates of native goats. In an early comprehensive study of Montana's mountain goat population, Casebeer et al. (1950) reviewed estimates of the statewide goat population during 1919–1942, as recorded by the US Forest Service, and during 1943–1948 from estimates made by the Montana Fish and Game Department (Rognrud and Lancaster 1947). Maximum annual estimates were from the years 1943 through 1946, when 5,000–5,200 goats were estimated statewide, of which about 940 occupied Glacier National Park. Although establishment of new herds in previously unoccupied mountain ranges began in 1941 (Picton and Lonner 2008), Casebeer et al. (1950) recorded an annual maximum of only 97 goats among all introduced populations during 1943–1946. From these records it appears that about 4,100 goats occupied native ranges across Montana during 1943–1946 (excluding national parks), a figure three to four times larger than the 1,159 goats estimated by Montana's biologists in 2016. Carlsen and Erickson (2008) estimated 2,719 mountain goats in Montana in 2007, based on population survey data. Of that total, 1,517 animals were in introduced populations and 1,202 were in native populations, based upon the raw data they provided to us from that analysis. While the potential for differences in estimation methods may confound direct comparisons across years, we estimated an additional 1,000 goats to exist in introduced populations compared to that estimated in 2007 (Carlsen and Erickson 2008). However, our native goat population estimate in 2016 (1,159) is only slightly lower than theirs from a decade earlier (1,202).

The disparity between native and introduced mountain goats evidenced by these changes in population estimates was also noted by area biologists' responses concerning population trends. Of the 30 native populations, at least 23 (77%) were judged to have declined or been extirpated since 1960, with trends for 3 additional populations labeled as unknown. To the contrary, 54% (15 of 28) of introduced populations were judged as stable or increasing, though some declines are also evident. In the Beartooth Mountains, for example, trend in recent summer aerial survey data suggests declines of >40% in this introduced population since the 1980s.

Survey responses suggested a variety of causes for declines in native populations over the years. During the 50 years prior to 2010, the limiting factors most often mentioned as responsible for influencing goat numbers were total hunter harvest, female harvest, and unknown reasons. Ranking of current and future threats to goat populations indicated a shift in factors influencing populations. As licenses were reduced in HDs with native populations, habitat changes, ORV/snowmobile disturbance, climate change, and small population risks were perceived as most affecting populations. For introduced goat populations, effects of harvest levels on populations (total and females), habitat changes, and predation ranked highest in importance.

Harvest management

For native goat populations, numbers of licenses and harvested goats have plummeted from an average of 967 licenses and 329 harvested annually during the decade of the 1960s to an average of 50 licenses and 33 goats harvested during 2007–2015 (39 licenses and 25 goats harvested in 2015). Contrarily, introduced populations have generally prospered at most transplant sites since their introductions. Numbers of licenses and goats harvested from introduced populations have increased from an average 169 licenses and 71 goats harvested annually during the 1960s to an average of 225 licenses and 165 goats harvested during 2007–2015 (202 licenses and 155 goats harvested from introduced populations in 2015).

Harvest management of mountain goats has been a topic of much interest and debate in the literature. Overharvest has been implicated as a source of population declines in native mountain goats in other parts of their range. Rice and Gay (2010) used population modeling to evaluate historical trends of mountain goats in Washington and found that population declines were primarily attributable to harvest. Goat populations, numbering less than 100 animals, are generally no longer hunted in Washington (Rice and Gay 2010). Hamel et al. (2006) modeled population dynamics of mountain goats in Alberta and showed high sensitivity of population dynamics to adult female survival and a subsequently detrimental role of female harvest in affecting population trends. As a result of these findings, the authors recommended closure of hunting in populations numbering <50 total individuals, and conservative harvest rates of 1–4% for larger populations depending on the population size and proportionate female harvest (Hamel et al. 2006, Rice and Gay 2010). In our study, the average license rates were 5.5% across hunted native populations and 7.7% across hunted introduced populations, while harvest rates averaged 2.0% for native and 6.3% for introduced populations. Twelve of the state's 52 currently delineated HDs have been closed to hunting, ostensibly due to populations too small to support harvest. Additionally, it's noteworthy that during the 55 years since 1960 about 38% of the mountain goats harvested in Montana were females.

Harvest rates of introduced populations have typically been higher, including cases of harvesting as many as 7.5–20% of the population in some cases (reviewed by Williams 1999 and Côté et al. 2001). Williams (1999) noted that introduced mountain goat populations likely occur in different stages of Caughley's (1970) 4 states of an ungulate irruption, as regulated by density-dependent quality of habitat. Thus, a single optimal harvest rate prescription may not apply to all populations after accounting for other limiting factors such as density dependence or predation rates. However, all authors have recommended caution with harvest of mountain goats in particular due to the difficulties of limiting harvest to males as well as their generally modest reproductive capacity.

Population monitoring

Current monitoring practices for mountain goats vary widely among local areas in Montana. Surveys are not frequently conducted in all HDs, and vary with respect to the platform, frequency, and season among HDs. Our results suggested that current monitoring practices using aerial surveys alone have not, for the most part, been adequate to reasonably distinguish increasing vs. decreasing population trends with statistical rigor over the most recent 15-year time period. Biologists offered that better and more frequent monitoring of populations was their top management need and suggested research leading to a better understanding population demographics of goats was a high priority.

Minimum counts documented during population surveys are a valid means of monitoring trend, as long as the average proportion of individuals seen relative to those in the entire population does not change over time (reviewed by DeCesare et al. 2016). In other words, an equal proportion of the population is assumed to be within the survey area and mean sightability of those within the area is assumed to be constant. While these counts provide a means of estimating trend, they cannot be used to estimate abundance without specific estimates of sightability. Measured sightability rates of marked goats have varied from ~40% to 80% in studies in British Columbia, Idaho, and Washington (Poole et al. 2000, Pauley and Crenshaw 2006, Rice et al. 2009). Sightability likely varies among goat populations and habitats in Montana, making it unlikely that a single sightability model would apply across the state (*sensu* Harris et al. 2015). Accounting for sightability bias across would Montana would likely require multiple studies and multiple models to fit varying conditions.

Managers of species that tend to occur in small populations commonly face an additional challenge of lacking statistical power when interpreting trend surveys. The precision of population estimates is known to decrease as the size of the population being monitored decreases (Taylor and Gerrodette 1993, Barnes 2002, DeCesare et al. 2016). For example, Barnes (2002) found that the confidence intervals for estimates for a West African elephant monitoring program were likely to be >100% of the point estimates when the population was below 600 animals. This threshold doesn't necessarily apply directly to mountain goat monitoring in Montana. Our results do suggest a positive relationship between the magnitude of counts and their precision (Figure 9). Thus, lumping subpopulations together into larger groups whether during surveys or during data analysis may increase our power to detect trends if done so consistently over time.

A formal power analysis of simulated and empirical mountain goat survey data would offer an improved depiction of how various survey sampling designs might affect the strength of results. Additionally, review of other survey techniques or monitoring practices (such as monitoring of trend via survival and reproductive rates of marked individuals or non-invasive DNA-based population estimation) may aid in evaluating current practices compared to those employed for mountain goats in other jurisdictions (Poole et al. 2011).

In addition to minimum counts, biologists indicated frequent use of recruitment ratios when monitoring mountain goat populations. These ratios are typically formulated as young/adult ratios, though the definition of the adult denominator appeared to vary across surveys depending on efforts to distinguish yearling or 2-year-old goats from older animals. Of significance to interpretation of these data is the important life history detail that the age of first reproduction for female mountain goats is 3 years of age (Rideout 1975) and primaparity can average >4 years-old for native populations (Festa-Bianchet and Côté 2008). It is likely that many of the adults counted in recruitment ratios are not in fact breeding-aged adults. Thus, variation in age structure of adults across years or populations should be expected to confound interpretation of recruitment ratio data.

Area biologists also indicated that other data, in addition to survey data, are used when managing mountain goats. These included hunter harvest data, hunter effort data, and data concerning the age and sex of harvested individuals. Statistical modeling of these forms of data is not typically employed, and it is currently unclear if catch-effort or age-at-harvest data would be sufficient to glean meaningful patterns statistically, whether as a stand-alone analysis or incorporated into an integrated population model (Skalski et al. 2007, Udevitz and Gogan 2012). Hunter success, in particular, may be of limited value in assessing the population status of mountain goats, particularly native goats in Montana. Over the past 60 years as harvest success has increased (Figure 2), we found that Montana's native goats have clearly been in decline as have the number of licenses issued annually. In HDs where only one or two licenses are issued annually, hunter success of 100% or 50% in a HD is dicey to interpret, and potentially misleading. Fidelity of goats to preferred areas of their ranges contributes to the ability of hunters to find and harvest goats, even when populations are small (Chadwick 1973, Smith 1976, Taylor et al. 2006, Festa-Bianchet and Côté 2008). This natural history trait may predispose hunted mountain goat populations to apparent "hyperstability" when monitored with hunter statistics alone (Hatter 2001). In such cases, hunter harvest statistics may convey a deceptively stable trend even for declining populations, because hunters continue to find and harvest goats in the same areas and with the same efficiency regardless of decreased numbers overall (Hatter 2001). Survey responses suggested that Montana's goat managers recognize the limited value of harvest success compared to biological data obtained from population surveys on which they place greater importance when establishing annual regulations (Table 6). Consequently, population monitoring ranked highest among management priorities (Appendix Q24).

Population identification

Defining and sampling populations is basic to wildlife management and conservation. For analytical purposes, we grouped mountain goat HDs into 28 "regional populations" (Figure 6), but the biological significance of these delineations is unknown.

Where goats occur on an isolated mountain range, for all practical purposes those animals can be considered a biological population. In mountain range complexes, however, geographically defining a population or subpopulations of a metapopulation can be problematic. This situation arises for a number of geographic areas of Montana's mountain goats, both native and introduced. In management practice, the definition of a population often necessitates imposing arbitrary boundaries on the landscape, which may not reflect population biology of the species on the landscape. Furthermore, if seasonal distributions of populations are not well understood, and population surveys do not reflect distributions during the hunting season, disproportionate harvests of individual populations or subpopulations could occur.

Concerns about small population effects raised by several biologists are justified, given the small and potentially isolated nature of many of Montana's goat populations. Biologists estimated that 25 of the state's 52 HDs may support fewer than 50 goats. Such populations risk heightened consequences of stochastic events and inbreeding depression, compared to large populations or metapopulations (Hebblewhite et al. 2010, Johnson et al. 2011). Effective conservation of mountain goats may require additional understanding of the extent to which populations face such risks. Research on movement and yearlong distributional patterns are needed for some of Montana's larger landscapes to determine where populations may now be reproductively isolated. For some native populations in Regions 1 and 2 this seems particularly germane.

Habitat changes

Of all Montana's large mammal species, the mountain goat's distribution is almost completely on federally or state-managed lands: national forest multiple-use lands, national forest wilderness areas, two national parks, plus state lands, and some tribal lands in the Mission Mountains. Steep, rugged terrain and snow are defining features of mountain goat ranges. For some populations, mineral licks are a seasonally important resource, such as the Walton Goat Lick in Glacier National Park (Singer 1978). These habitat features and associated, preferred, food sources largely dictate distributions and movement patterns of mountain goats.

Because of their high, rugged nature, mountain goat ranges tend to be less subject to human development and alteration than habitats of the state's other big game species. Yet, the biologists we surveyed offered a range of direct or indirect effects, both natural and anthropogenic, that are either suspected or known to be affecting mountain goats. Road construction into goat habitat to facilitate mining, energy and timber extraction, and motorized recreation can alter habitat with implications for goat distributions and demography (Fox et al. 1989, White and Gregovich 2017), and increased vulnerability of goats to harvest (Mountain Goat Management Team 2010). Numerous studies in Canada and the U.S. have demonstrated that mountain goats are particularly sensitive to helicopter disturbance (Foster and Rahs 1983, Côté, 1996, Gordon and Wilson, 2004). Mountain goat management plans for Alberta, British Columbia, and Washington review how habitat threats are being addressed.

In Montana, some of the most pertinent research conducted on habitat-mediated impacts on goats includes documentation of how helicopter over-flights associated with seismic testing affects population dynamics (Joslin 1986), and how road intrusion and timber harvest alter mountain goat behavior and distribution (Chadwick 1973). However, little is known about the effects of commercial and recreational activities on most mountain goat populations in the state, or about the condition and carrying capacity of most goat ranges and how that may relate to population performance. Likewise the effects of wildfire, or contrarily fire suppression, on goats through changes in habitat structure, plant succession, and forage are little known. These are noteworthy areas of research regarding the differing status and trends we identified of native versus introduced populations generally.

Mountain goats may also be among those species most sensitive to climate change because of their cold-adapted nature and because the climate is warming (and cascading environmental changes occurring) twice as rapidly at high elevations compared to the global mean rate of warming (Beever and Belant 2011).

FUTURE DIRECTIONS FOR RESEARCH AND MANAGEMENT

Montana is unique among the 8 U.S. and Canadian jurisdictions within the native range of the mountain goat. Montana supports more introduced populations in which numbers of goats collectively now exceed those in the state's native populations. Clearly one size fits all prescriptions for management would not serve the state's goat populations well. Management and conservation efforts require consideration of the wide range of habitats Montana's goats occupy with special attention to differences between native and introduced goats. However, statewide coordination of management planning and research prioritization may serve to leverage resources to address needs and answer questions for broad landscapes and multiple populations of goats.

From our findings, important topics deserving of future attention in comprehensive planning for Montana's mountain goats include:

- Recommendations for harvest of mountain goats: These may well differ for native and introduced populations. Not only population harvest rates, but sex-specific harvest prescriptions dependent on maintaining viable population size could be addressed. Given that mountain goats occupy habitats relatively secure from human impacts (with some exceptions) compared to other big game species, and that high natural mortality among juvenile cohorts is largely beyond managers' control, wildlife managers can influence mountain goat conservation largely through regulation of public harvest.

- Evaluation of monitoring practices: MFWP biologists rely heavily on population survey data to establish harvest levels of populations. Improved survey techniques, sightability modeling, and informed/optimal monitoring frequencies are all important management needs. Although biologists overwhelmingly felt that monitoring needed to be herd or hunting district specific because of local conditions, some consensus on data collected may be important for comparing populations and analyzing multi-year trends. The most difficult task in this study we conducted was to analyze population survey data due to inconsistencies in monitoring frequency and protocols. A formal power analysis of simulated and empirical mountain goat survey data would offer an improved depiction of how various survey sampling designs might affect the strength of results.

- Local monitoring protocols: We support area biologists' efforts to formally design, prescribe, and document monitoring protocols for mountain goats in their respective areas with the goal of detecting changes in population status that require management actions. These would greatly benefit future area biologists in their jurisdictions and synthesis efforts such as this one by ensuring comparable data streams over time.

- Species management plan: MFWP does not currently have a statewide management plan for mountain goats. Examples of such plans exist for other species in Montana, and for mountain goats in neighboring jurisdictions (e.g., Alberta, British Columbia, Idaho, Oregon, Utah, and Washington). Those state and provincial plans have brought together much of the pertinent literature and identified key planning elements, some unique to mountain goat conservation. Development of such a plan has been previously identified as a priority by MFWP, yet has not occurred in the face of limited time and resources. Relative to other ungulate species in Montana, a management plan for mountain goats may be particularly useful for a variety of reasons. First, various life history traits make them more sensitive to harvest management than other ungulates, which justifies a unique approach to harvest management of this species. Second, some of the variation in monitoring practices and/or harvest rates identified in this report might benefit from regional or statewide coordination or guidelines. Third, the reproductive isolation of many populations may render goats more vulnerable to natural and anthropogenic changes in their environment across broad areas of their distribution. Lastly, individual biologists have less funding and time to devote to gaining local experience and data with this species relative to other more abundant and/or controversial species, which might increase the value of a statewide resource for information and guidance.

- Ecological research: In addition to the monitoring-based research questions we identified above, our questionnaire indicated a variety of potential avenues for important research into mountain goat ecology. These included, but were not limited to, assessments of mountain goat foraging ecology and habitat condition, demographic vital rates and population dynamics, and causes of mortality.

ACKNOWLEDGMENTS

We thank Montana Department of Fish Wildlife and Parks for funding to support Bruce Smith's time and travel, and for staff time for Nick DeCesare. We especially thank the MFWP biologists from Regions 1–5 who provided digital and paper documents and data, completed our questionnaire, good-naturedly answered our many follow-up questions, and encouraged our work. J. Coltrane, J. Gude, K. Loveless, S. Stewart, and M. Thompson provided helpful reviews of earlier drafts of this report. Other FWP personnel assisted with reviewing and critiquing components of this project such as the initial research proposal and questionnaire. The list of contributors included, but was not limited, to V. Boccadori, L. Bradley, T. Chilton-Radandt, J. Coltrane, J. Cunningham, S. Eggeman, C. Fager, A. Grove, J. Gude, G. Joslin, J. Kolbe, K. Loveless, E. Lula, Q. Kujala, C. Loecker, B. Lonner, R. Mowry, J. Newall, J. Newby, K. Podruzny, J. Sika, S. Stewart, A. Taylor, M. Thompson, R. Rauscher, J. Vore, D. Waltee, and J. Williams.

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Appendix 1. Compiled Results from the Biologist Questionnaire

The following 18 MFWP biologists completed the questionnaire during May–September 2016:
Liz Bradley, R2-Missoula
Vanna Boccadori, R3-Butte
Tonya Chilton-Radandt, R1-Libby
Jessy Coltrane, R1-Kalispell
Julie Cunningham, R3-Bozeman
Scott Eggeman, R2-Blackfoot
Craig Fager, R3-Dillon
Adam Grove, R3-Townsend
Adam Grove, R4-White Sulphur Springs (on behalf of Jay Kolbe)
Cory Loecker, R4-Great Falls
Brent Lonner, R4-Fairfield
Karen Loveless, R3-Livingston
Rebecca Mowry, R2-Bitterroot
Ryan Rauscher, R4-Conrad
Jenny Sika, R3-Helena
Shawn Stewart, R5-Red Lodge
Mike Thompson, R2-Upper Clark Fork (on behalf of Julie Golla)
Dean Waltee, R3-Sheridan

Population Estimates

Q1. Based on available data and your professional opinion, please provide an estimate of the current total number of mountain goats (*N*) within each population that you manage (including 0's for extirpated populations), as of April, 2016. Please also provide an interval showing your confidence in the range of possible values for *N* ("Range of confidence"). If needed you can lump districts together and provide a single combined estimate.

HD	Bio	Native/ Introduced	*N*	Range of confidence
100	Chilton-Radandt	N	85	80 - 95
101	Chilton-Radandt	N	50	45 - 60
131	Coltrane	N	17	16 - 18
132	Coltrane	N	33	31 - 36
133	Coltrane	N	39	36 - 42
134	Coltrane	N	14	13 - 15
140	Coltrane	N	65	60 - 70
141	Coltrane	N	62	58 - 65
142	Coltrane	N	70	67 - 73
150	Coltrane	N	61	57 - 66
151	Coltrane	N	16	16 - 16
212	Golla	N	25	0 - 50
213	Golla	N	0	0 - 20
222	Golla	N	10	0 - 20
223	Golla	N	10	0 - 20
240	Mowry	N	100	80 - 120
250	Mowry	N	30	10 - 100
261	Mowry	N	0	0 - 10
270	Mowry	N	10	0 - 30
280	Eggeman	N	30	15 - 40
312	Fager	N	125	75 - 150
313	Loveless	I	450	330 - 550
314	Loveless	I	250	140 - 275
316	Loveless	I	55	40 - 62
320	Waltee	I	27	11 - 44
321	Fager	N	20	10 - 30
322	Boccadori	N	31	26 - 36
323	Loveless	I	295	221 - 338
324	Cunningham	I	210	156 - 252

HD	Bio	Native/ Introduced	*N*	Range of confidence
325	Cunningham	I	82	57 - 103
326	Cunningham	I	37	28 - 44
327	Cunningham	I	42	30 - 53
328	Cunningham	I	6	4 - 8
329	Loveless	I	150	115 - 170
330	Loveless	I	25	19 - 30
331	Waltee	I	48	22 - 48
332	Sika	I	0	0 - 1
340	Boccadori	I	10	10 - 15
361	Cunningham	I	92	66 - 115
362	Cunningham	I	148	106 - 185
380	Grove	I	20	9 - 30
393	Cunningham	I	78	56 - 98
414	Rauscher	N	40	20 - 60
415	Rauscher	N	75	50 - 125
442	Lonner	N	40	35 - 50
447	Loecker	I	60	50 - 75
453	Kolbe	I	55	45 - 70
460	Loecker	I	45	40 - 60
514	Stewart	I	75	60 - 100
517	Stewart	I	90	80 -100
518	Stewart	I	75	60 - 100
519	Stewart	I	50	50 - 60
Fill-in other populations **(**Sun River Preserve, Rattlesnake NRA, …)				
Bradley - Rattlesnake		N	10	5 - 15
Bradley – Great Burn		N	23	20 - 25
Lonner – Sun River Preserve		N	68	60 - 80
Grove – North Big Belts		I	50	36 - 60
Taylor – Big Snowy		I	1	1 - 2
Thier – Whitefish Range		N	0	-

For 26 Native HDs, plus the Great Burn, Rattlesnake, Sun River Preserve, and (extirpated) Whitefish Range herds, the estimated total population = 1,159 (885–1,537). For 26 Introduced HDs, plus the North Big Belt and Big Snowy Mountains, the estimated total population = 2,526 goats (1,842–2,958). Total statewide population (not including the two national parks) = 3,685 (2,727–4,495).

<u>PAST</u> trends and limiting factors

Q2. How have goat numbers in your area changed over the past 50 years (i.e., 1960-2010)?

Native Populations (HDs) **You can provide separate answers for individual or groups of HDs, or if answer is same across your area you can just put "ALL"	**Increasing**	**Stable**	**Decreasing**	**Uncertain**
100		X		
101		X		
131			X	
132			X	
133			X	
134			X	
140			X	
141			X	
142			X	
150			X	
151			X	
212			X	
213			X	
222			X	
223			X	
240			X	
250			X	
261			X	
270			X	
280				X
312				X
321			X	
322			X	
414			X	
415		X		
442			X	
Great Burn			X	
Rattlesnake				X
Sun River Game Preserve		X		
Whitefish Range (extirpated)			X	
NATIVE TOTAL		4	23	3

Introduced Populations (HDs) **You can provide separate answers for individual or groups of HDs, or if answer is same across your area you can just put "ALL"	**Increasing**	**Stable**	**Decreasing**	**Uncertain**
313	X			
314	X			
316	X			
320				X
323	X			
324	X			
325			X	
326			X	
327			X	
328			X	
329	X			
330	X			
331		X		
332			X	
340		X		
361	X			
362		X		
380			X	
393	X			
447	X			
453	X			
460	X			
514			X	
517			X	
518			X	
519			X	
North Big Belts (no HD)			X	
Big Snowy (formerly HD 516)			X	
INTRODUCED TOTAL	12	3	12	1

For 26 Native HDs, plus the Great Burn, Rattlesnake, Sun River, and Whitefish herds, goat numbers in 23 of 30 areas were judged to have decreased over the past 50 years with numbers in 4 others stable and 3 others uncertain.

For 26 Introduced HDs, plus the North Big Belt and Big Snowy Mountains, goat numbers in 12 increased, 3 were stable, and 12 decreased over the past 50 years.

Q3. Which limiting factors do you suspect may have affected goat numbers in your area of responsibility during the <u>past</u> (1960–2010)? Please numerically rank for each HD those that apply, with 1 being of highest importance. Leave blank those that don't apply. Compiled by hunting district (HD) as indicated by biologists (including Great Burn, Rattlesnake, Sun River Preserve, and North Big Belts). Weighted score accounts for relative rankings.

Count of HDs per category and ranking		Disease	Predation	Hunter harvest (total # animals)	Hunter harvest (proportion of females)	Habitat changes (non-anthropogenic)	ORV/Snowmobile disturbance	Energy exploration	Logging and/or road construction	Non-motorized recreation	Climate change	Small population risks (inbreeding, …)	Other (please describe in Q4)	Unknown
Native	Ranked 1st (7 points)		1	7	10	2	4					5		15
	Ranked 2nd (6 points)	1	3	10		1	1			1	1	1		1
	Ranked 3rd (5 points)	1	3	1		3	9			1		1		
	Ranked 4th (4 points)	1		3		10				1		1		2
	Ranked 5th (3 points)		3			1					9			
	Ranked 6th (2 points)	4										1		1
	Ranked 7th (1 point)													2
	Count of HDs	**7**	**10**	**21**	**10**	**17**	**14**			**3**	**10**	**9**		**21**
	Weighted score	**23**	**49**	**126**	**70**	**78**	**79**			**15**	**33**	**52**		**123**
Introduced	Ranked 1st (7 points)		3	2	2								4[a]	7
	Ranked 2nd (6 points)	2	3	2	4	2						3		
	Ranked 3rd (5 points)		2	5	2	2						1		1
	Ranked 4th (4 points)		2	1	1	5								
	Ranked 5th (3 points)		2							1				
	Ranked 6th (2 points)				1								1	
	Ranked 7th (1 point)	2		1		1								
	Count of HDs	**4**	**12**	**11**	**10**	**10**				**1**		**4**	**5**	**8**
	Weighted score	**14**	**63**	**56**	**54**	**43**				**3**		**23**	**30**	**54**
Pooled	**Count of HDs**	**11**	**2**	**32**	**20**	**27**	**14**			**4**	**10**	**13**	**5**	**29**
	Weighted Score	**37**	**112**	**182**	**124**	**121**	**79**			**18**	**33**	**75**		**177**

[a] Other factors were ranked 1st and described in Q4 below for 4 introduced populations (HDs 313, 331, 332, 340)

[b] Other factors were ranked 6th and described in Q4 below for 1 introduced population (HDs 320)

The most commonly cited factors limiting goat numbers over the past 50 years (through 2010) were total hunter harvest followed by unknown reasons, harvest of female goats, habitat changes, and predation. That sequence was very similar for both native and introduced populations of goats, with ORV/snowmobile use a concern in several HDs of native goats, and predation a greater concern for introduced populations.

Q4. Please elaborate here on the limiting factors you marked in Question 3. For example, if you selected predators, disease, hunter harvest of females or climate change, please explain.

Following are some specific comments reported by respondents:

- "I marked "UNKNOWN" as a top factor in my areas, as I think the bottom line is that we really don't know what has been driving declining goat numbers [native herds] and therefore research is crucial."
- The percent of adult females in the harvest is disturbing/a concern, and overall harvest was probably excessive in the past (several respondents).
- Small isolated populations are potentially affected by inbreeding depression.
- Others mentioned that they suspect climate change effects on goats (or their habitats) but have no direct information.
- Too little population data to assess changes.
- There has been pneumonia complex disease in sheep which may have affected goat production.
- "We have the full complement of predators and I would very much like to know how they influence survival."
- Cumulative effects (hunting + natural mortality) may have caused declines and kept some native populations low.
- Several hunting districts have unique circumstances where trapping and removal of goats may have contributed to declines (HD442); struggling native herds were supplemented with transplanted goats (HD101 and also the Rattlesnake); bighorn sheep were reintroduced on top of a small goat population and may have competed with goats (HD332); habitat was limited where goats were introduced (HD331 and 340); a population crashed possibly due to density-dependent factors and/or disease but has subsequently recovered (HD313).

Q5. In your area of responsibility, why have licenses for <u>native</u> goats been reduced in recent decades (check all that apply)? One response per biologist with responsibilities for native herds.

- Reduced licenses in response to observed declines in goat numbers based on monitoring data (6)
- Reduced licenses as precautionary action until more reliable population data are available (4)
- Reduced licenses in response to change in the objectives or science behind harvest management (2)
- Reduced licenses to maintain higher numbers for other users (e.g., non-consumptive recreationists) (1)
- Other (3) Please describe:

Note that for 2 biologists who indicated "Other," licenses had not been reduced in recent years, and in the third case, permits have been increased.

CURRENT trends and limiting factors

Q6. How do you feel those same populations are doing now (i.e., 2010-present)? Some biologists indicated more than one category for a HD.

Populations (HDs) **You can provide separate answers for individual or groups of HDs, or if answer is same across your area you can just put "ALL"	**Increasing**	**Stable**	**Decreasing**	**Uncertain**
100			x	
101		x		
131			x	
132			x	
133			x	
134			x	
140			x	
141			x	
142			x	
150			x	
151			x	
212			x	
213?			x	
222			x	
223			x	
240		x		x
250				x
261				x
270	x			x
280		x		x
312		x		
321				x
322	x			
414				x
415				x
442		x		
Great Burn				x
Rattlesnake				x
Sun River Preserve		x		
NATIVE TOTAL	2	6	14	10

Introduced Populations (HDs) **You can provide separate answers for individual or groups of HDs, or if answer is same across your area you can just put "ALL"	**Increasing**	**Stable**	**Decreasing**	**Uncertain**
313		x		
314		x		
316	x	x		
320				x
323		x		
324	x			
325		x		
326				x
327/362	x			
328			x	
329		x		
330		x		
331		x		
332		No goats		
340		x		
361	x			
380		x		
393		x		
447	x	x		
453				x
460		x	x	
514			x	
517			x	
518		x		
519		x		
North Big Belts (no HD)	x			
INTRODUCED TOTAL	6	15	4	3

Goats in HDs with native populations are mostly decreasing in recent years (2011–present) or their status is uncertain; whereas introduced populations are generally considered stable with a few increasing and a few others decreasing.

Q7. What are your thoughts as to the <u>current and future</u> threats to sustaining goat numbers? Please numerically rank for each HD those that apply, with 1 being of highest importance. Leave blank those that don't apply. Compiled by hunting district as indicated by biologists (including Big Burn, Rattlesnake, Sun River, and North Big Belts).

	Count of HDs per category and ranking	Disease	Predation	Hunter harvest (total # animals)	Hunter harvest (proportion of females)	Habitat changes (non-anthropogenic)	ORV/Snowmobile disturbance	Energy exploration	Logging and/or road construction	Non-motorized recreation	Climate change	Small population risks (inbreeding, …)	Other (please describe in Q4)	Ltd Available Habitat
Native	Ranked 1st (7 points)	2	3	1	9	4	1				1	9		
	Ranked 2nd (6 points)	2	2	9		3				1	8	3		
	Ranked 3rd (5 points)	4	1		3	11	9			2	1	2		
	Ranked 4th (4 points)		5	2			10			1	1	2	3[a]	
	Ranked 5th (3 points)		2	1	1		1				9		1[b]	
	Ranked 6th (2 points)	2	1	1										
	Ranked 7th (1 point)													
	Count of HDs	**10**	**14**	**14**	**13**	**18**	**21**			**4**	**20**	**16**	**4**	
	Weighted score	**50**	**66**	**74**	**81**	**101**	**95**			**20**	**91**	**99**	**15**	
Introduced	Ranked 1st (7 points)	5	3	2	4	3	1			1		1		2
	Ranked 2nd (6 points)	1	4	4	5		1							
	Ranked 3rd (5 points)		2	4	1	4						2		
	Ranked 4th (4 points)		3	1	1	4	1							
	Ranked 5th (3 points)					1				1				
	Ranked 6th (2 points)		1											
	Ranked 7th (1 point)									1				
	Count of HDs	**6**	**13**	**11**	**11**	**12**	**3**			**3**		**3**		**2**
	Weighted score	**41**	**69**	**62**	**67**	**60**	**17**			**11**		**17**		**14**
Pooled	**Count of HDs**	**16**	**27**	**25**	**24**	**30**	**24**			**7**	**20**	**19**	**4**	**2**
	Weighted score	**91**	**135**	**136**	**147**	**161**	**112**			**31**	**91**	**116**	**15**	**14**

[a] Other factors were ranked 4th and described below in Q8 for native populations (HDs 312, 321)
[b] Other factors were ranked 5th and described below in Q8 for 1 native populations (HD 442)

The most commonly cited factors currently limiting goat numbers were habitat changes, followed by harvest of female goats, total goat harvest, predation, and ORV/snowmobile disturbance. But there were marked differences between perceived factors limiting native versus introduced populations. For introduced populations, predation, harvest of females, total harvest, and habitat changes ranked nearly equally as most important. For native goats, habitat changes were most important, followed by ORV/snowmobile disturbance, small population risks, and climate change concerns.

Compared to historical limiting factors (Question 3), there was less uncertainty about perceived limiting effects on populations. For introduced goat populations, effects of harvest levels on populations (total and females), habitat changes, and predation remain high.

For native populations, there is a shift away from concerns about harvest levels, to how impacts of habitat changes, ORV/snowmobile disturbance, climate change, and small population risks are affecting populations. In part this is because harvest levels of native populations have been slashed over the years (9 HDs with native goats are now closed to hunting). Only 38 permits were issued to hunt goats in the 26 HDs with native populations in 2015. Thus other risks to population viability have replaced earlier concerns with harvest levels.

Q8. Please elaborate here on the limiting factors you marked in Q7. For example, if you selected predators, disease, hunter harvest of females, or climate change, please explain.

Native Populations:

- Several biologists wrote that the concerns they identified in Question 7 were cumulative, perpetuating suppression of goat numbers that may have begun prior to 2010.
- Where populations are now small and isolated, inbreeding depression is a concern.
- For several populations, habitat is limited. "Forest encroachment, due to fire suppression, on some of these higher elevation ranges may be limiting available winter forage." Also noted were concerns that fire suppression has exacerbated forage competition with elk, bighorns, moose, or deer populations in places.
- Concern was expressed that hunter harvest success and effort are not good measures of how a herd is doing.
- Disease impacts (both introduced and native goat herds) are surmised, but not documented. These concerns were expressed for HDs where bighorns have experienced pneumonia die-offs, although the same has not been documented in goats. A disease die-off is circumstantially implicated in HD313 in the past.
- Harvest of adult female goats (roughly 38% of the total harvest historically) is a concern in some populations of native and introduced herds.
- Increased recreation (both motorized and non-motorized) are suspected of impacting growth of goat populations. This could result from displacement and/or physiological stress, but neither has been studied to confirm.
- Through changing plant phenology, dwindling snow in summer, and late-winter snow events, climate change probably contributes to declining viability of some herds.

Introduced Populations:

- More concerns were expressed about predation on goats in introduced than native populations, with lions stated to be of greatest concern. However, several biologists noted that predation on goats was not well documented, or only suspected (in some introduced and native HDs).
- In HDs in the Madison, Gallatin, and Crazy Mountains, harvest objectives and rates that are higher than are sustainable in native herds are being monitored to insure overharvest doesn't occur.
- Concern expressed that for herds with limited habitat, insufficient harvest could lead to overuse of available range. And transplanting bighorns into HD332 may have not only disadvantaged a small goat population but contributed to an increase in lion predation on goats.

Harvest and Season-setting

Q9. What best describes your objectives when allocating mountain goat licenses (select one)? One response per HD only for those HDs open to hunting now.

Native Populations (HDs) **You can provide separate answers for individual or groups of HDs, or if answer is same across your area you can just put "ALL"	Provide conservative number of licenses to allow opportunity with **minimal impact**	Provide **maximum sustainable** number of licenses that still maintains current population size	Provide enough licenses to **limit or decrease the current population** size	Other (please describe):
100	x			
101	x			
131	x			
132	x			
133	x			
134	x			
140	x			
141	x			
142	x			
150	x			
151	x			
212				No licenses
213				No licenses
222				No licenses
223				No licenses
240	x			
250				No licenses
261				No licenses
270				No licenses
280				No licenses
312		x		
321				No licenses
322	x			
414	x			
415	x			
442	x			
Great Burn (No HD)				No licenses
Rattlesnake (No HD)				No licenses
Sun River Preserve (No HD)				No licenses
NATIVE TOTAL	16	1		

Introduced Populations (HDs) **You can provide separate answers for individual or groups of HDs, or if answer is same across your area you can just put "ALL"	Provide conservative number of licenses to allow opportunity with **minimal impact**	Provide **maximum sustainable** number of licenses that still maintains current population size	Provide enough licenses to **limit or decrease the current population** size	Other (please describe):
313			X	
314				x
316				x
320	x			
323				x
324		x		
325		x		
326				x
327		x		
328		x		
329				x
330				x
331	x			
332				No licenses
340				No licenses
361	x			
362		x		
380				No licenses
393		x		
447	x			
453		x		
460	x			
514	x			
517	x			
518	x			
519	x			
North Big Belts (no HD)				No licenses
INTRODUCED TOTAL	9	7	1	6

Biologists managing native HDs take an almost unanimously conservative approach to harvest. For HDs with introduced goats, objectives are more varied with the "Other" responses aimed at limiting population growth.

Q10. Which of the following describes the quantity and quality of your goat survey and inventory information with respect to making management decisions (select one)? One response per biologist.

	Adequate	Somewhat adequate	Somewhat inadequate	Inadequate
Native Populations (HDs)		2	4	4
Introduced Populations (HDs)	1	4	2	
Pooled	1	6	6	4

These results suggest that more adequate survey data are collected in HDs with introduced goats. This may be because most goat permits (84% in 2015) are issued in HDs with introduced goats and therefore these goat populations are surveyed more often or thoroughly.

Q11. What information do you currently use to set annual goat harvest regulations? Please numerically rank those that apply with 1 being of highest importance, leaving blank those that don't apply. Compiled by hunting district as indicated by biologists.

	Count of HDs per category and ranking	**FWP hunter harvest data**	**FWP hunter effort data** (e.g., kills per effort)	**FWP observations data** (e.g., number seen/hunter)	**Age and/or horn data**	**Anecdotal hunter reports** (i.e., not in MRRE)	**Survey minimum counts**	**Survey recruitment ratios**	Other (please describe):
Native	Ranked 1st (7 points)	1					3	2	
	Ranked 2nd (6 points)		1			1	1	3	
	Ranked 3rd (5 points)	2	1	1	1				
	Ranked 4th (4 points)		2	1			1		
	Ranked 5th (3 points)	1		2		1			
	Ranked 6th (2 points)	1				1			
	Ranked 7th (1 point)				1				
	Count of HDs	**5**	**4**	**4**	**2**	**3**	**5**	**5**	
	Weighted score	**22**	**19**	**15**	**6**	**11**	**31**	**32**	
Introduced	Ranked 1st (7 points)	2					6		1
	Ranked 2nd (6 points)		1				2	5	
	Ranked 3rd (5 points)	2	1		2	1		1	
	Ranked 4th (4 points)	1	3	2 /8				4	
	Ranked 5th (3 points)	1			3	2			
	Ranked 6th (2 points)	1	1	1		2			
	Ranked 7th (1 point)			1	1				
	Count of HDs	**7**	**6**	**4**	**6**	**5**	**8**	**10**	**1**
	Weighted score	**33**	**25**	**11**	**20**	**15**	**54**	**51**	**7**
Pooled	**Count of HDs**	**12**	**10**	**8**	**8**	**8**	**13**	**15**	**1**
	Weighted score	**55**	**44**	**26**	**26**	**26**	**85**	**83**	**7**

Survey minimum counts and survey recruitment ratios are the two types of data on which biologists place the greatest reliance in setting harvest regulations. This is true for both native and introduced populations. This emphasizes the importance of obtaining reliable population survey data.

The next two factors most relied on to set regulations were FWP harvest data (number of animals harvested relative to number of permits issued) and hunter effort data (number of days/animal harvested). With mandatory reporting of mountain goat kills, these may be the most consistently available data at biologists' disposal.

Q12. If better or more frequent survey data would help you set harvest quotas, what factors are *__most__* limiting to survey efforts (e.g., funding, time, aircraft availability, weather, other logistics, etc…)? Compiled by responses from each biologist (multiple factors listed by biologists are included).

The factors most frequently reported were:

- Aircraft/pilot availability (11)
- Weather (11)
- Funding (10)
- Time (6)
- Sightability Correction Model needed (1)
- Cooperation with Idaho on the border goat herd in HD322 (1)

Several biologists listed all of the top 4 factors in their responses.

Q13. Have any of your proposed quotas for other species, such as mountain lions, been affected by numbers or recruitment ratios of overlapping mountain goat populations? If so, please explain. One response per biologist.

	Yes	**No**
Native populations		9
Introduced populations	1	7
Pooled	**1**	**16**

Q14. Based on your conversations with hunters, what % of hunters in your area take into consideration the animal's sex (i.e., deliberately target males) when choosing to harvest a given mountain goat (circle one)? One response per biologist for those with licensed HDs.

0	10	20	30	40	50	60	70	80	90	100	Uncertain
1			2		5		2	1	2		2

The weighted average of the responses was 55%.

Q15. Based on your conversations with hunters, what % of hunters in your area would you expect correctly identify the animal's sex when choosing to harvest a given mountain goat (circle one)? One response per biologist for those with licensed HDs.

0	10	20	30	40	50	60	70	80	90	100	Uncertain
1			2		6	1		1	2		2

The weighted average of the responses was 52%. This suggests that half of permittees are as likely to kill a nanny as a billy, all other factors being equal (goat population demographics, sex-biased distribution, etc.).

Q16. Is the educational information provided to license-holders sufficient for hunters to make informed decisions about the age and sex of the animals they choose to harvest? If not, what more could be done? One response per biologist for those with licensed HDs.
[3] Yes
[6] No
[6] Uncertain

Comments offered:

- Work with other states to improve educational materials (3)
- Use Alaska education information or something similar (2)
- FWP used to send out informational letters (1)
- Mandate billy only seasons (1)
- Send hunters the brochure developed by Gayle Joslin (1)
- Hunters could be required to take in-person mandatory training (1)

Population surveys

Q17. What survey methodology do you use to assess mountain goat population size and trend? Please check all that apply. Compiled by responses from each biologist.

Populations (HDs)	Methodology			Season				Frequency				
	Fixed-wing	Heli-copter	Ground	Winter/ Early Spring	Jul-Aug	Aug-Sept	Early Fall	Annual	Every other year	Every few years	Rarely	Never
Fixed-wing	6				1	3	2	2		1	2	1
Helicopter		20		6	4	5	3	5	5	4	7	1
Ground			8		1	7		3	2	2	1	

Some respondents indicated they use multiple survey methods at differing times of the year.

Q18. Do you feel it is important that FWP monitors mountain goats using similar methods across regions of the state (e.g., timing and frequency of surveys, choice of aircraft, etc.)? One response per biologist.

Yes	No	Uncertain
2	14	2

Q19. Do you see a difference between native vs. introduced goat populations in terms of general health or productivity/recruitment? If so, please describe. One response per biologist.

Yes	No
5	1

Several biologists noted they did not have enough information to answer this question or that they only had either native or introduced goats in their area of responsibility and therefore could not judge. Several others did not respond.

Comment: "We have a health baseline for the Crazies. Maybe it would be prudent to do some health captures in other areas to compare, or at a minimum, get a hunter sampling protocol going similar to bighorns."

Habitat Considerations

Q20. What habitat management programs would promote mountain goat conservation and hunter opportunity in your area of responsibility? Please numerically rank those that apply for each population or group of populations with 1 being of highest importance. One response per biologist.

Count of HDs per category and ranking	**None;** Habitat isn't a limiting factor	**More fire** (natural or prescribed)	**Less fire** (suppression of wildfire)	**Weed management**	**Road management** (ie., more restrictive)	**ORV management**	**Snowmobile management**	**Non-motorized recreation management**	**Unknown**	**Other** (please describe):
Ranked 1st (3 points)	3	5	1			1	3	1	4	
Ranked 2nd (2 points)			1			1	1	2	1	
Ranked 3rd (1 point)				1					1	
Count	**3**	**5**	**2**	**1**		**2**	**4**	**3**	**6**	
Weighted score	**9**	**15**	**5**	**1**		**5**	**11**	**5**	**15**	

There was little consensus about which, if any, habitat management programs would benefit goat conservation or increase hunter opportunity. The three recreational management categories had a combined weighted score (21) larger than any other category.

Q21. Have you completed any habitat-related projects alone or with federal or other land managers related to the subjects in Question 20 that were geared to improve mountain goat habitat or conservation? Please explain, listing HDs for which the projects were completed. One response per biologist.

Yes	No
1	16

Comments offered:
- Would like to support more burning on USFS lands
- Have worked with BLM and USFS to remedy conifer encroachment but no projects yet
- Yes response is for comments on USFS motorized travel restrictions in goat habitat

Research & Management Needs

Q22. Is there a pressing need for translocation of mountain goats into a portion(s) of your area to sustain native and/or introduced populations? If so, would this be to reintroduce an extirpated population or augment an extant population? Please explain. One response per biologist.

	Yes	No
Native	2	4
Introduced	3	7
Pooled	**5**	**11**

Introductions need to be carefully evaluated on an area-by-area (herd-by-herd) basis, as indicated by the comments below.

Comments offered:

Native Herds:

- Need better population data to determine any needs for augmentation. (2)
- We would need to first understand what is driving population declines and get a better idea of the actual number of goats in the area. If it is disease or habitat driven, then why dump more goats into areas? (2)
- Yes, HD240 and possibly 250 to augment struggling populations.
- Yes, for augmentation in 212, and 222-223. However, the disease issue (bighorn pneumonia) is a huge unknown.

Introduced Herds:

- Yes, HD380 and North Big Belts: To augment small, extant populations.
- Yes, Boulder Baldy area and Big Baldy area of Little Belts
- Yes, Highwoods and Square Butte to improve genetic diversity of isolated populations.
- No, all habitat is occupied and goats are self-sustaining.

Q23. What are the most urgent *research* needs that would help you manage mountain goats in your area of responsibility?

- Habitat condition and use and carrying capacity (9)
- Population demographics: productivity, recruitment, kid survival, and adult survival (7)
- Causes of mortality (5)
- Animal health (3)
- Sightability correction model for survey data (2)
- Improved survey methodology (2)
- Effects of recreation on populations (1)
- Effects of climate change on populations (1)
- Better information on dispersal of introduced herds (1)
- Impacts on populations of female harvest (1)
- Competition and disease transmission of sympatric bighorns and goats (1)
- Do we know if population augmentation can overcome small population effects? (1)

Q24. What are the most urgent *management or monitoring* needs that would help you manage mountain goats in your area of responsibility?

- Better/more frequent monitoring of populations (10)
- Sightability correction model and improved, standardized survey methodology (5)
- Monitoring of health (2)
- Coordinated and cooperative management with Idaho of boundary herds (1)
- Field work to determine movements of goats between adjacent HDs (1)
- More time to devote to learning about goats to improve management (1)
- Transplant augmentation (1)
- Continue to collect harvest data and ages of harvested goats (1)

Q25. What other topics of relevance did we miss with these questions?

- Focus on predation of goats (1)
- Potential effects of goats on bighorns in the GYE, i.e. Bob Garrott's research (1)
- More FWP effort should be shifted to species that may be at risk, like goats (1)
- Need extended field studies of small goat populations to develop an understanding of how remnant native populations survive. This could help develop bigger research questions and conservation priorities. Need more first-hand familiarity via field studies (e.g. grad students) (1)

Appendix G

Seasonal Altitudinal Movements of Mountain Goats

CLIFFORD G. RICE,[1] *Wildlife Program, Washington Department of Fish and Wildlife, 600 Capitol Way N, Olympia, WA 98501, USA*

ABSTRACT I investigated seasonal altitudinal movements of 42 mountain goats (*Oreamnos americanus*) in the Cascade Range of Washington, USA. Because mountain goats typically move to lower elevations during the winter, I partitioned locations from Global Positioning System collars into summer and winter seasons based on elevation. Using an iterative narrowing search, I identified summer and winter start dates for each individual and year and derived several measures of altitudinal movements from these, and examined differences in these measures on the basis of sex and year and their interrelationship. Generally, female mountain goats started summer about 2 weeks earlier than nondispersing males; winter start dates varied among years. Horizontal distance moved between seasons was unrelated to measures of altitudinal movement. Based on elevation, winters were generally longer than summers for mountain goats I studied, suggesting that the common perception of mountain goats as inhabitants of alpine and subalpine terrain is biased, because they spent the greater part of the year at lower elevations. Mountain goats showed a wide range of responses to seasonal environmental changes and individuals cannot be easily classified as migratory or nonmigratory. Because ecological conditions in mountain environments are closely related to elevation and horizontal and altitudinal movements were unrelated, studies of seasonal movements of mountain animals based on horizontal movement may be misleading. Because seasonal altitudinal movements of mountain goats are highly variable, the management needs of each population must be considered separately. (JOURNAL OF WILDLIFE MANAGEMENT 72(8):1706–1716; 2008)

DOI: 10.2193/2007-584

KEY WORDS altitude, Global Positioning System, migration, mountain goat, *Oreamnos americanus*, Washington.

Seasonal altitudinal movements are common among cervids such as roe deer (*Capreolus capreolus*; Mysterud 1999, Mysterud et al. 2001), elk (and red deer; *Cervus elaphus*; Morgantini and Hudson 1988, Poole and Mowat 2005), mule deer (*Odocoileus hemionus*; Nicholson et al. 1997, Poole and Mowat 2005, Sawyer et al. 2005), and sika deer (*Cervus nippon*; Igota et al. 2004) and Caprinae such as ibex (*Capra ibex*; Francisci et al. 1985, Parrini et al. 2003, Grignolio et al. 2004), bighorn sheep (*Ovis canadensis*; Festa-Bianchet 1988), chamois (*Rupicapra rupicapra*; Hamr 1985, Lovari et al. 2006), and mouflon (*Ovis aries*; Gonzalez 1985), as well as mountain goats (*Oreamnos americanus*; e.g., Rideout 1974, Chadwick 1983, Nichols 1985, Côté and Festa-Bianchet 2003, White 2006). Many altitudinal movements in these species are migratory in that distinct ranges are used during different seasons and are generally to enhance access to high quality food and to reduce predation risk (Festa-Bianchet 1988, Albon and Langvatn 1992, Mysterud et al. 2001, Pettorelli et al. 2007). Snow is also considered an important factor affecting altitudinal movements because it incurs higher energetic costs for locomotion and covers forage (Sweeney and Sweeney 1984, Dailey and Hobbs 1989, Nicholson et al. 1997, Parrini et al. 2003, Luccarini et al. 2006). Consequently, mountain goats selected terrain with snow-shedding characteristics in winter and avoided chest-deep snow, and altitudinal movements were related to amount of snow (Rideout 1974, 1977; Smith 1977).

Other authors have defined seasons by fixed dates (e.g., Parrini et al. 2003, Igota et al. 2004, Lovari et al. 2006, Luccarini et al. 2006), departure from seasonal ranges (Nicholson et al. 1997, Mysterud 1999, Sawyer et al. 2005), and periods of high movement rate (Nicholson et al. 1997, Johnson et al. 2002, Taylor et al. 2006). Fixed dates fail to account for interannual differences in ecological conditions, departure from seasonal ranges can only be used if ranges are discrete and are ambiguous when movements are temporary (Stevens 1983, Festa-Bianchet 1988, Nicholson et al. 1997, Rice 2006), and periods of greatest movement may reflect habitat patch distribution or weather events rather than seasonal movements per se.

Because there is potential for considerable variation temporally, geographically, and among individuals in their response to these factors affecting altitudinal movement, my objectives were to 1) delineate summer and winter elevations used by mountain goats based on altitudinal movements, 2) determine seasonal timing and patterns of altitudinal movements, and 3) determine if there are gender- and age-related differences in seasonal patterns of altitudinal movements.

STUDY AREA

In the Cascade Mountain Range, mountain goats typically inhabited elevations between 600 m and 2,400 m. Topography extended as high as 4,267 m on several volcanic peaks, but most terrain was below 2,100 m.

On the western slope of the Cascade Range, precipitation ranged from 1,300 mm to 3,600 mm, mostly during October to June, and precipitation ranged from 500 mm to 3,040 mm on the eastern slope (McNab and Avers 1994). Snow accumulation in the Cascades varied greatly with elevation, aspect, and among years as was evident from example accumulation records from Snotel sites (Fig. 1; Natural Resources Conservation Service 1997).

METHODS

I captured 45 mountain goats in the Cascade Mountain Range in Washington State (Fig. 2; Rice and Hall 2007). All captures were in compliance with Washington Department of Fish and Wildlife Policy on Wildlife Restraint or Immobilization (M6003). I fitted captured mountain goats

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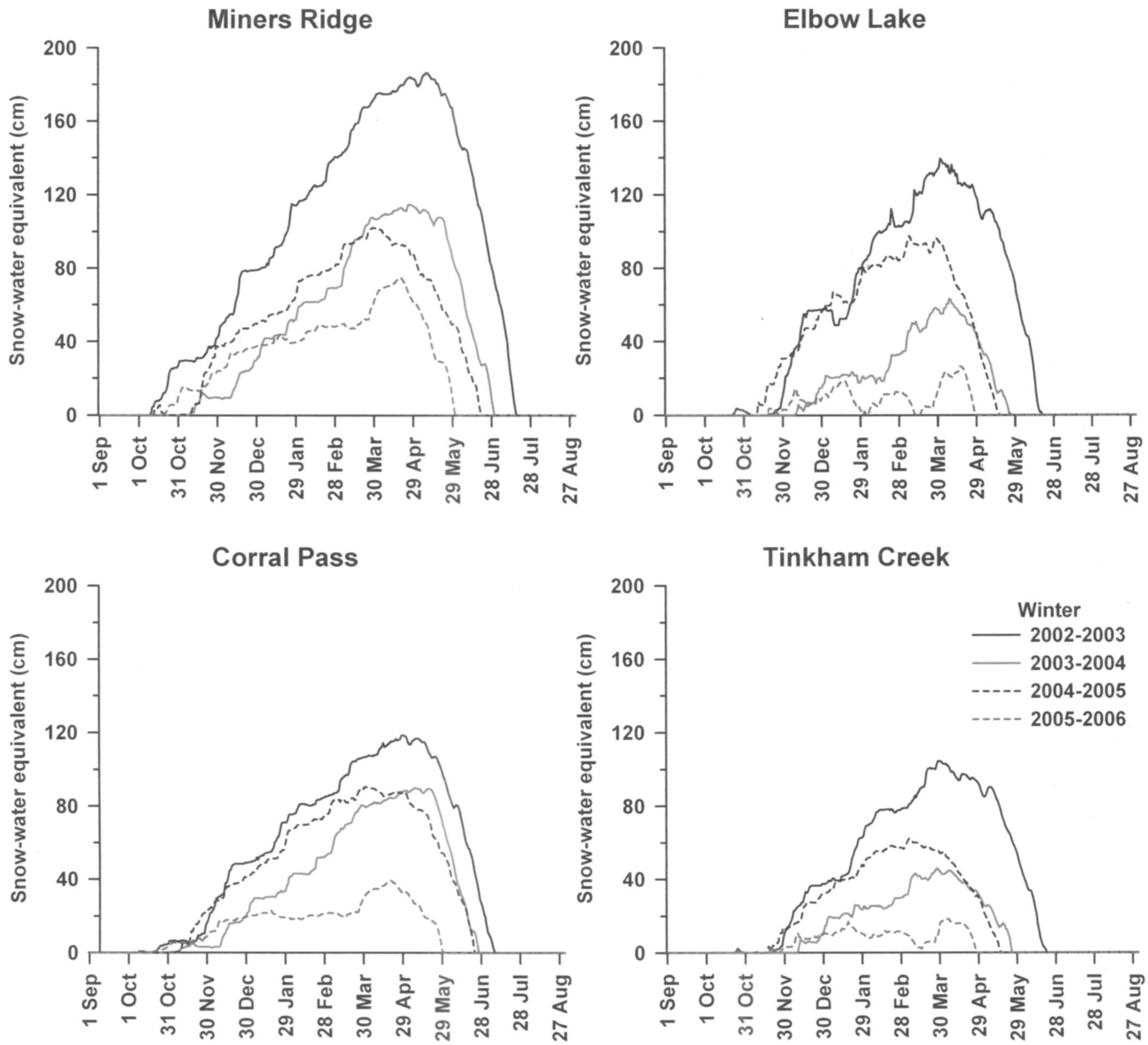

Figure 1. Snow-water equivalent (snow depth is approx. snow-water equivalent × 3) over 4 winters at 4 Snotel sites in the Cascade Range in Washington, USA, 2002–2006, representing high elevation northern (Miners Ridge, 1,890 m) and southern (Corral Pass, 1,929 m) conditions and low elevation northern (Elbow Lake, 975 m) and southern (Tinkham Creek, 936 m) conditions.

with Global Positioning System (GPS) tracking collars (Vectronic GPS Plus-4; Vectronic Aerospace, Berlin, Germany), usually with a 3-hour fix interval (I used rotating 5-hr intervals for 7% of the fixes).

Of the 45 collared mountain goats, I selected those that had fix records of ≥9 months of data. I removed outlier fixes by visually screening locations beyond the continuous distribution of distances of all fixes from the median for each individual and by visual inspection of travel paths (usually single fixes separate from temporal clusters). Because I was primarily interested in altitudinal movement as a response to seasonal changes in environment and habitat, and visits to mineral licks often involved excursions to low elevations that were not driven by these factors, I also removed fixes evidently associated with visits to mineral licks outside the usual range of the individual (fixes over 2–3 days several kilometers from all other fixes). I assigned each remaining fix an elevation by extraction from a 10-m digital elevation model (U.S. Geological Survey 1993) using ArcGIS 9.1.

As a framework for this analysis, I defined a season-year as the calendar year for summer, and the calendar year of the preceding summer for winter (e.g., Jan 2004 was in season-yr 2003), and stipulated that a season is a contiguous series of dates and only one summer and one winter were possible in any season-year. Furthermore, due to local spatial and temporal heterogeneity, seasons may be different among individuals and may vary among years due to differing weather patterns.

Terrain and habitat impose practical limits on the range of

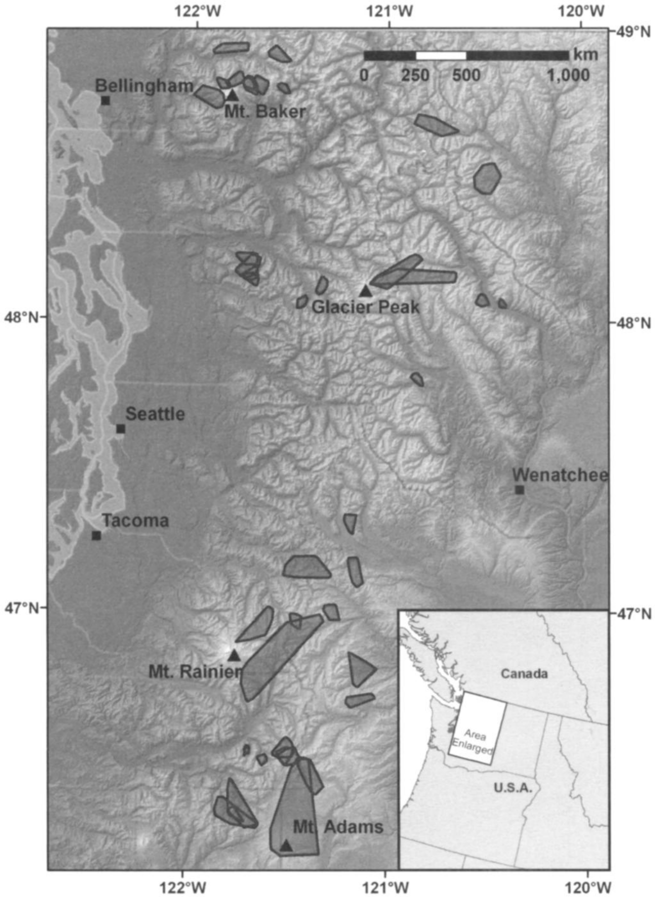

Figure 2. Minimum convex polygons for Global Positioning System fixes showing the locations of the 42 mountain goats in Washington, USA (26 Sep 2002 to 22 Sep 2006), with >9 months tracking.

elevations available to an individual mountain goat. For example, some mountain goats occupy mountain ridges with a maximum possible local elevation. For others, maximum elevations were constrained by transitions to permanent snow and ice. Minimum elevations were limited by habitat with suitable escape terrain. Because of this, I treated each animal individually. Also, the distribution of elevations used by an individual may be truncated where these limits were reached. Although distribution of elevations varied greatly among individuals, it generally could not be assumed to be normal but was not highly skewed. I chose the Van der Waerden Test (Conover 1980) for statistical evaluations because of its high efficiency and robustness against the normal assumption.

I partitioned fixes into summer and winter categories by an iterative process. Initially, for each mountain goat and for each year (2002–2006), summer start and end dates were 1 May and 1 October, respectively, and I assigned fixes a season according to their date. Then, for each mountain goat within each year, I changed summer start and end dates to later and earlier dates in 6 steps by 30 days, 15 days, 8 days, 4 days, 2 days, and 1 day. For each iteration, I contrasted elevations for each season using the Van der Waerden Test (Conover 1980) and selected the pair of dates with the highest test score for the start of the next step. I took the pair of dates for the final step (1 day) as the start and end of summer for each season-year. In this manner, I found the dates that represented the greatest contrast between summer and winter elevations. Because my interest was in partitioning seasons and all animals obviously experienced both summer and winter seasons, I did not evaluate significance of the Van der Waerden Test but used the test score as an index of separation between summer and winter elevations. Consequently, I did not adjust the analysis for temporal autocorrelation or position acquisition probability.

To provide a cross-check on whether these season delineations were spurious, I compared the overall selection for gross habitats by date with the seasonal classifications. For each point, I extracted the vegetation cover according to the Zone 1 coverage map (Sanborn 2007) reduced to 6 classes: bare, grassland, parkland, woodland, forest, and shrubland based on Comer et al. (2003). Bare cover was primarily North Pacific Montane Massive Bedrock Cliff and Talus, North American Alpine Ice Field, North Pacific Alpine and Subalpine Bedrock and Scree, and Rocky Mountain Alpine Tundra/Fell-field/Dwarf-shrub. Grassland was primarily North Pacific Alpine and Subalpine Dry Grassland. Parkland was primarily Northern Rocky Mountain Subalpine Dry Parkland. Woodland was primarily East Cascades Mesic Montane Mixed-Conifer Forest and Woodland and Rocky Mountain Subalpine Dry-Mesic Spruce–Fir Forest and Woodland. Forest was primarily North Pacific Dry-Mesic Silver Fir–Western Hemlock–Douglas fir Forest, Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest, and North Pacific Mountain Hemlock Forest. Shrubland was primarily Transitional Vegetation Short Shrub, Inter-Mountain Basins Big Sagebrush Steppe, and North Pacific Avalanche Chute Shrubland.

For each mountain goat for each day, I computed the expected frequency of occurrence for each cover class as the number of fixes each day (row total) times the total number of fixes for each class (column total) divided by the total for each mountain goat (grand total):

$$\mathrm{Exp}_{ij} = \sum_{i=1}^{\text{classes}} n_{ij} \sum_{j=1}^{\text{days}} n_{ij} \Big/ \sum_{i=1}^{\text{classes}} \sum_{j=1}^{\text{days}} n_{ij},$$

where Exp_{ij} is the expected frequency of occurrence in the ith cover class on the jth day, classes is the number of cover classes, days is the number of days in a year, and n_{ij} is the number of GPS fixes recorded in the ith cover class on the jth day. I then computed the mean deviation from expected (obs – expected) for each day of the year and cover class. To more clearly illustrate the change in deviations from expected through the year, I fitted a local polynomial regression to the daily mean deviations with R (v2.3.0; R Foundation for Statistical Computing, Vienna, Austria; <http://www.r-project.org/>) package KernSmooth using the plug-in bandwidth selector (dpill) and compared these values with the proportion of fixes classified as summer for each day of the year.

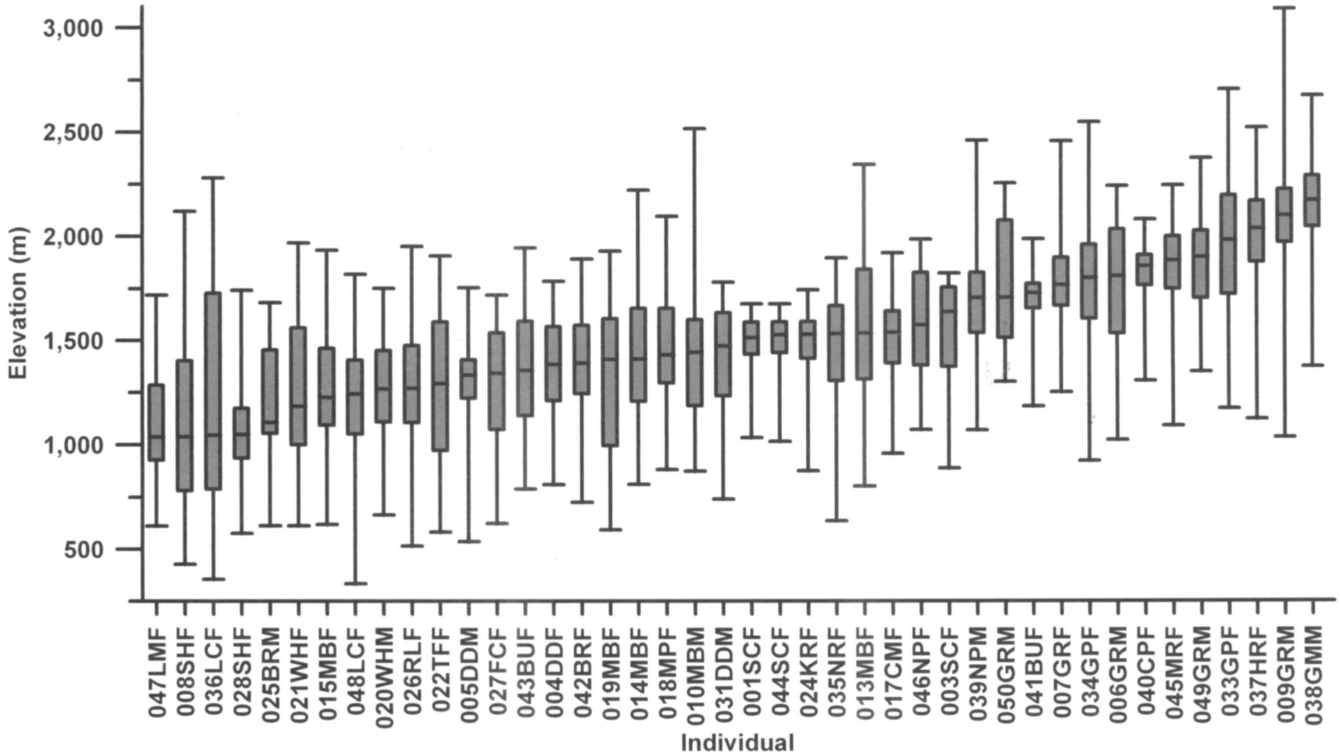

Figure 3. Distribution of elevation records for each mountain goat showing median, 25th and 75th percentiles, and maximum and minimum (Washington, USA, 26 Sep 2002 to 22 Sep 2006).

Based on the summer and winter start and end dates I computed additional statistics: duration of summer and winter (months), median elevations for summer and winter and their difference, and distance between summer and winter median centroids. I estimated overlap of summer and winter elevations by estimating the one-dimensional kernel density (Silverman 1986, Jones et al. 1996) of elevations for each mountain goat and season with the R package KernSmooth using the plug-in bandwidth selector (dpik). I transformed kernel densities to sum to one and took the overlap as the sum of the minimum of the summer and winter transformed densities. For each mountain goat, I also calculated the 5th and 95th percentiles of the elevation distributions, their differences being the 90% ranges.

I classified individual mountain goats as (ad) female, dispersing male, and nondispersing male. Dispersing males were those that moved long distances (>24 km between first and last fix) in a nonseasonal manner and did not return to previously occupied areas. Nondispersing males occupied consistent areas among successive seasons (as did females). I aged mountain goats by counting horn annuli at time of capture (Smith 1988).

To examine effects of these categories on season and elevation I used a multivariate equivalent of the Van der Waerden Test by transforming independent variables to normal percentiles for use in a least-squares analytic framework (Conover 1980) using an α level of 0.05. I included individual mountain goat as a random effect in this analysis due to repeated measures on individuals across years and I considered no interactions due to the low sample size.

Where effects were found, I used records from 23 Snotel stations of snow water equivalent (related to snow depth) and temperature to look for comparable differences to assess the extent that these differences could be explained by weather conditions. Snotel stations I selected were within rectangles defined by latitude and longitude limits of 4 regional groups of mountain goat collar GPS fixes.

RESULTS

Of the 42 mountain goats with GPS records >9 months, one covered 1 year, 16 covered 2 years, 23 covered 3 years, and 2 covered 4 years. Number of fixes per mountain goat ranged from 979 to 5,340 (median = 3,295, 25th percentile = 2,349, 75th percentile = 4,449). Thirty-one were females, 9 were nondispersing males, and 2 were dispersing males. Estimated ages during years of tracking were typically intermediate ($\bar{x} = 4.8$ yr, SD = 1.5 yr) with the bulk of the sample being for ages 3–6 years (86 summer starts and 67 winter starts) with less representation for younger (1–2 yr of age, 4 summer starts and 4 winter starts) and older (7–10 yr of age) animals (11 summer starts and 8 winter starts). Age was undetermined for animals covering 6 summer starts and 4 winter starts.

Of the 197,285 fix attempts by collars on the 42 mountain goats, 143,296 were successful, and 141,759 of these were not obvious errors (beyond the continuous distribution of distances from the median location). Examination of fix plots identified an additional 193 outliers, which I removed along with 324 fixes associated with visits to known or suspected mineral licks outside the individual animal's

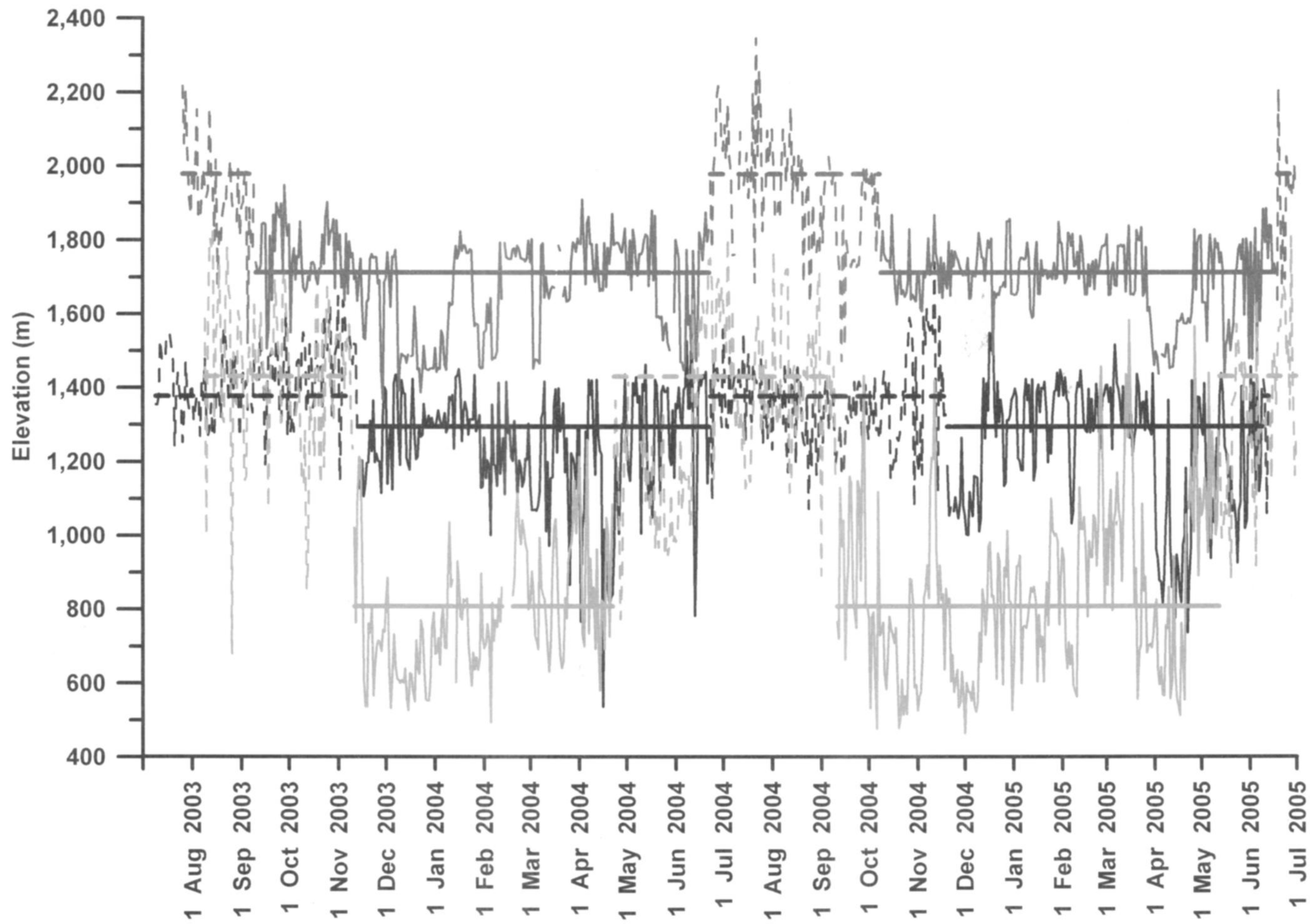

Figure 4. Example traces showing elevation records for the summer (dashed) and winter (solid) and median elevations by season for mountain goat 005DDM (black), 007GRF (gray), and 008SHF (light gray) in Washington, USA, 2003–2005.

normal range. Of the remaining 140,890 fixes I used in the analysis, 80.1% were 3-dimensional fixes.

Elevations recorded ranged 335–3,089 m and varied considerably among individuals (Fig. 3). Median elevations were 1,037–2,171 m and the interquartile ranges were 119–939 m. Short-term fluctuations in elevation were considerable, but even mountain goats using low ranges of elevation showed a tendency for higher elevation records to be in summer months and lower elevation records to be in winter months (e.g., Fig. 4).

Across all mountain goats and years, proportion of fixes classified as summer increased beyond 0.5 on 31 May, at almost the same time selection for bare terrain and parkland changed from negative to positive and selection for forest, grassland, and shrubland changed from positive to negative (Fig. 5). In the fall, transitions were more complex, with proportion of fixes classified as summer declining below 0.5 during a stable region of selection for bare terrain, slightly before selection for parkland changed from positive to negative, slightly after selection for grassland and shrubland changed from negative to positive, and about a month before selection for forest changed from negative to positive.

The iterative search designated start dates with a median of 6 June for summer and 19 October for winter across all individuals and years ($n = 66$ and 83, respectively), with a median duration of summer of 4.60 months and 7.32 months for winter ($n = 41$ and 66, respectively). Individuals varied considerably from these medians (Fig. 6).

Summer median elevations for individual mountain goats had a median of 1,591 m, which for winter was 1,353 m. Whereas many summer medians were 1,500–1,599 m, these ranged from 1,200 m to 2,257 m. Winter medians were more widely dispersed between 808 m and 2,103 m (Fig. 6). The difference between summer and winter medians also varied widely (median = 316 m, range 60–770 m; Fig. 6). The upper and lower extent of elevations also varied across individuals with the fifth percentile having a median of 1,101 m (range 569–1,757 m) and the 95th percentile having a median of 1,835 m (range 1,435–2,613 m; Fig. 6). Similarly, the central 90% range varied from 322 m to 1,562 m (median = 754 m; Fig. 6).

The proportional elevation overlap between summer and winter varied widely (Fig. 6) with a median of 0.39 (range 0.09–0.84). The nature of overlap also varied among individuals with some showing distinct peaks for each season that overlapped little (e.g., 050GRM; Fig. 7), somewhat (e.g., 045MRF), or highly (e.g., 024KRF). Other individuals showed a peak of elevation use for summer, but

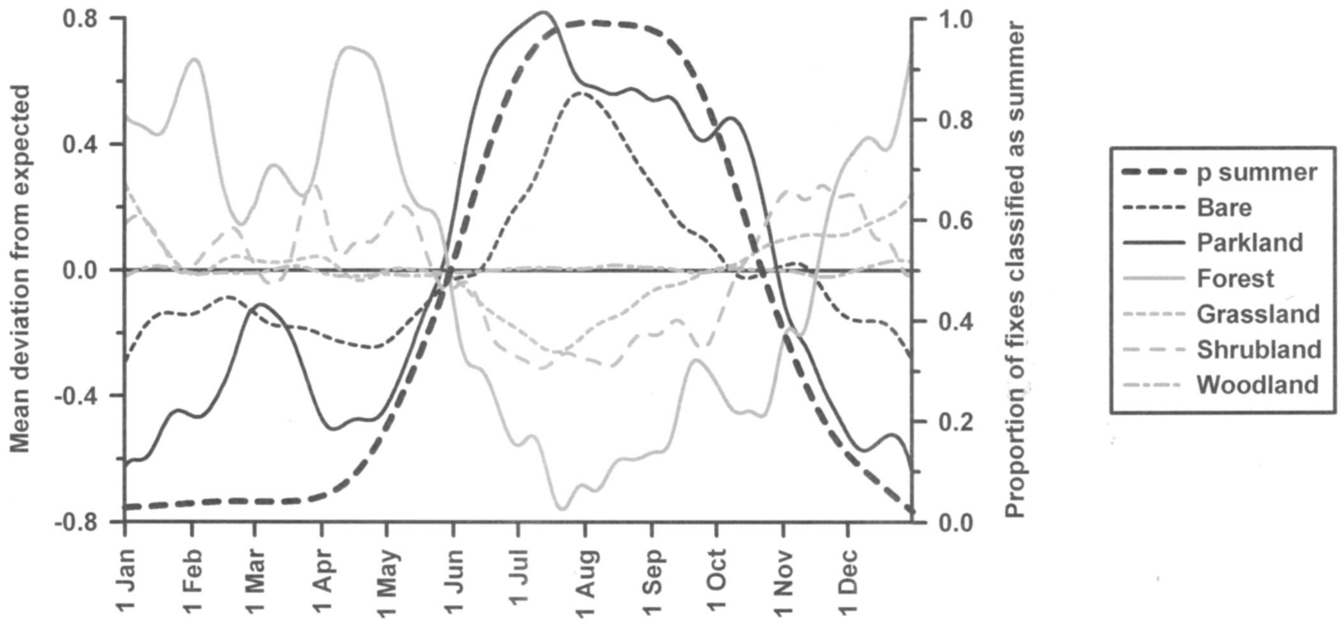

Figure 5. Proportion of mountain goat locations in Washington, USA, classified as summer (p summer) compared to selection for cover classes through the year. I smoothed proportions using local polynomial regression (plug-in bandwidth). Cover types favored in the summer are black, those favored in winter are gray (26 Sep 2002 to 22 Sep 2006).

not winter (e.g., 003SCF; Fig. 7), and vice versa (e.g., 047LMF) or a complex distribution of elevation use (e.g., 035NRF). Median distance between summer and winter median centroids was 1.8 km (range 0.1–19.8 km), most (83%) being <5 km (Fig. 6).

The date of the start of summer was affected by sex-dispersal class ($P = 0.049$; Fig. 8). Median date that females started summer was 14 days earlier than that of non-dispersing males (5 Jun and 19 Jun, respectively; Fig. 8). Median start of summer was much earlier for dispersing males (23 Apr) but is based on a small sample size for this group (5 summers for 2 individuals).

The date of the start of winter was affected by season-year ($P < 0.001$; Fig. 8). Median dates for 2003, 2004, and 2005 were 1 November, 18 October, and 17 October, respectively. The median date for 2002 of 17 December was based on only 2 individuals. Summer median elevation was not affected by any of the mountain goat classes considered ($P >$ 0.100; Fig. 8). Distance between summer and winter centroids varied by sex-dispersal class ($P = 0.013$; Fig. 8) with a median distance of 1.4 km for females, 3.4 km for nondispersing males, and 11.5 km for dispersing males ($n =$ 2).

Other measures (winter start, winter duration, summer duration, summer median, winter median, median difference, 90% range, overlap) were not related to sex-dispersal class ($P > 0.100$), nor were summer start, winter duration, or summer duration related to season-year, and age was not related to any of the measures ($P > 0.100$).

Metrics of altitudinal movements of mountain goats were often related. For instance, winter duration was correlated with summer and winter start dates (Table 1), which is not very informative. Other relationships can help in our understanding of altitudinal movements of mountain goats. Summer medians were correlated with winter medians. The difference in summer and winter median elevations was not correlated with the summer median elevation but was correlated with winter median elevation (Table 1). Notably, distance between summer and winter centroids was not correlated with any of the other measures.

DISCUSSION

This study area encompassed nearly all suitable mountain goat habitat in the Cascade Range so our results can be taken to represent the range of responses for the entire region. Nevertheless, the Cascade Range in Washington represents the southern limit of the distribution of mountain goats (Côté and Festa-Bianchet 2003) and patterns may be different in more northern coastal locations (BC and AK) and interior locations (the Rocky Mountains of Canada and the United States).

Visual inspection of the distribution of the measures I used to evaluate altitudinal movements (Fig. 6) showed a considerable range of values indicating a wide range of response among individuals. For the measures that most clearly define seasonal altitudinal migration, there is little evidence of central tendency (Fig. 6). Nor is there evidence in these distributions of a bimodal pattern that would be expected if individuals were naturally partitioned into migratory and nonmigratory groups. Rather, there is a continuous response among individuals in the degree of their altitudinal migration.

Distributions of summer and winter start dates (medians of 6 Jun and 19 Oct, respectively) exhibited several outliers (Fig. 6). Those at the start of summer included one of the dispersing males (009GRM), where he had his highest elevations in the spring of 2004 (around 2,650 m). These locations were on the flanks of Mt. Adams and were the

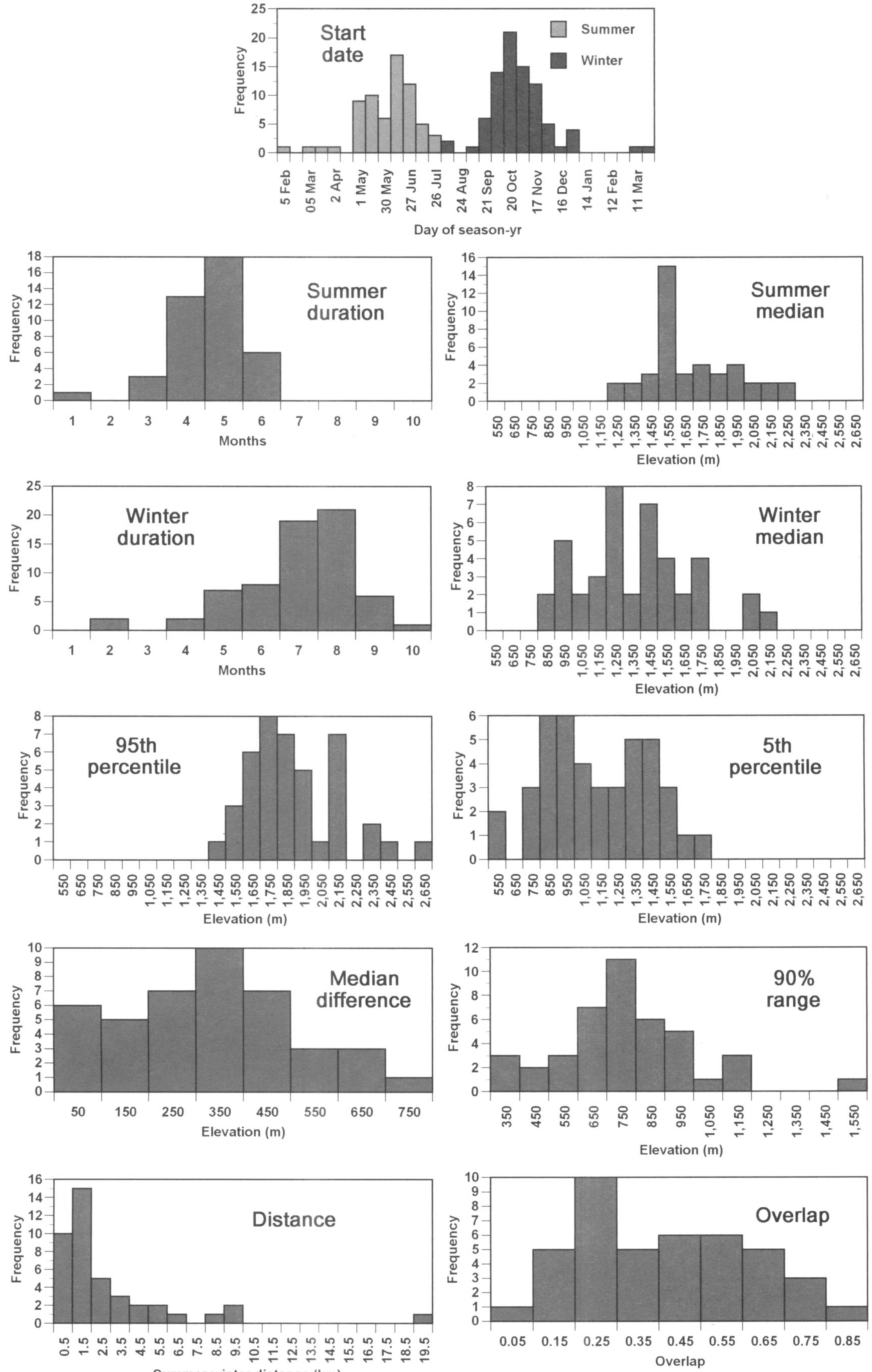

Figure 6. Frequency distributions of measures of seasonal altitudinal movements of mountain goats in Washington, USA (26 Sep 2002 to 22 Sep 2006).

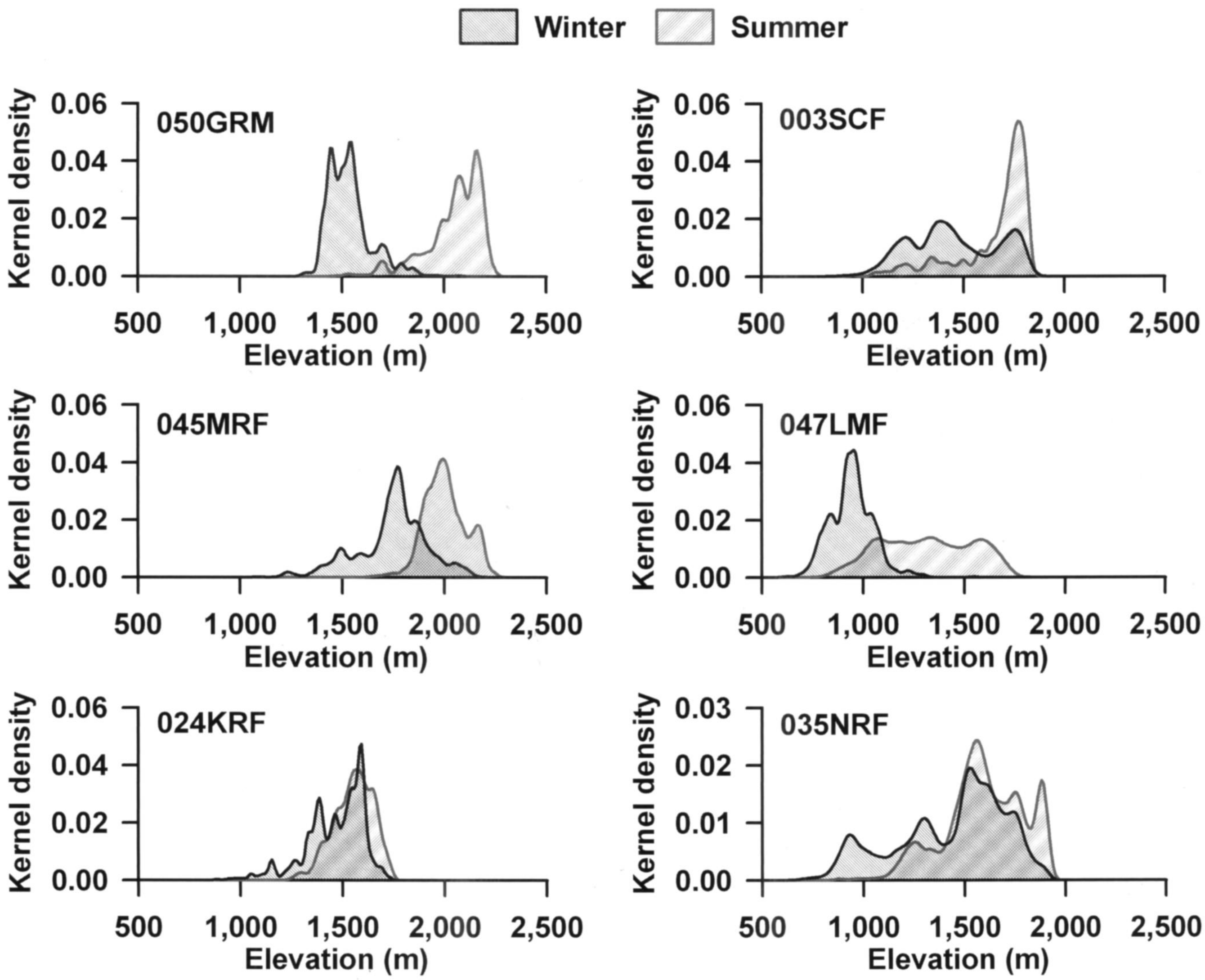

Figure 7. Example distributions of elevation use (kernel densities) by season for 6 mountain goats in Washington, USA (26 Sep 2002 to 22 Sep 2006). I transformed kernel densities to sum to one for each season for each individual.

highest locations for any of the collared mountain goats. Two other summer start date outliers occurred for females in 2006, when Snotel data showed that snow melt-off was 4–5 weeks earlier than other years. There were 2 extremely late values for the start of winter (Fig. 6). These were also in 2006, when there was little snow until mid-March, so some of these extreme values are associated with unusual movements by an individual or associated with low snow cover depth and duration, but some may be considered estimation error.

Notably, summer start dates did not vary consistently by season-year. Given that weather and snow cover vary and hence snow melt-off and vegetative resurgence vary greatly among years in the Cascade Range (Mote et al. 1999), parturition, predator avoidance, or possibly some other factor evidently determined when females returned to higher elevations.

Winter start dates did vary among years (Fig. 8) with medians of 1 November, 18 October, and 17 October for 2003–2005, respectively. Although patterns of snowfall vary greatly in the Cascade Range, records from Snotel sensors within mountain goat range typically recorded first snow accumulation later in 2003 (1 Nov) than in 2004 and 2005 (21 and 24 Oct, respectively), indicating a rough relative correspondence between initial snow accumulation and the start of winter. A detailed examination of relationships between date, elevation, and snow cover is beyond the scope of my analysis, but would further our understanding of the relationship between altitudinal movements of mountain goats and snow cover. Mountain goats apparently showed a similar pattern snow-induced synchrony in fall movements in Montana (Smith 1977) and eastern British Columbia (Poole and Heard 2003).

The correlation of the difference between summer and winter median elevations with winter median elevation, but not with summer elevation (Table 1), indicated that greater altitudinal movement was a consequence of utilization of lower elevations during winter and not due to utilization of higher elevations during summer.

It is noteworthy that the distance between summer and

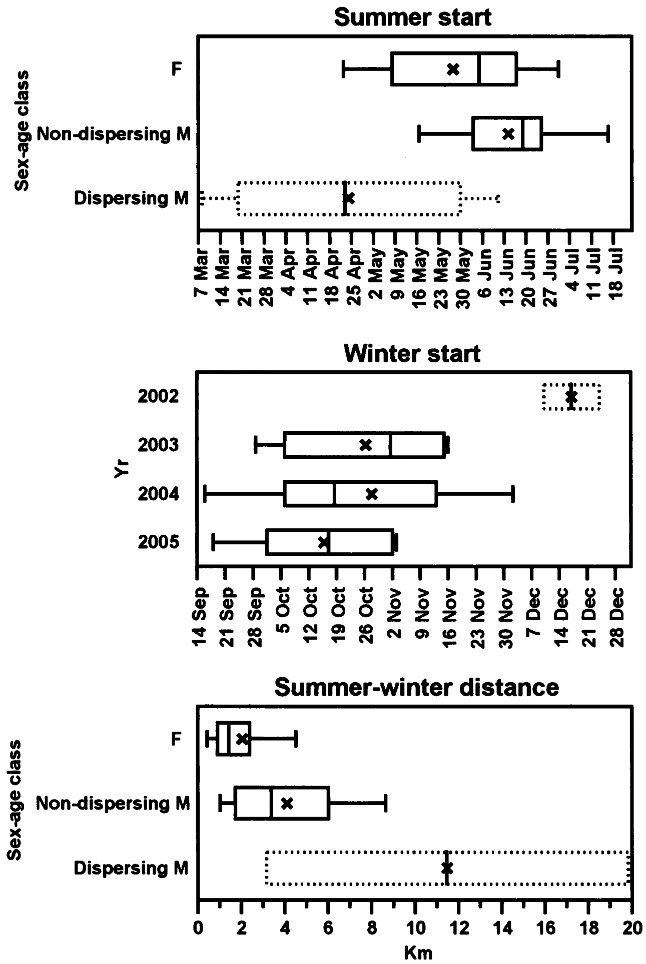

Figure 8. Comparisons of measures of altitudinal movement among mountain goats in Washington, USA, partitioned where I found significant differences (26 Sep 2002 to 22 Sep 2006). Each box shows the 25th–75th percentiles with the middle bar at the median. Means are marked by X. Whiskers extend from 10th to 90th percentiles. Groups with low sample size are shown in dashed lines.

winter centroids showed almost no relationship with the measures of altitudinal movement (Table 1). Horizontal movements have been the typical focus of seasonal movements of animals in mountain environments, including ibex (Parrini et al. 2003, Grignolio et al. 2004), mule deer (Nicholson et al. 1997), roe deer (Mysterud 1999) sika deer (Igota et al. 2004), elk and red deer (Hebblewhite et al. 2006, Luccarini et al. 2006) and coyotes (*Canis latrans*; Gantz and Knowlton 2005), even when altitudinal movement is considered to be the primary characteristic of these movements (Lovari et al. 2006; chamois). Using horizontal distance would appear to be a poor measure upon which to base analysis of this phenomenon and may be misleading.

Although the extent of horizontal movement has definite implications for conservation and management of these species and their habitats, in mountain environments elevation is closely tied to meteorological conditions, plant communities, and plant phenology and thus has greater ecological significance than distance. Therefore, I considered horizontal movement to be a consequence of altitudinal movement, not the reverse. Although longer distance movements incur greater energetic costs, energetic expenditures for altitudinal movements are also substantial (Dailey and Hobbs 1989).

Some mountain goats in my study showed little altitudinal movement, whereas other mountain goats showed considerable altitudinal movement. Likewise some moved several kilometers in the course of seasonal movements, others quite little. Also, some individuals moved frequently between elevations within the range they used, whereas others had more discrete distributions of elevation use (Fig. 7). In the latter case, altitudinal movements may be considered primarily facultative (Hahn et al. 2004), in response to conditions varying over short durations. To some extent, seasonal movements (altitudinal migration) may be considered long-term facultative movements, merely being a long-term response to a long-term change in conditions. In mountain goats, the distinction between facultative altitudinal movements and altitudinal migration is far from clear. Presumably, costs and benefits of remaining at a given elevation and costs and benefits of traveling to a new elevation in response to varying conditions are balanced over a wide range of conditions among years, locations, and individuals. Seasonal movement decisions are therefore more appropriately considered in the context of how much, rather than yes or no. The yes or no are instead a special case

Table 1. Pearson correlation coefficients for median values among individuals for mountain goat altitudinal movements in Washington, USA (26 Sep 2002 to 22 Sep 2006).

	Start date		Duration		Elevation					
Variable	Summer	Winter	Summer	Winter	Summer	Winter	Elevation difference	90% range	Overlap	Distance
Summer start date		0.011	−0.654	0.770	−0.103	−0.235	0.286	0.189	−0.288	0.035
Winter start date	0.011		0.645	−0.560	−0.168	−0.186	0.091	−0.092	0.012	0.045
Summer duration	−0.654	0.645		−0.875	−0.294	−0.054	−0.315	−0.381	0.286	0.003
Winter duration	0.770	−0.560	−0.875		0.160	−0.039	0.306	0.373	−0.265	0.009
Summer elevation	−0.103	−0.168	−0.294	0.160		0.826	0.011	0.012	−0.044	0.062
Winter elevation	−0.235	−0.186	−0.054	−0.039	0.826		−0.555	−0.395	0.394	0.081
Elevation difference	0.286	0.091	−0.315	0.306	0.011	−0.555		0.719	−0.765	−0.052
90% elevation range	0.189	−0.092	−0.381	0.373	0.012	−0.395	0.719		−0.306	−0.074
Elevation overlap	−0.288	0.012	0.286	−0.265	−0.044	0.394	−0.765	−0.306		−0.113
Horizontal distance	0.035	0.045	0.003	0.009	0.062	0.081	−0.052	−0.074	−0.113	

of a more generalized response that is seen when suitable conditions (i.e. habitat) are spatially separated.

MANAGEMENT IMPLICATIONS

Land managers need to recognize that seasonal altitudinal movements of mountain goats are highly variable. Consequently, the management needs of each population must be considered separately, and consequences of these movements for forest practices (e.g., logging, road and trail construction, and management of recreation) that can impact mountain goat habitat will be specific to each setting.

The general perception of mountain goats as an inhabitant of the alpine and subalpine zones would appear to be highly biased by the frequency of summer observations. In reality, mountain goats typically spent the majority of the year in shrubland, forests, and grasslands. Much of our knowledge of mountain goats is based on research conducted during the summer, but managers should encourage investigations emphasizing mountain goats during winter and in winter habitats.

ACKNOWLEDGMENTS

This study was a cooperative one and benefited from the contributions of the United States Forest Service (D. Gay, P. Reed, T. Kogut), Western Washington University (T. Bues, D. Wallin), the Sauk-Suiattle Tribe (C. Danilson), the National Park Service (R. Christophersen, J. Schaberl), and other employees of the Department of Fish and Wildlife (J. Bernatowicz, J. Bohannon, M. Davison, G. Falxa, S. Fitkin, B. Hall, L. Leschner, T. McCall, R. Milner, W. Moore, R. Spencer). W. Chang, S. Côté, K. Jenkins, T. Kogut, S. Pearson, E. Rice, K. White, and 4 anonymous reviewers provided comments on the manuscript. Support for this work was from United States Fish and Wildlife Service under the State Wildlife Grants Program and Federal Aid in Wildlife Restoration, the Wildlife Research Program of Seattle City Light, the Sauk-Suiattle Tribe, and the United States Forest Service.

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Associate Editor: Hudson.

Appendix H

Kylie Paul Environmental Consulting

4/28/17

POTENTIAL CONFLICTS BETWEEN WILDLIFE AND OVER-SNOW RECREATION IN THE SCOTCHMAN PEAKS/SAVAGE PEAK AREA

SUMMARY

The Scotchman Peaks, including Savage Peak and Savage Basin, contain valuable winter range habitat for mountain goats and important habitat for other species such as wolverines, grizzly bears, and Canada lynx. Winter is a difficult time for wildlife survival, with marginal food resources and higher physiological stress. For mountain goats in particular, winter range is a highly restricted and thus critical area for them, as they require both protection from predators and proximity to limited food sources in mountainous areas. In addition to these wintery challenges, mountain goats are also highly sensitive to human disturbances such as snowmobiles. Their responses to disturbance can change mountain goat population dynamics. Restricting motorized recreational use from mountain goat winter range helps minimize impacts during this difficult season.

Land and wildlife management agencies (Montana Fish Wildlife & Parks and United States Forest Service) have been concerned about snowmobiling in mountain goat habitat in the Scotchman Peaks area, particularly into Savage Peak/Mountain region for many years. Those agencies support the continuation of non-motorized activities and wilderness designation in the Scotchman Peaks and Savage Peak area. Preserving the year-round closure to motorized activity across the Scotchman Peaks including the Savage Peak area, regardless of wilderness designation, will continue to protect the wildlife and wildlife habitat in this unique setting.

THE SCOTCHMAN PEAKS CONTAIN HIGH-QUALITY WILDLIFE VALUES

The Scotchman Peaks Recommended Wilderness Area (Scotchman Peaks) is within the Cabinet Mountains on the border of Montana and Idaho. The Scotchman Peaks sit within both the Kootenai National Forest and the Idaho Panhandle National Forest. Savage Peak (also known as Savage Mountain) and Savage Basin, the basin northeast of Savage Peak, is an important area within the Scotchman Peaks on the Montana side in the Kootenai National Forest. This area contains valuable habitat and supports a variety of important wildlife species such as mountain goats, wolverine, and grizzly bears.

MOUNTAIN GOAT HABITAT IN THE SCOTCHMAN PEAKS

Mountain goats are native to most of the mountain ranges of western Montana (Rideout 1977). They occupy the highest, coldest, most rugged regions of any ungulate in North America (Chadwick 1983). Mountain goats display seasonal altitudinal migrations over short distances (White 2006; Rice 2008), with all mountain goat habitat generally characterized as areas close to escape terrain (steep slopes, usually ≥40°) such as cliffs and away from valleys (Festa-Bianchet and Côté 2008; Shafer et al. 2012). Mountain goats thus are limited to relatively small areas of suitable habitat (Canfield et al. 1999).

Winter is an important season for mountain goats and is characterized by high juvenile mortality (Poole et al. 2009) and restricted, shorter movements (Chadwick 1983; White 2006) that are influenced by snow depth and snowpack (Richard et al. 2014). Winter range is considered critical habitat for mountain goats (Côté and Festa-Bianchet 2003), and their winter ranges are much smaller than summer ranges, ranging from 2%–50% of the size of summer ranges (Taylor et al. 2006; Poole et al. 2009).

Generally, mountain goats winter range occurs in rugged habitat at upper mid-elevations and on warmer aspects, close to escape terrain (Poole et al. 2009). They spend most their time near escape terrain to avoid and escape predation (Chadwick 1983; Gross et al. 2002; Hamel and Côté 2007; Poole et al. 2009) and for shelter from harsh weather (von Elsner-Schack 1986). They also require easy access to summer range and kidding areas. As early as late April, nannies select the most isolated and forbidding terrain to give birth (MFWP 2016).

There are some winter habitat use differences between populations in western North America, with two wintering strategies that occur: (1) populations from interior regions (e.g., the Rockies) spend winter above treeline on windswept ridges and ledges found in steep rugged terrain (Hebert and Turnbull 1977; Côté and Festa-Bianchet 2003; Poole et al. 2009), while (2) coastal populations living in areas of greater snowfall migrate downhill to spend winters in low-elevation forested areas (Hebert and Turnbull 1977; Poole and Heard 2003; Taylor et al. 2006; Poole et al. 2009). There also appear to be different strategies to avoid deep snow within the populations of the interior mountainous regions, with animals wintering either: (1) on high-elevation wind-swept slopes or (2) inhabiting rocky bluffs at treeline in areas of higher snowfall where wind-swept slopes are unavailable (Hebert and Turnbull 1977; Rideout 1977; Chadwick 1983; Poole and Heard 2003). There are also differences of fine-scale habitat use in the winter depending on sex and individual, with some level of differing habitat preferences between the sexes (Festa-Bianchet and Côté 2008; Shafer et al. 2012) and with differences in movement patterns accounting for differences in home range sizes among individuals (Poole and Heard 2003).

Throughout the entire Kootenai National Forest, only the West Cabinet and Cabinet Mountains, within which the Scotchman Peaks is situated, offer mountain goat habitat (KNF 2015a). The Scotchman Peaks, including Savage Peak, contain high-quality mountain goat winter range (Figure 1) and have long had a population of mountain goats (Joslin 1980). Savage Peak and surrounding smaller summits are characterized by very steep slopes with cliffs, offering escape terrain. The Savage Peak area contains both important winter range and summer transitional range, between and within which mountain goats need to move easily to prosper (Joslin 1980; Joslin, G. personal communication, April 6, 2017).

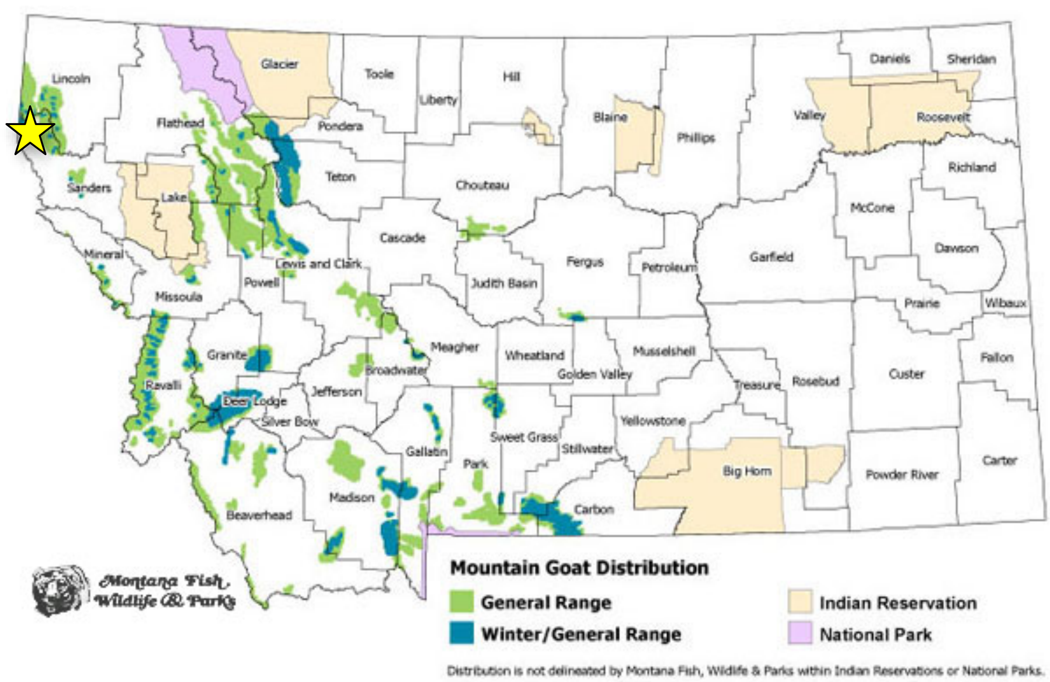

Figure 1 Mountain goat general range and winter range in Montana. Star is Savage Peak area. Data available at Montana Field Guide.

POPULATION AND STATUS OF MOUNTAIN GOAT IN MONTANA

Mountain goats are currently ranked as a Montana Species Ranking Code S4, so they are considered "apparently secure, though it may be quite rare in parts of its range, and/or suspected to be declining."[1] Similarly to other nearby regions such as Alberta, the overall population declined in the past and now contains some smaller populations that are stable, some that are increasing, and others that are continuing to decline (Gonzalez-Voyer et al. 2003; Koeth 2008).

Montana Fish Wildlife & Parks has documented mountain goats in the Scotchman Peaks area for decades (MFWP 2016). Goat numbers peaked in the late 1930s at 110 animals and steadily declined to 20-25 goats in the 1970s (Burleigh 1978). In the late 1970s, due to concerns over these decreasing mountain goat numbers, Montana Fish Wildlife & Parks closed goat hunting in mountain goat Hunting District 101, which includes the Scotchman Peaks. Montana Fish Wildlife & Parks and the Kootenai National Forest then performed research that led to the development of a goat management plan, a joint memorandum of understanding, and a population augmentation project for mountain goats (Joslin 1980). Montana Fish Wildlife & Parks slowly reinstated harvest in the late 1980s, but because mountain goat numbers did not increase to the degree expected and because of concerns over decreasing goat numbers in this area and across their range, the agency again reduced goat harvest quotas in mountain goat Hunting District 101 in 2010 (MFWP 2016). Currently, Montana Fish Wildlife & Parks continues to monitor goat numbers and other game species using aerial surveys and hunter harvest information.

GRIZZLY BEAR HABITAT IN THE SCOTCHMAN PEAKS

Grizzly bears are listed as a threatened species under the Endangered Species Act. Grizzly bear distribution has been reduced to five areas in the western United States, and there are six individual recovery zones delineated in the lower-48 states to include "adequate space and suitable habitat for securing and restoring viable self-sustaining grizzly bear populations in perpetuity" (USFWS 1993). These six recovery zones include the Greater Yellowstone, Northern Continental Divide, Cabinet-Yaak, North Cascades, Selkirk, and Selway-Bitterroot grizzly bear ecosystem.

The Cabinet-Yaak Recovery Zone includes the Scotchman Peaks, which contain core grizzly habitat (Figure 2)(Proctor et al. 2015). The grizzly bear population in the Cabinet-Yaak Recovery Zone was estimated at 48-50 bears in 2012, with 22-24 of those occurring in the Cabinets area (including Scotchman Peaks) (Kendall et al. 2016). To improve genetic diversity and increase the population, population augmentation has been successfully accomplished on several occasions in the Cabinet Mountains since 1979, with the most recent grizzly bear released in 2016 at Spar Lake, near the Savage Peak area (IGBC 2016). Given its small population size and the slow reproductive rate of the species, the Cabinet-Yaak population is highly sensitive to mortality and disturbance.

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[1] Montana Fish Wildlife & Parks. Montana Field Guide: Mountain Goat. http://fieldguide.mt.gov/speciesDetail.aspx?elcode=AMALE02010

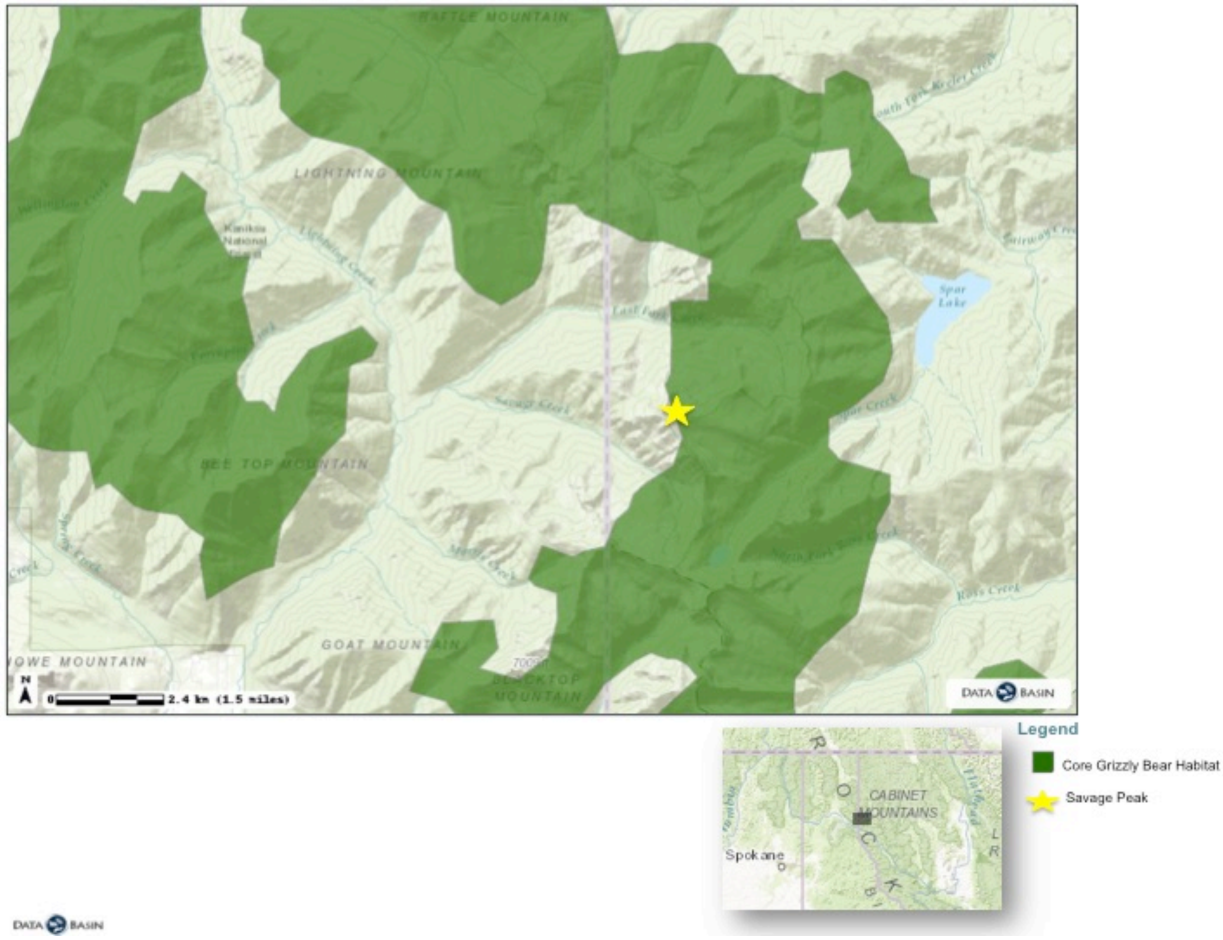

Figure 2. Grizzly bear core habitat in the Scotchman Peaks area. Data from Proctor et al. 2015 on Databasin.

WOLVERINE HABITAT IN THE SCOTCHMAN PEAKS

Wolverines are again under consideration for listing under the Endangered Species Act. Population number and trend in the contiguous United States are unknown, though the population is generally estimated at 250-300 individuals (USFWS 2013).

Wolverines in the northern Rockies live primarily in high-elevation environments that maintain colder temperatures and reduce competition with other carnivores (Copeland et al. 2010; McKelvey et al. 2011; Inman et al. 2013). The Scotchman Peaks contain both primary and maternal wolverine habitat, with the Savage Peak area containing maternal denning habitat, the most limiting and thus valuable habitat type for wolverines (Figure 3).

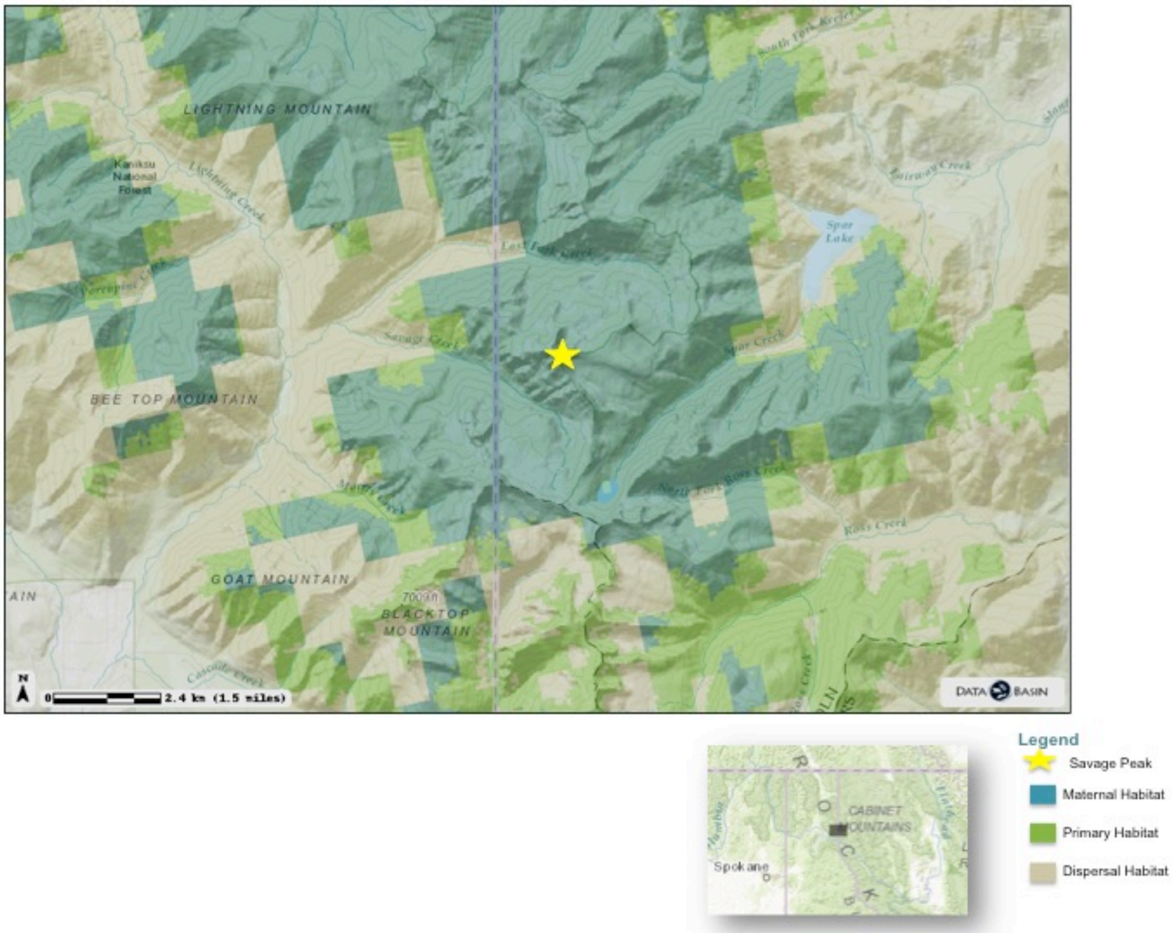

Figure 3. Wolverine primary habitat, maternal habitat, and dispersal habitat in the Scotchman Peaks area. Data from Inman et al. 2013 available on Databasin.org. Primary wolverine habitat is defined as the area within the climactic limits of wolverines that resident adult wolverines are expected to occupy, and maternal habitat is defined as areas that contain attributes consistent with those measured around the known wolverine dens used in the Inman et al. (2013) study.

CANADA LYNX HABITAT IN THE SCOTCHMAN PEAKS

Canada lynx are listed as threatened under the Endangered Species Act. Population number and trend in the contiguous United States are unknown.

Lynx habitat is characterized by moist boreal forests that have cold, snowy winters and a high-density snowshoe hare prey base (Interagency Lynx Biology Team 2013). The range of lynx in the West has diminished over the last century, suggesting that lynx may be negatively impacted by human activities (Koehler and Aubry 1994).

The Kootenai National Forest is home to one of just a few known resident lynx populations in the lower 48 states. Critical habitat has been designated within the Kootenai National Forest, and the Forest is designated “occupied lynx habitat” (Figure 4). The entire Kootenai National Forest is in “core area” as described in the Lynx Recovery Outline (USFWS 2005). The Scotchman Peaks are considered occupied and core habitat, though they are not included within Critical Habitat.

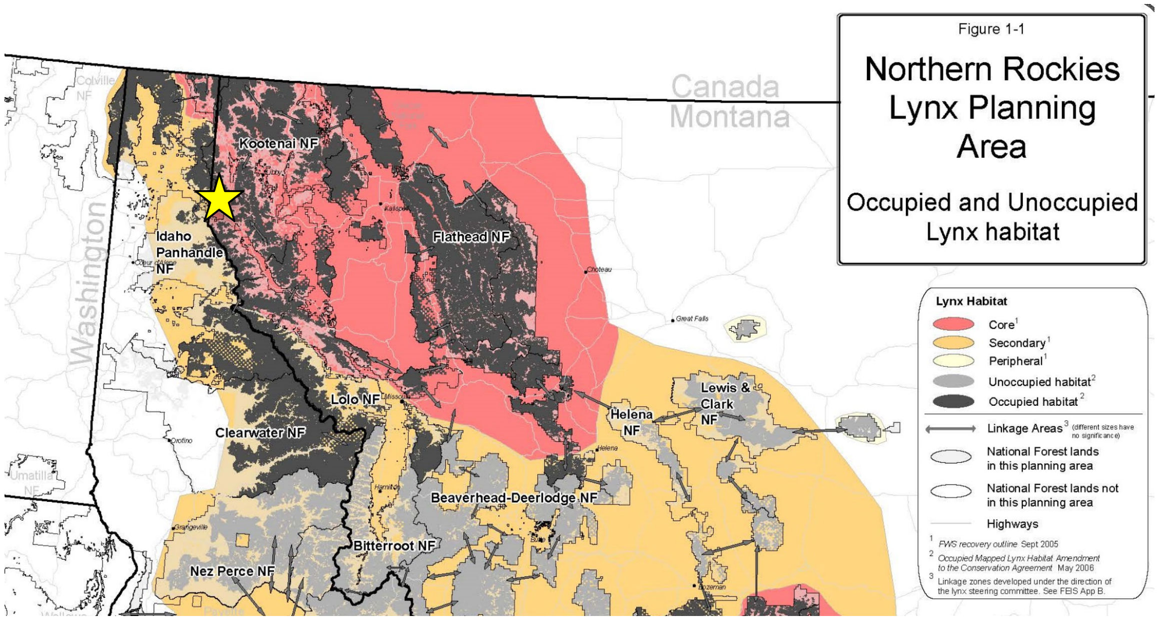

Figure 4 Canada lynx habitat in the Northern Rockies, including Kootenai National Forest and Scotchman Peaks area. Star is Savage Peak area. Map from USFS at www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5446686.pdf

WILDLIFE ARE IMPACTED BY SNOWMOBILES

Motorized winter backcountry recreation is one of the fastest growing recreational activities in the United States (Cook and O'Laughlin 2008). In 1982-83, government surveys put the number of snowmobile participants in the United States at 5.3 million (Cordell et al. 1999). The most recent survey, conducted in 2010, estimates that in the United States, 10.7 million people now snowmobile annually (Cordell 2012). Due to advanced technology with more powerful machines, snowmobiles and new "snow bikes" (modified motorcycles with tracks instead of wheels) are now better able to reach areas that were previously inaccessible.

While snowmobiling continues to grow in popularity, snowpack continues to decline due to climate change. Recent warming has already led to substantial reductions in spring snow cover in the mountains of western North America (Mote et al. 2005; Pederson et al. 2010). This continues to further concentrate motorized winter recreation into the smaller amounts of available, sufficiently snowy areas. Wildlife that require snowy habitats will also have reduced amounts of available habitat and will essentially need to compete for the same remaining snowy habitat as snowmobilers. For instance, numerous studies indicate that global climate change is likely to negatively affect wolverine habitat (Gonzales et al. 2008; Copeland et al. 2010; McKelvey et al. 2011; Peacock 2011; Johnston et al. 2012). Additionally, climate modeling suggests that snow accumulation and duration are expected to decline and that lynx habitat and populations are anticipated to decline accordingly (Carroll 2007) and may disappear completely from parts of their range by the end of this century (Johnston et al. 2012). This leads to increasing concern for wildlife and their ability to find secure winter habitat.

Any disturbance, such as that from snowmobiles, during this important winter period can negatively affect productivity and other vital rates (May et al. 2006; Krebs et al. 2007). Snowmobiles can cause harassment, habitat loss, and mortality of wildlife such as ungulates (Dorrance et al. 1975; McLaren and Green 1985;

Freddy et al. 1986; Tyler 1991; Olliff et al. 1999a; Olliff et al. 1999b; Seip et al. 2007; Harris et al. 2014; Switalski 2016).

OTHER SPECIES ARE IMPACTED BY SNOWMOBILES

This document focuses on snowmobiles and mountain goats – yet other species of concern within this region are also impacted by snowmobiles including wolverines, grizzly bears, and Canada lynx.

Wolverine researchers and natural resource managers have long expressed concerns about effects of winter recreation on wolverine populations, as motorized winter recreation can negatively impact wolverine particularly by disrupting natal denning areas (Hornocker and Hash 1981; Copeland 1996; Carroll et al. 2001; Rowland et al. 2003; May et al. 2006; Copeland et al. 2007; Inman et al. 2007; Krebs et al. 2007; Lofroth and Krebs 2007; Ruggiero et al. 2007; Heinemeyer and Squires 2013). Female wolverines select and enter dens and give birth in February to mid-March (Magoun and Copeland 1998) and the overlap of winter recreation with this energetically taxing period is highly concerning.

Grizzly bears denning habitat often overlaps with winter recreation areas, making them susceptible to disturbance at their den sites and upon emergence (Linnell et al. 2000). Potential effects of disturbance to denning bears include elevated energy use from increased movements in the den (Reynolds et al. 1986; Schoen et al. 1987), den abandonment (Craighead and Craighead 1972; Reynolds et al. 1976; Harding and Nagy 1980; Schoen et al. 1987), potential loss of cubs (Schoen et al. 1987), and displacement from denning areas (Craighead and Craighead 1972; Schoen et al. 1987). Females with cubs may be more vulnerable to snowmobile disturbance following den emergence than during the denning period (Mace and Waller 1997).

Snow-packed trails created by snowmobiles have been considered as possibly serving as travel routes for potential competitors and predators of Canada lynx, especially coyotes (Ozoga and Harger 1966; Murray and Boutin 1991; Koehler and Aubry 1994; Murray et al. 1995; Buskirk et al. 2000) though the causal relationship is not entirely clear (Bunnell et al. 2006; Kolbe et al. 2007; Burghardt-Dowd 2010). As snow levels diminish with climate change, lynx habitat will shrink and winter recreation will continually become a more serious threat to the persistence of lynx.

MOUNTAIN GOATS ARE IMPACTED BY SNOWMOBILES

Research has firmly established that undisturbed winter range is essential for ungulate survival (Canfield et al. 1999). Snowmobile activity disturbs wintering ungulates through physiological stress (Canfield et. al 1999; Creel et al. 2002) from increased movements and higher energy expenditures (Dorrance et. al 1975; Freddy et. al 1986; Tyler 1991; Colescott and Gillingham 1998; Borkowski et al. 2006).

Predation appears to be the main cause of mortality for mountain goats (Festa-Bianchet and Côté 2008). As such, predation risk appears to be the main factor influencing mountain goat space use, as they are strongly associated with escape terrain and aggregate in groups (Hamel and Côté 2007; Gross et al. 2002; Festa-Bianchet and Côté 2008; Richard et.al 2014). To avoid predators, mountain goats rely on detecting them by sight or sound from distance and then moving into escape terrain where predators are unable to follow (Festa-Bianchet and Cote 2008). Mountain goats are particularly sensitive to human disturbances (Festa-Bianchet and Côté 2008; St-Louis et al. 2013; Richard and Côté 2016), using the same anti-predator strategy. They change their behavior (e.g. increased alertness and reduced time foraging) and their spatial distribution (e.g. moving or running) when facing various human-caused activities (Singer 1978; Foster and Rahs 1983; Joslin 1986; Côté 1996; Gordon and Reynolds 2000; Côté et al. 2013; St-Louis et al. 2013; Richard and Côté 2016). These short-term impacts on behavior could translate to consequences to movement rates, range use, and ultimately, survival and population productivity (Festa-Bianchet and Côté 2008).

The trigger for behavioral responses to human disturbances can be quite distant; in one study in Alberta, goats were highly disturbed and increased their alertness behaviors when helicopters flew nearby, with no habituation seen across numerous years of helicopter traffic (Côté et al. 2013). Researchers subsequently recommended helicopter flights should not approach closer than 1,500 m (4,920 ft) from mountain goat groups (Cadsand 2012; Côté et al. 2013).

Mountain goats' struggle to move away from disturbance can be energetically taxing. Living in harsh winter habitat, mountain goats have a low margin for unnecessary energy costs without impacts on survival and reproduction (Harris et al. 2014). As Montana Fish Wildlife & Parks has noted, at winter's end, goats have nearly depleted all their fat reserves, and "goats are right on the survival line in late winter and early spring…That's also when snow is hardest and snowmobilers like to 'high-mark' [climb snow-covered mountainsides]" (Koeth 2008).

These responses to disturbance can change mountain goat population dynamics. One of the factors thought to contribute to declines in mountain goat populations is repeated disturbance (Joslin 1986; Festa-Bianchet and Côté 2008). For instance, the cumulative effects of stress caused by a high amount of motorized human disturbance in one Montana population may have been responsible for reduced kid production, reduced numbers of female goats, and a declining goat population (Joslin 1986). All-terrain vehicle use on trails in mountain goat summer range in Alberta caused moderate to strong disturbance reactions by goats 44% of the time, with potential detrimental effects on fitness-related behaviors such as feeding and parental care (St-Louis et al. 2013).

For mountain goats, winter range is a highly restricted area, as they spend most of their time close to escape terrain (Poole et al. 2009). While these small areas of winter range are often less accessible to humans, the advancing technology of over-snow vehicles offers increased human access to areas of mountain goat winter habitat (Koeth 2008). In general, mountain goats are at risk from snowmobile activity, with their high sensitivity to disturbance and with the ensuing behavioral responses and energetic costs that can negatively impact population dynamics.

POTENTIAL CONFLICTS BETWEEN MOUNTAIN GOATS AND SNOWMOBILES IN THE SCOTCHMAN PEAKS AND SAVAGE PEAK AREA

SNOWMOBILE USE IN THE SCOTCHMAN PEAKS AND SAVAGE PEAK AREA

The Kootenai National Forest has long recognized the ecological importance of the Scotchman Peaks area and has supported congressional action for wilderness designation of the Scotchman Peaks. In 1987 and 2015 the Kootenai National Forest recommended the Scotchman Peaks area for wilderness (KNF 1987). Motorized restrictions proposed in the 1987 Forest Plan in recommended wilderness were formalized in 2001, when the Kootenai National Forest created a Special Order (#F14-064S01) that restricted all motorized access year-round in the Scotchman Peaks (KNF 2013a). In the 2015 forest plan revision, the Kootenai National Forest re-evaluated the area and concluded it continues to merit for a recommended wilderness designation (KNF 2015b). The Scotchman Peaks thus remain closed to over-snow vehicles (KNF 2015b).

Over-snow motorized access was legal on the Idaho Panhandle National Forest until 2015, when the Forest signed an Order (#01-04-00-15-001) prohibiting winter motorized access on the Idaho Panhandle National Forest side of the Scotchman Peaks within the Sandpoint Ranger District. This preserved the motorized access restrictions on the Montana side, especially in the areas around Savage Peak, and helped maintain consistency of existing conditions from Idaho into Montana.

Some snowmobilers would prefer to have access into the Savage Peak/Basin area.[2] However, this is not feasible nor in line with Kootenai National Forest goals, as clarified by the Kootenai National Forest:

> The Savage Peak…area [is an] important part of the Scotchman Peaks recommended wilderness area…The Savage Peak area has been closed to over-snow vehicle use since the 1987 Forest Plan was adopted… Under the revised Forest Plan, the boundary for the Scotchman Peaks recommended wilderness area was drawn to be identifiable on the ground and manageable. (KNF 2013b).

CONCERNS WITH MOUNTAIN GOATS AND SNOWMOBILES IN SAVAGE PEAK AREA

The mountain goat population in the Scotchman Peaks has concerned Montana Fish Wildlife & Parks and Kootenai National Forest due to its declining population for decades (MFWP 2016). Research indicates that small mountain goat herds (<50 animals) have a high extinction risk (18%-82% over 40 years) even in the absence of harvest (Hamel et al. 2006), so managing for the factors underlying these population declines is critical.

Scotchman Peaks and Savage Peak/Basin area contain important high quality winter range for mountain goats, and there is concern with human disturbance to mountain goats in the area. The Savage Peak area contains "management situation 1" lands in Joslin (1980), which are areas that provide critical mountain goat range during summer and/or winter. Joslin (1980) states: "Mechanized human activities should not occur in these areas. Human activities on adjacent areas should be kept to a minimum during the seasons when these areas are used by goats."

For over a decade, Montana Fish Wildlife & Parks has shared concerns of snowmobiling in mountain goat habitat in the Scotchman Peaks area, particularly into Savage Peak/Mountain region:

> The need to maintain mountain goat habitat security in the Scotchman Peaks Area is no less relevant today than it was 25 years ago. It is unfortunate that snowmobiling activity into Savage Mountain, right in the heart of the Scotchman Peaks goat range, has been allowed to continue unchecked over the past several years, despite the illegality of motorized access into this area as identified in the MA guidelines for this area. (MFWP 2004).
>
> FWP concurs with the proposed Scotchman Peaks #662 proposed Wilderness area as identified due to its value as critical native mountain goat habitat, elk and mule deer habitat, and important grizzly bear season-long habitats. FWP will soon be initiating grizzly bear augmentation efforts in the vicinity of this area. This area also satisfies a national demand for a backcountry hunting experience. FWP also concurs with the 5A designations for areas surrounding this proposed wilderness area (MFWP 2005).
>
> There is a mountain known as Savage Peak…that, despite precipitous elevations and forested areas, shows snowmobile tracks nearly to the top of the 6900' peak into March of most years. Despite steep terrain and high tree lines, snowmobilers continue to make advancements into sensitive terrain, areas particularly important to mountain goats such as that on Savage Peak. Because of this, MFWP sees many of the wilderness recommendations, including increased wilderness and backcountry areas presented in Alt. B…as positive (MFWP 2012).

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[2] http://missoulian.com/lifestyles/recreation/scotchman-peaks-straddle-weird-winter-patchy-politics/article_69ebd027-600e-5597-a083-a4f671d3fd0d.html

> This closure has "helped maintain habitat security for a number of species including mountain goats, wolverine, elk, and mule deer, to name a few." If this area were open to snowmobiling, it would "contradict what FWP recognizes as important and what literature suggests is tolerated by species like goats, lynx, wolverine, elk, and mule deer" (MFWP 2015).
>
> Jerry Brown, the now-retired FWP Biologist whose experience dates back to the 70s, created maps of the areas that he recommended remain restricted to motorized access year-round... His map included the area north of Drift Peak and south, through Star Peak - including both the Savage Mountain and Dry Creek areas - and even extended into Idaho, the entire area of which we have had concerns over potential impacts to wildlife security since the 70s. (MFWP 2016).
>
> We would like to reiterate that the entire Scotchman Peaks area contains important winter range habitat. As winter is a time of restricted ranges, limited food resources, and stress for many species, winter range is known as a limiting factor for big game. Containing and/or limiting motorized recreational use on unique habitat like winter ranges can help minimize direct impacts to wildlife (e.g., mortality due to increased human pressure, which results in higher activity rates, increased energy use, and stress). In general, current wildlife literature recommends routing human activities – especially motorized – away from goat winter range when possible… This act [closure to snowmobiles] has helped maintain habitat security for a number of species in this area, including goats, and we at FWP wish to maintain this important status quo. This existing condition of use is especially important because we know that current literature recommends minimizing the impacts of human disturbance on wildlife with standards such as: 1. Minimizing activities outside of currently used sites (Canfield 1999), 2. Concentrating activities within existing and designated sites (Canfield 1999), and 3. Limiting human intrusion into critical area such as winter range (Canfield 1999, USFS and BLM 2007, and Olliff et al. 1999) (MFWP 2016).

The Kootenai National Forest acknowledges the issue of mountain goats, snowmobiles, and the partnership with Montana Fish Wildlife & Parks in the Scotchman Peaks and Savage Peak area:

> Even if over-snow motorized recreation does not occur on the exact spot where mountain goats winter, the presence of over-snow motorized recreation near to those mountain goat winter ranges may cause enough disturbance to apply the aforementioned revised Forest Plan. Additionally, if through coordination with the State, and review of the best available information, it is determined that an area was winter range for mountain goats historically but they may no longer be present, it may be desirable to keep those areas available for re-colonization by mountain goats in the future. Again, FW-DC-WL-16 states that the KNF would coordinate native ungulate habitat management with the State. During that coordination the State may help the KNF identify areas of historic mountain goat winter range that are important for future re-colonization by mountain goats. Montana Fish, Wildlife and Parks has repeatedly noted their concern over potential snowmobiling impacts to mountain goats on winter range in the Savage Peak area, including during the public comment period in 2012 on the draft Forest Plan and DEIS. (KNF 2013b).

CONCLUSION

The Scotchman Peaks, including the Savage Peak region, is a special area, containing critical winter range habitat for mountain goats and important habitat for other species. Winter range is a limiting factor for mountain goats, and winter is a time of restricted ranges, limited food resources, and higher stress. As mountain goats are highly sensitive to human disturbances such as snowmobiles, restricting motorized recreational use from mountain goat winter range helps minimize impacts during this difficult season. Land and wildlife management agencies (Montana Fish Wildlife & Parks and United States Forest Service) support the continuation of non-motorized activities and wilderness designation in the Scotchman Peaks and Savage Peak area. Preserving the year-round closure to motorized activity across the Scotchman Peaks including the Savage Peak area, regardless of wilderness designation, will continue to protect the wildlife and wildlife habitat in this unique setting.

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Appendix I

Proc. Fifth Bienn. Symp. North.
Wild Sheep and Goat Council 1986

MOUNTAIN GOAT POPULATION CHANGES IN RELATION TO ENERGY EXPLORATION ALONG MONTANA'S ROCKY MOUNTAIN FRONT

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Abstract: A mountain goat (Oreamnos americanus) study was initiated in 1981 along the east slope of Montana's Rocky Mountains (823 km²) to quantify population parameters and monitor energy exploration activity. Twenty-four radio-marked goats provided seasonal home range information. Observations of the radio-marked and 8 neckbanded goats provided reproductive histories for adult females, and annual survey efficiency. The adult female population trend was stable in the Birch-Badger segment but declined significantly in the Teton-Dupuyer segment. Kid:adult female (K:ADF) ratios in the Birch-Badger segment dropped 81% from 1983 to 1984, and 62% in the Teton-Dupuyer segment from 1982 to 1983. Beginning in 1981, energy exploration dramatically increased. From 1981 to 1985, about 579 km of seismic lines were shot within mountain goat habitat. This activity peaked during 1983 and 1984. Radio-telemetry information did not indicate abandonment of home range, however the peak in seismic activity did coincide with declining adult female numbers, kid numbers, and productivity in the Teton-Dupuyer segment. Differences in population characteristics in the Birch-Badger and Teton-Dupuyer segment appear to be attributable to differences in levels of human disturbance within each area. Other factors were addressed which may have influenced mountain goat population characteristics, including weather, hunter harvest, livestock grazing, timber harvest, and disease. The added impact of seismic activity, over and above other human activities in the Teton-Dupuyer segment, appeared to be the primary cause of changing population characteristics.

Native mountain goats of Montana's Rocky Mountain Front (RMF) occur along the theoretically petroleum-rich Overthrust Belt. Industrial and recreational projects have been implicated in declines of native mountain goat populations throughout North America (Chadwick 1973, Hebert and Turnbull 1977, Kuck 1977, Pendergast and Bindernagle 1977, Foster and Rahs 1983, Rice and Benzon 1985). Therefore, concern about human impacts from energy exploration has focused upon mountain goats along the RMF as the pace of exploration accelerates and gas/oil field development begins. Research on mountain goats from 1981 through 1986 was conducted to describe the mountain goat population along the RMF, document changes in population parameters, and describe the upsurge of human activity within the area and the possible consequences of human-induced stress upon the population.

This project was funded by the Mont. Dep. of Fish, Wildl. and Parks; U.S. For. Serv.; U.S. Fish and Wildl. Serv.; Bur. of Land Manage.; Allen Found.; with contributions from American Petrofina Inc., ARCO Exploration Co., Shell Western E and P Inc., Sun Exploration Co., and Superior Oil Co.. The field help and technical assistance of R. DeSimone and G. Olson, the excellent flying skills of G. Sherman and D. Getz, and the statistical aid and editorial comments of J. Swenson, S. Stewart, D. Hebert, B. McFarland, J. McCarthy, B. Foster, and L. Irwin are gratefully acknowledged. Figures were prepared by M. Lonner.

STUDY AREA

The RMF study area (Fig. 1) occured in the Sawtooth Mountains of northcentral Montana. Lying along the east slope of the Continental Divide, the study area extended some 82 km south of Glacier National Park to the main Sun River and was bordered on the east by the prairie. The study area was divided into 3 segments (Fig. 1) based on relatively autonomous mountain goat population segments. The Deep-Sun segment is not considered in this analysis because it was not intensively surveyed and was therefore not comparable.

Geological forces shaped the magnificent reefs of the RMF. The awesome cliffs and ridges of the RMF are composed primarily of Madison limestone from the Cambrian era, although the bulwark of the mountains is Precambrian sedimentary rocks (Alt 1985).

Gale-force chinook winds, often blowing over 100 km per hour, melts and blows away snow on the eastern slopes and exposes forage. The coldest average winter temperatures (January) range from -8.9°C at East Glacier to -6.0°C at the Sun River's Gibson Dam. The warmest average summer temperatures (August) range from 15.9°C to 16.7°C, respectively. Yearly precipitation averages 59.7 cm at East Glacier and 47.0 cm at Gibson Dam (Nat. Oceanic and Atmos. Admin. 1980-1985). Maximum snow pack occurs in April with depths (from north to south) averaging 252.5 cm at Badger Pass (2103 m), 168.1 cm at Mount Lockhart (1951 m), and 148.3 cm at Wrong Ridge (2073 m) (U.S.D.A. SCS 1922-1985) (Fig. 1). Meteorological data indicate a subtle gradient toward warm and dry, moving from north to south along the RMF. Detailed descriptions of vegetation, habitat types and landtypes are described in Harvey (1980), Thompson (1980), Holdorf et al. (1980) and Holdorf (1981).

METHODS

Repeated, systematic helicopter surveys were conducted on that portion of the population north of the Middle Fork Teton River (823 km², Fig. 1). Surveys were flown during July, from 1981 through 1986, during morning and evening hours, by the author in a G3 47 Bell helicopter. Subsequent to each helicopter survey, a radio-relocation flight was made to determine the presence or

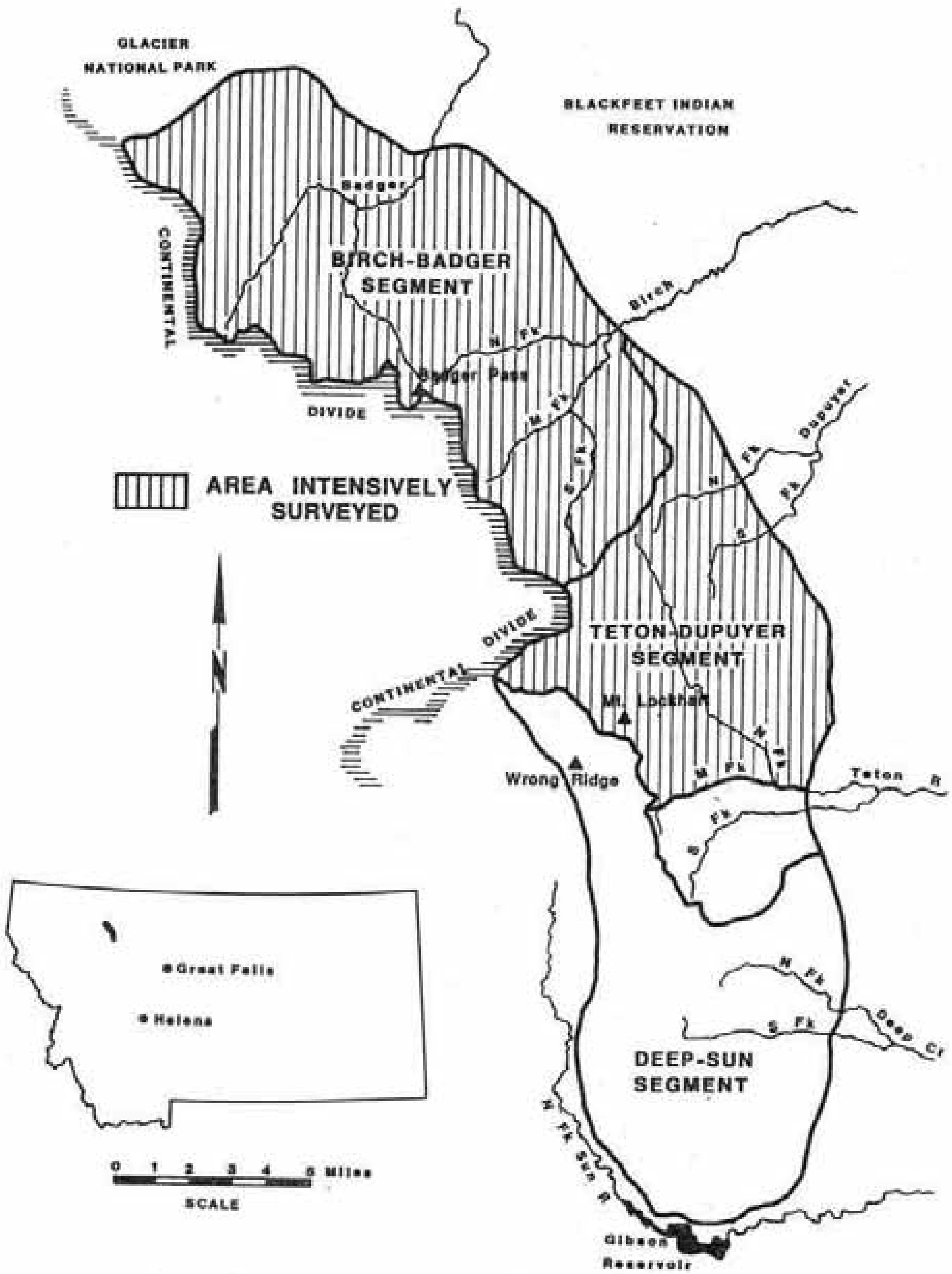

Figure 1. Rocky Mountain Front Study Area.

absence of radio-marked goats within the Teton-Dupuyer area. The percentage of radio-marked and neckbanded animals observed during annual surveys provided the basis for establishing survey efficiency.

Thirty-five mountain goats in the Teton-Dupuyer segment were fitted with radio collars (23), neckbands (8), and eartags (4), from 1979 through 1982 (Joslin 1986). Nine and 6 adult males, 8 and 2 adult females, and 6 (4 females and 2 males) and 0 subadults were marked with radio-collars and neckbands, respectively. Four male kids were eartagged. All radio-collars placed on subadults were expandable elastic collars which were not observable from the air. During aerial telemetry, observations of radio-marked animals were obtained when possible. Both air and ground observations provided data on the reproductive histories of 11 radio-marked and 2 neckbanded females. Mountain goats were classified as adults (male or female), 2-year-olds, yearlings, and kids based on morphological features, molting patterns, and group association.

Seasonal home range sizes (convex polygons) of 24 radio-marked mountain goats were calculated based on bi-monthly radio-relocation flights. Average number of fixes used in calculating home ranges for adult animals was 56 (range 25-120).

Snow depth information was collected from 3 snow survey sites which occur in the Birch-Badger, Teton-Dupuyer, and Deep-Sun segments of the study area, respectively (Fig. 1). These sites occur either within mountain goat winter range, or in the case of Badger Pass, which is at the edge of the study area, at an elevation which coincides with mountain goat winter range.

Information concerning energy exploration activities was provided by the Rocky Mountain Ranger District, Lewis and Clark National Forest. The term seismic activity, as used here, includes all ground and air activity associated with seismic line set up, shooting, and clean up.

RESULTS

Population Characteristics

Home range information was collected for 9 adult females, 9 adult males, and 6 subadults in the Teton-Dupuyer segment (Joslin 1986). Comparing adults for which at least 2 years of information was available, the largest yearlong home range was 181.5 km^2 for a male while the smallest was 16.0 km^2 for a female. Only 1 male had a yearlong home range (22.9 km^2) smaller than the average for females (34.9 km^2), while all female ranges were smaller than the average for males (89.4 km^2). The average female summer range (19.2 km^2) was slightly smaller than the average winter range (22.2 km^2), but the reverse was true for males (48.5 and 46.4 km^2). Although goats tended to adjust their movements over the course of the study, none were known to abandon their established home range.

All marked goats generally confined themselves to the Teton-Dupuyer segment. Over the course of the study, observability of marked adult females was higher (80%, SD=13) than marked adult males (30%, SD=18) (Table 1). Because observability of adult females was consistently high, population trends were based on actual number of females and kids observed in both the Teton-Dupuyer and Birch-Badger population segments.

Table 1. Observability of marked adult mountain goats, July 1981 - 1986.

YEAR	MARKED FEMALES	NO. OBSERVED	% OBSERVED	MARKED MALES	NO. OBSERVED	% OBSERVED
1981	3	2	67	3	0	0
1982	7	6	86	11	4	36
1983	7	5	71	8	1	12
1984	7	7	100	10	5	50
1985	4	3	75	8	4	50
Total	28	23	399	40	14	148
Average			79.8			29.6

Population trend of female goats in the Teton-Dupuyer segment from 1981 through 1986 is presented in Table 2. The decline in adult females in this segment (Fig. 2) was significant ($R=-0.851$, $p < .05$). The trend in the Birch-Badger segment on the other hand was not significant ($R=-0.833$, $p > .1$) (Table 3 and Fig. 3). At the beginning of the study, numbers of adult females in both population segments were similar, but by 1986, adult females in the Teton-Dupuyer segment had dropped about 50%.

Table 2. Summer helicopter surveys of mountain goats in the Teton-Dupuyer segment, 1981-1986.

YEAR	TOTAL	ADM	ADF	SA	KID	K:100ADF
1981	75	13	33	17	12	36.3
1982	60	16	25	10	9	36.0
1983	43	13	22	5	3	13.6
1984	58	15	28	9	6	21.4
1985	37	12	18	3	4	22.0
1986	32	9	15	6	2	13.3

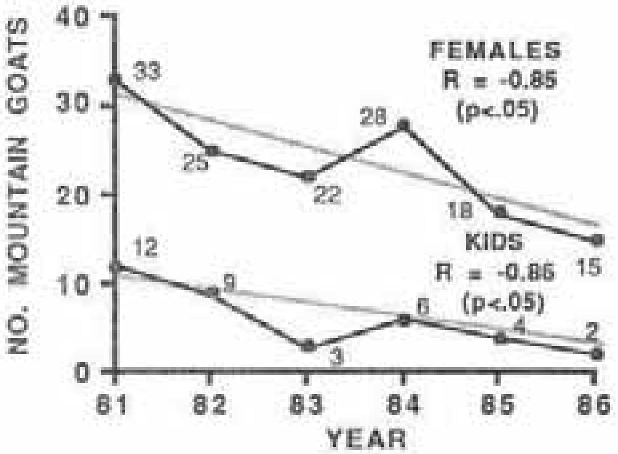

Figure 2. Adult female and kid mountain goats observed during annual surveys of the Teton-Dupuyer segment.

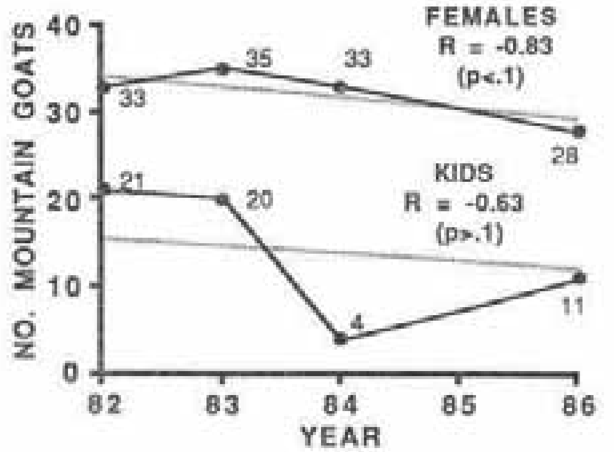

Figure 3. Adult female and kid mountain goats observed during annual surveys of the Birch-Badger segment.

Table 3. Summer helicopter surveys of mountain goats in the Birch-Badger segment, 1982-1986.

YEAR	TOTAL	ADM	ADF	SA	KID	K:100ADF
1982	77	15	33	8	21	63.6
1983	80	9	35	16	20	57.1
1984	56	10	33	9	4	12.1
1986	72	21	28	12	11	39.3

Even though population levels were similar at the onset of this study, kid production levels were not. In the Teton-Dupuyer segment, kid:adult female (K:ADF) ratios in 1982 were over 40% lower than in the Birch-Badger segment. By 1983 and 1984, kid production dropped 62% and 81% in the Teton-Dupuyer and Birch-Badger segments, respectively. By 1986, kid production in the Birch-Badger segment appeared to be recovering and had more than tripled from a low of 12 K:100ADF (Fig. 3). But kid production in the Teton-Dupuyer segment improved only slightly in 1984 and 1985, then dropped back to the low of 13K:100ADF in 1986 (Fig. 2).

Reproductive histories of 11 marked adult female goats indicates the possible cause of decline in both females and kids in the Teton-Dupuyer segment. From 1 to 6 years of reproduction information was documented for each marked adult female (Table 4). Potentially 42 young could have been born to these females over the course of the study, assuming 1 kid born per female per year. Six of 18 kids that were born died, while the fates of 4 others were undetermined. No twins were produced. Sixty percent of the kids that died did so between July and September. Production ranged from a maximum of 100% (N=3) in 1979 to 0 (N=5) in 1984. Recruitment was highest prior to initiation of this study (Thompson 1980), then it dropped to 0 (1984-86). Apparently, the consistently low kid production and poor recruitment resulted in a lack of reproductive females being recruited into the population, and therefore, the population continued to decline.

Table 4. Reproductive history of 11 marked female mountain goats.

Radio #	Age Marked (Yrs.)	1979	1980	1981	1982	1983	1984	1985	1986
1172	4	K →	Y K →	Y K-died	K-died	0	0	Trans[a]	
1082	4	K →	Y ?	?	?	0 Trans			
1052	3	K-died	K →	Y K-died	K Trans				
1222	3		K →	Y K →	Y K →	Y Trans			
1290	AD				K-died	K	Dead[b]		
1230	AD				K →	Y 0	0	0	0
42[c]	5				0	0	0	0	0
32[c]	AD				0	0	0	K	0
1240	2				---	0	0	0	0
1814	4				K-died	K/Dead[b]			
492	3					0			

[a] = transmitter failed
[b] = adult goat died
[c] = neckband

Energy Exploration

Seismic exploration activity along the RMF has increased 37 fold from the 1960-1980 period when an average of 9.5 km of line was shot per year, to 1981-1984 when an average of 351.0 km of line was shot per year (Fig. 4). Wildcat drilling in the 59 years between 1921 and 1980 amounted to an average of 1 well drilled every 2.7 years. From 1981-1984 an average of 1 well per year was drilled. Although only a portion of this seismic and drilling activity occurred within the study area, the trend is clear. Nearly all of the 579 km of seismic lines which were shot in the mountain goat study area since 1981 were helicopter supported. An estimated 21.7 man days and 6 to 8 helicopter km are associated with each km of helicopter based seismic line shot

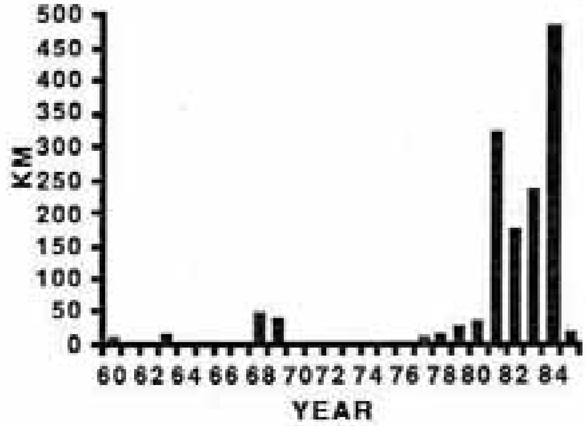

Figure 4. Rocky Mountain Front seismic exploration.

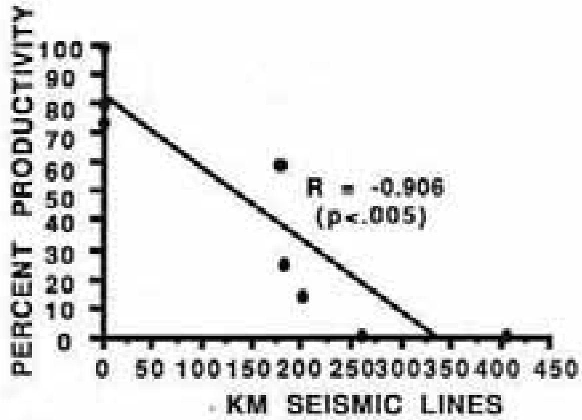

Figure 5. Productivity of radio-marked adult females in relation to cumulative seismic activity (2 previous years).

within mountainous terrain along the RMF. This equates with 12,564 man days and about 4,053 km of helicopter activity within the study area since 1981.

Declines in adult females, kids, and productivity of marked adult females in the Teton-Dupuyer segment were negatively correlated with the amount of seismic activity occurring in mountain goat habitat within the study area from 1979 to 1986. A regression of the amount of seismic activity occurring 1 year prior to the July annual population survey, and the number of females observed during that survey, accounted for 71% (R^2) of the variability in adult females ($R=-0.846$, $p < .05$) over the course of the study. The number of kids present in the population segment was inversely correlated ($R=-0.875$, $p < .05$) with the sum of seismic activity occurring 2 years previous to the year in which the population was surveyed, i.e. km of seismic line in 1979 plus 1980 were compared to the number of kids present in 1981. As might be expected, number of kids in the segment was positively correlated with number of females in the population segment ($R=0.874$, $p < .05$). As the number of adult females declined so did numbers of kids, indicating that compensatory reproduction was not occurring. This was also illustrated by reproductive information from marked adult females. Although the correlation between productivity and seismic activity that year, or the previous year was weak, the correlation of productivity and seismic activity for two years prior to the birth year was highly significant ($R=-0.906, p < .001$) (Fig. 5). Thus, the amount of seismic activity during 2 years explained 82% (R^2) of the variation in productivity during the birth year.

DISCUSSION

The objective of this study was to evaluate changes in the RMF mountain goat population in relation to energy exploration. At the beginning of this study, kid production was higher in the Birch-Badger segment than the Teton-Dupuyer segment. Reasons for this difference are not fully understood, although it may be related to the degree of human activity historically occurring in these areas. The Birch-Badger segment is relatively inaccessible, and has not been greatly influenced by human activities. In contrast, the Teton-Dupuyer segment has had a much higher level of human activity, including a seasonal ranger station, timber harvest, and developed recreation involving a downhill ski resort, a guest ranch, groomed snowmobile trails, developed campgrounds, and major trail head parking facilities. This has resulted in traditionally more motorized access and use.

Prior to the increase in helicopter based seismic activity along the RMF in 1981, it appeared that the Birch-Badger segment contained an undisturbed mountain goat population that had good reproductive performance, while the Teton-Dupuyer segment was comparatively more heavily utilized by people and contained a mountain goat population that had relatively low reproductive performance. The number of adult females in the Birch-Badger segment remained relatively stable from 1981 to 1986, but declined in the Teton-Dupuyer segment. During this period, the total number of kids in the Teton-Dupuyer segment declined, while the number of kids in the Birch-Badger segment showed a sharp decline in 1984, and then some increase in 1986 (although still substantially below 1982-1983 levels). The reproductive decline appeared coincident with the peak in seismic activity along the RMF from 1981 through 1984. The recovery of kids in 1986 in the Birch-Badger segment also appears coincident with the cessation of seismic activity in 1985. However, kid production, number of kids, and number of adult females in the Teton-Dupuyer segment continued to decline through 1986. The Teton-Dupuyer population did not respond as the Birch-Badger population had, once seismic activity ceased, possibly due to the long-term additive effects of several stressors upon the Teton-Dupuyer segment.

Other factors which may have influenced mountain goat population characteristics include weather, hunter harvest, livestock grazing, timber harvest, and disease. Several authors have documented an inverse correlation between winter snow depths and kid survival (Chadwick 1973, Rideout 1974, Smith 1976, Bailey and Johnson 1977, Thompson 1980, Johnson 1983, Swenson 1985). The average of March, April and May snow depths from 3 snow survey sites in or near mountain goat winter range along the RMF from 1980 through 1985 indicated that winter snow pack has been at or below normal during 5 of 6 years. A regression of Teton-Dupuyer kid:non-kid ratios upon snow depth showed little correlation ($r=0.5$, $df=5$, $p > 0.1$). The relatively low snow depths apparently did not have an influence on kid survival.

Cool wet summers are also known to affect survival of newborn young (Brandborg 1955, Johnson 1983). Temperature and precipitation data during June, July and August from 1980 to 1985 indicated that summers have generally been slightly warmer and dryer than average. The month of June in particular, is critical, but 1981 was the only year slightly cooler than normal (-0.4 C below average), and 1983 and 1984 were the only years slightly wetter than normal (1.0 cm and 0.1 cm above the average, respectively). A combination of abnormally cold and wet conditions did not occur during the course of the study.

Numbers of hunting permits issued for the 2 districts along the RMF have varied from 15 to 8 between 1978 and 1985, and currently stand at 8. An average of 4 to 5 mountain goats have been harvested per year. Since the beginning of this study in 1981, when population levels were first estimated (Joslin 1986), mountain goat harvest has not exceeded 4% of the population, and has averaged 3%. Females have composed 46% of the harvest, or between 2 and 3 per year. Analysis of harvest indicated that adult females in the Birch-Badger segment were neither negatively nor positively influenced by existing harvest levels ($R=0.321$, $p < .5$). A positive correlation between number of females harvested and number of females in the Teton-Dupuyer segment indicated that females were harvested in proportion to their abundance ($R=0.876$, $p < .05$). Hunting, therefore, does not appear to be responsible for the observed kid decline, although it is possibly a contributing stressor to the Teton-Dupuyer population segment.

Livestock grazing peaked along the RMF in the early 1900's. Changes in allotment size, duration of use, species use, and management systems have helped reduce livestock competition with wildlife. Generally, livestock use is now at its lowest level in 50 to 80 years, and the current level of use has been maintained since the most sweeping changes were instituted in allotment use 10 to 20 years ago. Although livestock grazing continues to be a significant land-use activity along the RMF, the extent and degree of use has not appreciably changed in the last 2 decades, and would not appear to have created a new or increased stress upon the mountain goat population.

Approximately 7,600 cubic meters (1 million board feet) per year of timber has been removed from the RMF over the past decade (USDA Lewis and Clark National Forest Plan 1986). All of the few logging roads that created access into mountain goat range occurred in the Teton-Dupuyer segment, but timber sales have generally not been located in critical mountain goat range. The decline in kid production in the Birch-Badger segment was not related to timber harvest since none occurred in this area. However, limited harvest in the Teton-Dupuyer segment may have indirectly affected that area's population.

The drop in mountain goat kid production in 1983 and 1984 tends to parallel the pattern of bighorn sheep decline due to a pneumonia die-off along the RMF in 1983 and 1984 (Hook 1986).

Onderka and Wishart (1984) indicate that in bighorns, some adults initially succumb of respiratory disease complex, while others may survive to become carriers and thus bare a poor lamb crop.

Mountain goat deaths as a result of respiratory disease complex were not documented, although 2 possible cases were discovered. In 1983, 2 mountain goats were found dead along the RMF, one along the South Fork Teton River in Green Gulch (T. Bivins 1983, pers. commun.) and the other near Many Glacier in Glacier National Park (K. Keating 1985, pers. commun.). The Teton goat, a 5-6 year old male, was diagnosed as having fibrinopurulent bronchopneumonia (Corynebacterium sp.) (J. Rhyan, DVM, Lab Rpt. No. 8-470 Veterinary Lab, Bozeman, MT). The Glacier goat also suffered from severe suppurative pneumonia (M. Harries DVM, Path. No. L83-3228-H Alberta Animal Health Division, via Glacier National Park, MT). Harries noted that the pathological changes in the Glacier goat were essentially similar to those of the bighorn sheep which had been suffering from a Pasteurella hemolytica biotype T pneumonia in areas of Alberta, British Columbia, and the RMF of Montana. Although significant bacteria could not be isolated, similar organisms to those of the sheep had very likely been present (op. cit.).

Limited evidence indicates that broncho-pneumonia might have been a contributing factor in the observed mountain goat population changes. Respiratory disease complex is often stress-induced (Onderka and Wishart 1984). If this stress-related pneumonia was latent in mountain goats along the RMF, it is possible that this disease, and the stress-inducing effects of seismic disturbance could have acted in concert to cause the observed decline in females and kid production.

The correlation between mountain goat productivity and seismic activity in previous years, suggest that the stress induced by this seismic activity is cumulative over the years. The 4 year period of very intensive activity probably created more stress than it would have, had the individual years of activity not been consecutive. Stemp (1983) indicated that pre-natal stress is of particular concern because the extreme sensitivity of the young is related to their rapid development, and the most rapid development of a mammal takes place as a fetus. Particular organs and behaviours are especially susceptible during the critical periods in which they are maturing most rapidly (Scott 1962). Changes in development can be so pronounced that the individual's emotionality and behavior, phenotype, and even viability can be profoundly and permanently altered (Stemp 1983).

A number of researchers have reported upon behavioral and physiological response of wildlife to helicopter harassment. Helicopters, sonic booms, gunshots, people on foot, stopped occupied vehicles, and domestic dogs elicit strong behavioral and/or heart rate responses from a variety of wildlife (Horejsi 1976, Ward and Cupal 1979, Gunn et al. 1983, Stemp 1983, Irwin and Gillin 1985). MacArthur et al. (1982), Stemp (1983), Ward and Cupal (1979) and others have indicated that behavioral response does not necessarily reflect physiological response to harassment. Despite the animals outward behavior, Stemp (1983) reported that heart rate of bighorn sheep was significantly elevated and remained elevated as long as helicopter activity occurred in their vicinity. Up to 45 minutes was required after the disturbance was gone for heart rate to return to normal. He indicated that "behavioral response can be extremely misleading: helicopters can sensitize bighorns and can produce marked and prolonged physiological responses in the absence of pronounced--or even any--behavioral reaction".

To avoid stress-inducing disturbance, an animal may withdraw, but withdrawal is also costly because exertion demands increased energy expenditure. Also, injury is a risk during escape attempts, and the opportunity to feed at that location is removed. If animals withdraw from key habitat areas, carrying capacity can be reduced (Geist 1975). During this study, mountain goats generally moved away from human activity, and used topographic relief to screen themselves from line-of-sight disturbance. Although they did redistribute themselves within their home ranges to avoid disturbance, fidelity to familiar terrain was strong and none abandoned their traditional home ranges.

Abundant literature exists detailing the maladaptations that may result from repeated or prolonged stress stimulation, including decreased resistance to infection and disease (Hudson 1973, Stein et al. 1976), and impaired or complete failure of reproductive function (Geber 1962, 1970; Petropoulos et al. 1972, Sontag 1970 - in Stemp 1983). Stemp (1983) indicated that "any stressor sensitizes the individual to other stressors. Moreover, a prolonged stress response decreases an individuals ability to cope psychologically (Shanan et al. 1976) which is likely to make them more susceptible to subsequent stressors". This is particularly evident in the Teton-Dupuyer segment where seismic activity appeared to be additive to other long-term, human-induced stressors. A constant level of stress may explain why kid production in this area did not improve, even though seismic activity ceased in 1985. Although the Birch-Badger segment was relatively immune from long-term stressors, it appeared that seismic activity did cause a decline in kid production in 1984. Once seismic work ended, productivity improved. In comparison, mountain goat populations in adjacent Glacier National Park (where no seismic activity occurred) appeared to be stable (K. Keating 1985, pers. commun.)

This study indicates that efforts should be made to reduce human activities in the Teton-Dupuyer segment in order to allow mountain goat population recovery. If the Birch-Badger segment remains inaccessible and relatively free of human activity, it appears that it might be able to recover from temporary, short-term disturbance. Monitoring will be necessary to determine whether mountain goat production returns to pre-1981 levels along the RMF.

Detailed multi-agency guidelines were developed to ameliorate the effects of energy exploration activities upon wildlife along the RMF (Interagency Rocky Mountain Front Wildlife Guidelines 1984). One objective of the guidelines was "to avoid or minimize human related activities which may adversely impact selected species of wildlife". The mountain goat population declines suggest that the guidelines were insufficient to maintain pre-development kid production and female population levels in the face of intense human activity. Application of the guidelines was particularly deficient in controlling distribution of seismic activity. If the mountain goat population is to increase and be maintained at or above the 1980 level, managing the timing and intensity of human activity within mountain goat habitat will be critical.

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QUESTIONS AND ANSWERS

Bruce Smith, Wyoming: Gayle, I was interested in your juvenile mortality rates and wonder if you could tell us how you determine those for kids and yearlings. Yours were fairly high.

Gayle Joslin: They were fairly high. They were determined from five consecutive years of actual survey information.

Smith: So it was actual counts of kids during consecutive years and comparing them from year to year?

Joslin: yes and over the course of the year by watching kids of radio-marked adult females from week to week.

Smith: Were you surveying during the winter?

Joslin: No, I surveyed in July.

Smith: You had an inverse correlation between productivity of the goats and the seismic activity, is that right?

Joslin: Right

Smith: Was there any correlation between the mortality rates of kids and yearlings and the activity in the areas you looked at. For example, before the seismic activity increased, did you have lower mortality of kids and yearlings than you did after you had higher levels of activity in the area.

Joslin: Yes. Using both yearly survey data and monthly observation data from marked females which had kids at side, I could see that as consecutive years of seismic activity elapsed, either productivity or survival or both decreased.

Smith: So then there was a correlation?

Joslin: Yes.

Nicki Goodson, Colorado: Do you have any information on distribution activity, or movement patterns of goats relative to disturbance?

Joslin: Regarding distribution, radio-marked goats did not leave established home ranges when disturbance occurred, but they would use topography to screen themselves from human activity by moving out of a drainage where the activity was occurring. I observed four marked goats do this. When disturbed, goats would often watch the activity for quite some time. They would be alert, not feed, and they seemed to chew their cud less, but this was not a behavior study per se, so I don't have quantitative ethological data. Doug Chadwick's thesis gives excellent descriptions of mountain goat response to disturbance. I did not observe anything during this work which was counter to what Chadwick reported.

Jim Bailey, Colorado: How far did they move?

Joslin: They always stayed within their home range, but males would move the greatest distances. It was common for three radio-marked males to travel about nine air miles over the Continental Divide into the Flathead drainage to summer, but that was more of a seasonal movement. Males had the opportunity to avoid the activity more because their home ranges included more wilderness area and were, therefore, more isolated.

Bailey: You said that was a seasonal thing. I was asking in addition to Nicki's question, how far do these animals move in response to seismic.

Joslin: Let me explain a complicating aspect of this work. Several of us who were collecting data along the Rocky Mountain Front at that time will attest that we often did not know where or when a seismic line would be shot. Communication from the Rocky Mountain Ranger District to field biologists regarding seismic activity was limited. So, we were often not aware that a particular line had been shot until it was too late to monitor an animal's response. Relative to those goats which I did observe subsequent to disturbance when I had the opportunity, they would often move no more than a half mile. They would go over a ridge to get away from direct line-of-sight disturbance. It is this kind of limited reaction by goats which elicits a judgment that goats are not affected by disturbance. However, in the case of mountain goats at least, I believe the population data is more revealing than behavioral reaction.

Wayne Heimer, Alaska: Is this exploration over at this point or ongoing?

Joslin: Good question, we would like to know, too. When the price of oil goes back up, I suppose we'll see more exploration. They do have three exploratory wells that are pending right now.

Heimer: The other question is, presuming with the price of oil being low like it is, there won't be anything going on right away, are you going to continue watching to see if the stress goes away if things get better?

Joslin: There's no more funding. No.

Heimer: There ought to be.

Peter Davidson, BC: There was obviously a lot of activity by helicopters in that area. I assume that most of this is done from helicopters judging by the terrain. You mentioned Raymond Stemp's work, University of Calgary, was there any attempt to collect that type of information from these goats?

Joslin: No heart rate response or fecal cortisol information was gathered so there was no direct measure of stress effects.

Davidson: I'm suggesting that the helicopters might have had as much effect as the blast itself or more.

Joslin: I think it had more. That's my personal opinion, but I think it had more. There was a great deal of helicopter activity.

Kirby Smith, Alberta: You said you lost 60% of your kids by September, did I miss the explanation or do you have any explanation? Were you watching kids on cliffs during helicopter passes or anything like that? Do you think it was because of falls or what?

Joslin: I don't know what the exact mechanism of the kid decline was. Of the kids born to marked female goats, six were known to have died. Four of these six disappeared between July and October.

Ted Benzon, South Dakota: After the seismic activity was gone, how long did it take before the goats went back into that area?

Joslin: Some times by evening they would come back. Especially when they were on salt licks. Goats will take big risks when their drive for salt is high. They almost seem suicidal.

Appendix J

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and Goat Counc. 14:131-136

NWSGC POSITION STATEMENT ON HELICOPTER-SUPPORTED RECREATION AND MOUNTAIN GOATS

Kevin Hurley, NWSGC Executive Director

July 9, 2004

Introduction:

Less is known about mountain goats than other North American ungulates, due primarily to their relative scarcity and the inaccessible terrain they inhabit (Smith 1982, Festa-Bianchet et al. 1994, Wilson and Shackleton 2001). Disturbance of ungulates by helicopters can result in a variety of negative effects, including habitat abandonment significant enough to affect population status and herd viability, dramatic changes in seasonal habitat use, increased vulnerability to predation, alarm responses, decreased bouts of foraging and resting, increased animal movement and energy expenditure, and reduced productivity (Pendergast and Bindernagel 1976, MacArthur et al. 1979, Foster and Rahs 1981, Foster and Rahs 1983, Hook 1986, Joslin 1986, Pedevillano and Wright 1987, Dailey and Hobbs 1989, Côté 1996, Frid 1999, Denton 2000, Duchense et al. 2000, Gordon and Reynolds 2000, Phillips and Alldredge 2000, Dyer et al. 2001, Frid 2003, Gordon 2003, Keim and Jerde 2004).

Population and/or fitness-enhancing behaviors such as feeding, parental care, and mating may be detrimentally impacted in response to repeated helicopter disturbance, even when overt reactions to disturbance are not visible (Bunnell and Harestad 1989, Gill and Sutherland 2000, Frid and Dill 2002). Significant effects on reproduction, survival, and population persistence may occur. Increased vigilance resulting from disturbance may reduce the physiological fitness of disturbed animals by increasing stress, increasing locomotion costs (particularly during winters with severe snow conditions), and by reducing time spent in necessary behavior such as foraging or ruminating (Frid 2002). Physiological responses (e.g., elevated heart rates) to disturbance may not be directly reflected in overt behaviors, (Macarthur et al. 1982, Stemp et al. 1983, Harlow et al. 1986, Chabot 1991), but are nonetheless costly to individual animals, and ultimately, to populations.

Although the short-term behavioral responses of mountain goats to helicopter activity have been documented, longer-term habitat use and demographic consequences of disturbance remain poorly understood. Our recommendations are aimed at minimizing short-term behavioral disruptions that we believe are correlated with longer-term impacts. Research to date has not clearly identified thresholds of disturbance that trigger unacceptable responses; as a result, approach distances and other specific mitigation measures are precautionary recommendations.

Management recommendations:

Exclusion zones/avoidance:

Habitat segregation is typical of many ungulate species (Main et al. 1996), including mountain goats. During spring/summer/fall periods, adult male goats occupy habitats other than those occupied by nanny-juvenile ("nursery") groups (Geist 1964, Foster 1982, Risenhoover and Bailey 1982), with nursery groups typically occupying habitats more favorable for survival and reproduction (Fournier and Festa-Bianchet 1995). Adult female mountain goats have heightened sensitivity to disturbances during kidding and post-kidding periods (Penner 1988). Mountain goats are known to have a lower recruitment rate, compared to other ungulates (Bailey 1991, Festa-Bianchet et al. 1993). The health of mountain goat nursery groups provides obvious contributions to the reproductive success and survivorship of goat populations. Due to the sensitivity of adult female mountain goats to disturbance, and the importance of this age/sex class to the persistence of local goat populations, restrictions on late spring and early summer helicopter activities should focus on areas occupied or likely to be occupied by nursery groups. The very activities that serve to document use are, in themselves, disruptive to mountain goats. However, documentation of crucial winter habitat use by mountain goats is essential to identify and conserve those important winter ranges, particularly in coastal mountain ranges where deep snows are typical.

Recommendation:
Helicopter avoidance should focus on those areas identified as crucial winter range, and those areas occupied or highly suspected as used by nursery groups. Particular attention should be given to helicopter activities during identified pre-kidding, kidding, and post-kidding periods; such restrictions require identification and mapping of mountain goat habitats and identifying exclusion zones prior to the issuance of annual or multi-year heli-recreation special use permits.

Distance from occupied habitats:
Behavioral responses to helicopter activity have been documented at distances of up to 2 km for mountain goats and other ungulate species (Côté 1996, Frid 2003, Gordon 2003). Recent studies have shown that short-term behavioral responses of mountain goats increase as helicopters approach within approximately 1.5 km of mountain goats. It must be noted, however, that minimum distance needed is modified strongly by topography and the amount of cliff cover/escape terrain available; increased buffer distances may be needed in more rolling terrain with less cliff cover, or in very narrow canyons/valleys.

Recommendation:
Helicopter activity should not occur within 1.5 km of occupied/suspected nursery group or crucial winter range habitats during critical periods.

Timing of activities:
Winter is of particular concern for management of disturbance stimuli. Winter is a period of severe nutritional deprivation for mountain goats (Chadwick 1983, Fox et al.1989, Shackleton 1999). Periods of deep snow can reduce food availability and dramatically increase locomotion costs (Dailey and Hobbs 1989). In winter, mountain goats are known to be relatively immobile (i.e., movements not exceeding 50m/hour) (Keim 2003), to occupy small ($<4km^2$) and specific habitat areas (Keim 2003, Schoen and Kirkoff 1982, Smith 1982), and to have high rates (>0.66) of winter home range fidelity (Keim 2003. Schoen and Kirkoff 1982). Selection of small, isolated winter habitats by goats may become compromised if management of helicopter-recreation activity neglects to consider winter mountain goat habitats and the needs of wintering goats. It is imperative that management of activities such as helicopter-skiing address and acknowledge the potential effects on mountain goat populations, through development of enforceable mitigation strategies.

Recommendation:
Helicopter activity should not occur on or near occupied winter ranges between November 15-April 30 each year. Helicopter activity should not occur on or near occupied or suspected nursery group habitats between May 1-June 15 each year. Mountain goat winter and kidding distribution and habitat selection should be known and mapped prior to issuance of annual or multi-year heli-recreation special use permits.

Helicopter approach vectors:
The rate and horizontal distance of helicopter approach vectors affect the degree of overt disturbance to ungulates. The degree of overt disturbance also varies, according to the availability of escape terrain and topography (Frid 2003, Wilson and Shackleton 2000). Additional research should be directed at identifying and documenting best management practices for mitigating approach vectors.

Recommendation:

Vertical and horizontal approach vectors should be considered when developing mitigation strategies. Strategies should also consider local conditions including refuge availability, topography, and amount and distribution of cliff cover suitable as escape terrain.

Habituation/Sensitization:

Animals may not be able to habituate to disturbance stress when disturbance is irregular and unpredictable (Bergerud 1978, Risenhoover and Bailey 1982, Penner 1988). Frid (2003) found that the proportion of Dall's sheep fleeing did not decrease with the number of cumulative weeks of disturbance. Habituation to disturbance stimuli often is partial or negligible, and habituation to strong disturbance stimuli may only partially occur (Bleich et al. 1994, Steidl and Anthony 2000, Frid 2003). Flight-initiation distance or vigilance might actually increase with repeated exposure to non-lethal stimulus if the stimulus is sufficiently adverse, resulting in sensitization to disturbance stimuli, the opposite of a habituation response (Frid and Dill 2002).

Recommendation:

It is inappropriate to assume that habituation of mountain goats to helicopter disturbance will occur over time. Reluctance to flee should not be perceived as habituation; numerous physiological responses occur, even in the absence of overt behavioral responses. All helicopter flights over or near crucial mountain goat habitat should be considered harmful to mountain goats populations, based on current knowledge. Additional research on the long-term behavioral effects of helicopters on mountain goats should be undertaken. Establishment of a cross-jurisdictional Research Steering Committee comprised of state and provincial government and non-government/academic experts is recommended. To enable such behavioral research to occur, spatially explicit control areas should be designated in which no helicopter-supported recreation term permits are issued.

Monitoring/Enforcement

Additional monitoring of the medium and long-term effects of helicopter activity on mountain goats is needed (Wilson and Shackleton 2000). Comprehensive, long-term land use and resource management plans, as well as project-specific activity plans, need to incorporate strategies and mitigation to protect and conserve critical mountain goat habitats, while still allowing commercial activities to occur, where appropriate. These plans need to thoroughly address helicopter-supported recreation effects on wildlife populations, both short and long term. These plans should identify research needed, cite pertinent existing research from other areas, and base helicopter-activity management on the best available scientific information. Enforcement of existing terms and conditions in special use permits should occur. If lacking, those terms and conditions, along with appropriate sanctions, should be developed for inclusion in activity/operating plans.

Recommendation:

Long-term monitoring is essential. If baseline data on mountain goat numbers, distribution, and seasonal habitat selection are lacking, steps should be taken to obtain those data. Monitoring should include both compliance with, and evaluation of the effectiveness of, mitigation strategies and exclusion zones. Long-term monitoring of mountain goat population performance is needed. Control areas to facilitate future behavioral research should be maintained, in which commercial helicopter activity is not permitted. Term permits should include enforceable provisions to address cases of non-compliance. Provisions should be included to modify permitted areas or conditions, based on new information, in an adaptive management approach. Permit fees should be adequate enough and used to conduct the monitoring and baseline data collection to manage these activities. Permitting of helicopter-supported recreation, especially in new areas, should not occur until managers have the ability, funding, and mechanism to collect adequate population demographic and habitat use data, to properly manage, mitigate, and monitor this activity.

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Appendix K

Eur J Wildl Res (2014) 60:45–58
DOI 10.1007/s10344-013-0749-0

ORIGINAL PAPER

Effects of winter recreation on northern ungulates with focus on moose (*Alces alces*) and snowmobiles

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Received: 9 October 2012 / Revised: 27 February 2013 / Accepted: 25 June 2013 / Published online: 28 July 2013

Abstract Winter recreation can displace ungulates to poor habitats, which may raise their energy expenditure and lower individual survivorship, causing population declines. Winter recreation could be benign, however, if animals habituate. Moreover, recreation creates trails. Traveling on them could reduce energy expenditure, thereby increasing ungulate survivorship and generating population benefits. Balancing recreation use with wildlife stewardship requires identifying when these effects occur. This task would be simpler if guidelines existed to inform assessments. We developed and tested such guidelines using two approaches. First, we synthesized literature describing the effects of winter recreation—motorized and nonmotorized—on northern ungulates. This synthesis enabled formulating six guidelines, while exposing two requiring further attention (ungulate habituation and displacement). Second, we tested these two guidelines and evaluated the others by quantifying the behavioral responses of moose to snowmobiles, in two areas of south-central Alaska, differing by snowmobile predictability. For each location, we modeled moose preferences during the snowmobile period using different combinations of eight variables—static (elevation and slope), biotic (habitat and cover), and anthropogenic (distance to roads, railroads, snowmobile trails, and trail density). We identified the model with the most support and used it to estimate parameter coefficients for pre- and post-recreation periods. Changes in coefficients between periods indicated snowmobile effects on moose. Overall, we produced and evaluated six guidelines describing when winter recreation is potentially detrimental to ungulates as follows: (1) when unpredictable, (2) spanning large areas, (3) long in duration, (4) large spatial footprint, (5) nonmotorized, and (6) when animals are displaced to poor quality habitats.

Keywords *Alces alces* · Moose · Recreation · Resource selection function · Snowmobiles · Ungulate

Communicated by C. Gortázar

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Introduction

In northern ecosystems, snowmobiling and other forms of winter recreation can displace ungulates into habitats of poor quality, which decreases the animals' nutrient intake and increases their physiological stress and energy expenditure (White 1983; Colescott and Gillingham 1998; Tyler 1991; Seip et al. 2007; Creel et al. 2002). These outcomes reduce fitness of ungulates, whereby disease, predators, and starvation further lower individuals' survival and reproduction, thereby contributing toward population decreases (Gasaway and Coady 1974; Hobbs 1989; Van Ballenberghe and Ballard 1994).

Alternatively, winter recreation could provide benefits, like compacted trails. It is easier for animals to traverse these trails relative to deep snow (James and Stuart-Smith 2000;

Bunnell et al. 2006; Rinaldi 2010). Ungulates may also use the packed trails to range more widely, thereby obtaining safety, thermal cover, or better forage, which reduces density-related constraints on resource use (Dorrance et al. 1975; Richens and Lavigne 1978; James and Stuart-Smith 2000). These effects may increase ungulate survival and reproduction, increasing population sizes.

Since ungulate responses to recreation can result in this variety of physiological, behavioral, and population outcomes, an understanding of which consequence ensues in a particular setting provides the foundation for science-based management. Currently, despite many studies examining recreation effects on ungulates, the conclusions are unorganized and can appear contrasting. This limits the use of scientific information to identify the effects of recreation on ungulates or understand the circumstances describing when negative effects are likely to occur, thereby impeding appropriate management responses. Hence, a synthesis of scientific results formulated into a set of criteria, or guidelines, which describe when winter recreation is most likely to negatively impact ungulates, is necessary. Such guidelines would be useful for evaluating, and therefore better managing, situations where winter recreation and ungulates occur. The guidelines would also reduce needs for embarking on potentially lengthy and expensive investigations to examine recreation's effects on ungulates for every specific site or situation.

We developed and evaluated these guidelines by combining two approaches. First, we reviewed literature describing the effects of winter recreation—motorized and nonmotorized—on northern ungulates [elk (*Cervus canadensis*), caribou (*Rangifer tarandus*), muskoxen (*Ovibos moschatus*), white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), and moose (*Alces alces*)]. We synthesized data describing ungulate responses to these different disturbances, such as distances moved, disturbance duration, and the distances between the recreation and the animal at the time of first disturbance. We sought commonalities in ungulate responses to winter recreation across geographical locations, circumstances, and species.

This synthesis enabled formulating the guidelines and highlighted two guidelines requiring more attention. One topic was determining if recreation activity, when predictable in location and time, would have less effect than unpredictable recreation. Animals could habituate with predictable recreation, thereby minimizing the potential effects. The second issue was the displacement of ungulates to poor quality habitats for extended periods. Such displacement could negatively affect ungulates more than direct human provocation (Nellemann et al. 2000). Both guidelines were described regarding motorized and nonmotorized recreation, with many authors discussing the possibilities (e.g., Eckstein et al. 1979; Tyler 1991; Nellemann et al. 2000), but few quantifying them (e.g., Colescott and Gillingham 1998; Seip et al. 2007).

The second approach tested these two guidelines, by using field studies to examine the relationships between the predictability of recreation and ungulate displacement (geographic and temporal). We focused on moose inhabiting two sites with snowmobile recreation, on the Kenai Peninsula of south-central Alaska. One location, Juneau Creek, had snowmobile recreation predictable in location and time, whereas the second area, Placer Valley, had unpredictable snowmobiling. We compared moose responses across these sites based on global positioning system (GPS) location data and resource selection functions (RSF) (Sawyer et al. 2006, 2007, 2009). Our goal was to synthesize information from both steps, to build and evaluate criteria describing when the effects of winter recreation may be detrimental to ungulates. Such criteria would serve as a guide for managers to predict the responses of northern ungulates to recreation in any given area.

Materials and methods

Literature review

We reviewed published studies to evaluate the potential for snowmobile activity and other forms of winter recreation to affect ungulates (positive or negative). We searched for publications published before September 2012 with the Web of Science, Wildlife & Ecology Studies Worldwide, and Google Scholar search engines.

Study location

To compliment this synthesis, we examined moose habitat use in response to winter recreation for moose inhabiting the Kenai Peninsula in south-central Alaska, USA (23,310 km2). The western third of the Peninsula consists of lowland plains and lakes (sea level). Glaciated mountains and ice fields dominate the remainder, with peaks reaching approximately 2,000 m. Analyses occurred in two separate areas, which differed by the spatial extent and predictability of snowmobile use (Fig. 1). Placer Valley (northeast peninsula; 244 km2) has unpredictable snowmobile use throughout the entire valley (no designated trails), and recreationists can travel extensively throughout the valley. Snowmobile activity within Juneau Creek (central peninsula; 443 km2) is predictable, as the majority of use is confined to one trail (Resurrection Trail; USDA FS, unpublished).

Moose captures

In the months of March and November of 2006 and 2007, employees from the Alaska Department of Fish and Game

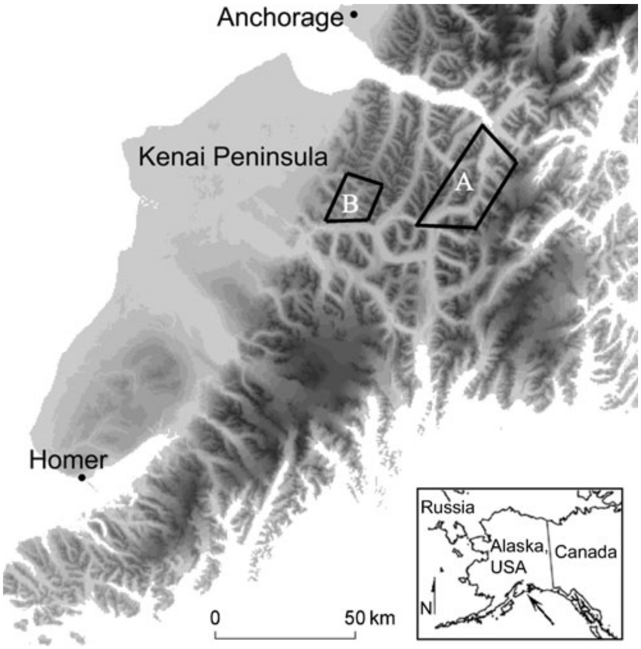

Fig. 1 This study evaluated moose behavioral responses to snowmobile recreation on the Kenai Peninsula of south-central Alaska. Placer Valley (polygon with *white A*) had snowmobile recreation unpredictable in location and time. Juneau Creek (polygon with *white B*) had predictable snowmobile recreation. *Gray shading* indicates elevation, ranging from sea level (*white*) to high altitudes (*black*)

captured and fit female moose (cows) on the Kenai Peninsula with GPS-enabled radio collars. Moose were darted via helicopter or from the ground and immobilized with a combination of carfentanil citrate and xylazine hydrochloride (ZooPharm, Fort Collins, CO, USA). Adult cows received collars because they are the most abundant sex and age class of moose and therefore those most likely encountered by recreationists. Moreover, cows are typically pregnant during winter and their nutritional condition affects calf recruitment the following year (Thorne et al. 1976). All field and capture methods were approved by the Alaska Department of Fish and Game, Animal Care and Use Committee, Assurance No. 06-03.

In Placer Valley, we began the study with four moose wearing Tellus collars (Followit AB, Lindesberg, Sweden) and seven moose wearing Lotek GPS collars (Lotek Wireless, Inc. New Market, ON, USA; Table 1). Between winters, some moose left the valley, and other GPS collars either failed or consumed all power. Therefore, during the winter of 2007–2008, we received data from two moose in this area.

At Juneau Creek, the study began by fitting eight moose with collars manufactured by Telonics Inc. (Telonics, Mesa, AZ, USA), three moose with ATS GPS collars (Advanced Telemetry Solutions, Inc., Isanti, MN, USA) and two moose with Televilt collars (Table 1). A second capture fixed 11 Telonics collars on moose before the winter of 2007–2008.

In both locations, fix intervals varied among GPS collars. This occurred to either extend battery life or to provide fine-scale movements of moose for a separate study (Table 1). All GPS collars had an average fix success >97 % during the study period.

Mapping snowmobile trails

We photographed snowmobile trails at Placer Valley and Juneau Creek during the winter of 2006–2007 (March 25, 2007). We conducted aerial photography in March since the bulk of snowmobile activity occurs in late winter, and light conditions minimized shadows in the photographs (USDA FS, unpublished). We used a 206 aircraft flying at 1,000 m, with a Nikon D2X digital camera (focal length of 28 mm). For Placer Valley, individual photos were stitched into mosaics using Autopano software (Kolor Inc., Challes-les-Eaux, France). Some photos were stitched by hand due to lack of overlap. The stitched scenes were georeferenced to digital orthophoto quadrangles (DOQs) (1996–2000) using ERDAS ERMapper software (Intergraph ERDAS, Norcross, GA, USA). All snowmobile trails were digitized from the georeferenced photos, using ArcMap 9.3 (ESRI, Redlands, CA, USA). We quantified snowmobile trail location and density based on the digitized layer. Because the majority of snowmobile activity in Juneau Creek occurred along the Resurrection Trail (USDA FS, unpublished), the geographical location for Resurrection Trail was used as a surrogate for the location of snowmobile trails in Juneau Creek.

Snow depth

For Placer Valley, the Placer Railroad Station cataloged snow depth (http://www.akrr.com/wthr/). For Juneau Creek, we relied on data gained by the closet SNOTEL site, located at Summit Creek (http://www.wcc.nrcs.usda.gov/snotel/Alaska/alaska.html). At each location, we quantified the mean depth of snow, or snow accumulation, for each period of analysis (pre-, during, and post-recreation activity). Including snow depth enabled us to account for its effects on moose behavior, thereby improving our interpretation of moose reactions to snowmobile recreation.

Periods of snowmobile use

Data collection in Placer Valley covered two winters, each with three periods. These periods were defined by snow depth and the presence or absence of snowmobile activity. Preseason in the first winter, before snowmobile activity commenced, occurred from December 1, 2006 through January 3, 2007. There was a low snow period (mean 7.4 cm; CV 72.7) from December 1, 2006 to December 19, 2006 and a high snow period (mean 98.0 cm; CV 12.5)

Table 1 Attributes describing the sampling used to evaluate behavioral responses of moose to varying spatial extent and predictability of snowmobile recreation at two study sites located on the Kenai Peninsula of south-central Alaska

Study site	Period	Dates	GPS collar type	Number	*N* total	GPS fix interval	Mean # locations/ moose	SE
Placer	Preseason (LS)	December 1, 2006–December 19, 2006	Lotek/Televilt	7/4	11	4 h/15 min	670.7	236.0
	Preseason (HS)	December 20, 2006–January 3, 2007	Lotek/Televilt	7/4	11	4 h/15 min	464.3	158.9
	During season	January 4, 2007—March 31, 2007	Lotek/Televilt	7/3	10	1 h/15 min	2,778.5	868.4
	Preseason	December 1, 2007–January 3, 2008	Lotek	2	2	4 h	207.5	20.5
	During season	January 4, 2008–March 6, 2008	Lotek	2	2	1 h	930.0	579.0
	Postseason	March 7, 2008–March 31, 2008	Lotek	1	1	1 h	597.0	–
Juneau	During season	December 14, 2006–February 15, 2007	Telonics/ATS/Televilt	8/3/2	13	2 h/1 h/15 min	1,603.7	476.1
	Postseason	February 16, 2007–March 31, 2007	Telonics/ATS/Televilt	8/3/2	13	2 h/1 h/15 min	1,140.2	351.3
	Entire winter	December 1, 2007—March 31, 2008	Telonics	11	11	1 h	2,105.9	171.2

Preseason indicates the period before snowmobile recreation, during season represents the period when snowmobile recreation occurred, while postseason categorizes the period after snowmobile recreation happened

LS low depth of snow, *HS* high depth of snow

from December 20, 2006 to January 3, 2007 (Table 1). Since snow depth tends to increase over the winter, dividing this preseason enabled us to evaluate if deep snow altered moose behaviors in the absence of snowmobile activity. This information helped identify the effects of snowmobile activity on moose habitat choices, beyond those influenced by snow depth. The third period described when snowmobile recreation occurred (January 4, 2007–March 31, 2007; mean snow depth 74.7 cm; CV 24.9). This winter lacked a postseason (Table 1).

The second winter had one preseason from December 1, 2007 to January 3, 2008 (mean snow depth 16.5 cm; CV 95.2). Since snow depth was relatively low throughout this period, we did not divide it. Snowmobiles occurred from January 4, 2008 to March 6, 2008 (mean snow depth 50.2 cm; CV 26.2). The third period for this winter was a postseason from March 7, 2008 to March 31, 2008 (mean snow depth 42.8 cm; CV 54.5). Then, snowmobile recreation did not occur, although snow cover and trails could persist (Table 1).

In Juneau Creek, snowmobile recreation occurred from December 14, 2006 to February 15, 2007 (mean snow accumulation = 37.1 cm; CV 17.2). Postseason was February 16, 2007–March 31, 2007 (mean snow accumulation = 44.8 cm; CV 1.3). This winter lacked a preseason, and we did not compare low to high snow periods. Moreover, no snowmobile activity occurred in Juneau Creek during the second winter of 2007–2008, due to a National Forest closure (mean snow accumulation = 34.5 cm; CV 21.1). We considered this entire winter a preseason (Table 1).

Data analyses

We used the RSF approach described by Sawyer et al. (2006, 2007, 2009) to model moose habitat use and distribution in Placer Valley and Juneau Creek. We developed the RSF models with the moose location data obtained during the periods corresponding to snowmobile use, for the 2006–2007 winter, in each location. Moose data obtained during the 2007–2008 winter was used for model validation.

Specifically, our approach relied on fitting generalized linear models to relate the probability of use (or relative frequency) by moose within a study area, during a specified period, to habitat characteristics (Sawyer et al. 2009). The approach consisted of four steps. Namely, we (1) measured predictor variables at systematically selected circular sampling units, (2) estimated the relative frequency of use in the sampling units for all collared moose, (3) modeled the relative frequency of use by moose as a function of the predictor variables, and (4) bootstrapped individual animals to account for the fact that individual moose was likely to respond differently to human disturbances.

Study areas were identified by buffering all moose locations by 1 km and creating a minimum convex polygon around them. This is standard practice for identifying second order habitat selection (Sawyer et al. 2009). Sampling units for measuring the habitat variables were circular units with 200 m radii. This size captured differences in relative frequency of use and matched the spatial heterogeneity of the landscape (Sawyer et al. 2009). These sampling units were selected via a systematic sample with a random start. They represented the entire study area in respect to special extent and habitat characteristics.

For each sampling unit, we counted the number of moose locations within it and measured average elevation (kilometers), average slope (percent), distance to forage (kilometers), distance to cover (kilometers), distance to road (kilometers), distance to railroad (kilometers), distance to snowmobile trail (kilometers), and the percentage of area with snowmobile trails. Distance to forage included the following categories: aspen (*Populus tremuloides*), birch (*Betula papyrifera*), black cottonwood (*Populus trichocarpa*), mixed deciduous, mixed forest, and willow (*Salix* ssp.). Distance to cover included black, white, lutz, or sitka spruce (*Picea* ssp.); mixed conifer; and mountain hemlock (*Tsuga mertensiana*) vegetation. All vegetation classes were taken from http://www.kenaiwatershed.org/research/Watershed_atlas_pdfs/KNWR_vegetation.pdf. The maximum distances to road, railroad, and snowmobile trail were set to 3 km based on the presumption that moose do not respond to these anthropogenic features or human disturbance beyond 3 km. Similar analyses for other mammals including elk (Rowland et al. 2000), lynx (Kolbe et al. 2007) caribou (Preisler et al. 2006), and mule deer (e.g., Sawyer et al. 2006, 2009) have seen maximum effects at distances <3 km.

Before modeling habitat use, we conducted a Pearson's pairwise correlation analysis to identify potential multicolli nearity issues. If two variables were highly correlated ($|r|>0.70$), both variables were not allowed in the same model.

The relative frequency of locations from the GPS-collared moose found in each sampling unit was an empirical estimate of probability of use by the moose. We used an offset term (McCullagh and Nelder 1989) in the GLM to estimate probability of use by the GPS-collared moose as a function of a linear combination of predictor variables, plus or minus an error term assumed to have a negative binomial distribution. The negative binomial distribution allows for overdispersion (White and Bennetts 1996). In this application, overdispersion is due to many sampling units with zero locations and many sampling units with larger numbers of moose locations. The form of the GLM used was:

$$\ln(E[l_i]) = \ln(\text{total}) + \beta_0 + \beta_1 X_1 + \ldots + \beta_p X_p, \quad (1)$$

which is equivalent to

$$\ln\left(\mathrm{E}\left[l_\mathrm{i}\big/ total\right]\right) = \ln(\mathrm{E}[relative\ frequency_\mathrm{i}])$$
$$= \beta_0 + \beta_1 \mathrm{X}_1 + \ldots + \beta_\mathrm{p} \mathrm{X}_\mathrm{p}, \quad (2)$$

where l_i is the number of GPS-collared moose locations within sampling unit i, total is the total number of GPS-collared moose locations within the study area, β_0 is an intercept term, $\beta_1,\ldots,\beta_p$ are unknown coefficients to be estimated for habitat variables $X_1,\ldots,X_p$, and $E[.]$ denotes the expected value. The offset term, ln(total), converts the response variable from an integer count to a relative frequency by dividing the number of collared moose locations in each sampling unit by the total number of moose locations. This approach estimated the probability of use by the collared moose for each sampling unit as a function of predictor variables (Manly et al. 2002). Models were fit using the negative binomial function (glm.nb) in the MASS contributed package (Venables and Ripley 2002) for the R language and environment for statistical computing (R Development Core Team 2012). This function includes maximum likelihood estimation of the dispersion parameter for the negative binomial GLM. Because of gaps between sampling units, predictions from Eq. 1 are not subject to a unit-sum constraint. The final RSF represents probability of use, so is termed a resource selection probability function (RSPF; Manly et al. 2002).

For each geographical area, we pooled all moose location data to estimate one model for all animals within each period. Animals providing more data had more weight in the estimates of coefficients and standard errors for the final model (Thomas and Taylor 2006). To estimate standard errors (SEs) and 90 % confidence intervals (CIs) for model coefficients, we bootstrapped data from the individual animals 500 times (Manly 2007). Bootstrapping individuals treated the animal as the experimental unit and ensured that we were estimating the correct error for population level selection (Thomas and Taylor 2006). Percentile-based CIs were reported, and coefficients with 90 % CIs that did not encompass 0.0 were considered statistically significant ($\alpha=0.10$).

For Placer Valley, datasets for the preseason were small, which precluded the use of bootstrapping techniques on individuals. Instead, confidence estimates were based on pooled data for all moose. This procedure excluded between animal variation, narrowing the CI estimates.

In Placer Valley, we began by determining which model gained the most support for predicting moose preferences during the snowmobile period (2006–2007), based on AIC criteria (Burnham and Anderson 2002). We determined a priori that the explanatory variables of elevation and slope would occur in all models, as these variables were likely a proxy for snow depth and gradient of terrain. We then approached model selection using two stages. The first stage used AIC criteria to determine if distance to forage and/or distance to cover should enter the final RSPF. Only the best model containing these explanatory variables entered the second stage (Arnold 2010). This second stage used AIC criteria to determine if a substantial portion of the remaining variation in the moose location data could be explained by anthropogenic factors (i.e., distance to road, distance to snowmobile track, distance to railroad, and percent of circular unit covered by snowmobile tracks). Selection of the anthropogenic explanatory variables occurred in a stepwise fashion, proceeding until the AIC value for the model could no longer be reduced. Due to high correlations between some variables (e.g., distance to snowmobile track and percent snowmobile track), not all anthropogenic variables were included in the same model.

The model gaining most support for predicting moose preferences during the snowmobile period was used to estimate parameter coefficients for the 2006–2007 preseason, high and low snow periods. This approach enabled evaluating how moose selection for the same variables may change, before snowmobile activity occurred. For example, if moose were averse to snowmobile activity, then preferences for areas dense with trails should show a negative parameter (as the density of snowmobile activity increases, moose use decreases). Displacement would have occurred if this parameter was positive during the preseason. This would indicate that moose were attracted to the area before snowmobile activity, but then avoided those places after it began. The effects of such displacement could be detrimental, where moose also positioned further from areas with adequate forage and cover during the snowmobile period.

We validated the model describing moose behavioral choices during the snowmobile period of 2006–2007 with moose and covariate data from the corresponding snowmobile period in 2007–2008. We also validated the 2006–2007 preseason models with preseason data from the winter of 2007–2008. The predictions were placed into 20 bins of equal area, and the count of use in each bin was compared to the bin rank using Spearman's rank correlation coefficient (Sawyer et al. 2009; Coe et al. 2011).

We took a similar approach in Juneau Creek. We began by determining which model was best supported by data describing when snowmobile activity occurred during the 2006–2007 winter (using AIC criteria; Burnham and Anderson 2002). We used this same model structure on the 2006–2007 postseason. As above, we estimated parameter coefficients and evaluated any coefficient changes between periods. We did not apply the during recreation model on the 2006–2007 preseason since we lacked sufficient data.

We validated the model describing the during recreation period with data from the entire second winter, a period without snowmobiles, using Spearman's rank correlation coefficient. If the model describing moose choices during snowmobile recreation validated well with data describing moose choices without snowmobile recreation, it would indicate little effects of snowmobile activity on moose habitat choices, as one season had snowmobiling and the other did not.

Results

Literature review

Seventeen publications document the effects of snowmobiles and other forms of winter recreation on moose and northern ungulates (Table 2). Most studies evaluate disturbances based on behavioral observations and measure the distances between the disturbing agent (i.e., snowmobile) and the animal, at the time of reaction. Sometimes these distances and times are quantified to estimate energetic costs (i.e., Neumann et al. 2010).

Four studies explore disturbances to moose from winter recreational activity, with two focused on snowmobiles. One of them reports that moose within 150 m of snowmobile trails were more likely to alter their behavior from the activity (e.g., feeding, bedding). The frequency of snowmobiles did not affect moose numbers in the study area (Colescott and Gillingham 1998). In the second publication, Nordic skiing and snowshoeing elicited greater disturbances to moose than snowmobile use (Rudd and Irwin 1985).

The remaining two publications covered Nordic skiers. In one, skier activity reduced moose numbers within 500 m of ski trails, and moose wintered in areas with lower skiing activity (Ferguson and Keith 1982). During the second study, skiers disturbed moose for 180 s, and when disturbed, moose movements increased by 33 times for the first hour after disturbance. This doubled moose use of energy (Neumann et al. 2010).

Thirteen studies examine responses of other ungulates (caribou, elk, deer, bison, reindeer, and muskox) to winter recreation activity (Table 2). Disturbances to animals occur inconsistently (within and across species), and the interpretations of disturbance vary from body movement to geographical displacement. For example, white-tailed deer within 61 m of a trail were sometimes disturbed from snowmobiles (e.g., disturbance measured by the animals walking or moving their heads; Eckstein et al. 1979). Dorrance et al. (1975) also report variation in deer disturbance, but when deer are displaced, they relocate within 200 m of a snowmobile trail. McLaren and Green (1985) measured an initial reaction by muskox individuals to snowmobiles at 345 m. Freddy et al. (1986) found that flight responses in mule deer occurred at 191 m for people on snowshoes and 133 m for snowmobiles. Elsewhere, reindeer groups fled from snowmobiles occurring within 80 m (Tyler 1991). Some elk within 400 m of a skier in an area infrequently used by people would move 1,675 m. Elk more conditioned to human activity, if displaced, moved 40 m (Cassirer et al. 1992). Borkowski et al. (2006) report that elk did not flee from snowmobiles or snow coaches. Contrarily, Seip et al. (2007) found snowmobile use displacing caribou from areas of high habitat quality (Table 2).

Table 2 Summary of literature synthesis describing the effects of snowmobile use and nonmotorized winter recreation on moose (*Alces alces*) and other ungulates inhabiting northern ecosystems

Reference	Location	Species	Activity	Dates	Method	Effect[a]	Distance
Mahoney et al. (2001)	Gros Morne National Park, New Foundland, Canada	Caribou	Snowmobiling	March 1994–May 1997	Behavioral observations	1, 3, 10	100 fd, 65 dm, 1.2 du
Borkowski et al. (2006)	Yellowstone National Park, USA	Elk	Snowmobiling and snow coaching	Winter 1999–2000 and 2002–2004	Behavioral observations	1	N/A
Cassirer et al. (1992)	Yellowstone National Park, USA	Elk	Nordic skiing	Winter 1987–1988	VHF telemetry and behavioral observations	2, 3, 4	40 fd, 1,675 dm (15 fd, 40 dm for habituated animals)
Creel et al. (2002)	Yellowstone National Park, USA	Elk	Snowmobiling	Winter 1998–1999	Fecal glucocorticoid hormone levels	1	N/A
Colescott and Gillingham (1998)	Greys River Drainage, WY, USA	Moose	Snowmobiling	January–February 1994	Behavioral observations	2, 4, 10	150–300 fd
Ferguson and Keith (1982)	Elk Island National Park, Alberta, Canada	Moose	Nordic skiing	Winter 1970–1978 (aerial counts); winter 1978–1979	Aerial counts, pellet counts, track counts	2, 4, 5	500 dt
Neumann et al. (2010)	Northern Sweden	Moose	Nordic skiing	March 6–11, 2006	Behavioral observations/ VHF telemetry	1, 2, 9, 10	<180 du
Rudd and Irwin (1985)	Western WY, USA	Moose	Snowmobiling, snowshoeing, and Nordic skiing	Winter 1981–1983	Behavioral observations	6	75 fd, 15 dm (snowshoeing/ Nordic skiing); 55 fd, 10 dm (snowmobiling)
Seip et al. (2007)	Hart Range, British Columbia, Canada	Mountain caribou	Snowmobiling	March 1999, 2002, 2005, and 2006	Aerial census, GPS telemetry, resource selection function	2, 5	N/A
Freddy et al. (1986)	Junction Butte State Wildlife Area, CO, USA	Mule deer	Snowmobiling and snowshoeing	March 1979 and 1980	Behavioral observations	6	191 fd, 193 dm, 6.6 du (snowshoeing); 133 fd, 100 dm, 1.2 du (snowmobiling)
McLaren and Green (1985)	Melville Island, NWT, Canada	Muskoxen	Snowmobiling	April–May 1982	Behavioral observations	1, 10	345 first reaction distance (alert), 2.1–6 du
Reimers et al. (2003)	Southern Norway	Reindeer	Snowmobiling and Nordic skiing	Winter 1998–2000	Behavioral observations	6	756 fd, 970 dm (Nordic skiing); 570 fd, 660 dm (snowmobiling)
Tyler (1991)	Svalbard, Norway	Reindeer	Snowmobiling	April 1987	Behavioral observations	1	80 fd, 160 dm, 3.2 du (max)
Dorrance et al. (1975)	St. Croix State Park and Mille Lacs Wildlife Management Area, MN, USA	White-tailed deer	Snowmobiling	Winter 1972–1973; 1973–1974	Home range estimation/ VHF telemetry	2, 3	~10–100 dt
Eckstein et al. (1979)	Northern Wisconsin	White-tailed deer	Snowmobiling	February–March 1973–1974	VHF telemetry	1	~10–80 fd
Moen et al. (1982)	Wildlife Ecology Lab, Cornell University, Ithaca, NY, USA	White-tailed deer	Snowmobiling	December 1976–March 1977	Heart rate monitoring, behavioral observations	8, 9, 10	2–40 dm, 2 du (heart rate)
Richens and Lavigne (1978)	Somerset County, ME, USA	White-tailed deer	Snowmobiling	Winter 1972–1975	Pellet counts and tracks	1, 6, 7	N/A

Distances are in meters and time is in minutes

fd flight distance, *dm* distance moved, *dt* distance animal displaced, *du* duration animal disturbed, *N/A* no data

[a] Codes included the following: 1—Snowmobile use and nonmotorized recreation had negligible effects on ungulates. 2—Ungulates displaced to alternate area; sometimes alternate area less productive; some animals returned after disturbance ceased. 3—Ungulates appearing habituated to disturbance were less disturbed. 4—Number or frequency of recreation users less important than area affected and timing. 5—Recreation use had negative impact on ungulates. 6—Nonmotorized recreation had a greater disturbance than snowmobile use. 7—Ungulates used snowmobile trails to access forage. 8—Ungulates exhibited a physiological response to snowmobiles (e.g., increase in heart rate). 9—Ungulates did not habituate. 10—Ungulates altered behavior by changing or increasing activity and movement

As a measure of physiological stress, Moen et al. (1982) demonstrate that heart rates of white-tailed deer increase from snowmobile activity within 40 m, for an average of 2 min, without signs of habituation. The effects are unknown. For elk, the amount of glucocorticoid in feces paralleled the variation in the number of snowmobiles present (Creel et al. 2002). There was no evidence that snowmobile activity negatively affects elk population dynamics (Creel et al. 2002).

Guidelines describing the effects of winter recreation on northern ungulates

Our literature synthesis exposed how various forms of winter recreation can elicit diverse and inconsistent behavioral responses from ungulates. Sometimes animals are undisturbed by winter recreation, while at other times they are disturbed and leave the area. Animals may or may not return after the disturbance.

Despite this, commonalities emerged. Some ungulate responses appear independent of species or geographical location. Explanations for the different outcomes depend on the duration of the activity, the predictability of disturbance, the type of recreation, and habitat availability. Information on these factors enabled formulating six guidelines that describe the effects of winter recreation on ungulates.

1. Recreation causes the most disturbances to ungulates when it is unpredictable in timing and geographical location.
2. The size of the area having the recreational activity is more influential than the magnitude of users or intensity of use. Recreation spanning larger areas tends to have more negative impacts to ungulates than recreation occurring in smaller areas.
3. The duration of the activity is more influential than the magnitude of users or intensity of use. Short-term disturbance events are less likely to reduce the physical well-being of ungulates. Therefore, months of recreation activity generate negative effects more than recreation activity spanning a few days or weeks.
4. Because motorized disturbances have a greater spatial footprint, there is a higher likelihood for them to disturb ungulates.
5. Nonmotorized recreation generates greater disturbances to wildlife than motorized activities such as snowmobiling. An animal is at risk of displacement when humans afoot are within approximately 15–756 m and snowmobiles 10–570 m (min/max). Animals tend to move further from nonmotorized activity (15—1,675 vs. 10–660 m (min/max) for motorized) and disturbances last longer (<3 h (max) nonmotorized vs. <6 min (max) motorized).
6. Long-term concerns of disturbance occur when recreation use is high enough to displace animals to poor quality habitats for extended periods.

The authors discussed point 1 most. Point 6 was least tested. Indeed, only two studies conclude negative impacts to ungulates based on displacement (Nordic skiers—Ferguson and Keith 1982; snowmobiles—Seip et al. 2007). The field studies provided more information for these two guidelines.

Field evaluations

During snowmobile activity in Placer Valley, the model receiving most support contained variables of elevation (β=−3.89), slope (β=−0.11), distance to forage (β=−3.43), distance to road (β=0.78), and percentage of snowmobile trails (β=−0.05) (Tables 3 and 4). There were no competing models (Burnham and Anderson 2002; Arnold 2010). Positive parameters described selection increasing as the variables increased. For example, moose preferences increased with distances from roads. Negative parameters indicated moose preferences increasing as the variable declined. Hence, moose preferred lower elevations, gentle slopes, and areas close to forage. Moose avoided areas of high snowmobile trail density (Table 4).

We applied this model describing moose preferences during the snowmobile period to data describing the prior two preseason periods. Moose always preferred areas near forage, low slope, and distant from roads (Fig. 2). During the low snow, preseason period, values for parameter estimates were as follows: elevation—β=3.37, slope—β=−0.24, distance to forage—β=−7.60, percent snowmobile trails—β=0.05, and distance to roads—β=1.93 (Table 4, Fig. 2). Changes in parameter estimates suggested the effects of snowmobile activity on moose behavior. During low snow conditions, moose preferred areas with high elevation. Moose also selected locations soon to have high proportions of snowmobile trails, with a positive, exponentially shaped relationship. The probability of use for areas that would receive >60 % snowmobile trails was 20–100 % (Fig. 3).

During high snow conditions, parameter estimates changed by the following: elevation (β=−9.29), slope (β=−0.07), distance to forage (β=−1.92), distance to road (β=0.66), and percentage of snowmobile trails (β=−0.01) (Table 4). Moose preferred gentle slopes and lower elevations, proximity to forage, and greater distances from roads. The probability of a moose being in an area increased as the percentage of snowmobile trails declined. The relationship was linear (Fig. 3). Moose avoidance or selection for areas with high density of future trails remained indeterminate, since confidence intervals overlapped zero (Table 4).

We identified the following pattern: In early winter, moose selected areas that would eventually receive high snowmobile

Table 3 Comparison of models describing moose (*Alces alces*) habitat preferences for eight variables in three different periods during the winter of 2006–2007 with snowmobile recreation at Placer Valley in south-central Alaska, USA

Stage of model selection	Covariates	*k*	AIC	ΔAIC	Model weight
1	Elevation + slope + distance to cover	5	6,409.6	46.8	0.0
	Elevation + slope + distance to forage + distance to cover	6	6,363.6	0.8	0.4
	Elevation + slope + distance to forage	5	6,362.8	0.0	0.6
2	Elevation + slope + distance to forage + distance to railroad	6	6,361.9	61.5	0.0
	Elevation + slope + distance to forage + distance to snowmobile trail	6	6,360.2	59.8	0.0
	Elevation + slope + distance to forage + % snowmobile trail	6	6,353.7	53.3	0.0
	Elevation + slope + distance to forage + distance to road	6	6,328.0	27.6	0.0
	Elevation + slope + distance to forage + distance to road + distance to snowmobile trail	7	NA	NA	NA
	Elevation + slope + distance to forage + distance to road + distance to railroad	7	NA	NA	NA
	Elevation + slope + distance to forage + distance to road + % snowmobile trail	7	6,300.4	0.0	1.0

The letters "NA" indicate a model that did not converge. Model weights were based on AIC values within each stage of model selection

use. Moose probability of use was ≥20 % for areas that would later receive 60–100 % snowmobile trails. As snow depth increased, preferences for areas with future snowmobile trails tapered. Now, moose were 30–50 % more likely to remain in areas that would later have a density of 50–100 % snowmobile trails. When snowmobile activity occurred, moose retreated to places with low percentages of snowmobile trails. Moose probability of being in an area with ≥50 % snowmobile trails fell <10 %. This occurred despite declining depth of snow at the valley. If snow depth was the primary factor, then moose use of areas with a high density of trails should have increased, since the period with snowmobiling had less snow than the period prior without snowmobiling. Instead, the presence of snowmobile recreation was the primary factor. Moose were displaced to areas with proximity to forage similar to their original locations (Table 4). The geographical locations used before snowmobile recreation and after were equivalent in area (~50 km2), so moose density in these habitats remained unchanged. Moreover, these locations had similar model parameters (regarding distances to forage, roads, and slope).

The model describing moose preferences during snowmobile activity was validated with moose and covariate data during the 2007–2008 snowmobile season (Spearman's rank coefficient, $r2=0.81$). The entire preseason model of 2006–2007 (low and high snow periods combined) was validated against data gained during the 2007–2008 preseason ($r2=0.84$). Lastly, the preseason low snow period was validated against the entire 2007–2008 preseason ($r2=0.93$). High values of validation support the models' predictive abilities.

For Juneau Creek, we identified the model with most support, based on AIC criteria, during the period of snowmobile recreation (Table 5). Moose showed no preference for elevation, slope, or proximity to roads, as all confidence intervals spanned 0 (Table 6). Moose preferences increased for areas with closer distances to forage and cover. As distances to the Resurrection Trail increased, moose preferences declined, indicating attraction to the trail or features associated with it.

Table 4 Parameters, parameter estimates, and 90 % confidence intervals (LL, UL) for variables included in the most supported model describing moose (*Alces alces*) preferences during the snowmobile period in Placer Valley, Alaska, USA (winter of 2006–2007; Table 3), applied to the two preseason periods

Parameter	Preseason 2006–2007			Preseason 2006–2007			During season 2006–2007		
	Low snow			High snow					
	Estimate	LL	UL	Estimate	LL	UL	Estimate	LL	UL
Intercept	−11.64	−12.28	−10.99	−6.69	7.34	−6.03	−7.11	−7.45	−6.78
Elevation	3.37	1.98	4.77	−9.29	−11.57	−7.01	−3.89	−4.76	−3.01
Slope (%)	−0.24	−0.27	−0.21	−0.07	−0.11	−0.04	−0.11	−0.13	−0.09
Distance to forage	−7.60	−9.56	−5.63	−1.92	−3.64	−0.19	−3.43	−4.30	−2.56
Distance to road	1.93	1.68	2.19	0.66	0.41	0.92	0.78	0.65	0.92
% Snowmobile trail	0.05	0.03	0.06	−0.01	−0.03	0.75	−0.05	−0.06	−0.04

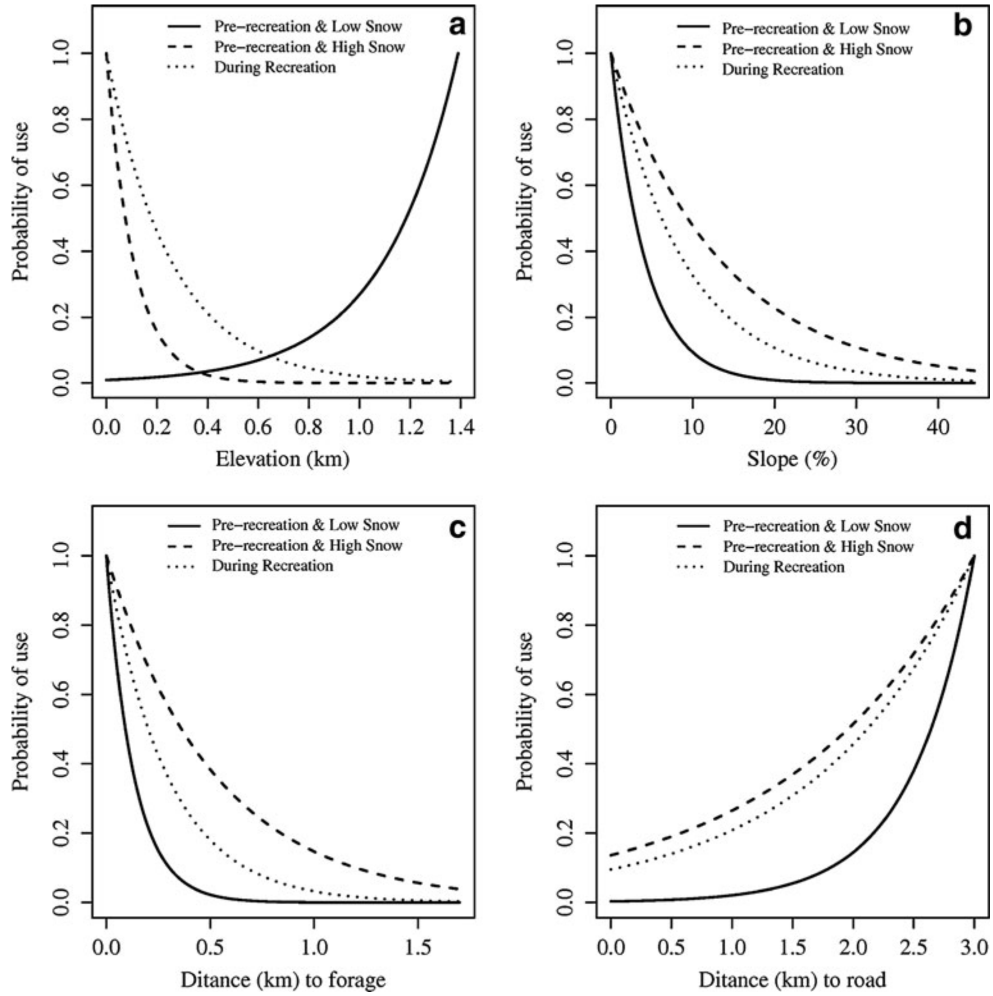

Fig. 2 Plots describing the probability of use for four variables, across three periods, by moose inhabiting Placer Valley, south-central Alaska. The three periods include (1) preseason with low snow conditions (*solid line*), (2) preseason with high snow conditions (*dashed line*), and (3) during snowmobile recreation (*dotted line*). *Panels* represent the following four variables: **a** elevation, **b** percent slope, **c** distance to forage (kilometers), and **d** distance to road (kilometers). Moose preferences for these four parameters were not influenced by snowmobile use in Placer Valley

We calculated parameter estimates for the 2006–2007 postseason using the same model developed during the recreation period. Model analysis suggests that moose preferred lower elevations and steeper slopes (Table 6). Moose continued to prefer locations near forage and cover. Model results are similar, particularly with respect to the variable describing distances to the Resurrection Trail.

The model describing moose preferences during snowmobile activity was validated with data spanning December 1, 2007–March 31, 2008 ($r2=0.86$). During these dates, Juneau Creek was closed to snowmobiles. The post-recreation model also validated well against the 2007–2008 winter ($r2=0.83$). The validation demonstrates similarity in moose behaviors during periods with and without snowmobiling.

Results of the field studies corroborated that recreation, when unpredictable in time and space, caused more disturbances to ungulates than predictable recreation. We also demonstrated that unpredictable recreation spanning long durations (months) can displace ungulates to different locations. In our study, animals moved to locations with similar habitat characteristics. This reduced the potential for long-term negative effects.

Discussion

We reviewed literature describing the responses of northern ungulates to various forms of winter recreation and quantified moose behavioral changes to snowmobile activity in south-central Alaska. Our goal was to formulate and evaluate guidelines describing conditions when winter recreation may be detrimental to ungulates, to help resource managers balance recreation with wildlife stewardship. We offered six guidelines. Recreation impacts on ungulates increase when it occurs over long periods and across large areas, with disturbances unpredictable in location and time (guidelines 1–3). Because motorized use covers greater area, the numbers of disturbance events increase (guideline 4). However, these disturbances have less affect than disturbances generated by nonmotorized users (guideline 5). Lastly, the presence of alternative habitats for animals to relocate reduces the impacts of disturbances from winter recreation (guideline 6). Managers can use these guidelines for predicting the responses of ungulates to recreation in any given area.

The second and third guidelines are straightforward. Recreation occurring in small areas has less impact relative to

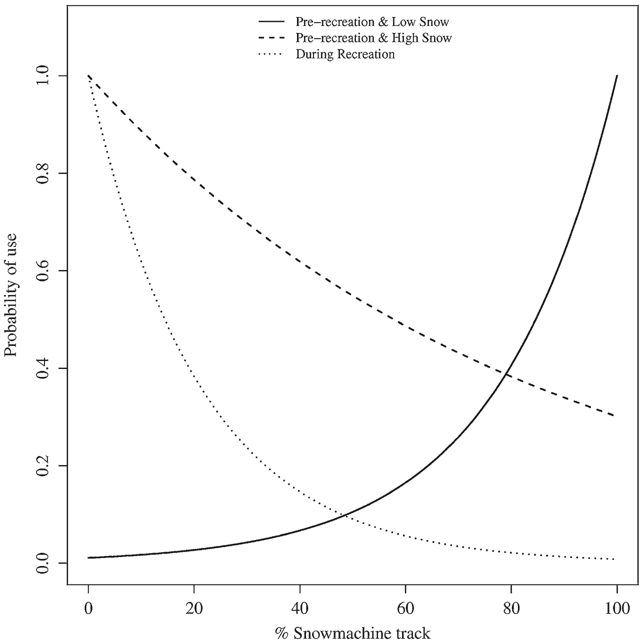

Fig. 3 Plot describing moose probability of use for areas that vary in their proportion of snowmobile trails, across three periods, by moose inhabiting Placer Valley, south-central Alaska. The three periods include (1) preseason with low snow conditions (*solid line*), (2) preseason with high snow conditions (*dashed line*), and (3) during snowmobile recreation (*dotted line*). Probability of use is determined by using the best model describing moose preferences during snowmobile recreation, applied to the other periods. During the preseason and low snow period, moose selected areas that would have high density of snowmobile use, with a positive, exponentially shaped relationship. Moose probability of use was ≥20 % for locations that would be covered >60 % with snowmobile trails. During preseason and high snow depth, moose preferences declined linearly with the proportion of snowmobile trails. During snowmobile recreation, the probability of moose using areas with increasing proportion of snowmobile trails declined in exponential form. The probabilities of moose being in locations with percent snowmobile trails ≤30 % and below were 20–100 %

recreation occurring across large areas. Moreover, recreation activities occurring over short periods (days or hours) have less impact than those occurring over longer periods (months). We addressed the remaining guidelines in turn.

Predictability

When recreation activity is visually or acoustically predictable in location and time, then animals can habituate (Dorrance et al. 1975; Schultz and Bailey 1978; Epsmark and Langvatn 1985; Westworth et al. 1989; Cassirer et al. 1992). Recreation that is unpredictable in location or time can cause displacement (Kuck et al. 1985; Freddy et al. 1986; Cassirer et al. 1992). Most studies report that when displacement occurred, it was temporary, with animals returning after disturbance (Dorrance et al. 1975; Richens and Lavigne 1978; Tyler 1991; Cassirer et al. 1992; Andersen et al. 1996). Deer, for example, did not abandon bedding and feeding sites from snowmobile disturbances, and some followed snowmobile trails for short distances when near major bedding areas (Richens and Lavigne 1978). Eckstein et al. (1979) report no differences between the sizes of home ranges or habitat use for white-tailed deer between areas with and without snowmobiles. Fewer studies demonstrate winter recreation causing permanent displacement in ungulates (Dorrance et al. 1975; Ferguson and Keith 1982).

Amount and type of recreation

Because motorized activity is more likely to cover larger areas than nonmotorized recreation, the number of ungulate disturbance events seems greater. Despite this, when disturbance events occur, nonmotorized recreation causes greater disturbances to ungulates than motorized users (e.g., Richens and Lavigne 1978; Eckstein et al. 1979; Rudd and Irwin 1985; Freddy et al. 1986; Canfield et al. 1999; Reimers et al. 2003). Therefore, nonmotorized recreation causes fewer, stronger disturbance effects in relatively smaller areas, while motorized recreation generates more, weaker disturbances across larger areas. Nonmotorized activity also causes animals to flee sooner and move further. The disturbances last longer. For instance, it takes longer for heart rates of moose to normalize after responding to nonmotorized

Table 5 Comparison of models describing moose (*Alces alces*) habitat preferences for seven variables during the winter of 2006–2007 with snowmobile recreation at Juneau Creek in south-central Alaska, USA. Model weights were based on AIC values within each stage of model selection

Stage of model selection	Covariates	*k*	AIC	ΔAIC	Model weight
1	Elevation + slope + distance to cover	5	17,491.3	53.5	0.0
	Elevation + slope + distance to forage	5	17,479.1	41.3	0.0
	Elevation + slope + distance to forage + distance to cover	6	17,437.8	0.0	1.0
2	Elevation + slope + distance to forage + distance to cover + distance to road	7	17,436.4	169.2	0.0
	Elevation + slope + distance to forage + distance to cover + % snowmobile trail	7	17,413.9	146.7	0.0
	Elevation + slope + distance to forage + distance to cover + distance to snowmobile trail	7	17,295.1	27.9	0.0
	Elevation + slope + distance to forage + distance to cover + distance to snowmobile trail + distance to road	8	17,267.2	0.0	1.0

Table 6 Parameters, parameter estimates, and 90 % confidence intervals (LL, UL) for variables included in the best model describing moose (*Alces alces*) preferences during the snowmobile period in Juneau Creek, Alaska, USA (winter of 2006–2007), applied to the post-recreation period

Parameter	During season 2006–2007			Post-recreation 2006–2007		
	Estimate	LL	UL	Estimate	LL	UL
Intercept	−7.204	−8.448	−6.222	−5.163	−6.993	−5.071
Elevation	0.466	−3.467	2.847	−5.278	−7.482	−0.795
Slope (%)	−0.007	−0.025	0.017	0.066	0.017	0.080
Distance to forage	−2.634	−5.651	−1.235	−0.959	−2.468	−0.213
Distance to cover	−1.395	−2.071	−0.498	−1.786	−2.539	−0.039
Distance to snowmobile trail	−0.720	−1.270	−0.476	−0.884	−1.272	−0.510
Distance to road	0.410	−0.180	1.224	0.217	−0.106	0.856

disturbances (Andersen et al. 1996), even though animals are aware of snowmobiles sooner (Reimers et al. 2003).

Irrespective of the type of winter recreation, animals respond to the initial event, even at low levels. What matters is the amount of time the recreation occurred and the area covered (Cassirer et al. 1992). Hence, the amount of use—be it nonmotorized or motorized—has little influence (Geist 1971; Dorrance et al. 1975; Ferguson and Keith 1982; Cassirer et al. 1992; Colescott and Gillingham 1998). This made quantifying the intensity of recreation in our study sites unwarranted.

Habitat availability

Understanding ungulate behavioral responses to recreation relies on evaluating recreation in the context of habitat quality and quantity, within the geographical area. Seemingly, an animal in quality habitat with winter recreation would be displaced more readily if vacant, equally good winter habitat occurred nearby, without the activity. Alternatively, animals inhabiting quality habitat are probably less likely to permanently relocate to poorer habitat, when the quality habitat is in short supply. Then, animals may temporarily vacate an area during recreation and return when recreation ceases.

For example, imagine a 100-km2 area with 100 moose (1 moose/km2). In winter, because of snowmobile activity, moose used only half of this area (50 km2 at 2 moose/km2). Would this situation be detrimental to the population? The answer depends on the relationships between the quality and quantity of habitat in an area, moose density, and the amount of time spent in it. Displacement would be most problematic if ungulates relocate to environments with low quality food, or if they aggregate into smaller areas of preferred habitat, for extended periods, such that these habitats are unable to sustain them. The worst situation occurs when animals avoid quality winter habitat during the severest parts of winter (extreme cold and deep snow). Then, displacement increases energy expenditure, weakening individual survival (Hobbs 1989). For example, disturbances that cause large ungulates to stand from a lying position can consume 25 % more energy than remaining idle (Parker et al. 1984; Renecker and Hudson 1986). Such displacement was quantified by two studies (Colescott and Gillingham 1998; Seip et al. 2007). Others hypothesized the outcome (e.g., Eckstein et al. 1979; Tyler 1991).

Field evaluation

Our field evaluation examined recreations' predictability on ungulate behavior and identified conditions when ungulates may be displaced to poor quality habitats for extended periods. This investigation also served to evaluate the other guidelines. For example, in Placer Valley, recreation was unpredictable in location and time, so moose were unlikely to habituate. The size of the recreation area was large, and snowmobile activity lasted 3 months. This increased the number of disturbance events and likelihood of displacement (temporary or permanent). Since recreation was motorized, it also raised the likelihood of disturbance events, but decreased their severity in comparison to nonmotorized users. These circumstances describe a situation where displacement of moose was likely, and snowmobiling would probably be detrimental to moose. However, in Placer Valley, alternative habitats without recreation exist, and these were available for moose to access. During periods of snowmobile activity, moose were displaced, as predicted, but they remained close to forage (Table 4; 11 % of Placer Valley classified as forage). These outcomes infer that snowmobile activity was unlikely to have negative effects on moose residing in Placer Valley. Granted, we do not know what made the locations where snowmobiles occurred attractive to moose during the preseason. The potential exists for the habitats that moose used between periods to differ in quality, despite our classifying them identically.

At Juneau Creek, winter recreation occurred over long periods (2 months), increasing the number of disturbance events and likelihood of displacement. However, human use was confined to a relatively small, linear area (one trail), making recreation more predictable in location and time.

This should encourage habituation by moose. The valley is also expansive with alternative habitats existing off the main trail (15 % of the area classified as forage). Overall, moose were not displaced in Juneau Creek, but may have habituated to human use. Motorized and nonmotorized recreation shared the trail (snowmobiles, Nordic skiers, ATVs, and snowshoers). Evaluating moose responses to the differing forms of recreation was beyond our scope, although we noted that moose preferences did not change between winters with and without snowmobile use. Moose always preferred areas close to this trail. We concluded that snowmobile activity did not negatively affect moose at Juneau Creek.

Professionals managing areas with ungulates and winter recreation can use these six guidelines, as exemplified above, to predict recreations' effects on ungulates. While subtleties in species-specific responses or locations are likely to exist, these guidelines are designed to apply to any northern ungulate in any of their habitats.

In practice, when applying these guidelines, logistical or fiscal constraints may challenge abilities to gain information describing recreation type, duration, and spatial use. For these situations, the most important requirement would be knowing the location and extent of quality habitat without recreation. This would cover a worst-case scenario of animals relocating to these habitats, where winter recreation long in duration, covering large areas, being nonmotorized and unpredictable. The amount of habitat necessary to minimize the potential for negative effects would depend on the habitat, animal species, and the density of animals anticipated to use it. Provided that a suitable amount of alternative habitats exists, then the influence of snowmobiles and other forms of winter recreation on ungulates is rather benign (e.g., Richens and Lavigne 1978; McLaren and Green 1985; Tyler 1991; Mahoney et al. 2001; Creel et al. 2002; Reimers et al. 2003; Borkowski et al. 2006). If sufficient habitat free of recreation did not exist, and animals were displaced to poor quality habitats, then their nutrient intake would decline, and increases in physiological stress and energy expenditure would ensue. This would reduce individual health and survivorship during winter, contributing toward population declines.

This study built and tested criteria describing when the effects of winter recreation may be detrimental to ungulates. We provided six guidelines. Wildlife managers can use these guidelines for predicting the responses of northern ungulates to recreation in any given area. Such analyses would identify the effects of winter recreation on ungulates.

Acknowledgments We thank the following individuals for project support and advice: Martin Bray, Jose DeCreft, Michelle Dragoo, Howard Golden, Greg Hayward, Dana Kuiper, Michael Litzen, Kristine Metzger, Mike Novy, Susan Oehlers, Terry Onslow, Jeff Selinger, Paula Smith, and Aaron Poe.

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Appendix L

Management Plan for the Mountain Goat (*Oreamnos americanus*) in British Columbia

Prepared by the Mountain Goat Management Team

BRITISH COLUMBIA
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Ministry of Environment

May 2010

About the British Columbia Management Plan Series

This series presents the management plans that are prepared as advice to the Province of British Columbia. Management plans are prepared in accordance with the priorities and management actions assigned under the British Columbia Conservation Framework. The Province prepares management plans for species' that may be at risk of becoming endangered or threatened due to sensitivity to human activities or natural events.

What is a management plan?

A management plan identifies a set of coordinated conservation activities and land use measures needed to ensure, at a minimum, that target species or ecosystem do not become threatened or endangered. A management plan summarizes the best available science-based information on biology and threats to inform the development of a management framework. Management plans set goals and objectives, and recommend approaches appropriate for species or ecosystem conservation.

What's next?

Direction set in the management plan provides valuable information on threats and direction on conservation measures that may be used by individuals, communities, land users, conservationists, academics, and governments interested in species and ecosystem conservation.

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<http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm>

To learn more about the British Columbia Conservation Framework, please visit the B.C. Ministry of Environment Conservation Framework webpage at:
<://www.env.gov.bc.ca/conservationframework/>

Management Plan for the Mountain Goat (*Oreamnos americanus*) in British Columbia

Prepared by the Mountain Goat Management Team

May 2010

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Recommended citation

Mountain Goat Management Team. 2010. Management Plan for the Mountain Goat (*Oreamnos americanus*) in British Columbia. Prepared for the B.C. Ministry of Environment, Victoria, BC. 87 pp.

Cover illustration/photograph

Courtesy of Kim Poole.

Additional copies

Additional copies can be downloaded from the B.C. Ministry of Environment Recovery Planning webpage at:

http://www.env.gov.bc.ca/wld/recoveryplans/rcvry1.htm

Publication information

ISBN 978-0-7726-6296-5
Date: June 2, 2010
British Columbia. Ministry of Environment.
Management plan for the Mountain Goat (*Oreamnos americanus*) in British Columbia [electronic resource]

[British Columbia management plan series]

Disclaimer

This management plan has been prepared by the Mountain Goat Management Team, as advice to the responsible jurisdiction and organizations that may be involved in managing mountain goats in British Columbia.

This document identifies the management actions that are deemed necessary, based on the best available scientific information, to prevent mountain goat populations in British Columbia from becoming endangered or threatened. Management actions to achieve the goals and objectives identified herein are subject to the priorities and budgetary constraints of participatory agencies and organizations. Recommendations provided in the plan will be used by the Ministry of Environment to guide the development of new or modification of existing provincial policies and procedures. While the recommendations herein are based on the best available science and expert judgement of the Mountain Goat Management Team, policy considerations may modify these recommendations, while respecting their intent, in order to address social and economic objectives in Mountain Goat management. These goals, objectives, and management actions may be modified in the future to accommodate new objectives and findings.

The members of the Mountain Goat Management Team have had an opportunity to review this document. However, this document does not necessarily represent the personal views of all individuals on the Mountain Goat Management Team.

Success in the conservation of this species depends on the commitment and cooperation of many different constituencies that may be involved in implementing the directions set out in this management plan. The Ministry of Environment encourages all British Columbians to participate in the conservation of mountain goats.

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The British Columbia Ministry of Environment is responsible for the management of mountain goats.

ACKNOWLEDGEMENTS

We thank Kim Poole, lead author, for his expertise and diligence in developing this management plan. We also thank all team members for their contributions, particularly Gerry Kuzyk (Chair), Pierre Johnstone (Co-Chair of the Habitat Technical Working Group), and George Schulze (Co-Chairing of the Harvest Technical Working Group). Alec Dale (Wildlife Science Section Manager, Ecosystems Branch) and Ian Hatter (Wildlife Manager, Fish and Wildlife Branch) provided much appreciated support throughout this plan development. Doug Martin (B.C. Ministry of Environment, Cranbrook, BC) and Helen Schwantje (B.C. Ministry of Environment, Victoria, BC) provided additional editorial input. We thank the following scientific reviewers for their input: Marco Festa-Bianchet (Université de Sherbrooke, Sherbrooke, PQ), Steeve Côté (Université Laval, Sainte-Foy, PQ), and Kirby Smith (Alberta Fish and Wildlife Division, Edson, AB). Distribution and survey coverage maps were updated with input from regional B.C. Ministry of Environment staff; Dave Wickstrom (Darkwoods Forestry, Nelson, BC) and Guy Woods (B.C. Ministry of Environment - retired, Nelson, BC) provided additional comments. The North American mountain goat range map was developed with input from states, provinces and territories, and we thank all biologists for their assistance and Byron Woods (B.C. Ministry of Environment, Victoria, BC) for his GIS support. The B.C. Ministry of Environment provided funding and support for development of this management plan.

EXECUTIVE SUMMARY

The purpose of this plan is to provide science-based advice to the Government of British Columbia to help ensure mountain goats (*Oreamnos americanus*) are conserved in perpetuity. The Province of British Columbia is responsible for the management of mountain goats within its boundaries and guidance is required to help inform appropriate management actions. Approximately one half of the world's mountain goats are found in British Columbia, therefore the province has a global responsibility to ensure their long-term persistence. Many view mountain goats as an iconic species, symbolizing rugged mountains and true wilderness. Mountain goats are a valued species, having social and economic value to First Nations for ceremonial use and as a source of food and clothing. There is ample interest in recreational mountain goat hunting; annually, income from licence fees average approximately $110,000 for residents and $300,000 for non-residents.

In B.C., mountain goats are ranked S4 (apparently secure) by the B.C. Conservation Data Centre and ranked G5 (secure) globally (NatureServe 2008). The Conservation Framework has assigned mountain goats a conservation priority 1, the highest priority rank under Goal 2: prevent species and ecosystems from becoming at risk. The Conservation Framework is British Columbia's new approach for maintaining the province's rich biodiversity by selecting appropriate conservation actions for species and ecosystems at risk. A key output from this tool is the requirement to develop a management plan to provide scientific advice on management actions to conserve mountain goats. This plan reviews the most up-to-date science on mountain goats, documents their current threats, discusses available management tools, and provides science-based recommendations to guide management decisions. It includes specific sections on habitat, harvest, human disturbance, and access.

The management goal for mountain goats in British Columbia is to **maintain viable, healthy and productive populations of mountain goats** throughout their native range in British Columbia. The management objectives include (1) to effectively maintain suitable, connected mountain goat habitat; (2) to mitigate threats to mountain goats; and (3) to ensure opportunities for non-consumptive and consumptive use of mountain goats are sustainable.

There are numerous threats to mountain goats, and although individually these threats may have only a low to medium impact provincially, the overall threat impact value is calculated as high due to cumulative effects. Recommended management actions included in this plan try to address ways to mitigate these threats and specifically address issues pertaining to habitat, harvest, disturbance and access. Harvest recommendations are focused on sustainable harvest rates of 1–3% of the population depending upon population size. Populations with less than 50 adults should have no harvest. Harvest of female mountain goats should be minimised because of their low reproductive rates through education and changes in regulation. Mountain goats react more strongly to human disturbance and may be more sensitive to muscle exertion than most ungulates, particularly from the extreme physical exertion and stress caused by helicopter disturbance. Therefore, it is recommended that helicopters have a 2000-m horizontal and 400 m vertical separation from all mountain goat habitat. A habitat risk matrix is provided as a key habitat recommendation and provides advice on the relative risk of physical disturbance to vegetation adjacent to important habitat for mountain goats. Increased access to mountain goat

habitat can have implications to all forms of management and there is a need for integrated management decisions that capture all forms of resource development and recreational activities. Finally, there is a need for research to fill data gaps on mountain goats in British Columbia that could help address management decisions to benefit the conservation of the species.

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1.0 INTRODUCTION

Mountain goats (*Oreamnos americanus*) are adapted to live in rugged mountainous terrain. Their global distribution is limited to western North America, where British Columbia is home to over 50% of the world's population. Within British Columbia, mountain goats are found in a variety of habitats, from wet coastal environments that receive heavy snowfalls, to arid regions of the interior such as the Okanagan. Although widely distributed throughout British Columbia, mountain goats are rarely viewed by the general public because of their affinity for high elevations and steep terrain. Mountain goats have long been seen as a symbol of wilderness (Chadwick 1983).

First Nations value mountain goats economically and culturally as a source of meat and for social ceremonial uses. Mountain goats appear sporadically in records from early European explorers. In 1778, Captain James Cook was intrigued by the mountain goat hides of the Pacific Coast First Nations, thinking they may be from polar bears (*Ursus maritimus*) (Banfield 1974; Chadwick 1983), and Captain George Vancouver reportedly gathered a mountain goat hide from the British Columbia coast in 1792–1794. In 1807, David Thompson shipped about 100 mountain goat hides taken near Windermere in the East Kootenay to England (Banfield 1974).

Early management concerns for mountain goats in the 1960s and 1970s were related to overharvest, mostly associated with increased access created by resource industries such as forestry. These roads opened up previously lightly hunted and inaccessible valleys, and resulted in progressive overharvest on a regional scale (Phelps *et al.* 1983). In the 1980s and 1990s, logging pushed to higher elevations, which allowed for easier access for hunting mountain goats and in some areas encroached on their winter range.

In 1979, the British Columbia government released a *Preliminary Mountain Goat Management Plan* (B.C. Ministry of Environment 1979). Since that time, there has been no formalized provincial management plan to guide the conservation and management of mountain goats. In 2008, the British Columbia government adopted the Conservation Framework (Bunnell *et al.* 2009), a new approach to conserving species and ecosystems by prioritizing and managing species in a proactive manner. Using the Conservation Framework as a science-based decision support tool, resource managers ranked the mountain goats as a high priority species for proactive conservation to prevent the species from becoming at risk. A recommended action for conservation was to develop a management plan. Subsequently, in May 2008, B.C. Ministry of Environment initiated the development of a provincial mountain goat management plan.

The purpose of this mountain goat management plan is to provide scientific advice to assist managers and decision makers in guiding management direction and preventing mountain goats from becoming at risk. Specifically, this plan synthesizes global science-based information on mountain goats. Then, on a provincial level, it describes current threats and management tools presently in use, and makes high-level management recommendations that will assist in the conservation and management of the species.

2.0 BACKGROUND

2.1 Description of the Species and Taxonomy

Mountain goats are not true goats, but are bovids (family Bovidea) most closely related to the chamois (*Rupicapra* spp.) of Europe and the goral *(Nemorhaedus goral*) and serow (*Capricornus* spp.) of Asia (Côté and Festa-Bianchet 2003). These mountain-dwelling ungulates are characterized by extraordinary climbing skills (hence the common name goat antelopes), use of steep terrain to escape predators, and presence of horns in both sexes. Although sexual dimorphism is evident, with adult male mountain goats roughly 40–60% heavier than adult females, sexes can appear more similar in size (adult males shoulder height and chest girth are ~5–7% larger than adult females) (Côté and Festa-Bianchet 2003). Thus, it can be difficult to differentiate between sexes in the field. Body mass continues to increase with age up to 6 years for females and beyond for males (Côté and Festa-Bianchet 2003), about 93% of horn growth is completed by 3 years of age, with a peak length at about 6 years of age (Côté *et al.* 1998). While adult horn circumference is substantially larger in males and males initially have longer horns because of their longer first increment, horn length of adults > 6 years is similar for males and females (Côté *et al.* 1998; Festa-Bianchet and Côté 2008). Horn shape differs between sexes; the horns of males curve smoothly backward from the base to the tip, whereas the horns of females tend to grow straight up from the base and then bend more sharply backward near the tip.

There are presently no recognized subspecies of mountain goats (Cowan and McCrory 1970). Current genetic analysis of mountain goats at the continental level suggests that British Columbia may be divided into two broad groupings: northern B.C. and southern B.C. This finding suggests evidence of two glacial refugia, encompassing 12 distinct subgroups in the north, and 8 subgroups in the south (A. Shafer *et al.*, University of Alberta, unpublished data, 2009). There is no evidence of a high degree of inbreeding within mountain goat populations in British Columbia.

However, striking differences in seasonal habitat use and movement patterns between populations from coastal and interior regions of British Columbia have led researchers to recognize both “coastal” and “interior” ecotypes (Hebert and Turnbull 1977). Coastal ecotype mountain goats typically winter at moderate to lower elevations in forested habitats, and interior ecotype animals inhabit areas of generally drier and lower snowfalls at higher elevations. Interior populations in most areas undergo seasonal movements tied to elevation, using higher elevation at or above treeline during summer and fall, and lower elevations including forests during spring and early summer. These movements are primarily related to access to green-up vegetation and mineral licks. Further division within these broad ecotypes may be warranted (Hebert and Woods 1984; Gilbert and Raedeke 1992) (e.g., “outer coastal” populations that may reach sea level during winter, versus “inner coastal” populations).

2.2 Conservation Status

The mountain goat is considered secure globally (Table 1) (NatureServe 2008), and is listed in the International Union for the Conservation of Nature (IUCN) Red List as category Least Concern with a stable population trend (IUCN 2008). The species has not been assessed at the national level (COSEWIC 2009). In British Columbia the mountain goat is ranked S4, is on the provincial Yellow List, and is considered "apparently secure and not at risk of extinction" (B.C. Conservation Data Centre 2010). Mountain goats rank as priority 1, the highest priority rank, for Goal 2 "Prevent species and ecosystems from becoming at risk" by the British Columbia Conservation Framework, a tool to assess and rank species and ecosystems for conservation action (B.C. Ministry of Environment 2009).

Table 1. Mountain goat status (NatureServe 2008) and estimated numbers (Festa-Bianchet and Côté 2008; several updated for 2008) in British Columbia and adjacent jurisdictions.[1]

	BC	AB	YT	NWT	AK	WA	ID	MT	Canada	USA	Global
Rank [2]	S4	S3	S3	SND	S4	S2S3	S3	S5	N4	N5	G5
Estimate	39 000–65 500	3400	1400	1000	24,000–33,500	4000	2600	2700	--	--	--

[1] AB = Alberta (estimate updated Smith and Hobson 2008); YT = Yukon Territory; NWT = Northwest Territories; AK = Alaska; WA = Washington; ID = Idaho (estimate updated Toweill 2008); MT = Montana (estimate updated Carlsen and Erickson 2008).
[2] Rank: S = State/province; N = National; G = Global; 1 = critically imperilled; 2 = imperilled; 3 = special concern, vulnerable to extirpation or extinction; 4 = apparently secure; 5 = demonstrably widespread, abundant, and secure; ND = Not determined.

2.3 Trends across North America

Native populations of mountain goats are found within the mountains of western North America from Alaska, Yukon, and western Northwest Territories, to Washington, Idaho, and Montana (Festa-Bianchet and Côté 2008) (Figure 1, Table 1). The greatest numbers of mountain goats occur within coastal mountain ranges from Alaska to Washington, but significant populations are found in the interior, primarily within the Rocky Mountain Range. British Columbia (~52%) and Alaska (~29%) have most of the estimated 80,000–120,000 mountain goats within the global population (Festa-Bianchet and Côté 2008).

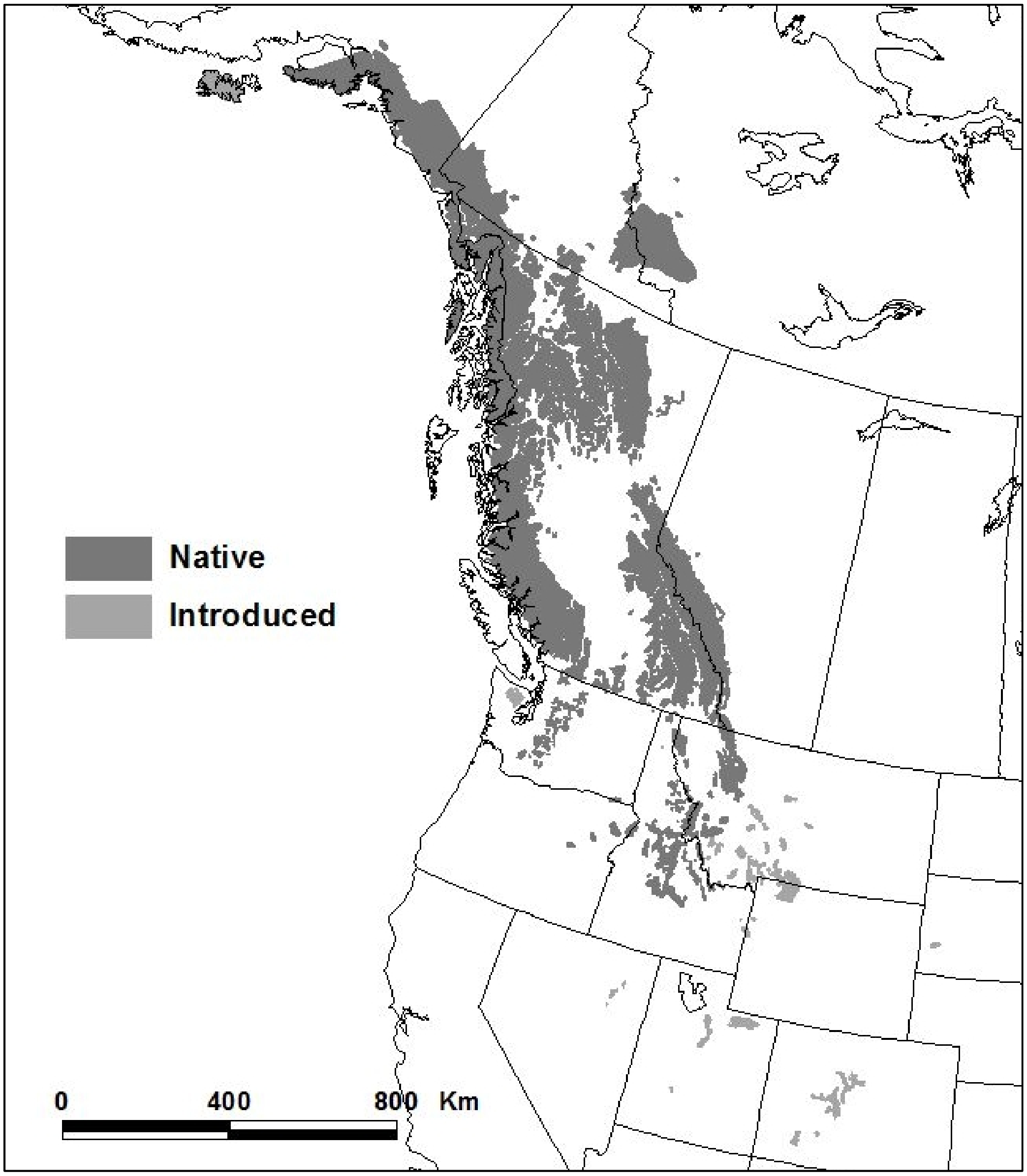

Figure 1. Geographic distribution of mountain goats in North America.

2.4 Distribution/Range of Mountain Goats in British Columbia

Mountain goats are found throughout mountainous regions of British Columbia (Shackleton 1999) (Figure 2). Mountain goat range covers roughly 391,000 km^2, about 40% of the province. Outside of mountainous areas, they are found in only a few isolated locations associated with cliffs and banks along rivers east of the Rocky Mountains in the northeast of the province (EBA Engineering Consultants Ltd. 2004).[1] There are no established natural populations of mountain

[1] Foster, B.R. 1981. Preliminary reconnaissance of wild bovids inhabiting Boat Creek and the Sikanni Chief River, northeastern British Columbia. Progress Report No. 1. Unpublished report submitted to Westcoast Transmission Co. Ltd., Vancouver, BC.

goats on the large coastal islands (e.g., Vancouver Island, Haida Gwaii). There is evidence of mountain goats on Vancouver Island from the early Holocene (post-glacial ~10,000–12,000 years ago; Nagorsen and Keddie 2000).

With the possible exception of the southern fringes of range, the overall distribution of mountain goats in British Columbia has changed little in the past 300–400 years. At least two small (< 30 animals) and relatively isolated populations along the southern edge of distribution in the West Kootenay may have disappeared over the past 10–20 years (Keenleyside dam and Big Sheep Creek; G. Woods, pers. comm. 2008). Hunting may have contributed to the declines, but severe winters in the late 1990s and high cougar (*Puma concolor*) predation may have also contributed to the local extirpations (G. Woods, pers. comm. 2008). Several populations in the Okanagan were extirpated due in large part to over-harvest.[2] The Almond Mountain complex near Grand Forks once held 50–80 mountain goats, but none have been reported in the past 20 years (B. Harris, pers. comm. 2009).[3] The Similkameen/Ashnola population has been reduced by half since the early 1980s, with goats in the Cathedral Lakes, Upper Ashnola River bluffs, and Snowy Mountain areas absent or at very low numbers.[4] However, in parts of the south Okanagan, mountain goat numbers appear to be down, but the distribution is up (i.e., they appear to be abandoning some traditional areas and distributing more thinly in “new” areas) (B. Harris, pers. comm. 2009).

[2] Wilson, S.F. and R.L. Morley. 2007. Mountain goat management and population restoration plan for the Okanagan Region. Unpublished report for B.C. Ministry of Environment, Penticton, BC.

[3] Gyug, L. 2006. Mountain goat population and harvest assessment in the Okanagan Region. Unpublished report for B.C. Ministry of Environment, Penticton, BC.

[4] Gyug, 2006.

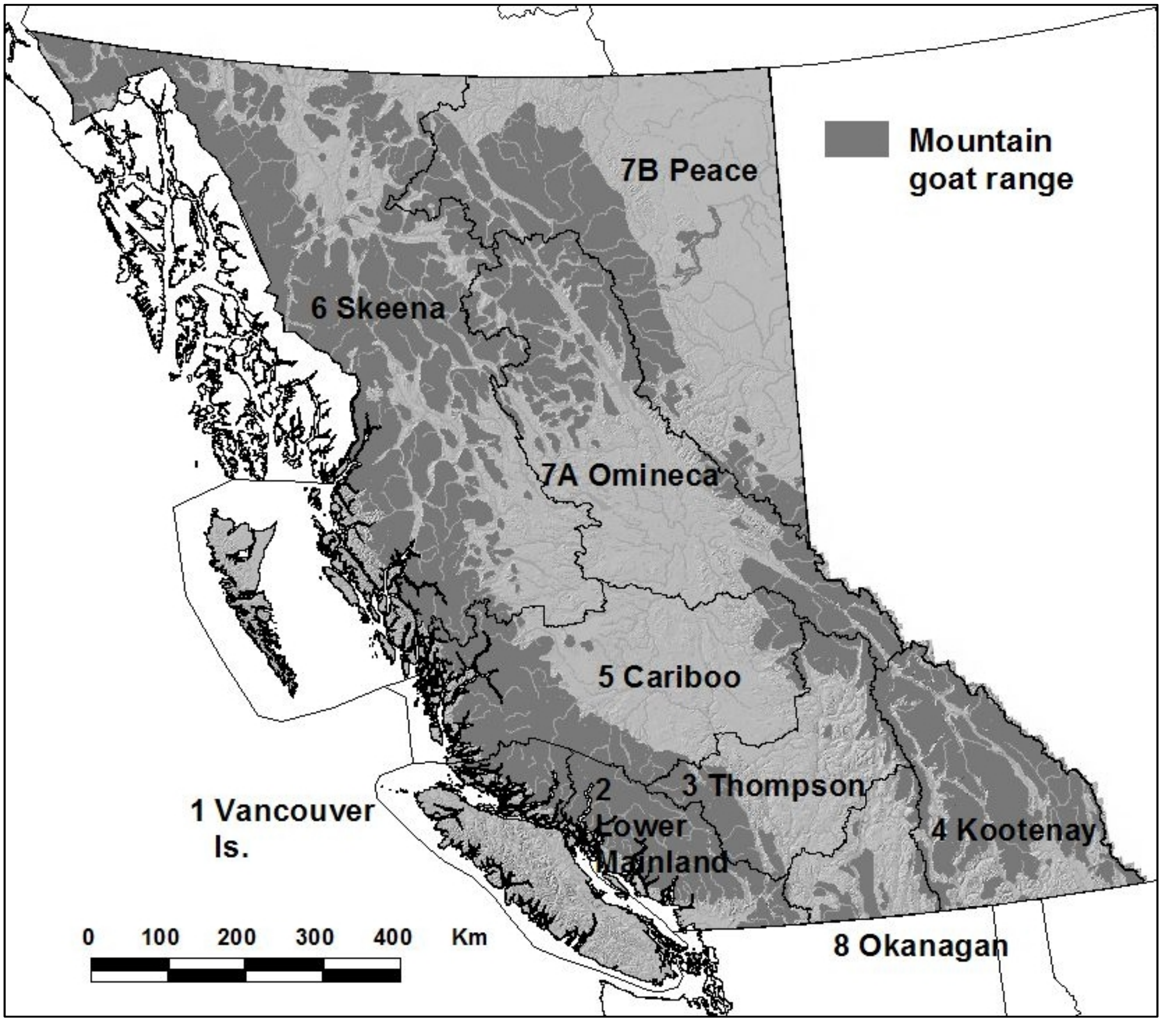

Figure 2. Distribution of mountain goats in British Columbia. Based on a map provided in Shackleton (1999), and updated from B.C. Ministry of Environment biologists in 2008–2009. B.C. Wildlife Management regions are illustrated by number and name.

2.5 Populations within British Columbia

Approximately 39,000 to 66,000 mountain goats are currently believed to inhabit British Columbia (Table 2, Figure 3). The Skeena region has nearly half of the province's total, with the Kootenay region holding nearly 20%. Based on the range around the midpoint of the estimated numbers for each region, Skeena also has the widest confidence in their estimate (37% above and below the midpoint), followed by the Peace (33%), Vancouver Island (24%), Lower Mainland (26%), and Thompson (25%). The Kootenay region had the tightest confidence in the estimate (4% above and below the midpoint), a result of continuing and recent inventories over much of the region.[5]

[5] Poole, K.G. 2006. A population review of mountain goats in the Kootenay Region. Unpublished report for B.C. Ministry of Environment, Cranbrook, BC.

Table 2. Estimated number and trend of mountain goat populations within MoE administrative regions of British Columbia in 2008. Data are based on information supplied by regional wildlife biologists. Estimated numbers are a range from the minimum thought to be present, to a more optimistic estimate for each region.

Region	Estimated number	% of total	Estimated trend[a]
1 Vancouver Island	1900–3100	5%	S-D
2 Lower Mainland	1000–1700	3%	S-D
3 Thompson	1500–2500	4%	D
4 Kootenay	9200–9900	18%	S
5 Cariboo	4000–5000	9%	S
6 Skeena	16,000–35,000	49%	S
7A Omineca	3000–4000	7%	S
7B Peace	2000–4000	6%	S
8 Okanagan	200–300	< 1%	D
Provincial total	39,000–65,500		S-D

[a]Trend: S = stable; D = decreasing.

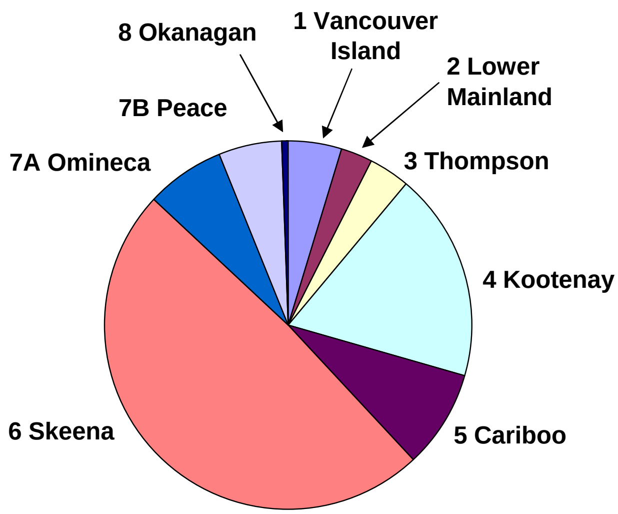

Figure 3. Approximate division of mountain goat numbers among regions of British Columbia (based on midpoint of range estimates from Table 2).

Many interior populations and some coastal populations (e.g., portions of Lower Mainland region) were believed to have declined through the 1960s and early 1970s, primarily as a result of "massive overharvest" of mountain goat populations due to liberal harvesting regulations combined with increased access (Phelps *et al.* 1983). The recent trend in mountain goat numbers within the province is stable in areas with the highest numbers (northern and central British Columbia and the Kootenay), but stable/decreasing or decreasing in southern and south coastal areas where numbers are lower (Table 2). Since most regions lack extensive inventories, trend data are based in large part on surveys of small portions of each region, or on indices to population trend (hunter harvest, hunter success, observations, kid:adult ratios).

2.6 Transplants

In North America transplants have been used to re-establish extirpated populations, but also to introduce mountain goats into areas where they do not appear to have occurred in the past. For example, mountain goats introduced into Olympic National Park in Washington State increased and spread to the point where there were concerns over their possible negative effects on alpine vegetation (Houston and Stevens 1988). Transplants have established mountain goat populations in Nevada, Utah, and Colorado, well south of historic range, and on some islands in Alaska. Based on a review of Alberta mountain goat transplants, Jorgenson and Quinlan (1996) suggested that due to the great distances moved between the release sites and home range establishment, transplants are not particularly successful in re-establishing populations in desired target areas).

Hatter and Blower (1996) summarized translocations involving British Columbia mountain goats, and Blood[6] further examined ungulate transplants within the province. Regional biologists were polled for updated information to 2008. To date, 151 mountain goats had been transplanted within the province, and 93 mountain goats had been moved out of the province. Almost all transplants occurred between 1983 and 1996. Only one transplant has occurred since the 1996 summary, where 15 animals were moved from three areas in the East Kootenay to the Trail area in the West Kootenay (Kootenay region). Most within-province transplants occurred within the Kootenays (53 animals), Thompson (38), and Peace (29) (Table 3). Most were re-established into areas where mountain goats had been locally extirpated or to augment existing populations, and only one (Fountain Ridge) was a relocation to a site outside of historically known range (Blood 2001). A 1924 transplant of 4 animals from Banff, Alberta, to the Cowichan Valley on Vancouver Island resulted in a small population that may have persisted until the early 1940s (Macgregor 1977). The bulk of out of province transplants were from the Thompson (22), Kootenay (32), and Peace (20), and most of these went to Alberta (79 mountain goats, primarily in the mid-1990s).

With the exception of the Okanagan region, about three-quarters of the transplants appear to have been successful at establishing self-sustaining mountain goat populations within the desired target area (Table 3). There may be a correlation with number of animals transplanted and success. Two of the populations are currently hunted.

[6] Blood, D.A. 2001. Success of ungulate translocation projects in British Columbia. Unpublished report for Habitat Conservation Trust Fund, Victoria, BC.

Table 3. Summary of mountain goat transplants within British Columbia (updated from Hatter and Blower 1996; Blood 2001) and the current (2008) status of populations at the transplant sites.

Region	Transplant location	Years	No. goats	Hunted?	Status (2008)
1 Vancouver Island	Shaw Ck. (Cowichan L.)	1924	4	--	Extirpated in 1940s
3 Thompson	Dunn Peak (N. Thompson)	1985–1990	30	N	Increasing? (20–30)
3 Thompson	Fountain Ridge	1994	8	N	Increasing? (10–20)
4 Kootenay	Slocan Valley	1990–1992	20	Y in 2009	Successful (50–100; R. Milton)
4 Kootenay	Mt. Broadwood	1991–1993	18	N	Unsuccessful (1–2?)
4 Kootenay	Trail	1999	15	N	Increasing (~35; L. Bursaw)
5 Cariboo	Potato Mt.	1984	5	N	Successful (~10–20); ingress from adjacent areas
5 Cariboo	Nemaia/Tsuniah	1989	6	N	Low numbers (~5–15)
7B Peace	Bullmoose Mt.	1983–1984	20	Y	Successful (~110 in ~2002)
7B Peace	Mt. Spieker	1989	9	N	Unsuccessful (no established pop'n)
8 Okanagan	Shorts Ck.	1984	5	N	Unsuccessful (0): Dispersed (Blood 2001)
8 Okanagan	Tulameen Mt.	1986	3	N	Low numbers
8 Okanagan	Snass Mt.	1986	8	N	Unknown

2.7 Importance of Mountain Goats to Humans

The mountain goat is valued by First Nations as a source of meat and for social ceremonial uses. The mountain goat is called *Matx* by the Nisga'a People of western British Columbia (Festa-Bianchet and Côté 2008), and the Klahoose First Nation's symbol (from the Toba Inlet area on the south coast) is the mountain goat. Historically, the Nisga'a and Gitsxan made clothing, drums, implements, and ceremonial regalia from the hide, wool, horns, and hooves, and stored oil in the bladder (Shackleton 1999; Festa-Bianchet and Côté 2008). The Chilkat blanket from the Gitxsan culture was made from mountain goat wool (Shackleton 1999).

Mountain goats are hunted by residents and guided non-residents, and provide significant income and value. Annually, income from licence fees average approximately $110,000 for residents and $300,000 for non-residents (C. Addison, pers. comm. 2010). Although specific goat-viewing industries are limited, the mountain goat is a valued part of the experience in the mountains, and contributes to ecotourism and related non-consumptive use.

2.8 Ecology and Natural History

Presented here is a brief review of the population ecology and dynamics of mountain goats as relevant to this management plan. It is not intended to be an in-depth review of mountain goat ecology. Thorough reviews are provided elsewhere (Chadwick 1983; Côté and Festa-Bianchet 2003; Glasgow *et al.* 2003; Festa-Bianchet and Côté 2008).

Many of the recent insights into mountain goat ecology are based on continuing long-term research that began in 1989 and conducted at Caw Ridge in west-central Alberta, the continent's best-studied mountain goat population (Festa-Bianchet and Côté 2008). Caw Ridge is 28 km^2 of alpine habitat geographically isolated from adjacent suitable habitat in the foothills of the Alberta Rocky Mountains, with a mountain goat population that has increased from approximately 80 to 150 animals during the study. Since there are no comparable long-term studies of individually marked and monitored mountain goats elsewhere in North America, it is difficult to know whether observations and conclusions derived from Caw Ridge directly apply to healthy populations of mountain goats in areas of continuous alpine habitat such as occurs in much of British Columbia.

2.8.1 Habitat needs

Mountain goats primarily inhabit alpine and subalpine areas in northwestern North America (Figure 1), often residing in areas with snow cover for more than half the year. Mountain goats occupy a wide variety of mountainous habitat, from rainforests near sea level in coastal areas, to dry interior peaks > 3000 m in elevation. Climate within mountain goat distribution varies from extremely wet to dry (xeric), with associated winter conditions ranging from coastal temperate to interior continental.

All populations are associated with escape terrain that is critical for predator avoidance. Although mapped definitions of escape terrain vary, these are generally steep slopes usually ≥ 40º or ≥ 84% of shear or broken cliffs where most mammalian predators would be unable to access (e.g., Chadwick 1983; Gross *et al.* 2002; Poole *et al.* 2009). Rock is the main substrate for escape terrain, but for populations living along river valleys, steep mud and clay banks often are used (Harrison *et al.* 1998; Harrison 1999; EBA Engineering Consultants Ltd. 2004). Mountain goats are usually reluctant to venture more than 400–500 m from escape terrain, often less distance during winter (Chadwick 1983; Fox *et al.* 1989; Haynes 1992; Gross *et al.* 2002; Poole and Heard 2003; Taylor *et al.* 2006; Taylor and Brunt 2007), thus it is the juxtaposition of forage and escape terrain that provides quality habitat. Data from Caw Ridge suggests that females may trade off forage abundance, and to a lesser extent forage quality, for safety (nearness to escape terrain; Hamel and Côté 2007).

Cover in alpine areas for mountain goats are generally provided by cliffs and associated features with scattered ledges, overhangs, and caves. Conifer forests may also provide additional shelter from wind and snow, particularly along the west coast where heavy snowfall occurs. Topographic and conifer cover also functions as protection from summer heat.

Winter is a critical season for mountain goats (Chadwick 1983; Fox *et al.* 1989; Côté and Festa-Bianchet 2003; Taylor and Brunt 2007; Poole *et al.* 2009) and movement is restricted, likely because of the energetic cost of moving through deep snow (Dailey and Hobbs 1989). Data from Caw Ridge indicate adult females lose about 27% of late summer mass over winter (Festa-Bianchet and Côté 2008). Foraging in deep snow areas is centred on steep, snow-shedding slopes that expose forage (Foster 1982; Fox *et al.* 1989). In coastal areas with deep snowpacks, mountain goats are often associated with steep slopes on southerly aspects, and low volume stands of scattered short trees, or with moderate volume stands of old, large coniferous trees, which presumably afford greater snow interception (Hebert and Turnbull 1977; Smith 1994; Gordon and Reynolds 2000; Taylor *et al.* 2006; Taylor and Brunt 2007). Interior mountain goats appear to adopt wintering strategies that differ among populations, with animals wintering either on higher-elevation windswept slopes, or inhabiting rocky bluffs at and below treeline in areas of heavier snowfall where wind-swept slopes are unavailable (Poole *et al.* 2009). During periods of heavy snowfall, mountain goats may also use caves and shallow snow wells at the base of large trees in sparsely forested winter ranges (Shackleton 1999). Some interior populations in drier climates winter on exposed ridges and upper elevation grasslands where wind and sun reduce snow depths (Poole *et al.* 2009). Proximity to escape terrain, increased terrain ruggedness, warm aspect, and in some cases increased timber volume are main factors affecting selection of winter range (Smith 1994; Lele and Keim 2006; Taylor *et al.* 2006; Taylor and Brunt 2007; Poole *et al.* 2009).

Summer habitat in parts of the province may reflect areas designed to avoid summer heat. In the southern Okanagan and Similkameen, the hottest and driest occupied mountain goat habitat in British Columbia, mountain goats move off the cliffs into the forest and canyons, presumably to escape summer heat (B. Harris, pers. comm. 2009).

Parturition sites are where nannies give birth and spend their first few days in isolation with their young. These sites are generally widely dispersed within or near winter ranges, and no fidelity to specific parturition ranges is apparent (Lentfer 1955; K. Poole, unpublished data, 2008).[7] Parturition sites are often in rugged, inaccessible cliffs, but in areas with limited precipitous habitat, may occur near treeline within the forest (Holroyd 1967; Festa-Bianchet and Côté 2008). Adults and subadult females, subadult males, and young of both sexes tend to form nursery groups shortly after nannies and kids leave the parturition sites; these groups typically begin moving upslope following green-up to their summer range. Summer range is important during the early rearing period and is typically associated with meadow-like openings that have rich forage and nearby escape terrain.

Mountain goats are generalist herbivores, eating what is available (Côté and Festa-Bianchet 2003), and are considered to be intermediate browsers (Hofmann 1989). Diets vary seasonally, between ecotypes, and among populations, but in general mountain goats focus on grasses, forbs, and browse in descending order of importance (Laundré 1994). Winter diets tend to shift to greater amounts of conifer browse, especially in coastal areas. Litterfall (e.g., fallen lichens and branches) can be an important winter food source (Fox *et al.* 1989).

[7] Lemke, S.L. 1999. Mountain goat population survey Management Unit 3-16. Unpublished report, B.C. Conservation Foundation, Kamloops, BC.

Alpine vegetation contains low sodium content and high potassium levels, thus many populations of mountain goats obtain supplemental minerals to their diet from mineral licks (Hebert and Cowan 1971a; Ayotte *et al.* 2006). While most early evidence pointed to the requirement to maintain sodium balance (Hebert and Cowan 1971a), elevated levels of magnesium, manganese, iron, and copper at lick sites have also been reported (Ayotte *et al.* 2006; Dormaar and Walker 1996). Supplemental sources of magnesium may help offset high dietary potassium levels, and carbonates may help stabilize rumen pH (Ayotte *et al.* 2006). Mineral licks can be characterized into three types: dry earth exposures, muck (wet) licks, and rock face licks (Dormaar and Walker 1996).

The importance of mineral licks among populations seems to vary substantially (Glasgow *et al.* 2003), possibly related to the mineral content of the matrix substrate. Many populations of mountain goats, including most interior populations, generally make extensive use of natural mineral licks, often travelling to low elevation sites or areas distant from their usual home ranges (Hebert and Cowan 1971a; Rideout 1974; Hebert and Turnbull 1977; Hopkins *et al.* 1992; Ayotte *et al.* 2008; Poole *et al.* 2010).[8] Prevalence of mineral lick use by coastal animals may be less than interior populations, possibly due to different geology, as there are no mineral licks currently known on the coast (D. Reynolds, pers. comm. 2008). High elevation licks are also used (Poole and Heard 2003).[9] Lick use occurs primarily between April and early autumn, with males generally using licks earlier in the year, and females and family groups beginning to use licks in early June (Ayotte *et al.* 2008; Poole *et al.* 2010).[10] Mountain goats generally use traditional trails to access licks (Hebert and Cowan 1971a).[11] These trails often traverse extensive areas of forest, and mountain goats may stage and rest at rocky bluffs within the timber as they make periodic excursions to the lick (Hebert and Cowan 1971a). Movements of up to 24 km to mineral licks, often involving low-elevation sites, occur in some populations (Hebert and Cowan 1971a; Poole and Heard 2003; Poole *et al.* 2010).[12] Studies on use of traditional trails and mineral licks after timber removal are underway in the Peace region.[13]

2.8.2 Population ecology

General structure of populations

Management of a species is generally directed at a *population* of that species. Caughley (1977) used the following working definition of a population: "a biological unit at the level of

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[8] Rice, C.G. 2009. Mineral lick visitation by mountain goats. Unpublished report, Washington Department of Fish and Wildlife, Olympia, WA.

Corbould, F.B., J.B. Ayotte, M.D. Wood, and G. Blackburn. 2010. Ospika goat adaptive management trial: short-term effects of logging on mineral-lick use by mountain goats. Peace/Williston Fish and Wildlife Compensation Program Report No. XXX. Draft March 2010.

[9] McCrory, W.P. 1979. An inventory of the mountain goats of Glacier and Mount Revelstoke National Parks, British Columbia. Unpublished report. Parks Canada, Western Region, Glacier National Park, Revelstoke, B.C.

Rice, 2009.

[10] Corbould *et al.,* 2010.

[11] Corbould *et al.,* 2010.

[12] Rice, 2009.

[13] Corbould *et al.,* 2010.

ecological integration where it is meaningful to speak of a birth rate, a death rate, a sex ratio and an age structure in describing the properties of the unit." The popular concept is of a group of intermixing animals with a discrete boundary, having little contact with other such groups; these may be termed *local populations* or *subpopulations*, the complex of which can be referred to as a *metapopulation* (Caughley and Gunn 1996). However, at the practical level the definition of a population for management purposes necessitates imposing sometimes-arbitrary boundaries on the landscape. Distinct populations of mountain goats can be surmised in some areas of the province, where individual mountain blocks or groups of mountain blocks where regular exchange is known or suspected can be considered to be relatively discrete. In the Okanagan and Cariboo, these are termed "population units" (P. Dielman, pers. comm. 2009).[14] But in other areas (e.g., sections of the Coast Range in the Skeena; much of the Rocky Mountains in the Kootenay) arbitrary boundaries dividing essentially continuous populations are required. Here we use the term *population* relatively loosely to refer to the managed unit of mountain goats. The term *herd* is generally used synonymously with *population* (Côté and Festa-Bianchet 2003; Festa-Bianchet and Côté 2008).

Other than during breeding, male mountain goats are usually solitary or found in small groups with other adult males (up to more than 20 individuals in early summer), while females are more gregarious and are found in nursery groups (Côté and Festa-Bianchet 2003). The number of animals in nursery groups varies substantially depending upon population size, season, and possibly habitat. At larger scales, distinct groups (herds) of mountain goats may show limited interaction with adjacent groups on an annual basis, with interchange supplied to a large extent by greater movements of males during the rut, and dispersal of young males (generally 2–3 year olds).

Mountain goat females maintain a stable and linear social hierarchy based on dyadic (one on one) relationships (Côté 2000). Social rank increases strongly with age, and adult females are generally dominant over all other age-sex classes (Côté 2000). Conflict is usually avoided, possibly because their sharp horns can inflict injuries if interactions escalate.

Reproduction

For reasons that are not clearly known (but may be related to higher quality habitat in new, lightly browsed ranges), reproductive rates are generally much higher in "introduced" populations of mountain goats transplanted to areas outside of historically occupied range, compared with "native" populations of mountain goats that occur on historically occupied range (e.g., Adams and Bailey 1982; Swenson 1985; Houston and Stevens 1988; Williams 1999; Lemke 2004). It is not clear how many years must elapse before an introduced population takes on more characteristic "native" reproductive parameters.

Mountain goats are polygynous (a male may mate with more than one female), and breed from early November to early December, normally peaking 15–20 November (Brandborg 1955; Côté and Festa-Bianchet 2003). Males can start participating in the rut at 3 years, but most have success when 6 years and older (Mainguy *et al.* 2009). Males may travel longer distances during this period seeking females in estrous, reduce feeding, and as a result come out of the rut and enter winter in poor body condition (Mainguy and Côté 2008).

[14] Wilson and Morley, 2007.

Parturition is highly synchronized and occurs between mid-May and mid-June. Females disperse and isolate themselves from other animals just before parturition (Holroyd 1967; Côté and Festa-Bianchet 2001b, 2003). Within 5–14 days of birth, nannies and kids rejoin other females and young in nursery groups (Côté and Festa-Bianchet 2003; Glasgow *et al.* 2003).

Female mountain goats appear to follow a conservative reproductive strategy by delaying age of first reproduction (primiparity) and reduce frequency of breeding to minimize the cost of reproduction (Festa-Bianchet and Côté 2008; Hamel *et al.* 2009). Data from Caw Ridge show females produce their first kid at an average of 4.6 years of age (most at 4–5 years; range 3–7 years), although females in introduced populations can produce their first kid at 2 years of age, or more normally at 3 years (Houston and Stevens 1988; Côté and Festa-Bianchet 2001b). Age at first reproduction in coastal Alaska also appears to be at 4 years (K. White, pers. comm. 2008), although data from Alaska suggest about 40% of 2-year-olds produce young even in native populations (Smith 1984). Kid production at Caw Ridge peaks from ages 8 to 12 (Festa-Bianchet and Côté 2008), later than other populations (Côté and Festa-Bianchet 2003). Reproductive senescence normally begins at 10–12 years of age (Côté and Festa-Bianchet 2003, Festa-Bianchet and Côté 2008). About 25% of adult females are in reproductive pause each year at Caw Ridge (Festa-Bianchet and Côté 2008), although in one study in coastal Alaska all females ≥ 5 years (n = 33) gave birth (Smith 1984). Limited sample sizes from British Columbia suggest, as determined by progesterone levels in the blood, lower pregnancy rates in some areas (55% ≥ 3 years, n = 11, Ospika area in northeastern British Columbia[15]; 38% ≥ 3 years, n = 13, East Kootenay; K. Poole, unpublished data. 2008).

Females normally have one kid but twins have been reported in some native populations (e.g., Holroyd 1967; Foster and Rahs 1985; Festa-Bianchet *et al.* 1994), and are more common in introduced populations (Lentfer 1955; Hayden 1984; Houston and Stevens 1988). Triplets have been reported in introduced populations (Lentfer 1955). Kids are precocious (rapidly able to move about independently), and can move about on steep slopes within hours of birth. Kids remain with their mother during their first winter, and may associate with their mother as yearlings and occasionally as 2 year olds (Festa-Bianchet and Côté 2008).

Kid production appears to be negatively associated with winter severity during pregnancy (Adams and Bailey 1982; Swenson 1985) and April–May snowfall and snow depth (Thompson 1980; Hopkins *et al.* 1992). The causal mechanism for this may be large inter-annual variation in crude protein in the diet, which is a measure of habitat quality. Similarly, in coastal Alaska snow depth during February to May had the greatest influence on survival of older animals (K. White, pers. comm. 2008).

Studies at Caw Ridge (Festa-Bianchet and Côté 2008) highlight the following characteristics of reproduction in mountain goats. Female body mass and social rank affect the probability of giving birth (Côté and Festa-Bianchet 2001b). Older females contribute the most to the population, and tend to produce more males (Festa-Bianchet and Côté 2008); these males are larger and of higher phenotypic quality. Male breeding success is related to larger body mass but

[15] Corbould *et al.,* 2010.

not horn size, with older males generally tending the oldest females (Mainguy and Côté 2008). For example, at the Caw Ridge population (currently numbering ~150 animals), about half of the offspring in the last 10 years have come from five individual males (Mainguy *et al.* 2009). The largest male mountain goats produce the largest sons, but the smallest daughters (Mainguy *et al.* 2009).

Mortality factors

Causes of natural mortality are numerous, and include predation, accidents as a result of falls, falling rock, avalanches, and starvation (particularly of kids) (Côté and Festa-Bianchet 2003). Predation is likely the most important mortality factor. Grizzly bears (*Ursus arctos*), wolves (*Canis lupus*), and cougars are cited as the most important predators, although wolverines (*Gulo gulo*), coyotes (*Canis latrans*), and black bears (*Ursus americanus*) are other potential predators (Côté and Festa-Bianchet 2003; Glasgow *et al.* 2003). Golden eagles (*Aquila chrysaetos*) prey on kids in some areas (Brandborg 1955; Smith 1976; Hamel and Côté 2009), although they likely have limited impact at the population level. Predation may primarily affect young (kids and yearling) and older animals (> 8 years of age; Smith 1986). Mountain goat populations are unlikely to support a predator population, which would be maintained mostly by sympatric cervid populations—deer (*Odocoileus* spp.), elk (*Cervus elaphus*), and moose (*Alces alces*). Predation may be considered a stochastic event; one individual, such as a single cougar, may specialize or focus on mountain goats and have serious consequences to a particular herd (Côté and Festa-Bianchet 2003). Severe winters may weaken animals or force them to take greater risks to obtain forage, pre-disposing them to higher levels of predation or risks of accident (e.g., avalanche).

Mountain goats have an increased risk of predation at and below treeline (Festa-Bianchet *et al.* 1994; Côté and Beaudoin 1997). This risk may be compounded if cutblocks alter the prey and predator community at these lower elevation sites. Increases in early seral habitats may increase populations of deer, elk, and moose such that potential predators of mountain goats–wolves, cougars and bears (Côté and Festa-Bianchet 2003)–may become more numerous within the forest matrix. The result is higher levels of predators being supported by higher numbers of prey, and mountain goats therefore may be taken more often as secondary prey. However, the consequences of altered predator-prey relationships are unpredictable (Festa-Bianchet and Côté 2008), and to our knowledge have not been examined in mountain goats.

Although not thought to be a frequent mortality factor, deaths from falls and avalanches have been reported (Brandborg 1955; Holroyd 1967; Chadwick 1983; Taylor *et al.* 2006). Virtually no mountain goats are killed by vehicle collisions within British Columbia (Sielecki 2004) because of the scarcity of high velocity roads in their natural range.

Weather can affect animal condition through the quality and quantity of forage produced and accessed. Winter severity appears to influence kid production and survival. Severe winter weather with deep or heavily crusted snowpacks can result in population declines through increased starvation, predation, and possibly avalanches (Adams and Bailey 1982; Hebert and Langin 1982; Bailey 1991).

Survival

Kid survival to 1 year of age is highly variable, and at Caw Ridge ranged from 38 to 92% ($\bar{x}$ = 64%; Festa-Bianchet and Côté 2008), and in Montana averaged 69% (Smith 1976). These values are higher than reported for most other ungulates (Gaillard *et al.* 2000). Yearling survival is less variable, but greater for females (85%) than males (74%). Survival of 2 year olds and older mountain goats remains lower for males than females at Caw Ridge. As a result, the sex ratio in a population favours females. Between 1994 and 2003, the adult sex ratio in the unhunted Caw Ridge population averaged 49 males/100 females, with a range from 27 to 72 males/100 females in different years (Festa-Bianchet and Côté 2008). A range of 23–56 males/100 females has been reported from other areas (Chadwick 1973; Rideout 1974; Foster and Rahs 1985; Houston and Stevens 1988).

Population modelling of small- to medium-sized mountain goat populations in western Alberta suggests that while recruitment is more variable, survival of adult females > 5 year olds has the greatest potential to influence population changes (Hamel *et al.* 2006).

Density dependence

Density dependence occurs when vital rates of the population (e.g., births, deaths) and its growth rate vary with the density of the population. For example, as a population approaches theoretical carrying capacity (K, the limit to the number of individuals the area can support), pregnancy rates should decline in a density-dependent population. Introduced herds of mountain goats have reported annual growth rates as high as 15% and evidence of density-dependence in reproduction (Adams and Bailey 1982; Swenson 1985; Houston and Stevens 1988; Bailey 1991; Williams 1999; Lemke 2004). However, most studies suggest that native (non-introduced) populations of mountain goats have limited ability to withstand harvest, likely because of low kid production, either-sex harvest, and additive hunting mortality (reviewed in Côté *et al.* 2001a; Gonzalez-Voyer *et al.* 2003; Hamel *et al.* 2006). It is unclear when the characteristics of an introduced population evolve into those of a native population, with the consequential lower sustainable harvest level.

Toweill *et al.* (2004) suggested that density-dependent factors limit further expansion of transplanted populations after the initial expansion phase. However, no density-dependent responses or compensatory reproduction (increased pregnancy and fecundity in response to lower densities) to harvest or natural declines have been reported for native populations (Côté *et al.* 2001; Gonzalez-Voyer *et al.* 2003). Most of this debate has been framed around Caw Ridge; with a doubling of the population over the past 15 years (Hamel *et al.* 2006), there has been no evidence of density dependence in kid production or survival, recruitment (Festa-Bianchet and Côté 2008), or adult survival (Festa-Bianchet *et al.* 2003). However, nutrient availability may limit the reproductive performance of mountain goats by retarding their growth (Festa-Bianchet *et al.* 1994), litter size (twinning) may be related to resource availability (Houston and Stevens 1988), and there may be density dependence in costs of reproduction (Hamel *et al.* 2010), suggesting that some density-dependent response should occur. Theoretically, a density-dependent response should be most noticeable near carrying capacity, and it is possible that most native populations are held at densities below carrying capacity such that responses by the population are difficult to detect (Festa-Bianchet and Côté 2008). An alternative hypothesis is that most populations are near carrying capacity and the harvest does not decrease the population below carrying capacity enough that density dependence is apparent; however, empirical data in support of this latter theory are limited (Côté *et al.* 2001). That mountain goat populations appear to be very weakly density-dependent means that population dynamics are more difficult to predict, and argues for comparatively cautious management compared to species that are known to show stronger responses to density.

2.8.3 Movements and range use

There are large differences in daily, seasonal, and annual movement rates, migrations and home range sizes, and few patterns seem to hold constant across populations. Daily and short-term movement patterns for mountain goats could be described as relatively rapid movement to a new focal area, followed by days or even weeks concentrating and feeding in the same general area. Although there are wide differences among areas and seasons, male mountain goats may move < 1 km each day, and females may move 2–5 km per day or more (Côté and Festa-Bianchet 2003). In the East Kootenay, mean movement rates as calculated from 6-hour GPS collar fix intervals peaked in June through mid-August for both females (~100–125 m/hr) and males (~85–100 m/hr) and were lowest during winter (~5–15 m/hr for both sexes), with a 5- to 6-fold difference in average movement rates between these two extremes.[16] Activity generally peaks in early morning and late afternoon/evening, and can be affected by weather conditions (Singer and Doherty 1985; Romeo and Lovari 1996).

Migration between seasonal ranges generally involves movements in elevation, with or without significant horizontal movements of up to 35 km (Nichols 1985; Poole and Heard 2003).[17] Migration between seasonal ranges occurs in many populations (Côté and Festa-Bianchet 2003), but the degree of movement is highly variable – generally a blend of horizontal and elevational movements (Rice 2008). Concurrent with smaller overall range sizes, maximum migration distances for females were about 25% less than males for a population in the East Kootenay.[18] Seasonal migration in coastal areas tend to be shorter than in interior areas, often averaging < 2 km (Schoen and Kirchhoff 1982; Taylor *et al.* 2006). Analysis of only horizontal movements by mountain goats may be somewhat misleading, and analysis of elevational movement may better reflect ecological conditions affecting animals (Rice 2008). There is a continuous response among individuals and populations in the degree of elevational migration (Rice 2008), a comment that applied equally well to horizontal migration.

Many populations move to lower elevations during winter, presumably to find habitats with lower snow levels or associated forests with higher snow interception to reduce costs of locomotion and foraging. Some populations, associated with drier snow and wind-swept slopes, remain in higher-elevation habitats (Poole *et al.* 2009). Elevational movements are associated with changes in forage quality and quantity; in east-central British Columbia mountain goats moved lower with the first heavy winter snowfall and with the onset of the spring vegetation green-up (Poole and Heard 2003), and moved up through late spring and summer, likely coinciding with greening up of vegetation and snow melt at progressively higher elevations, as

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[16] Poole, K.G., I.E. Teske, and K. Stuart-Smith. 2008. Kidding areas, high use areas, and movement patterns of mountain goats in the East Kootenay, 2004–2005. Unpublished report, Aurora Wildlife Research, Nelson, BC.
[17] Poole *et al.*, 2008.
[18] Poole *et al.*, 2008.

found in other studies (Stevens 1983; Varley 1994). Elevational movements in both coastal and interior populations can occur rapidly (Taylor *et al.* 2006).[19]

Annual home ranges can vary from 3 to 90 km^2, and ranges appear to be smaller in coastal populations (Rideout 1977; Singer and Doherty 1985; Fox *et al.* 1989; Lemke 1999; Côté and Festa-Bianchet 2003; Poole and Heard 2003; Taylor *et al.* 2006; Poole *et al.* 2009). While annual ranges of males are typically larger than females, female ranges appear to be equal or even larger than males in some studies, especially during summer (Festa-Bianchet and Côté 2008). Seasonal ranges may overlap to a large extent, or be distinct.[20] Range size is often much smaller during winter, when snow depths impose high costs of locomotion, and may be as small as 8–20 ha (Fox *et al.* 1989; Taylor *et al.* 2006). Winter range comprises < 14% of annual range in a recent East Kootenay study, emphasizing the importance and the degree of restricted movement shown during this season (Poole *et al.* 2009). Crust conditions that form in late winter facilitates easier movement.

In general, mountain goats show high fidelity to annual ranges (Smith and Raedeke 1982; Nichols 1985; Taylor *et al.* 2006), but seasonal differences are apparent. Males may show lower (Nichols 1985; Poole *et al.* 2009) or similar (Taylor *et al.* 2006) fidelity to winter ranges than females. Reported home range sizes vary widely among areas, in large part likely related to topography, forage, and wintering areas, but also with method used to obtain locations (e.g., VHF vs. GPS locations) and method used to calculate ranges (e.g., minimum convex polygons, kernels).

Little is known about dispersal patterns in mountain goats, although there have been a number of reports of mountain goats moving very long distances. Dispersal distances of 16–93 km were reported from a high-density, introduced population on the Olympic Peninsula in western Washington (Stevens 1983), and distances of 12–35 km were reported from the Caw Ridge population isolated by 12 km of coniferous forest in Alberta (Festa-Bianchet and Côté 2008). At both the Olympic Peninsula and Caw Ridge, most of the known emigrants were 2–3 years of age, where males were far more likely to emigrate than females and most dispersal occurred during late summer (Stevens 1983; Festa-Bianchet and Côté 2008). Sporadic observations have been reported of likely dispersing subadult animals in unusual locations well removed from mountainous terrain (e.g., in central Prince George, and in an industrial yard in Fort Nelson; H. Schwantje, pers. comm. 2009).

2.8.4 Interspecific relationships

In British Columbia, mountain goats share portions of their distribution with bighorn sheep (*Ovis canadensis*), and parts of their northern range with thinhorn sheep (*Ovis dalli*). Distribution also overlaps with white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*) and elk in some interior areas, and with black-tailed deer (*Odocoileus hemionus columbianus*) on coastal winter range. The relationship between native populations of mountain goats and wild sheep or other sympatric wild ungulates is poorly known. Laundré (1994) suggested that while substantial overlap in forage classes of diet occur between mountain goats and wild sheep (less

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[19] Poole *et al.,* 2008.
[20] Poole *et al.,* 2008.

so during winter; Dailey *et al.* 1984), there is little evidence of resource overlap and competition within sympatric populations, largely due to differences in selection of habitat. Some introduced mountain goat populations may compete for forage or habitat with bighorn sheep (Hobbs *et al.* 1990), and may deter sheep from some resources through behavioural dominance (Reed 2001). Such inter-specific competition may be more expressed in areas lacking natural predators (e.g., Colorado), where mountain goats are less limited to steep terrain (Hobbs *et al.* 1990). Simulation modelling in national parks in Colorado suggested that once established, introduced mountain goats would reduce bighorn sheep populations by 10 to 50% through competition and disease (Gross 2001). The concern from infectious diseases is likely due to a unique situation rather than a concern for all sympatric wild sheep and goat populations. Johne's disease or paratuberculosis is a common, chronic bacterial infection of domestic livestock that is rarely seen in free-ranging wildlife. Clinical disease is reported to occur in some herds of mountain goats and bighorn sheep in Colorado and Wyoming for over 25 years where efforts to control it with culling have been unsuccessful (Williams 2001). As is evident from the references in this section, this issue has been largely examined only in Colorado with an introduced population of mountain goats that suffers from a chronic bacterial condition, likely introduced from cattle or other domestic species.

Contact between mountain goats and domestic species is considered a higher risk than contact with other wild ungulates due to the potential transmission of pathogens. British Columbia's silviculture industry has used domestic sheep and goats for vegetation management of forestry lands to varying degrees since the 1980s. Tens of thousands of domestic sheep were transported from prairie provinces to clearcuts of many areas of British Columbia to spend months grazing and browsing to reduce competition in tree plantations. Recently, the technique has become less popular but domestic goat herds were trialed for efficacy in the British Columbia interior in the early 2000s. Concerns for infectious disease transmission to wild sheep and mountain goats, and susceptibility to a variety of pathogens carried by domestics, led to standards and guidelines designed to locate browsing activities away from known wild populations and actions to ensure and maintain the health of the domestic sheep (Province of British Columbia 2007).

The use of camelid species (llamas and alpacas) for trekking activities also raised concerns for disease transmission. A risk assessment concluded broadly that the introduction of disease into wild populations must be considered with greater concern than for domestic animals because there are few viable options for controlling and eradicating introduced diseases in wildlife.[21] Risks from camelids to wildlife in British Columbia remained hypothetical, as no direct evidence was found to implicate camelids as sources of significant diseases in wildlife in the province or elsewhere. However, since introduced disease agents can and have had important negative effects on wildlife populations, and wildlife under population stress at the time of pathogen or parasite exposure are more susceptible, the authors believed there was enough concern to advise precautionary approaches to managing disease risks to wildlife from camelids.

[21] Schwantje, H. and C. Stephen. 2003. Communicable disease risks to wildlife from camelids in British Columbia. Unpublished report for B.C. Ministry of Water, Land and Air Protection, Victoria, BC. <http://www.env.gov.bc.ca/wld/documents/wldhealth/camelid_risk03.pdf> [Accessed Feb. 1, 2010]

2.8.5 Health

Reviews of parasites and diseases present in mountain goat populations are available elsewhere (Côté and Festa-Bianchet 2003; Glasgow *et al.* 2003; Jenkins *et al.* 2004; Toweill *et al.* 2004; Garde *et al.* 2005) and only general statements are presented here. Infectious organisms of various types are reported in mountain goats where health studies and opportunistic sampling data are available, which should be representative for most mountain goat populations. Some diseases and parasites do cause mortality and compromise health of individuals, but there is limited evidence of serious wider-scale consequences at the population level. Within shared range, mountain goats and wild sheep can harbour the same parasite species (Jenkins *et al.* 2004) and a number of other organisms can infect both species. However, there is no clear evidence of disease transmission from wild sheep to mountain goats.

Parasites known to be present in mountain goats in British Columbia include a range of helminths (nematodes, cestodes [tapeworms]) and protozoa (coccidian) of the gastro-intestinal tract, lungworm (*Protostrongylus stilesi* and *Protostrongylus rushi*), muscleworm (*Parelaphostrongylus odocoilei*), and ectoparasites such as ticks (*Dermacentor* spp.) (Cowan 1951; Jenkins *et al.* 2004). Some of the parasites may be potentially pathogenic but no studies have addressed their impacts at an individual or population level. The prevalence (percent of samples positive) and intensity (mean number of eggs or larvae per sample) of gastro-intestinal parasites were greatest in mountain goats from coastal British Columbia compared to interior populations (Jenkins *et al.* 2004).

The most common ectoparasites on mountain goats are single host ticks (*Dermacentor andersoni* and *Dermacentor albipictus*). *Dermacentor albipictus*, or winter tick, has significant effects on northern moose populations; however, when they occur on mountain goats they may cause hair loss around the shoulders and lower neck from animals scratching and rubbing. High numbers of winter ticks have not been reported to occur on British Columbia mountain goats. The spinose ear tick (*Otobius megnini*) is reported to have occurred historically in British Columbia mountain goats but not cause significant effects (Cowan 1951).

Mountain goats are reported to die from fatal pneumonia similar to bighorns (Schommer and Woolever 2008) but only individuals, rather than herds, have been affected. Contact between domestic sheep or goats and wild sheep is considered high risk and likely to predispose to pneumonia die-offs and separation of the species is highly recommended; therefore, management of mountain goats to ensure their separation from domestics is also prudent (Toweill *et al.* 2004). A risk assessment and review for the Northwest Territories concluded that substantial negative and long term effects on population dynamics and sustainability of wild sheep and mountain goat populations would likely result from contact with domestic sheep and goats (Garde *et al.* 2005).

Other infectious diseases reported in mountain goats in British Columbia include lumpy jaw, an infection of the jawbone, usually caused by one or more bacteria (*Actinomyces* or *Arcanobacterium* spp.) entering through the oral cavity and causing noticeable hard swelling of the mandible or lower jaw. Teeth may be loosened, resulting in their loss and/or improper growth. Infections generally stay in the jaw but may occasionally spread to other body locations.

Animals may live for years or die as a result of poor body condition from difficulty in feeding. These infections are considered opportunistic and no control is possible.

One of the most commonly reported viral diseases of mountain goats is contagious ecthyma (or soremouth). It appears to be endemic in some British Columbia mountain goat populations and can be fatal. It is a virus shared with wild and domestic sheep and goats, but whether the origin of the infection is from direct contact is unclear. Affected animals may have scabs around and in their mouths and other areas of the body but these lesions usually resolve within 4-6 weeks. The virus can survive in the scabs for years. Any management strategies that concentrate infected animals may also increase the likelihood of disease transmission to unaffected animals.

Mountain goats survive predation attempts by retreating to escape terrain quickly. Any chases that result in sustained muscle activity can produce a peracute or more chronic degenerative and often fatal muscle condition or myopathy that can occur with capture attempts and is then referred to as capture myopathy. Low levels of selenium may predispose animals to this condition (also referred to as white muscle disease) and there is evidence that some populations may have reduced levels of this mineral (Hebert and Cowan 1971b; Fielder 1986). Animals may die acutely if heart or other vital muscle areas are affected or have chronic scarring of large leg muscles and be therefore predisposed to predation within weeks of muscle injury. Mountain goats are one of the more sensitive ungulate species to capture myopathy and any capture attempts by humans for management purposes must be done quickly and efficiently by experienced personnel that understand this risk.

Chronic stress is known to affect long-term health and fitness through secretion of corticosteroids and the depression of the immune system. Although well known in many species and an often-quoted issue for mountain sheep (e.g., Spraker *et al.* 1984; Moberg 2000; Millspaugh *et al.* 2001), the implications of chronic stress are expected to apply to mountain goats but are not well researched. Joslin (1986) suggested that stress caused by human activities can make mountain goats more susceptible to disease, similar to what happens with wild sheep.

Health assessments of individuals and populations of British Columbia mountain goats have been done opportunistically, but sample analysis, collation, and interpretation of results have not been done on a systematic basis. New techniques are now available that should be used to improve baseline data on mountain goat populations and monitoring over time. A health assessment and management protocol for species at risk (SAR) was developed for British Columbia, and is designed to identify health threats and improve management and recovery planning.[22] Wildlife health in the province is prioritized by species and disease, with SAR given the highest priority. Health evaluations are carried out using opportunistic sampling as well as more formal risk assessment and monitoring. For mountain goats, this should include evaluating the demographics of the herd, sampling individuals for disease exposure, and examining herd genetics for the degree of genetic diversity. The general approach is to (1) sample and monitor

[22] Fraser, E. and J. Parmley. 2008. Health assessment and management resource for Species at Risk in British Columbia. Unpublished report for B.C. Ministry of Environment, Ecosystems Branch, Victoria, BC.

the population in question; (2) gather more data through targeted sampling to include collecting and archiving samples; and (3) implement and assess intervention strategies.

2.9 Management/Conservation Issues and Threats

2.9.1 Threat classification

To understand broad-scale threats to mountain goats, we followed the classification system adopted from the International Union for the Conservation of Nature (Salafsky *et al.* 2008), which has been previously used for many species (Master *et al.* 2009). The output from this analysis was low to medium threat impacts determined for 10 of the 11 threats categories (Appendix A). However, the overall impact value was calculated as high because of the large number of medium and low values (i.e. > 2 medium and 2 low). Detailed information on threats to mountain goats is provided within the provincial management framework.

2.9.2 Habitat threats

The relative importance of potential threats to mountain goat habitat varies among regions of the province. Most threats relate to habitat effectiveness, an area's actual ability to support mountain goats given the quality of the habitat and the extent of human disturbance. Threats reduce habitat effectiveness by altering its suitability and function, or changing the quality and/or quantity of forage and/or cover available.

Removal of forest cover increases exposure to the elements, while reducing the availability of forage during winter. Of particular concern is the removal of mature or old-growth forest cover from winter range associated with forest harvesting or other development activities (e.g., transmission line corridors), particularly in coastal and interior wet-belt areas, where lower elevation commercial forests are used by mountain goats for snow interception and foraging habitat during winter. Examples of this occur in coastal areas in the Kispiox, North Island – Central Coast, Campbell River, Sunshine Coast, and Kalum Forest Districts (Gordon and Wilson 2004; Taylor *et al.* 2006; Taylor and Brunt 2007), but it also occurs in other mature and old forest mountain goat habitat, such as in the Robson Valley of east-central British Columbia (Poole and Heard 2003). Use of early forest (20–40 years old) by mountain goats has occurred in some populations, primarily during summer (Gilbert and Raedeke 1992; Poole and Heard 2003), and to a lesser degree during winter, which may be related to snow level (Taylor *et al.* 2006).

Direct habitat loss can occur due to road construction within or adjacent to sensitive habitats (e.g., winter range, parturition sites) associated with forest harvesting, mineral exploration, mines, independent power producers, oil and gas exploration and development, backcountry tourism, and roads from other industrial activities. In some cases vertical road cuts and fills across an already steep slope create upslope to downslope movement barriers causing mountain goats to expend additional energy to move around them. In other situations, roads in goat habitat can reduce habitat connectivity, increase fragmentation, and improve access.

Habitat fragmentation can have several consequences, including isolation of individual herds and sub-populations, reduction of suitable habitat, loss of connectivity and increased energy expenditures to reach suitable habitat (which may reduce fitness), and increased predation (from reduced fitness and the increased exposure to predation that is facilitated by roads). Indirect habitat loss primarily occurs in the form of human disturbance, which temporarily or permanently affects habitat effectiveness, and may indirectly affect animal and population health (disturbance is covered later in this document).

Alteration of habitat within mountain goat areas may cause animals to abandon a feature and use other, possibly less suitable locations. For example, mountain goats frequent important mineral licks, primarily in interior populations. If cover is removed (particularly where mountain goats focus on minerals under mature conifer trees), these features may be abandoned (Taylor and Brunt 2007; Poole *et al.* 2010), with secondary effects on animal health.

Fire suppression, which contributes to habitat succession and forest in-growth, may affect forage quality and quantity in subalpine and even alpine areas. Declines in mule deer populations have been attributed in part to fire suppression that has altered the natural pattern of forest succession, resulting in forest regeneration, forest canopy closure, and reduction in shrub cover (Peek *et al.* 2002), and concomitant declines in forage conditions across broad areas of the west (Peek *et al.* 2001). Similar broad changes in mountain goat habitat quality may occur over time, possibly resulting in changes to recruitment and survival. Mountain goats are thought to have increased in Penticton Creek and Okanagan Mountain Park in the Okanagan following fires in 1971 and 2003, respectively.[23] Wildfire can alter mountain goat habitat in parks, as witnessed during the 2003 fire season in the Rocky Mountain National Parks when substantial areas of subalpine habitat was burned.

Where mountain goat habitat occurs within national and provincial parks and other conservation areas, it will generally be protected from industrial development by those designations. Within the province, approximately 14% of the land base is within parks, where no industrial activity may occur (this includes Class A, B, and C parks; conservancies; recreational areas; ecological reserves; protected areas; wildlife management areas; other undesignated conservation lands for fish and wildlife; and national parks). Approximately three-quarters of the area covered by parks in British Columbia is mountain goat habitat. Other threats to mountain goat habitat in parks may occur, such as recreation activities that may reduce habitat effectiveness.

2.9.3 Population threats

A number of factors may separately or cumulatively affect mountain goat populations. Many of these factors are associated with or made more important because of the impacts of habitat loss and fragmentation discussed above that isolate herds, cause chronic stress, and amplify the risk of local extirpation (Hamel *et al.* 2006; Festa-Bianchet and Côté 2008). The relative importance of these factors is poorly understood, and may include regulated and unregulated hunting, predation, severe winter weather, disease, disturbance associated with human access, and demographic stochasticity (variability in population growth rates arising from random differences among individuals) and loss of genetic diversity.

[23] Wilson and Morley, 2007.

Regulated hunting

Regulated hunting of mountain goat populations in British Columbia occurs through a combination of allocation and/or season restrictions. Allocations are based on population estimates or trend data. Problems with sustainable harvests may occur when inventory data are poor, excessive numbers of female mountain goats are harvested, or the harvest is not distributed proportionately to the distribution of the population. Problems may also occur when incorrect assumptions are made regarding sustainable harvest rates (due to poor understanding of recruitment rates), or lack of understanding of specific population dynamics and distribution.

Mortality associated with hunting can be entirely additive to population losses from natural events because of relatively low reproductive rates, low propensity for dispersal, and limited ability of any density-dependent response in reproductive and survival parameters (Toweill *et al.* 2004). This problem is magnified in small, relatively isolated populations.

Hunting is allowed in many Provincial Parks and Protected Areas in the province, where a more conservative harvest is generally set. Provincial policy directs that harvest be managed more conservatively within British Columbia Parks than outside of parks. Activities within parks are also influenced by Park Management Plans specific to each park. When compared to management of opportunities outside of parks the seasons in parks may be shorter, the allowable harvest determination with in a park may be lower or the harvest guidelines may be worded differently.

Resident and guided hunting is not legal in national parks. National parks comprise only 0.6% of the provincial land base, and with the exceptions of coastal national parks (Pacific Rim National Park Reserve, Gwaii Hanaas National Park, and Gulf Island National Park Reserve) occur only within the Kootenay region. About 8% of mountain goats in the Kootenay region reside within national parks.[24]

Not all mountain goat populations on provincial lands can be hunted, for reasons often related to small or isolated populations. The regional percentage of mountain goats residing in areas that can be hunted ranges from 94 to 100% of mountain goats (Vancouver Island, Kootenay, Skeena, Omineca, and Peace Regions) down to 75–85% (Lower Mainland, Thompson, and Cariboo Regions), and as low as 30% (Okanagan Region).

The degree of wounding losses during mountain goat hunting in British Columbia is unknown.

Unregulated hunting

The levels of unregulated hunting of mountain goats in the province are largely unknown, but not thought to be significant. Unregulated hunting levels are also thought to be insignificant in Alberta (Glasgow *et al.* 2003). Generally most people do not consider mountain goats as a primary source of sustenance because they are generally difficult to hunt and are not considered the best table fare, so it is unlikely that many mountain goats are being illegally harvested. Mountain goats taken illegally from specific areas are likely reported as having been killed in other areas, making the kill appear legitimate. The degree of opportunity, the accessibility of the

[24] Poole, 2006.

animals, and the size of the hunting zones likely influence the risk of this occurring (i.e., the more numerous and smaller the zones, the greater likelihood).

Levels of First Nations harvest of mountain goats within the province are poorly known, but are thought to be minimal in most areas. The exception may be in the Skeena region, where First Nations harvest surveys suggest that First Nations harvesters could account for about 10–15% of the total harvest from some areas (G. Schultze, pers. comm. 2009). The number of mountain goats harvested by First Nations likely depends upon a variety of factors including the availability of alternate (perhaps more preferable) food animals, the ability to access mountain goats, and the societal significance of harvesting a mountain goat. Annual harvest will likely fluctuate from year to year similar to provincially licensed harvest and will likely be most concentrated in areas of easiest access.

Harvest rates
Native populations of mountain goats are sensitive to high harvest rates (Festa-Bianchet and Côté 2008). Modelling from Alberta data suggest a 1% harvest (assuming equal harvest of males and females) for small, native populations may be sustainable (Gonzalez-Voyer *et al.* 2003; Hamel *et al.* 2006). However, implicitly acknowledging that the ecology of mountain goats at Caw Ridge (an isolated population of 100–150 mountain goats in the foothills of the Rocky Mountains) may not reflect other situations, Côté and Festa-Bianchet (2003) suggest that the best management strategy for native populations of mountain goats is to combine a 2–3% annual harvest of a population with a strong encouragement to harvest adult males. Coupled with these suggestions, Côté and Festa-Bianchet (2003) recommend annual monitoring of population size, an approach that is not fiscally and logistically practical across the broad expanse of mountain goat range in British Columbia. Within North America, the targeted harvest rate ranges from 2 to 10%, although most jurisdictions aim for 3–5% of the population (Toweill *et al.* 2004).

Significant reductions in mountain goat numbers throughout much of their North American range during the 1950s through to the 1980s were likely a result of application of management principles taken from other ungulates with greater productivity and less susceptibility to harvest. Harvest is the primary cause of declines of mountain goats in many areas (Phelps *et al.* 1983; Hamel *et al.* 2006; Rice and Gay 2010), and mountain goat may be the only North American ungulate to have suffered local extirpation through regulated hunting (Glasgow *et al.* 2003). Introduced herds in non-native habitat can tolerate much higher harvest levels than native herds because of higher productivity (Swenson 1985; Houston and Stevens 1988; Williams 1999, but see Côté *et al.* 2001).

Female harvest
Mountain goat populations are sensitive to adult female mortality because of comparatively late age at first reproduction (e.g., 4–5 yrs at Caw Ridge) and low production and survival of kids (Festa-Bianchet *et al.* 1994; Côté and Festa-Bianchet 2001b; Hamel *et al.* 2006). Hunter harvest tends to be concentrated on the largest individuals, consequently harvested females are often the dominant animals of the most productive age group (Côté and Festa-Bianchet 2001b), which has a significant impact on recruitment (Festa-Bianchet *et al.* 1994; Côté and Festa-Bianchet 2001b). Females aged ≥ 7 years, those of the highest social rank, and females of the highest body mass account for most of the kid production and recruitment of yearlings to the population (Côté and

Festa-Bianchet 2001; Festa-Bianchet and Côté 2008). Population modeling of small to medium size (25–50 animals) mountain goat populations in western Alberta suggests that while recruitment is more variable, survival of adult females > 5 year olds has the greatest potential to influence population changes (Hamel *et al.* 2006). Modelling by Hatter (2005) suggested that smaller populations require lower harvest rates on females to remain stable. Many jurisdictions in North America report the proportion of females in the harvest between 20 and 40% (Toweill *et al.* 2004). The negative impact of female harvest on small populations is probably magnified (Hamel *et al.* 2006).

Increased access

Access related threats are associated with the development of wilderness areas for industrial or recreational purposes. One of the most pervasive threats of increased access is that it can facilitate increased hunting activity. Many populations in the Kootenays were believed to have declined in the 1960s to early 1970s, primarily as a result of "massive overharvest" of mountain goat populations due to increased access combined with liberal harvesting regulations (Phelps *et al.* 1983). Similar scenarios occurred in the Okanagan region,[25] and in portions of the Skeena region and were realized when hunter success rates were declining. Other access issues occurred in parts of the Lower Mainland region, and in the Omineca region. In the Kootenays, each new road opened access to previously inaccessible watersheds, which resulted in high and continued harvest rates. This continued until most drainages had been substantially impacted (Phelps *et al.* 1983). In some areas in the Lower Mainland region (e.g., Chilliwack Forest District), local populations have not recovered from the decline despite more than 20 years of closed hunting seasons. In such cases other forms of ongoing human disturbance, habitat loss, and cumulative effects are believed to be the reasons for a lack of recovery.

Population size, stochastic events, and small populations

Small populations are at greater risk of extirpation simply by being relatively few in number and therefore more vulnerable to stochastic variation. Three main categories of risk characterize small populations of a species (Caughley and Gunn 1996). Demographic stochasticity may affect small numbers of animals simply by chance, such that the individual fortunes of each animal (e.g., breaking a leg, succumbing to a predator, producing only males) swamp probabilities that would determine the outcome for larger populations. Environmental stochasticity—the variation in environmental conditions (e.g., drought, severe winter)—has an unpredictable influence on population persistence that can have greater impact on small numbers. Finally, low population levels and reduced genetic variation may induce inbreeding depression and reduced genetic fitness.

Small population size is recognized in management of mountain goats. Populations of less than 50 individuals are generally not hunted in Alberta, British Columbia, and Alaska (Glasgow *et al.* 2003; Hatter 2005; Hamel *et al.* 2006; McDonough and Selinger 2008). Washington State recently increased the minimum population size that can be hunted from 50 to 100 (Washington Department of Fish and Wildlife 2008; Rice and Gay 2010).

[25] Gyug, 2006; Wilson and Morley. 2007.

2.9.4 Disturbance and access

Sensitivity to disturbance

The potential effects of human disturbance on mountain goats have been well summarized (Hurley 2004; Goldstein *et al.* 2005).[26] Human proximity can cause disturbance that varies from short term (e.g., increased vigilance and short flight response) to long term (displacement from preferred habitat). Population demographic effects may also occur from human disturbance, as has been shown for elk through reduced calf production (Shively *et al.* 2005). The effects vary depending on the type of access and approach (i.e., zone of influence and mountain goat response are different for walking, horseback, motorized, and aerial) (Thompson 1980).[27]

Mountain goats appear to react to human disturbance to a higher degree than most ungulates. Although some apparent habituation has been observed in some populations to predictable, continuous, non-threatening stimuli (Singer 1978; Singer and Doherty 1985; Pedevillano and Wright 1987; Penner 1988; Goldstein *et al.* 2005),[28] no habituation has been observed in other populations (Foster and Rahs 1983; Côté 1996). Extreme alarm responses can occur from sudden, loud noises (Singer 1978; Singer and Doherty 1985; Pedevillano and Wright 1987; Penner 1988), and sensitization (progressive amplification of a response) to hydroelectric exploration activity has been reported (Foster and Rahs 1983). Nannies appear to be most sensitive to disturbance during the kidding and post-kidding (early rearing) seasons (Penner 1988). Chronic disturbance may make mountain goats more susceptible to disease that over time depresses the immune system (Joslin 1986).

Helicopter and fixed-wing aircraft disturbance

Mountain goats show high sensitivity to helicopter disturbance (Côté 1996; Gordon and Wilson 2004; Goldstein *et al.* 2005). Behavioural response of mountain goats to helicopter disturbance ranges from weak (e.g., no observed disruption, increased vigilance), to strong (e.g., severe flight response to escape terrain either forest cover or cliff terrain and temporary abandonment of range), and is inversely related to the distance of the helicopter from the group. Strong responses are very likely to increase the risk of muscle damage or myopathy or accidents and may lead to direct mortality (Spraker 1993). Whether weak or strong, repeated responses likely lead to higher than normal levels of corticosteroids and populations suffering from increased stress (Kraabel and Miller 1997). Côté (1996) observed that mountain goats walked or ran > 100 m or were alert for > 10 minutes 85% of the time when flights were < 500 m, and 37% of flights at < 1500 m caused at least a moderate reaction (animals moved 10–100 m or were alert 2–10 minutes); one female broke a leg while fleeing a helicopter. Goldstein *et al.* (2005) found less reaction in four areas studied in Alaska, with > 90% of disturbances not causing a response if distance to a group was > 990 m, > 1320 m, > 1480 m, and > 1730 m among the four areas. Reaction to helicopters varies among areas, and may be related to the degree of prior exposure to helicopters

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[26] Wilson, S.F. and D.M. Shackleton. 2001. Backcountry recreation and mountain goats: a proposed research and adaptive management plan. Unpublished report, Wildlife Research Group, Agroecology, Faculty of Agricultural Sciences, University of British Columbia, Vancouver, BC.

[27] Wilson and Shackleton, 2001.

[28] Churchill, B. and S.F. Wilson. 2008. Environmental management plan recommendations, mountain goats Highway 97 - Bentley Road to Okanagan Park. Unpublished report for B.C. Ministry of Transportation, Kamloops, BC.

(habituation) and topography (Goldstein *et al.* 2005). A lower alarm response was observed in a river canyon dwelling population in northeast British Columbia, where only 18% of mountain goat groups showed concern or took flight at approach distances < 500 m (EBA Engineering Consultants Ltd. 2004). However, a fright response that involves freezing on the spot rather than running does not necessarily mean a lower level of stress.

Fixed-wing aircraft appear to be less disruptive than helicopters for mountain ungulates, including mountain goats (Frid 2003),[29] but little empirical data are available for comparison. Fixed-wing telemetry flights on mountain goats appeared to cause an increase in movements subsequent to telemetry flights (Poole and Heard 1998), especially during winter.[30]

Although helicopter and human disturbance are likely to affect mountain goats at both the individual and population scales, the physiological and demographic impacts are poorly understood due to the difficulty of field studies of this nature. Studies to further examine this topic are currently being conducted in the Skeena Region (Wilson *et al.* 2007), where the objective is to determine whether helicopter disturbance leads to changes in seasonal movement behaviour, habitat selection, or temporary range abandonment (Cadsand 2009).

Industrial disturbance and access

Industrial activities that can cause disturbance to mountain goat populations primarily include exploration and development for oil, gas, coal and minerals, pipelines, transmission line corridors, independent power projects, wind power projects, and forestry development. Most of these activities are mechanized in nature and require heavy equipment for sustained periods of time, and may use helicopters. Road construction is associated with almost all industrial activities, and road construction in steep terrain often requires blasting and sustained heavy equipment use. Threats to mountain goats include habitat changes that facilitate access and disturbance that displaces mountain goats from preferred habitats (Pendergast and Bindernagel 1977). For example, removal of forest cover near escape terrain may increase human access and lead to frequent disturbance and subsequently lower use by mountain goats of otherwise suitable habitat (Hengeveld *et al.* 2004).

Timber harvesting can affect various seasonal mountain goat habitats. Harvesting in areas previously considered marginal for forestry development is encroaching on winter habitat in some areas (Demarchi *et al.* 2000; Taylor and Brunt 2007). In steep coastal terrain, helicopter logging in areas earlier thought inaccessible by conventional logging also exacerbates this concern. Winter range is generally thought of as a critical component of mountain goat habitat, with specific requirements and restricted distribution within the annual range. There appears to be relatively low risk of disturbance from logging on most winter range in the Kootenay and east-central British Columbia (Poole and Heard 2003; Poole *et al.* 2009) and in some inner coastal areas (Lemke 1999), but disturbance from forest development can occur in coastal areas and wet interior climates where heavy snowpacks result in mountain goats wintering at lower

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[29] Wilson and Shackleton, 2001.

[30] Keim, J. and C.L. Jerde. 2004. Measuring spatial movement responses from GPS collared mountain goats and mountain caribou during periods of aerial telemetry occurrence. Unpublished report prepared for B.C. Ministry of Water, Land and Air Protection, Smithers, BC.

elevation in sites often associated with high volumes of merchantable timber (Gordon and Wilson 2004; Taylor *et al.* 2004; Taylor and Brunt 2007). On the north coast, 90% of mountain goat habitat is outside of the timber harvesting land base (THLB), however much of the productive forest available for snow interception may be in the THLB (Horn 2009). Logging near or adjacent to winter range may displace animals to lower quality habitat, and reduce the proportion of time spent feeding or resting (Gordon and Wilson 2004). The timing of logging operations (winter vs. summer/fall), method (conventional vs. helicopter), or distance (within 2000 m) can also affect disturbance of seasonal mountain goat habitats. Timber harvesting may also affect use of mineral licks and trails to licks.[31]

Activities related to mining and mineral and oil and gas development can have similar impacts as timber harvesting on mountain goats. In northern British Columbia, mountain goats abandoned an area subject to drilling disturbances (helicopters, drilling, noise), but returned after the disturbance was removed (Foster and Rahs 1983). Studies in Montana suggested that while mountain goats did not abandon home ranges because of seismic activities, declines in adult female numbers, kid numbers and productivity occurred, which were postulated to be a result of cumulative stress (Joslin 1986).

Some habituation of goats to industrial disturbance has been documented. Mountain goats near Summerland, B.C., displayed little observable reaction to proximity to the highway and extensive blasting to construct a new highway.[32] Working with a canyon-dwelling population in Alberta where noise stimuli was pre-recorded and delivered at 400–600 m distance, Penner (1988) stated “mountain goats appeared to develop a tolerance of indirect and persistent noise stimuli in their environment, but continued to exhibit elevated behavioural response levels to initial, novel or sudden noise and visual stimuli” (i.e., they did not habituate to periodic or inconsistent noise). Penner (1988) later stated “Goats exhibited their greatest sensitivity to unusual or sudden stimuli such as rock falls, aircraft overflights and predators… The goat’s response to fixed wing aircraft was usually unconcerned while the sounds of a helicopter frequently elicited concerned or alarm responses.” Whether populations are hunted or not may influence their readiness to habituate to disturbance.

The potential impact to mountain goats from the recent increase in independent power projects throughout British Columbia is not well documented, but the impacts caused by associated road access, development of transmission lines, and use of mechanized equipment may be similar to other industrial activities.

Recreation disturbance and access

Activities associated with backcountry tourism and recreation can result in disturbance or displacement of mountain goats. Examples include a variety of heli-recreation (heli-skiing, heli-hiking, heli-sightseeing), hiking, rock climbing, summer ATV use, ski touring, snowmobile use, and motorized access to recreation facilities (Canfield *et al.* 1999), all of which have increased dramatically through much of British Columbia in the past three decades. Legal hunting and illegal poaching can also affect mountain goat populations, through disturbance and removal of animals.

[31] Corbould *et al.,* 2010.
[32] Churchill and Wilson, 2008.

The direct impact of many outdoor recreation pursuits on mountain ungulates is poorly quantified. Presumably mountain, rock, and ice climbing would place humans closest to mountain goat habitat. Simulated non-mechanized recreational impacts had a negligible effect on mountain goat activities in Colorado (Thompson 1980) and disturbance due to human foot traffic appears to be generally minor,[33] but may be more important at some times of the year (e.g., calving; Shively *et al.* 2005). However, research on reindeer (*Rangifer tarandus tarandus*) in Norway observed that provocations by skiers or snowmobiles revealed similar behavioural responses (Reimers *et al.* 2003). In addition to increasing energy costs for wintering animals, recreational activity often results in displacement of animals to less desirable habitat (Cole *et al.* 1997; Canfield *et al.* 1999). Varley (1998) concluded that during winter, conflict between mountain goats and most types of non-mechanized recreation are rare because of spatial segregation. However, increases in the use of snowmobiles and snowcats for winter recreation, and technological advances in machinery that enable people to travel farther, faster, and in steeper terrain, may have reduced spatial segregation in recent decades (Canfield *et al.* 1999).[34] In Montana, a decrease in a mountain goat population and reproduction is attributed to an increase in snowmobile use.[35] Intensive snowmobile activity on mountain caribou (*Rangifer tarandus caribou*) winter range resulted in complete displacement of caribou from an entire mountain block of high quality habitat (Seip *et al.* 2007). The increased access for recreation (and the potential impacts this may bring) and the relative lack of integrated access management for resource development access are clearly linked.

2.9.5 Climate change

Potential impacts of climate change to mountain goats are not well understood, but are expected to strongly affect northern and alpine areas (IPCC 2007). Global mean annual temperatures could increase by 4ºC over the next century. Climate change is already driving changes in ecosystem structure (vegetation, species composition), function (productivity, decomposition, water and nutrient cycling), processes (disturbance regimes, successional pathways, hydrological regimes), and species distribution (Pojar 2009). Existing ecosystems will lose some species, gain others, and experience changes in abundance and dominance of the species that persist.

Evidence of changes observed include shrinkage of glaciers in most areas of British Columbia in recent decades. Most climate change models suggest an average 1ºC increase over the next 50 years, which will force a shift of ecosystems a predicted 300 m higher in elevation and 150 km farther north (IPCC 2007). The IPCC (2007) also forecasts that more than 50% of the alpine tundra ecosystems will eventually disappear as subalpine forests shift up in elevation, affecting the location of the alpine treeline ecotone (the area between forest and tundra). A reduction of moist forests and an expansion of dry forests in the southern portion of the province are also expected.

[33] Wilson and Shackleton, 2001.

[34] McCarthy, F.G. 2008. The impact of snowmobiles on the Bridger-Teton National Forest: considerations for winter travel plans. Unpublished report, The Wyoming Wilderness Association, Sheridan, WY.

[35] McCarthy, 2008.

Thus, a climate change scenario in British Columbia is predicted to include increased winter and summer temperatures (greater increase in winter), greater warming in the north and least in coastal areas, wetter winters, drier summers in the south, generally wetter conditions in the north, increased intensity and amount of precipitation, and increased extreme weather events, all of which in part will result in smaller and fewer glaciers (Rodenhuis *et al.* 2007; Spittlehouse 2008). Although greater precipitation is predicted in the winters, average snowlines will be found farther north in latitude and higher in elevation, snow accumulation will decrease and the spring snowmelt may occur later in the season.

Mountain goat distribution will continue to be limited by the availability of steep rugged escape terrain. With an upward shift in treeline, mountain goat may move to higher elevations where that opportunity exists, effectively becoming forced to rely on continually shrinking islands of suitable habitat. An indirect implication of this is that there may be an increased risk of predation when animals must move through more forested habitat to access suitable escape terrain.

The timing of spring green-up is very important for body size in young of the year, which has implications for survival and reproductive output (Côté and Festa-Bianchet 2001a). Greater variability in green-up will likely affect kid survival and health, and therefore recruitment. However, due to the more generalist feeding strategy used by mountain goats and their ability to tolerate deeper snowpacks, mountain goats should hold their own and could increase and thrive (Pojar 2009).

Short-term adaptation strategies may include increasing a species resistance to change (i.e., by reducing other pressures upon these species from other sources), promoting resilience to change (i.e., by changes to hunting regulations to counter the effects of sudden habitat alteration), and enabling ecosystems and resources to respond to change (which may include assisted migration of wildlife).

2.10 Conceptual Ecological Mountain Goat Model

A conceptual model of the interactions among mountain goat habitat features, stressors, and vital rates was developed by S.F. Wilson (Ecologic Research, Gabriola, B.C.) to help understand interactions and relationships among parameters (Figure 4). The model can help clarify relationships among habitat features and stressors that affect key vital rates, and ultimately population size.

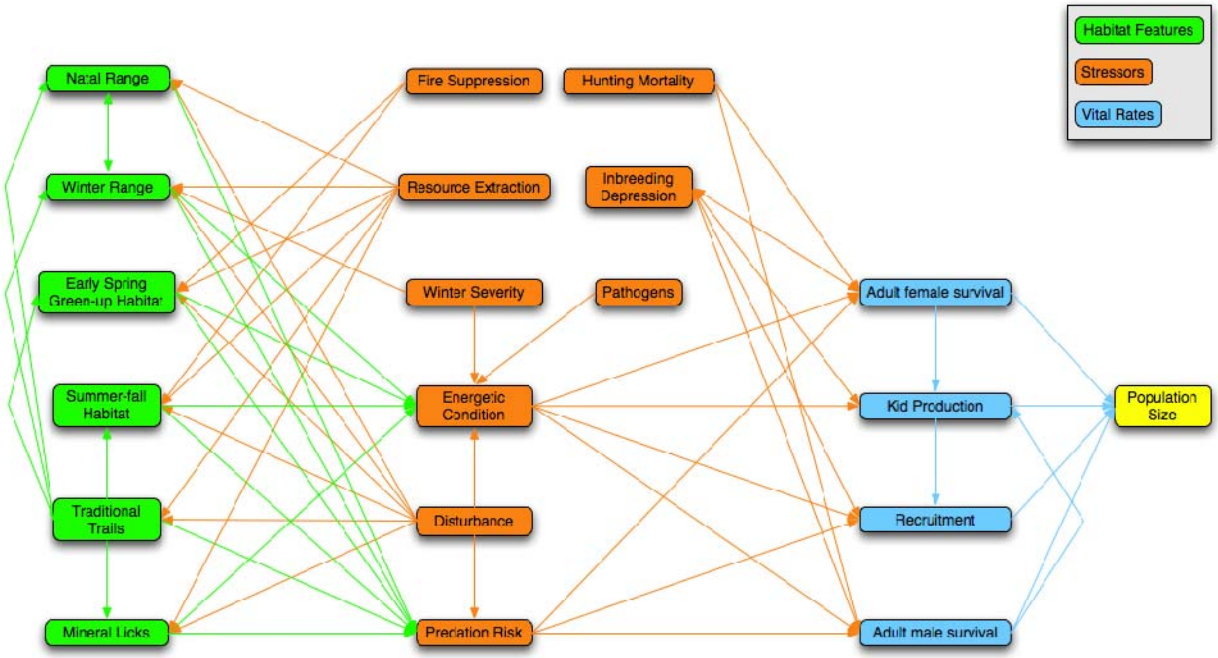

Figure 4. Conceptual model of interrelationships among mountain goat habitat features, stressors, and vital rates. Definitions accompanying the model are presented in Appendix B. Developed by S.F. Wilson, with assistance from K.G. Poole.

2.11 Knowledge Gaps / Research Needs

There has been relatively limited research conducted on mountain goats in British Columbia in recent years. Much of the recent data and understanding of mountain goats comes from intensive research conducted at Caw Ridge and surrounding small- to medium-sized, discontinuous populations in the western Alberta foothills (Festa-Bianchet and Côté 2008), which arguably may not be indicative of larger populations residing in the continuous alpine and subalpine habitat of British Columbia. Knowledge about the ecology of coastal mountain goat populations is limited. Following is a list of research needs and data gaps that could be considered.

Impacts of habitat alteration: Little is known about the implications of the loss of forested winter ranges (primarily coastal) to mountain goat survival. Properly designed experimental research is required to determine the effects of forest removal on mountain goats. There are many examples of forest harvesting in and adjacent to occupied mountain goat winter range; suitable study areas are thus available. The long-term impacts of forest canopy removal are of particular concern in relation to population viability, migration routes and travel corridors, trail use to and use of mineral licks, and habitat selection. In addition, little is known about the impacts of forestry on predator-prey relationships as they relate to mountain goats.

Population dynamics: Many aspects of mountain goat ecology are unknown or poorly known, in particular the dynamics surrounding the apparent lack of density dependent responses in established, native populations (Festa-Bianchet and Côté 2008). Research programs focussed on clarifying parameters of fecundity and mortality (e.g., female age at first reproduction, productivity, optimum sex ratios for recruitment) could be linked with data and models derived from Caw Ridge and elsewhere in Alberta (Gonzalez-Voyer *et al.* 2003; Hamel *et al.* 2006) to examine population dynamics and refine levels of sustained yield. Potential differences in coastal and interior ecotypes should be considered.

Population viability: We can best address questions of minimum population size that can sustain harvest with better demography data from British Columbia. These data could feed into models to address population size, percent females in harvest, and sustainable harvest rates. Sensitivity analysis in modelling could be conducted.

Dispersal and seasonal movements: Little is known about dispersal patterns in almost all mountain goat populations. Even basic data on seasonal movements are not available in many areas (e.g., the Okanagan).[36] This information would contribute to further understanding of population viability and genetic exchange among populations.

Response to fire: Little is known about whether mountain goats respond numerically or spatially to prescribed fire. There are many opportunities throughout the province to study this relationship with wildfire or, if an opportunity exists, with prescribed fire.[37]

Sensitivity analysis of harvest data: A provincial level analysis of the compulsory inspection and Big Game Harvest Questionnaire data has not been conducted, but could provide insights into trends and regional differences in mountain goat harvest parameters. Hunter effort and success, harvest age, and sex ratio in the harvest can be used to index trends in populations. Preliminary summaries are presented in this management plan.

Non-consumptive use: There are limited data on the response of mountain goats to non-consumptive use. Suitable sites where the public can observe mountain goats should be identified and developed with site management plans. Viewing sites should be developed to control vehicular traffic and to keep mountain goats and people safely separated (i.e., the mountain goats should be easily viewed without disturbing them). Appropriate on-site interpretive and educational materials about the life history, behaviour, and management of mountain goats can be developed. If mountain goat viewing is the priority for an area, then a hunting closure might be considered for those populations.

Inventory methodology: A criticism of most aerial mountain goat inventories is the lack of a reliable sightability correction, and no statistical bounds to population estimates. The first stages of a regression-based sightability model for the species have been developed (Poole 2007b; Rice *et al.* 2009). Further work with marked animals could develop and refine a British Columbia based model. The models would likely be specific for ecotypes within the province. Additional testing of population estimates derived from DNA obtained from non-invasive sampling of scat or hair should be conducted, as the initial results appear promising (Poole and Reynolds, in prep.).

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[36] Wilson and Morley, 2007.
[37] Wilson and Morley, 2007.

Climate change: Climate change may produce increased risks to mountain goat populations. Conservation needs during climate change are poorly understood, but if populations are assessed as high priority and at risk, then management options could be developed. It is unknown whether expanding forests into higher elevations will result in shifts in mountain goat distribution, abundance, or differences in predator/prey dynamics. It is also not clear whether warmer or wetter conditions might change parasite loads and life cycles, and affect disease transmission vectors (Jenkins *et al.* 2004). Baseline data collection with ongoing monitoring is needed.

Develop baseline health assessment: Whenever mountain goats are handled, individual animals should be sampled by applying a standard sampling and collection protocol (provided by the B.C. Ministry of Environment Wildlife Health Program). When mortality or illness is observed or suspected, consultation with the Wildlife Health Program for a follow-up investigation of the cause and sampling should occur.

The British Columbia species at risk (SAR) health assessment tool (http://www.env.gov.bc.ca/wld/documents/wldhealth/SARfinal072009.pdf) should be applied to mountain goat herds of concern or of high management interest such as translocation donor herds[38] and should include the initiation of health sampling programs. Herd health assessments should include an evaluation of herd demographics, individual animal sampling for disease and parasite exposure, examination of herd genetics for the degree of genetic diversity, as well as other individual and herd-related information since all of these parameters can influence wildlife population health. Further attention to the assessment of the impacts of interactions between mountain goats and sympatric ungulates in British Columbia is necessary. Health monitoring should be repeated periodically to monitor for the effects of climate change and to assess the risk from infectious disease and parasites following contact with other wild and domestic species.

Mountain goat samples previously archived should be analyzed and the results collated and interpreted for the database. New research techniques that include stable isotopes, genomics, and noninvasive sampling methods should be examined as they may play an important role to improve knowledge of the effects of various factors on goat population health over time. Also, their use may reduce the necessity to directly handle and cause stress to live animals.

Disturbance thresholds and buffers: Limited data are available that link disturbance events to long-term demographic consequences. More information is needed about the effects of different types of helicopter activity (e.g., predictable and repeated vs. unpredictable and short term) on mountain goat behaviour, fecundity, habitat selection, and movement patterns. The study currently underway in the Skeena region will provide new information (Wilson *et al.* 2007); however, additional research is still needed. Similarly, mitigation of the impacts of industrial development on mountain goats would benefit from studies on behavioural and physiological reactions to different stimuli over a range of distances.

Consider a reassessment of the provincial listing: The mountain goat in British Columbia is on the Yellow List (ranked S4, apparently secure and not at risk of extinction) (Table 1). Not all populations (primarily some southern populations) throughout the province are considered stable

[38] Fraser and Parmley, 2008.

(Table 2). It may be necessary to consider re-evaluating this designation for some southern populations.

3.0 CURRENT MANAGEMENT FRAMEWORK

3.1 Review of Management Frameworks in Other Jurisdictions

Most jurisdictions adjacent to British Columbia provide goals that address mountain goat habitat. For example, the first state-wide goal in the Washington mountain goat management plan is to “preserve, protect, perpetuate, and manage mountain goats and their habitats to ensure healthy, productive populations” (Washington Department of Fish and Wildlife 2008). Alberta, however, proposed a number of key elements to address their goal “to maintain viable, productive and interconnected habitats for mountain goats throughout their range in Alberta” (Glasgow *et al.* 2003). The Alberta objectives were determining the distribution, suitability, and effectiveness of the habitat that can support mountain goats; establishing habitat targets in concert with population targets; developing habitat management strategies to meet established targets, including the development and implementation of habitat protection guidelines for all human use activities in mountain goat habitat; and developing cooperative programs with British Columbia and the national parks in Alberta to manage and protect the habitat of interjurisdictional herds.

All jurisdictions address harvest management in much greater detail. Toweill *et al.* (2004) summarized the various mountain goat harvest management approaches used in North American jurisdictions. Almost all jurisdictions have hunter orientation (primarily aimed at sex identification in the field), and an “any goat” regulation with a bag limit of one (some specify an adult or minimum horn restrictions, and/or no harvest from larger groups or adults accompanied by kids). Many jurisdictions do not permit hunting of herds with less than 50 individuals (Alaska, Alberta, British Columbia, Idaho, Oregon, and Washington) (Toweill *et al.* 2004, and see below). Season length varies widely (11–153 days), but most have 45–75 day seasons.

Alberta has set population goals for its four management areas, including minimum population sizes, and has restricted hunting to a nil to low harvest rate in these areas to meet these (Glasgow *et al.* 2003). Populations of less than 50 mountain goats are not hunted. A form of double-quota system is used, where if more than one-third of the harvest within a management unit is females, the season may be closed for one or more years unless there are data that indicate this closure is not necessary. Regular surveys are conducted in areas where hunting is permitted, and hunting is suspended where observed numbers or sex ratios drop below established targets. Compulsory education covering sexing of mountain goats in the field is required for all hunters. Successful hunters are required to complete compulsory registration, and to submit the lower incisor bar for aging. At present, eight licences are available to residents in Alberta under a once in a lifetime opportunity.

Most game management units in Alaska have adopted a point system for mountain goat harvest management that uses criteria to achieve a harvest rate based on recruitment levels, and recognizes the negative implication of harvesting females (McDonough and Selinger 2008; K. White, pers. comm. 2008). Explicit criteria for the number of hunting permits issued consider past harvest rates, the sex and age structure of the harvest, population size and trends, the age of the survey data, access, ecotype, winter severity, and other factors (McDonough and Selinger 2008). Briefly, harvest levels are set at 5–6 points per 100 mountain goats observed during aerial surveys, based on assumed rates of recruitment. Surveys assume 45–65% sightability, thus the maximum harvest rate (assuming a male-only harvest) is about 3.5%, but in reality the actual harvest rate is lower. Harvested females (2 points) are rated twice that of males (1 point). Therefore, using a 5-point system for a population of 200 mountain goats observed during surveys in southeast Alaska (K. White, pers. comm. 2008), the annual harvest could be 10 males, or 5 females, or some combination thereof. Legislation is in place to close the harvest mid-season by emergency order should a harvest cap be reached. More conservative harvest rates may be chosen after extreme winters when survival is assumed to be reduced, or when kids comprise < 18% of the population and the population is assumed to be declining. No permits are issued in areas with < 50 mountain goats.

Washington State monitors mountain goat numbers and trends within hunted range by conducting frequent surveys. Management units with < 100 mountain goats are not subject to harvest in Washington (Washington Department of Fish and Wildlife 2008). Mountain goat hunting within the state is an once-in-a-lifetime opportunity. Legal animals are limited to those with horns > 4 inches (10 cm); hunters are urged not to harvest a nanny and it is unlawful to harvest a nanny accompanied by a kid.

3.2 Management Tools and Approaches Used within British Columbia

Management of mountain goats and their habitats has occurred in British Columbia since the mid-1900s, but was characterized by a lack of inventory and use of a poor approach to managing conservatively when those inventory data were lacking (B.C. Ministry of Environment 1979; Phelps *et al.* 1983). Changes in harvest management by the mid-1970s halted the declines observed in many areas of the province. Progress on habitat management generally lagged behind harvest management, but advancements were observed by the 1980s and early 1990s. Components of mountain goat habitat (e.g., winter range affected by forest practices) were provided an opportunity for legal protection beginning with the *Forest Practices Code of British Columbia Act* in 1995 (Province of British Columbia 1996a), and reaffirmed by the *Forest and Range Practices Act* in 2004.

3.2.1 Habitat management

The following planning and management tools are currently available for mountain goat habitat in British Columbia. Some of these tools are proactive (e.g., strategies related to the *Forest and Range Practices Act* [FRPA], *Land Act* reserves) and some are reactive (e.g., reclamation plans); however, in all cases, high value mountain goat habitat must be identified before these tools can be applied. Most tools currently being deployed are under the authority of FRPA.

***Forest and Range Practices Act* (FRPA)**

The *Forest and Range Practices Act* (FRPA) and its regulations govern the activities of forest and range tenure holders in British Columbia (Province of British Columbia 2002a, 2004a, 2004b, 2008a). The statute sets the requirements for planning, road building, logging, reforestation, and grazing. The minister responsible for the *Wildlife Act* has several authorities related to wildlife and habitat management enabled by the Government Actions Regulation (GAR) of FRPA. Specifically, the minister may identify species at risk (SAR), regionally important wildlife species (RIW), or a specified ungulate.

Once a species has been identified in one of these categories, areas of special management may be designated including Wildlife Habitat Areas (WHAs) for SAR and RIW, and Ungulate Winter Ranges (UWR) for ungulates. Special management of these designated areas is delivered through establishing objectives or General Wildlife Measures (GWMs) that restrict or prohibit forest or range practices. GWMs may also be applied to specified areas (e.g., an area surrounding ungulate winter range), if the measure is deemed necessary to protect and conserve the species in that area. Objectives become planning requirements that must be addressed in a tenure holder’s Forest Stewardship Plan or range use plan, whereas GWMs become practice requirements, like those in regulation. WHAs and UWRs were established for some species in some localities under the *Forest Practices Code of British Columbia Act* (FPC), before FRPA; those established under the FPC are continued under FRPA.

Under FRPA, mountain goat is currently listed as a specified ungulate species for which winter range habitat can be conserved, and is a candidate for listing as RIW (no species have yet been identified as RIW). A list of Wildlife Habitat Features (WHFs) is also being considered for identification under the GAR. Identified WHFs must not be damaged or rendered ineffective by forest or range activities. Currently, significant mineral licks are being proposed as candidate WHFs.

Ungulate Winter Range (UWR)

The establishment of Ungulate Winter Ranges is one of the most important tools for managing mountain goat habitat. The Government Actions Regulations (GAR) lists mountain goat as a species for which UWR can be established under FRPA. The Ministry of Environment retains authority to establish UWR, subject to limitations set under GAR (e.g., the order must be consistent with established objectives, the order would not unduly reduce the supply of timber from British Columbia’s forests, the benefits to the public outweigh any material adverse impacts on delivered wood costs, and the order must provide an opportunity for review and comment). Wilson (2004) reviewed desired conditions for UWR in the Coast Mountains, and stated that UWR areas must meet at least one of the following criteria:[39]

- a combination of topographic and vegetative features defining high-quality winter range, as appropriate for the species and the locality, as determined by Ministry of Environment regional staff in consultation with species experts;
- a documented history of winter use, as determined by Ministry of Environment regional wildlife staff; or
- in localities that are regularly occupied by an ungulate species during the winter but that do not have sufficient high-quality winter range as defined under points 1 or 2, winter range areas can be identified by recognizing a combination of topographic and vegetative features that provide the most suitable habitat available for winter range. This is the least

[39] Wilson, S.F. 2004. Desired conditions for Coastal Mountain goat winter range. Unpublished report for B.C. Ministry of Water, Land and Air Protection, Biodiversity Branch, Victoria, BC.

preferred of these three criteria and should be used only when options 1 or 2 cannot be met.

Ungulate Winter Ranges specific to mountain goats have been established in numerous forest districts across the province; however, there are still high-priority areas that remain to be legally designated (e.g., Sunshine Coast, North Coast) (http://www.env.gov.bc.ca/wld/frpa/notices/uwr.html).

General Wildlife Measures (GWM)
The Minister responsible for the *Wildlife Act* by order may establish a GWM, to be applied to an UWR, WHA, or specified area, for a category of species at risk (Identified wildlife and specified ungulate species), regionally important wildlife, or specified ungulate species, if satisfied that: (1) the measure is necessary to protect or conserve the species in the category in the area to which the measure relates; (2) the measure is necessary to protect or conserve the wildlife habitat area or ungulate winter range; and (3) this regulation or another enactment does not otherwise provide for that protection or conservation. General Wildlife Measures are used to set restrictions related to forest and range harvesting activities (e.g., no timber harvesting, no road construction, timing restrictions during winter). All holders of agreements under the *Forest Act* or *Range Act* must follow approved GWMs (Province of British Columbia 2008b); this includes minor tenure holders (when consulted) and holders of temporary licences (such as an Occupant Licence to Cut for mineral tenure holders or an independent power producer). Because GWMs are legally required, provisions are in place to enable exemptions, which are approved by the Ministry of Environment Regional Managers of Environmental Stewardship Division.

Regionally Important Wildlife (RIW)
This category of identified wildlife includes species that are considered important to a region of British Columbia, and relies on habitats that are not otherwise protected under FRPA and that may be adversely impacted by forest or range practices. Work is currently underway to develop a species account for mountain goat as RIW (J. Psyllakis, pers. comm. 2009). At the time of printing of this document, no species has been legally designated as RIW in the province.

Wildlife Habitat Areas (WHA)
Wildlife Habitat Areas for mountain goats are intended to protect small-scale features such as critical, non-winter habitats (e.g., parturition sites, escape terrain, mineral licks). WHAs exist for mountain goat parturition sites and escape terrain, and in one case, for a significant mineral lick feature (P. Johnstone, pers. comm. 2009). A total of 11 WHAs for mountain goat exist in the province, all of which are in the Peace Region. At this time, under FRPA, Identified Wildlife Management Strategy (IWMS) does not currently include mountain goat (Province of British Columbia. 2004b), but this is currently under review.

Wildlife Habitat Features (WHF)
Wildlife Habitat Features are small-scale, important points that are used by identified wildlife. High significance mineral licks would include those that are relatively rare on the landscape, requiring individuals to travel relatively long distances from traditional escape terrain (> 1 km) and/or be used annually by multiple species, or by many individuals within a species. WHF have

not been designated for mountain goats, and until that occurs it is optional for proponents to plan for their protection.

The Wildlife Act

The provincial *Wildlife Act* provides several tools for managing mountain goat habitat (Province of British Columbia 2002b). The Minister of Environment can designate areas of value to wildlife as Wildlife Management Areas (WMAs). Land or resources in a WMA cannot be used without the written permission of the Regional Manager of Environmental Stewardship Division, who has the power to impose restrictions for access and development. Access management provisions also exist through the *Wildlife Act*. The minister may make regulations that prohibit, restrict or allow access by members of the public to designated areas of British Columbia, for the purposes of wildlife management. Examples of these are regulations restricting motor vehicle use in high elevation ungulate habitat, and the Muskwa-Kechika access management area in northern British Columbia. The Minister of Environment may also, with the approval of the minister responsible for the highway or road, temporarily close or impose restrictions on vehicular access to a highway or road for the purpose of protecting wildlife.

Mining legislation

Wildlife biologists can use existing mining legislation to manage mountain goat habitat in certain specific instances. The *Health, Safety and Reclamation Code for Mines in British Columbia* (B.C. Ministry of Energy, Mines and Petroleum Resources 2008) requires proponents to deactivate and reclaim exploration impacts (grids, camps, roads, trails, landing pads, etc.) within 1 year of cessation of exploration activities (unless authorized by an inspector), and recommends that the Ministry of Environment be consulted for access management, and to avoid sensitive wildlife areas. Notices of work are required, and are referred to provincial agencies for review and comment; mountain goat habitat concerns can be identified at this time. Under the *Mines Act* (Province of British Columbia 1996b), proponents are required to reclaim their developed tenures according to an approved plan. The Act also allows the Chief Inspector to require, as a condition of issuing a permit, that the owner, agent, manager, or permittee provide a security, subject to conditions, specified by the Chief Inspector, which can be used to pay for “mine reclamation and protection of, and mitigation of damage to, watercourses and cultural heritage resources affected by the mine.” Permits may include conditions that require proponents to provide monitoring and mitigation of impacts to specific valued ecosystem components.

Oil and Gas Activities Act (OGAA)

The *Oil and Gas Activities Act* (OGAA) and its regulations will govern oil and gas activities in British Columbia. The Lieutenant Governor in Council may make regulations authorizing the minister responsible for administering the *Wildlife Act* to designate categories of wildlife and as such establish wildlife habitat areas (WHA), ungulate winter ranges (UWR), and associated measures for the protection and effective management of the environment. The Lieutenant Governor in Council may also authorize the minister responsible for administering the *Wildlife Act* to identify wildlife habitat features. OGAA is not in effect at this time, but regulations are currently being finalized.

Parks and protected areas
Much habitat that is suitable for mountain goats in the province occurs on land with some form of conservation, but often mountain goat habitat in parks is not specifically identified for management. When known, this habitat can be identified and managed through provincial park and protected area management plans; for example, Elk Lakes Provincial Park in southeastern British Columbia has a separate mountain goat management plan (M. Holley, pers. comm. 2009). In the Peace Region permanent mountain goat monitoring plots are located in two provincial parks: Gwillim and Sikanni Chief Canyon.

Conservation lands
Conservation lands are not considered formally under the Parks and Protected Areas system, but are designated to conserve and manage habitat for the benefit of regionally, nationally, and internationally significant fish and wildlife species. Conservation lands administered and managed by the Ministry of Environment include the following:

- Wildlife Management Areas;
- conservation land acquisitions (acquired through purchase, exchange or donation);
- transfers of administration to Ministry of Environment for conservation purposes; and
- privately owned sites under long-term lease to the ministry from conservation organizations such as The Nature Trust of BC.

Conservation lands can be established by several administrative instruments under the *Land Act* (Province of British Columbia 1996a, 2008b). Those most likely to be useful for management of mountain goat habitat include the following:

- Order-in-Council Reserve;
- Map Reserve;
- Land Act Designation (e.g., old growth management areas); and
- Notation of Interest.

These provisions allow the Minister responsible for the *Land Act* (or an authorizing agency) to withdraw an area from disposition or establish reserves for various specified short or long terms, depending on the provision.

Guidelines and Best Management Practices
Guidelines and Best Management Practices (BMPs) are available for mitigating impacts of resource development, recreation, and tourism. Guidelines can define results, desired behaviours, indicators, and limits for resource use, development, and enjoyment activities. Direction given in guidelines is only enforceable if written into a government instrument (e.g., development permit, management plan) by a decision maker, and are consequently not always followed. The provincial *Wildlife Guidelines for Backcountry Tourism/Commercial Recreation* were developed to ensure that backcountry recreation activities do not compromise the current distribution of wildlife, the sustainability of their populations, or the integrity of their habitats (B.C. Ministry of Environment 2006).

Commercial tourism operators, tenured under the *Land Act*, are required to develop a management plan and incorporate guidelines specific to their activity and season (e.g., aerial-related recreation in all habitats in winter and snow-free seasons; motorized recreation in alpine tundra, forest and grasslands during snow-free seasons). Guidelines list the results to be achieved, along with desired behaviours designed to meet those results.

Monitoring plans are currently in development and research is underway in the Skeena Region via a partnership among Ministry of Environment, Helicat Canada, University of Northern British Columbia, and a heli-ski operator to determine the medium- and long-term effects of helicopter activity on mountain goat behaviour and habitat use patterns (Wilson *et al.* 2007).

Landscape-level habitat management

Several planning tools can be useful for managing mountain goat habitat at the landscape level. Regional Land and Resource Management Plans, Sustainable Resource Management Plans, and other landscape-level planning documents currently exist for many areas of the province. Resource development industries may have planning processes that include wildlife values for various certification and permitting requirements (e.g., Forest Stewardship Plans and oil and gas pre-tenure plans). These higher level plans give strategic direction for large areas, and may include specific objectives and strategies for managing mountain goat habitat.

Direct habitat management

Direct management techniques have been used to improve or provide important habitat for mountain goats. Important habitat can include winter range, kidding/early rearing areas, escape terrain (including forested), mineral licks, and travel corridors. Prescribed burning of range areas can promote growth of preferred forage and reduce ingrowth of less desirable species. In other situations, maintaining or establishing mature forest cover may be the objective, and planting or thinning may be the preferred prescription to reach optimal stand conditions. Discrete important habitat can be identified and managed within other processes, such as fire management planning and resource development project reviews.

Provincial databases and mapping

The province currently has a large amount of stored data that relates to mountain goat habitat use and management. For example, all Ungulate Winter Ranges and Wildlife Habitat Areas approved for mountain goats are available online (http://www.env.gov.bc.ca/wld/frpa/iwms/index.html); simple searches on the Species Inventory Database website (http://www.env.gov.bc.ca/wildlife/wsi/siwe.htm) will yield regional informal surveys to telemetry data to summary reports; searching Ecocat (https://a100.gov.bc.ca/pub/acat/public/welcome.do) provides links to regional mountain goat habitat management projects; and searching the BC Species and Ecosystems Explorer (http://a100.gov.bc.ca/pub/eswp/) provides information on the conservation status, conservation framework priority and other general information on mountain goats. The available information varies throughout the province, and both the databases and the regional offices should be consulted. The British Columbia Integrated Land Management Bureau manages the Land and Resource Data Warehouse (LRDW) (http://www.lrdw.ca/), where capability and suitability mapping, as well as some Terrestrial Ecosystem Mapping, Predictive Ecosystem Mapping, and Vegetation Resources Inventory can be found. The LRDW also houses the Broad Ecosystem Inventory tool, which can be queried to produce mountain goat habitat reports at a relatively coarse scale (1:250,000).

3.2.2 Harvest management

Past and current harvest management

Historic management of mountain goats within British Columbia through to the 1960s led to reductions in populations in many areas (B.C. Ministry of Environment 1979). Liberal seasons and unrestricted hunter numbers often resulted in unsustainable harvests. As an example from the Kootenay Region, this overharvest occurred as a result of (1) a philosophy of maximizing harvest, (2) the low management priority assigned to the species, (3) a lack of understanding of the vulnerability of the species, and (4) the proliferation of uncontrolled access (Phelps *et al.* 1983). Beginning in late 1960s across much of the province, hunting closures and progressive restrictions in mountain goat season length and bag limit halted the decline, and allowed the next phase of mountain goat management to proceed. Beginning in mid-1970s, mountain goat hunting in some closed parts of the province was re-instated under a Limited Entry Hunting (LEH) system (Phelps *et al.* 1983), but most northern areas and areas with limited access were managed under General Open Seasons (GOS). In west-central British Columbia, which was still felt to have high densities of mountain goats, a system was implemented in 1971 to regulate the number of hunters and mountain goats harvested by distributing hunters in relation to the mountain goat densities (Sumanik 1970) that was similar to today's LEH strategy. LEH subzones within management units were used more regularly starting in the 1980s in an effort to distribute hunting pressure more evenly.

Management of mountain goat harvest in British Columbia since the 1990s (Hatter 2005) has been based on a combination of estimated population size and proportion of females in the harvest derived from the literature and modelling in the program RISKMAN (Taylor *et al.* 2002), in large part using data from Caw Ridge in west-central Alberta. Mountain goat harvest allocations across the province vary with estimated population size, with a recommended maximum of 4% allocation for populations > 200 individuals and ≤ 30% females in the harvest, and a lower allocation with smaller populations (down to 2% allocation for populations of 50–100 mountain goats with ≤ 25% females in the harvest) (Table 4). This protocol applies to populations that have been surveyed at least every 5 years (Hatter 2005). Note that this management protocol has been in place in most of the province, but regional variations occur. For example, in the Skeena Region, management was based upon an assumed allowable harvest rate of 4% applied to the specific population of mountain goats where the female harvest cannot exceed 30%, but no clear minimum population size was identified before harvest was considered (G. Schultze, pers. comm. 2009). In that instance, populations estimated to have less than 25 animals were generally not hunted.

Table 4. Maximum acceptable harvest rates for British Columbia mountain goat populations (Hatter 2005).

Population size	Maximum desired harvest rate	Maximum % females in harvest
< 50	0%	n/a
≥ 50 to < 100	2%	≤ 25%
≥ 100 to < 200	3%	25–30%
≥ 200	4%	≤ 30%

Currently, the provincial bag limit is one mountain goat of any age or sex, and the species requires compulsory inspection (the horns must be submitted to a compulsory inspector within

30 days). Mountain goat harvests within the province are managed under both GOS and LEH. GOSs limit the timing of the season over large areas, whereas LEH provides additional control over allocations and areas (smaller LEH zones distribute hunting effort). GOSs are the primary harvest management tool in the Vancouver Island (2 management units), Cariboo, Skeena, Omineca, and Peace Regions. LEH management predominates or is used solely within the Lower Mainland (3 authorizations only), Thompson, Kootenay, and Okanagan (1 authorization only) Regions. An LEH archery-only season is available in the Kootenays covering 10 days before the opening of the firearms season.

Mountain goat hunting season lengths vary across British Columbia, with most seasons in the southern half of the province beginning in early September, and running until the end of October or the end of November. Most seasons in the northern half of the province begin in early August to early September, and end in mid-October or mid-November. However, most LEH seasons in the southern half of Skeena run to 28 February, in part to address low success rates (G. Schultze, pers. comm. 2009). The current hunting synopsis is available at http://www.env.gov.bc.ca/fw/wildlife/hunting/regulations/.

All hunters are encouraged (but not required) to select males. A video "Is It a Billy or Is It a Nanny?" is available to hunters (Duncan Gilchrist Productions), and further information is presented in the annual hunting synopsis ("Important notice for mountain goat hunters"; http://www.env.gov.bc.ca/fw/wildlife/hunting/docs/notice_to_mtn_goat_hunters.pdf). In addition, a mountain goat sex identification presentation courtesy of the Utah Division of Wildlife Resources is available on the Ministry of Environment website (http://www.env.gov.bc.ca/fw/wildlife/hunting/docs/goat_orientation_08Utah.pdf).

Mountain goat harvest is currently allocated to resident and non-resident hunters according to a suite of 8 policies and procedures collectively referred to as the "Wildlife Allocation Policy'' (http://www.env.gov.bc.ca/fw/wildlife/harvest_alloc/). This process considers the relative importance and degree to which each residency group uses their allocated share. Mountain goats are an important species for guide outfitters, and guide outfitters are assured no less than 20% of the annual allowable harvest (AAH). Similarly, residents are assured no less than 60% of the AAH. The current allocation period is 2007–2011, to be followed by the next period covering 2012–2016.

Harvest data

Over 28,500 mountain goats have been recorded as harvested in British Columbia between 1976 and 2008 (Figure 5). Since 1976, the annual harvest has ranged from 600 to 1160 animals ($\bar{x}$ = 865 mountain goats per year), with the annual harvest peaking in the late 1980s and early 1990s (Figure 6). The division of harvest among regions has varied over time, but averaging over the period the Skeena and Kootenay Regions have produced 34% and 30% of the harvest, respectively (Figure 7). The Omineca and Peace Regions have collectively contributed 28% of the harvest.

Much of the change in provincial harvest over time is attributed to changes in the Kootenay harvest. This appears primarily related to changes in hunting opportunity and hunter interest. Between 1979 and 1984, the number of LEH authorizations available in the Kootenay Region increased from about 100 to over 1100 annually, during which time the number of mountain goats harvested annually increased from 75 to almost 450 animals. Between the mid-1990s to mid-2000s, the number of LEH authorizations allocated increased from 1500 to 2200 annually, yet the annual harvest has declined from roughly 350–430 animals in the early to mid-1990s, to 160–230 during the 2000s. This may in large part be related to the number of active hunters in the region, which peaked at roughly 700–850 in the mid-1990s, and declined to 400–500 during the 2000s, despite the increase in LEH authorizations available.

Overall, residents took 52.2% of the harvest during 1976–2008, with guided hunters (generally non-residents of Canada or Canadians from out of province) taking the remainder. Since the mid-1980s, the proportion of the mountain goat harvest taken by residents has steadily declined from 57–58% to approximately 43% for the past 5 years of record (Table 5). The proportion of mountain goats harvested by non-residents varies among region, with the highest proportion in the Omineca and Peace Regions (Table 6).

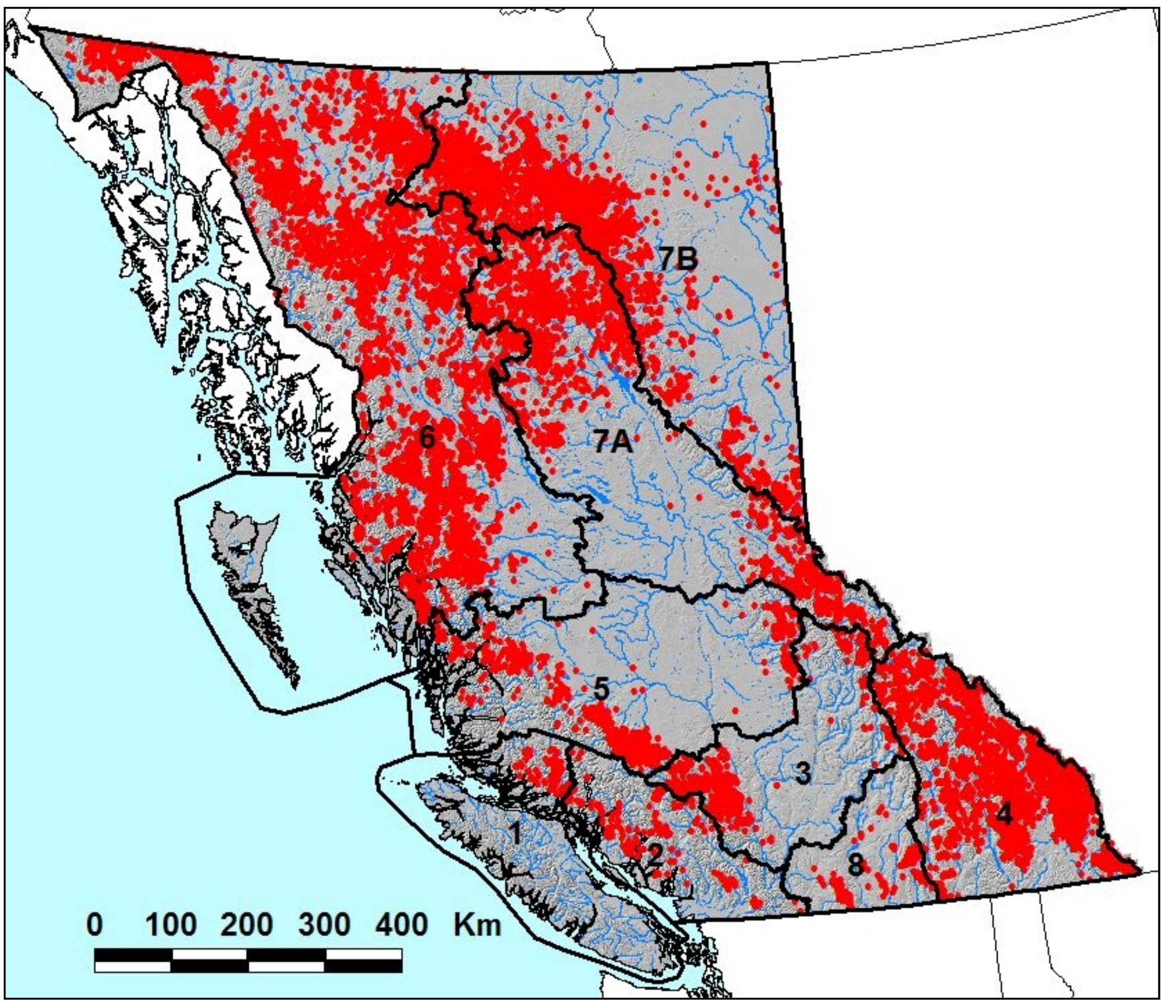

Figure 5. Map depicting compulsory inspection harvest data (red dots) for British Columbia, 1976 to 2008 (*n* = 28,533 records). MoE regions: 1 Vancouver Island; 2 Lower Mainland; 3 Thompson; 4 Kootenay; 5 Cariboo; 6 Skeena; 7A Omineca; 7B Peace; 8 Okanagan.

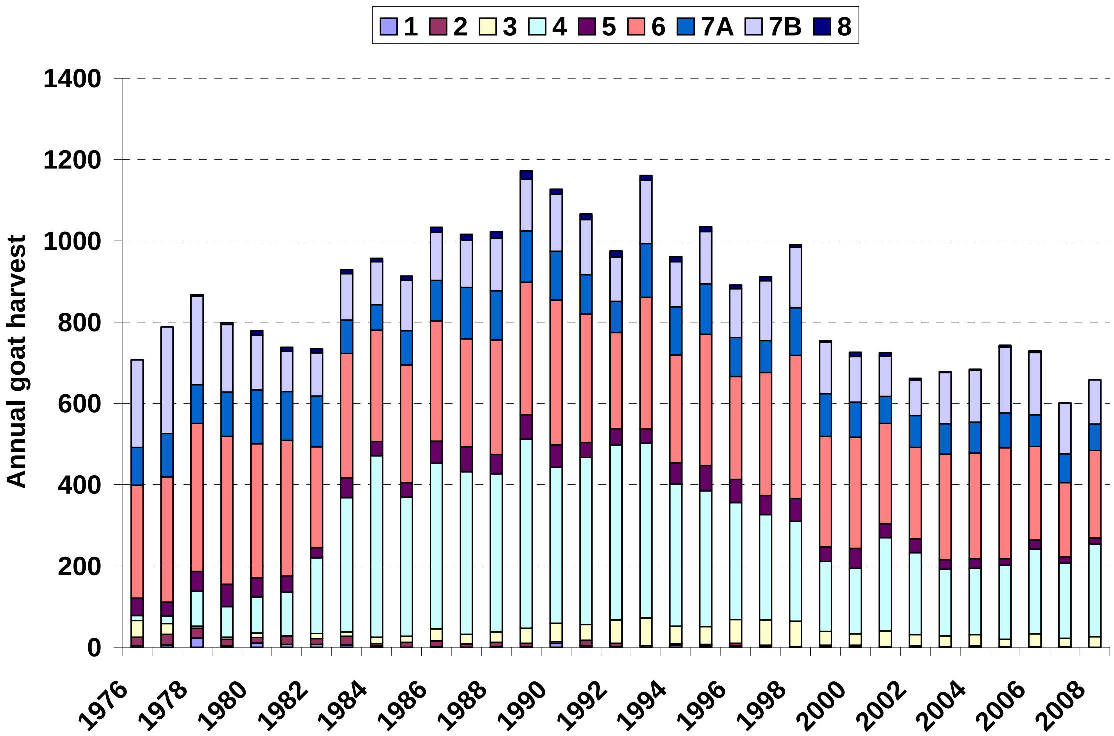

Figure 6. Annual mountain goat harvest by MoE region, 1976 to 2008. Data from compulsory inspection reports. MoE regions: 1 Vancouver Island; 2 Lower Mainland; 3 Thompson; 4 Kootenay; 5 Cariboo; 6 Skeena; 7A Omineca; 7B Peace; 8 Okanagan.

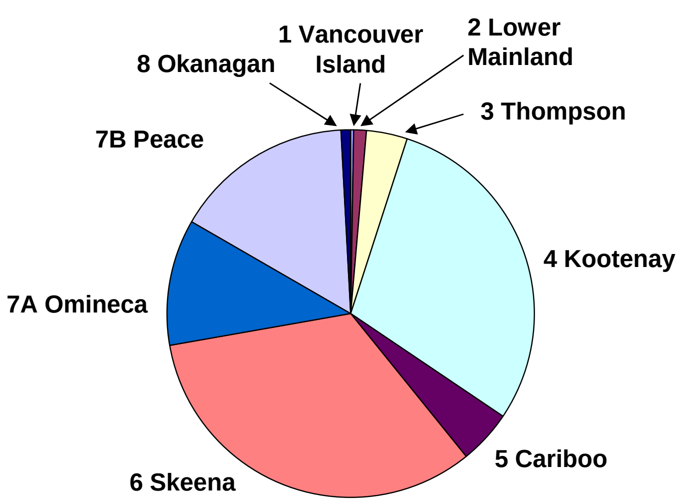

Figure 7. Division of mountain goat harvest among MoE regions of British Columbia, 1976 to 2008. Data from compulsory inspection reports.

Table 5. Proportion of British Columbia mountain goat harvest by residents and non-residents by 5-year period, 1979 to 2008.

Time period	Residents (%)	Non-residents
1979–1983	54.3	45.7
1984–1988	57.0	43.0
1989–1993	57.6	42.4
1994–1998	53.3	46.7
1999–2003	45.9	54.1
2004–2008	42.9	56.5

Table 6. Proportion (%) of mountain goat harvest between residents and non-residents in British Columbia, 1999 to 2008.

MoE region	% Resident harvest	% Non-resident harvest	Total number harvested
1 Vancouver Island	100	0	5
2 Lower Mainland	89	11	18
3 Thompson	55	45	280
4 Kootenay	66	34	1896
5 Cariboo	47	53	268
6 Skeena	41	59	2439
7A Omineca	20	80	785
7B Peace	32	68	1227
8 Okanagan	49	51	41

Proportion of females in the harvest

The proportion of female mountain goats in the harvest has averaged 30% province-wide since 1976; however, the trend indicates a significant decline over time (Figure 8). In the most recent 5 years of data, the proportion of females in the overall provincial harvest averaged 20%. On average, the proportion of females in the harvest has declined 6% per decade in absolute terms since 1976. Non-residents typically harvest 9–15% fewer females in their harvest than residents (Table 7). Increased hunter education and heightened awareness of the importance of sex identification during hunts likely resulted in this decline.[40], [41] The proportion of females in recent harvest is 39% in Alberta (Smith and Hobson 2008) and 28% in Idaho (Toweill 2008).

The proportion of females in the harvest varied among regions (Table 8). Since the late 1970s, the Skeena, Omineca, and Peace Regions have consistently had the lowest proportion of females in the harvest, in part because of the higher non-resident harvest. During the latest 5-year period (2004–2008), the Kootenay, Skeena, and Peace Regions had the lowest proportion of females in the harvest (Okanagan was also low, but the sample size was only 12 animals).

[40] Poole, 2006.

[41] Poole, K.G. 2007a. A population review of mountain goats in the Thompson Region. Unpublished report for B.C. Ministry of Environment, Kamloops, BC.

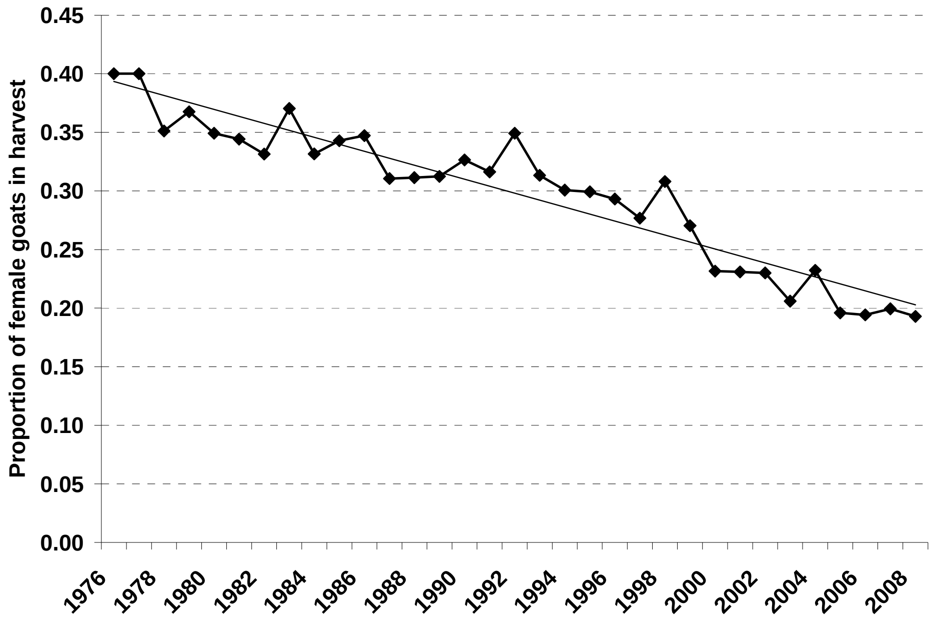

Figure 8. Proportion of female mountain goats in the total harvest in British Columbia from 1976 to 2008. Linear regression: $y = 12.172–0.006x$, $r^2 = 0.89$, $P < 0.001$.

Table 7. Proportion (%) of female mountain goats in resident and non-resident harvests averaged over 5-year periods, British Columbia, 1979 to 2008.

Time period	% female mountain goat harvest by residents	% female mountain goat harvest by non-residents	Total % female harvest
1979–1983	40	30	35
1984–1988	39	25	33
1989–1993	39	24	32
1994–1998	36	22	29
1999–2003	28	19	23
2004–2008	26	16	20

Since 1976 the mean age of male and female mountain goats harvested in British Columbia has averaged 5.3 and 5.7 years, respectively. Mean age has fluctuated over time, and for males has remained relatively stable over the past 10 years, while mean age of harvested females has fluctuated more widely since about 2000 (Figure 9). During the past 10 years, mean age of mountain goats harvested by non-residents was higher than mean age of animals harvested by residents for both females (5.9 and 5.6 years, respectively) and males (5.6 and 5.3 years, respectively). Declining harvests (Figure 6) coupled with declines in the proportion of females in the harvest (Figure 8) have lead to fewer females being killed, especially since the late 1990s.

Table 8. Proportion (%) of female mountain goats in regional harvests averaged over 5-year periods, British Columbia, 1979 to 2008.

	Region								
Time period	**1**	**2**	**3**	**4**	**5**	**6**	**7A**	**7B**	**8**
1979–1983	47%	54%	44%	34%	34%	36%	35%	33%	30%
1984–1988	0%	53%	41%	37%	34%	29%	29%	29%	39%
1989–1993	20%	42%	38%	37%	33%	30%	28%	23%	27%
1994–1998	43%	44%	36%	34%	31%	25%	28%	22%	40%
1999–2003	40%	40%	31%	25%	35%	22%	24%	18%	31%
2004–2008	-	38%	28%	20%	31%	17%	26%	19%	17%
Total	35%	50%	36%	33%	33%	27%	29%	25%	33%

Note that sample sizes were < 15 animals during 2004–2008 in regions 1 (0 goats), 2 (8), and 8 (12). MoE

Regions: 1 Vancouver Island; 2 Lower Mainland; 3 Thompson; 4 Kootenay; 5 Cariboo; 6 Skeena; 7A Omineca; 7B Peace; 8 Okanagan.

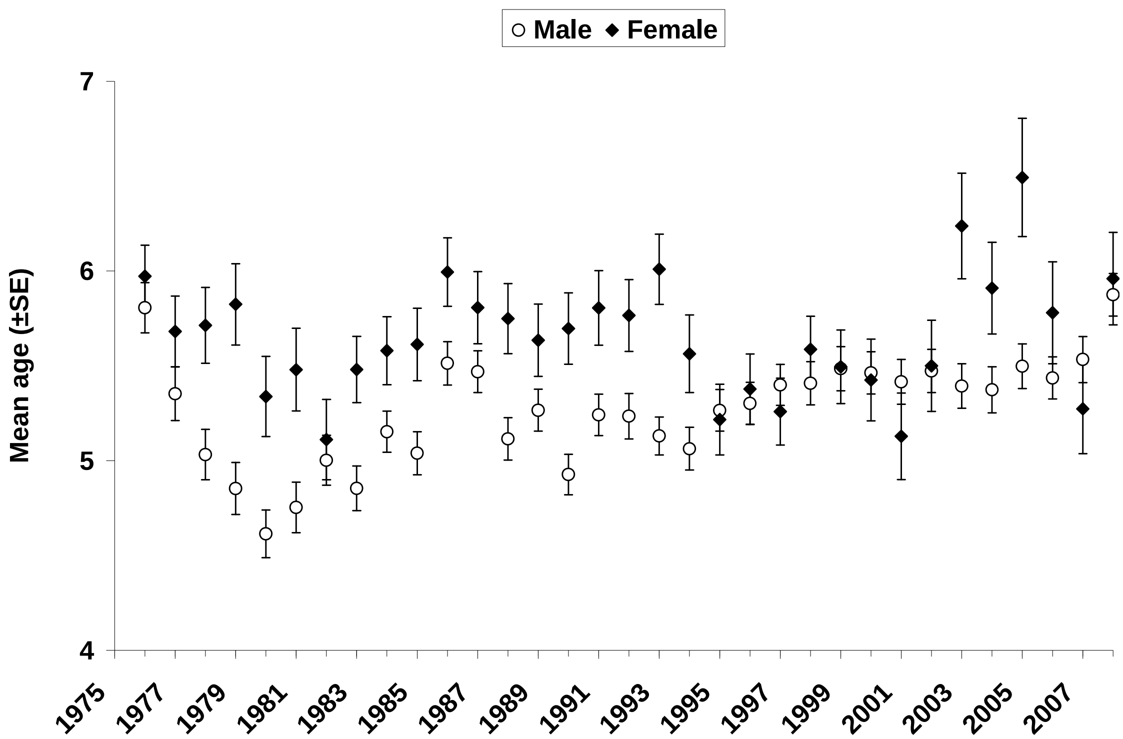

Figure 9. Mean age of female and male mountain goats harvested in British Columbia, 1976–2008.

The distribution of age of harvested mountain goats (based on counting annuli) between 1999 and 2008 was concentrated in the 3- to 6-year-old age categories, with an earlier peak for males than females (Figure 10). Mountain goats ≥ 8 years of age comprised 24% of the female harvest, and 21% of the male harvest.

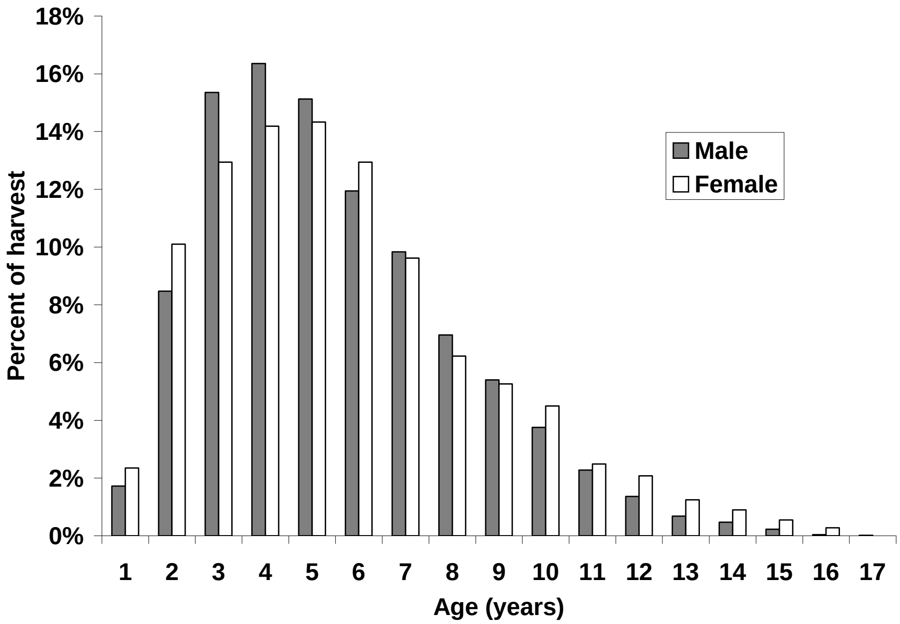

Figure 10. Distribution of age of harvested male (n = 5276) and female (n = 1445) mountain goats, British Columbia, 1999–2008. Note that aging from horn annuli beyond 8 years of age is not reliable (S. Côté, pers. comm. 2010).

Number of active hunters, hunter success

An active hunter is defined as someone who buys a licence and hunts mountain goats, whether successful or not, and is determined from hunter questionnaires and guide outfitter declarations. The number of active resident mountain goat hunters in the province peaked in the mid-1990s at about 1900 hunters, and declined to approximately 1100–1300 hunters in recent years (Figure 11). Note that this is far lower than the number of LEH authorizations available. For example, in the Kootenay region resident hunters actively hunted on 50–55% of LEH authorizations during the mid-1980s to mid-1990s, but only 25–35% since the late 1990s. The number of non-resident hunters within the province has remained relatively constant over time, generally in the 600–650 range, although this number was slightly lower in 2007 and 2008 (Figure 11). Non-resident hunter numbers would presumably closely mirror the number of mountain goat licences allocated to guide outfitters, but may be affected by the global economy (less discretionary income during hard times).

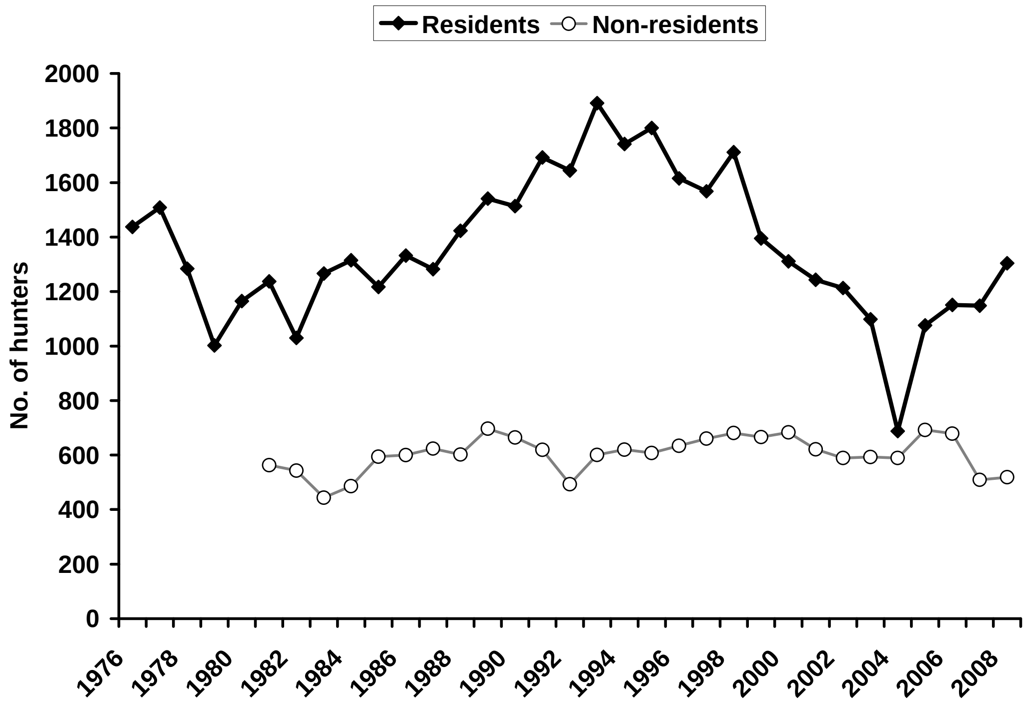

Figure 11. Number of active resident and non-resident mountain goat hunters in British Columbia, 1976–2008.

Mean number of days each active hunter actually hunted mountain goats has remained relatively stable for residents and non-residents since the mid-1970s and mid-1980s, respectively (Figure 12). Between 2004 and 2008, active resident and non-resident mountain goat hunters hunted an average of 5.0 and 5.4 days, respectively.

Resident hunter success (defined here as kills per active hunter) declined between the early 1980s and the late 1990s, and subsequently stabilized, averaging 23–28% for most of the past 10 years (Figure 13). Non-resident hunter success appears to have declined from the early 1990s to 2000, and averaged 63% between 2004 and 2008.

The mean number of kills per 100 days spent hunting for residents declined from the mid-1980s and tended to stabilize around the year 2000. For non-residents, number of kills per 100 days also decreased slowly from the mid-1990s through to year 2000, and has trended up in the past 5 years (Figure 14). Non-residents were more successful than residents at harvesting mountain goats; from 2004 to 2008, kills per 100 hunter days averaged 5.8 and 11.6 for residents and non-residents, respectively.

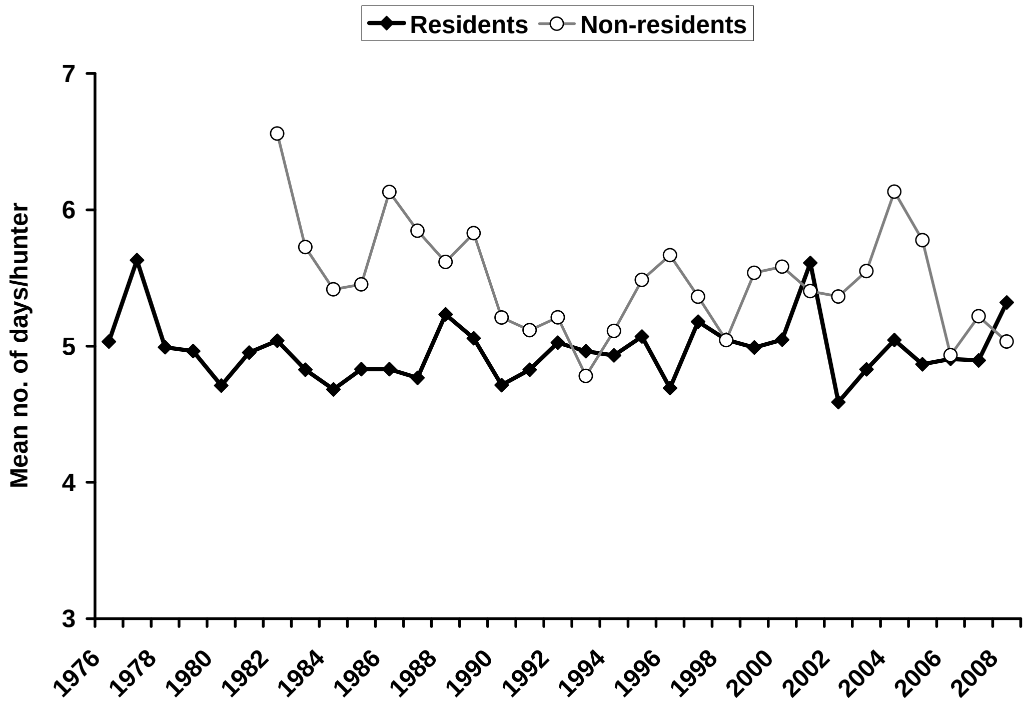

Figure 12. Mean number of days per active resident and non-resident mountain goat hunter in British Columbia, 1976–2008.

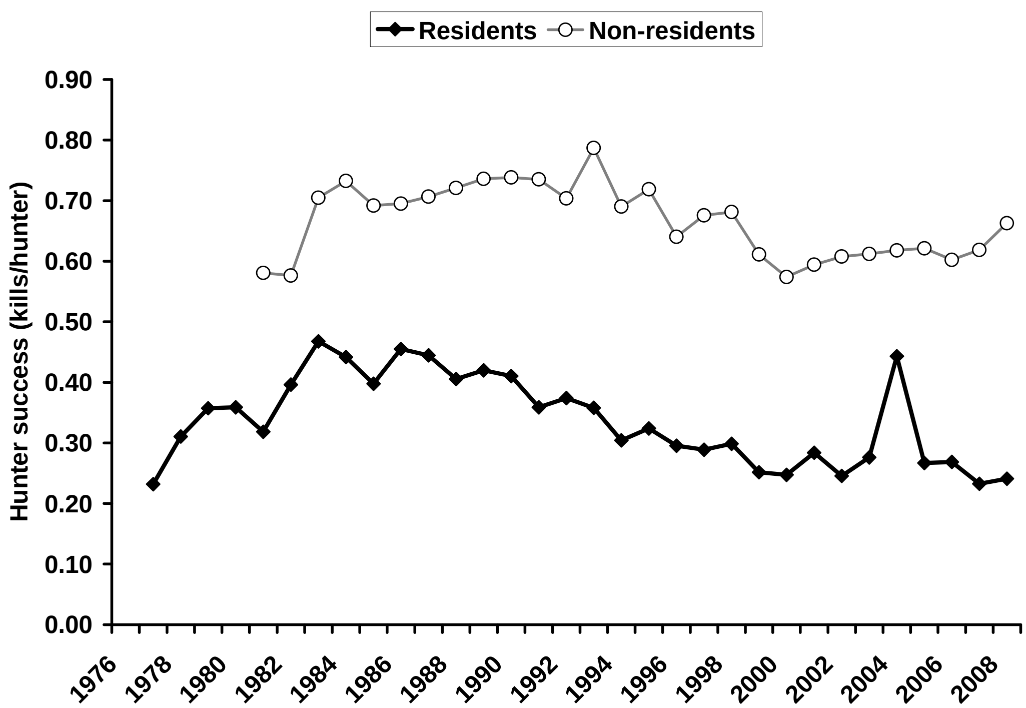

Figure 13. Resident and non-resident mountain goat hunter success (kills per active hunter) in British Columbia, 1976–2008.

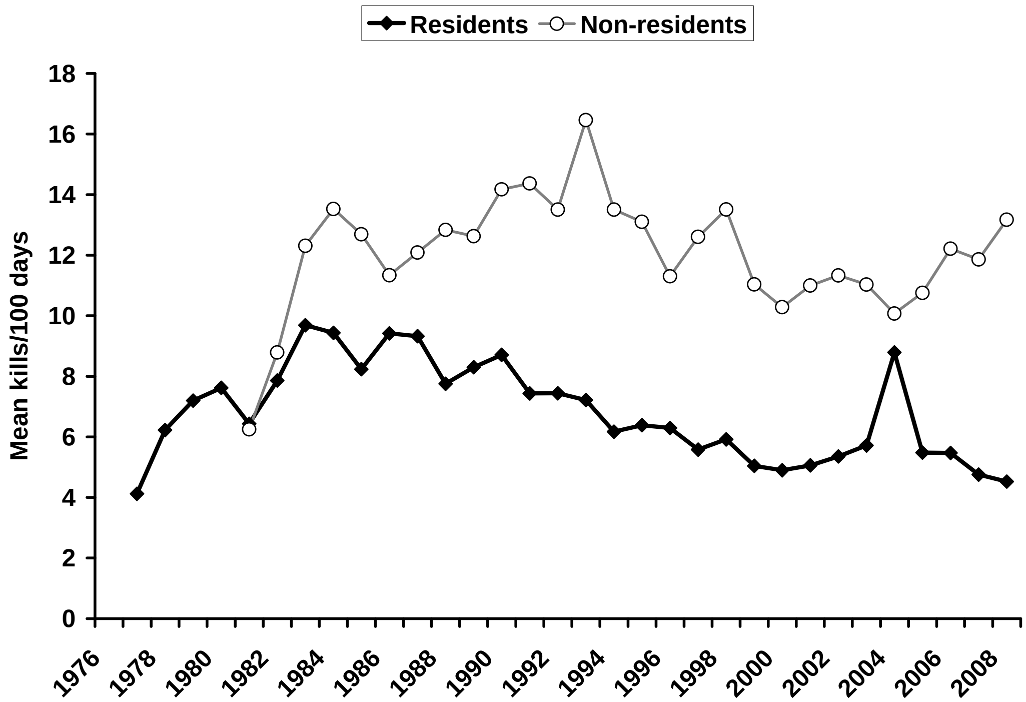

Figure 14. Mean number of kills per 100 days hunting effort for resident and non-resident mountain goat hunters in British Columbia, 1976–2008.

Harvest rate

Harvest rates can be calculated in different ways. In British Columbia, the harvest rate is defined as the harvest (estimated or known) divided by the population estimate for the area in question. All animals, including kids, are used to derive the population estimate. There is greater likelihood of inaccurate estimates of the denominator in this equation (poor population estimates), which may contribute to incorrect harvest rates. Tracking of the non-kid ("adult") portion in population trend analyses would likely reduce the inherent variance compared with total population numbers.[42]

Average annual harvest rates calculated for the 2001–2005 hunting seasons for the Kootenay and Thompson Regions were 2.2% and 1.0%, respectively.[43] Both areas showed a steady decline in harvest rate from the late 1980s (4.7% and 1.9%, respectively), although this may have been a result of both declining harvest and increasing population estimates. However, regional versus local scale issues may confound reporting of harvest rates, as local overharvest may not be identified in regional summaries. Most regions lack precise enough regional population estimates, resulting in actual harvest rates available only for local areas.

3.2.3 Population inventory

Large portions of British Columbia have been inventoried for mountain goats over the past three decades (Figure 15). However, many of the surveys have only occurred once and are dated,

[42] Poole, 2006.
[43] Poole, 2006, 2007a.

especially in the northern half of the province, resulting in a poor understanding of population trends and changes to distribution.

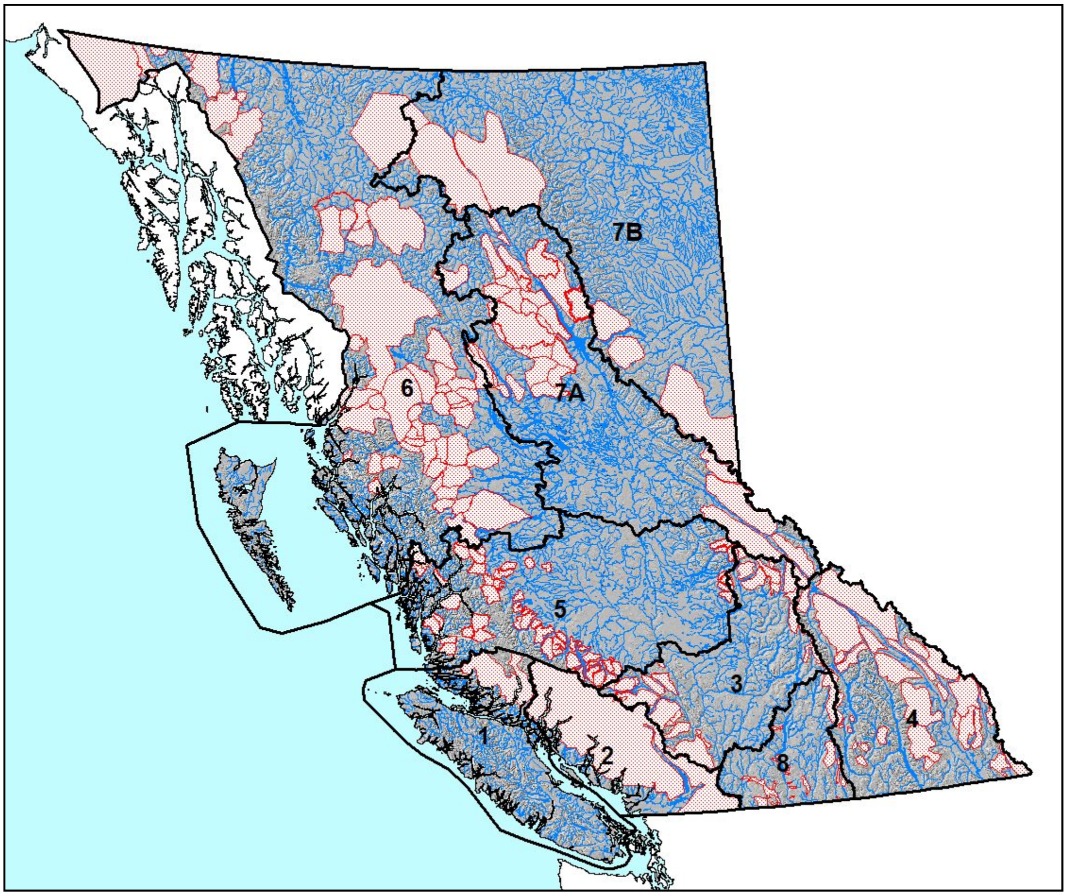

Figure 15. Areas surveyed for mountain goats in British Columbia since the early 1970s. Regions: 1 Vancouver Island; 2 Lower Mainland; 3 Thompson; 4 Kootenay; 5 Cariboo; 6 Skeena; 7A Omineca; 7B Peace; 8 Okanagan.

In most areas of British Columbia, aerial surveys are used to inventory mountain goats within selected study areas (RISC 2002; Poole 2007b). Although fixed-wing aircraft are used in Alaska, aerial surveys within British Columbia and other jurisdictions utilize helicopters. Total counts are generally used, as other techniques are less developed or provide wide confidence limits (Poole 2007b). Reliable mark-resight techniques have not been well tested and tend to produce wide confidence limits (Smith and Bovee 1984; Cichowski *et al.* 1994; Poole *et al.* 2000; Pauley and Crenshaw 2006; Schulze *et al.* 2008). Regression-based sightability models have only recently been developed for mountain goats (Poole 2007b; Rice *et al.* 2009), where group size, terrain obstructions, and vegetation cover are principal factors affecting sightability.

Surveys in most areas of British Columbia are conducted during mid-July to September, consistent with most other jurisdictions (Toweill *et al.* 2004). Surveys in the Vancouver Island and Okanagan Regions are often conducted during winter (B. Harris, pers. comm. 2009; K. Brunt, pers. comm. 2009). During mid-summer through early fall most mountain goat populations are at high elevation (above treeline), enhancing sightability. In interior populations, variable portions of the population may use low-elevation mineral licks to a greater extent before mid-July, reducing visibility in forested habitats.

Survey techniques generally involve flying contours within potential mountain goat range, counting and recording all mountain goat locations using a Global Position System. Correction to account for animals presumed missed during the survey is generally applied afterward (see below), unless a study-specific correction is obtained or sightability model is used. Mountain goats are often classified only into kids and non-kid (yearlings and older) based on body size (B.L. Smith 1988) to reduce survey time, to minimize harassment (Côté 1996), and because researchers familiar with classification from aircraft agree more detailed age and sex classification is not reliable (Houston *et al.* 1986; Stevens and Houston 1989; Gonzalez-Voyer *et al.* 2001). Most other jurisdictions in North America obtain kid to non-kid ratios during aerial surveys, although a number use ground surveys for more detailed classification data (Toweill *et al.* 2004). Aerial counts of mountain goats have limited precision, but standardized surveys can be used as indicators of broad population trends over time (Gonzalez-Voyer *et al.* 2001; Poole 2007b). However, management agencies still require estimates of population size, which are typically based on infrequent surveys (every 5–10 yr).

The ratio of kids to adult females can be used as a rough index to reproductive success of a population. Differences in timing of the surveys and definition of an adult female can lead to variation in this index. Also, due to the difficulty of accurately identifying sex and age classes of mountain goats during aerial surveys, managers often use the ratio of kids to older animals (≥ 1 year of age) as an index to reproductive success (Glasgow *et al.* 2003). Regardless of ratio used, sex/age ratios are poor predictors of recruitment or of population change (McCullough 1994), because of errors in classification, overwinter survival of juveniles is highly variable (Gaillard *et al.* 2000), and true recruitment into the reproductive, adult population may not occur until age 3 or 4.

Ground counts can be more precise than aerial surveys, but are logistically difficult to conduct in large, remote areas (B.L. Smith 1988). From the ground and with an experienced observer, kids, yearlings, 2-year-old males and females, and adult males and females can be classified.

Research is being conducted in the province to determine the feasibility of population estimates derived from identification of individuals using DNA obtained from collected scat and hair samples (Poole and Reynolds, in prep.). Such methodology may be appropriate where mountain goats are difficult to observe and aerial sightability is low, where populations are small, or as a comparison with aerial survey-derived estimates.

Reliable trend data over time can also be provided by hunters with long familiarity with a given area or population. Scandinavian research suggests that hunter observations can be a useful tool for estimating long-term population trends in moose (Solberg and Sæther 1999; Sylvén 2000; Rönnegård *et al.* 2008).

Sightability

Portions of the animals in an area are not observed during aerial surveys. For example, out of 100 mountain goats in a surveyed area, perhaps only 65 will be seen. To provide a more accurate estimate of the number of animals present, an adjustment for sightability is often applied to the number seen. The average sightability during mountain goat surveys for interior populations are 60–70% (Gonzalez-Voyer *et al.* 2001; Poole 2007b). Rice *et al.* (2009) modeled 85% sightability for an interior population in Washington, but lower sightability is assumed for most coastal populations (46%: Smith and Bovee 1984; Alaska 45–65%: K. White, pers. comm. 2008). For south coastal British Columbia, aerial sightability values of 15–25% were estimated based on mark-recapture techniques using radio-collared animals (K. Brunt, pers. comm. 2009).

Calculation of density within the census zone of potential mountain goat habitat
Density of mountain goats observed on summer range may be a useful metric of population health or ecosystem capacity. Demarchi *et al.* (2000) used this to calculate the density in the census zones in west-central British Columbia (~70 goats/100 km^2; no correction for sightability). For south-coastal British Columbia, densities of 30–65 goats/100 km^2 of potential mountain goat habitat were estimated based on mark-recapture techniques using radio-collared animals (K. Brunt, pers. comm. 2009). Recent surveys within adjacent areas of the Rocky Mountains (~170 goats/100 km^2) and Purcell Mountains (~70 goats/100 km^2) (all corrected for sightability) have generated similar mountain goat densities within broad areas.[44] These consistencies lend support for an ecological basis for mountain goat densities, possibly related to broad habitat carrying capacity or similar density-independent factors in operation (e.g., weather), and could lead to the ability to model and extrapolate density estimates to other areas.

Survey reporting
Reports on mountain goat surveys conducted within British Columbia should provide sufficient detail to allow others to compare data among areas and over time. These details include time on survey (to calculate survey effort), area of potential mountain goat habitat surveyed (to calculate survey effort and density), and age/sex breakdown of sightings (as appropriate).

4.0 MANAGEMENT

4.1 Management Goal

The management goal for mountain goats is to maintain viable, healthy and productive populations of mountain goats throughout their native range in British Columbia.

4.2 Rationale for the Management Goal

This management goal has been set to prevent mountain goats from becoming at risk in British Columbia (Goal 2 of the Conservation Framework; B.C. Ministry of Environment 2009).

4.3 Management Objectives

1. To effectively maintain suitable, connected mountain goat habitat.
2. To mitigate threats to mountain goats.

[44] Poole 2006.

3. To ensure opportunities for non-consumptive and consumptive use of mountain goats are sustainable.

4.4 Recommended Management Actions

Our approach to mountain goat management in British Columbia is to provide recommendations that were developed from empirical data based in science. The purpose of this section is to provide scientific recommendations on a provincial scale that could be used by government and stakeholders for policy development and implementation of management actions for mountain goats. However, in areas where the science is unclear or lacking, we followed a precautionary approach to recommendations, including consideration of recommendations from other jurisdictions.

A summary table of recommended actions for mountain goat management in British Columbia can be found in Appendix C. This table groups actions by the management objective they help to achieve and indicates within which Conservation Framework Action Group each of the actions belongs. The table also notes what threats or concerns each action helps to address. Details about these recommended actions on habitat, population/harvest, disturbance and access management is found in the following text.

Please note that specific recommendations apply consistently to all industries within the province and all recommended actions are not listed in any order of priority.

4.4.1 Habitat management recommendations

Issues and information relevant to mountain goat habitat management are summarized here:

- Escape terrain is the key habitat feature required by mountain goats to avoid predators; escape terrain usually means cliffs or cliff complexes, but can include forest cover, particularly when associated with cliff habitat or in mountain goats associated with river/canyon situations;
- Winter is the most critical season for mountain goats, generally characterized by restricted movements and habitat availability;
- The importance of snow interception habitat to mountain goats during winter differs among areas of the province, with the greatest requirement in coastal and interior wet-belt areas;
- Mineral lick use is high in interior populations, but appears less important to coastal populations;
- The influence of habitat change (i.e., succession, forest encroachment, wildfires, human development) on habitat productivity and carrying capacity is poorly known;
- Connectivity of habitat is important, especially among river goat populations, and between important habitats such as cliff complexes and mineral licks; and
- Climate change may have a direct impact on habitats occupied by mountain goats (and hence mountain goats) through increased temperatures, changes in precipitation—both with influences on forage quality and quantity and parasite life cycles, and greater

variability in extreme weather events, and indirectly through changes in alpine and other mesic south-facing cliff habitat.

Specific recommendations:

1. **Review, update, and validate/refine habitat suitability modelling:** Habitat capability and suitability models have been developed for some mountain goat populations in British Columbia (e.g., Heinemeyer *et al.* 2003; Keim 2004; Turney 2004; McNay *et al.* 2006; Taylor *et al.* 2006; Poole *et al.* 2009). Many of these models use different techniques and methodologies, and most have limited field-testing and verification.
   - Current habitat models should be reviewed for utility to determine which are the most useful within a particular ecosystem, their feasibility, and the most suitable approach to modelling within an area and on a province-wide scale to encompass all mountain goat range. Inventories should be conducted to validate models and confirm mountain goat occupation. Models should be standardized within an area, but may need adapting to fit certain regions.
   - Innovative GIS techniques such as use of solar incidence modelling (Kumar *et al.* 1997), or terrain ruggedness (Poole *et al.* 2009) should be considered to update regional habitat capability and suitability models for mountain goats within all regions of the province.
   - Suitability modelling should include a measure of connectivity.
   - Site-specific habitat assessments should be conducted where appropriate (e.g., where modelling results prove to be inaccurate, in localized areas).

2. **Inventory habitat used by mountain goats:** Inventory of important mountain goat habitats across the province is incomplete. These important habitats include kidding/early rearing and winter ranges (Keim 2004; Turney 2004; McNay *et al.* 2006; Poole *et al.* 2009, 2010), as well as key habitat components such as mineral licks and trails (Ayotte *et al*. 2008.).[45] Traditional trails often lead into lick complexes, or are used to connect suitable habitat and sub-populations of goats.
   - Important mountain goat habitat should be identified, especially for kidding/early rearing and winter ranges, and for mineral licks and trails. This should ensure an adequate level of habitat inventory across the province, and may take the form of habitat inventories (as opposed to population inventories), such as modelling, aerial inventory, and radio-telemetry. Once identified, important habitat for mountain goats must be more formally included in resource use decisions.
   - Local knowledge should be used to assist in the identification of mountain goat habitat. Consider partnering with First Nations, guide outfitters or others to identify licks or trails in poorly-known areas.
   - Focus should be on important habitats where the disturbance risk is relatively greater (e.g., merchantable forest, oil and gas areas, mineral tenures, recreation tenures, and areas with developed access).
   - Important, non-sensitive goat habitat information should be readily available to First Nations, stakeholders, project proponents, and the general public.

[45] Rice, 2009; Corbould *et al.,* 2010.

3. **Identify habitat connectivity:** Most populations of mountain goat undertake seasonal movements (Côté and Festa-Bianchet 2003).[46] Other populations of goats use forest trails to maintain connectivity among groups and among discrete habitat patches.
   - At the landscape level, connectivity of forest cover between occupied habitats should be identified and maintained.

4. **Initiate and apply consistent habitat guidelines for mountain goats:** There is a need for consistent guidelines for management of mountain goat Ungulate Winter Range (UWR), Wildlife Habitat Areas (WHA), and Wildlife Habitat Features (WHF) and for goats as Regionally Important Wildlife (RIW). However, guidelines will likely differ across broad regions. For example, winter range may be more critical in coastal and wet interior areas (e.g., Gordon and Reynolds 2000; Taylor *et al.* 2006; Taylor and Brunt 2007). Mountain goats are usually reluctant to venture more than 400–500 m from escape terrain, often staying even closer to escape terrain during winter (Chadwick 1983; Fox *et al.* 1989; Haynes 1992; Gross *et al.* 2002; Poole and Heard 2003; Taylor *et al.* 2006; Taylor and Brunt 2007)

The following recommendations in Table 9 were developed through expert opinion from Ministry of Environment biologists, technical reports, and peer-reviewed literature. Table 9 is a risk matrix related to physical disturbance of habitat (i.e., vegetation removal) in proximity to important mountain goat habitat. The table relates to areas measured from the edge of important mountain goat habitat where the removal of a significant amount of the vegetation will lead to increased levels of risk to maintaining the effectiveness of these habitats. For example, removing over 25% of the vegetation cover within 350 m of escape terrain may result in a moderate risk that the escape terrain will no longer be effective. The intent is to maintain the effectiveness of these important habitats by preventing blowdown, reducing predation risk, and minimizing edge effects.

Two size classes of UWRs have been included in this table, because the relative risk to habitat effectiveness is considered to be related to the size of the habitat polygon. Larger polygons are considered to be more able to remain effective with adjacent vegetation removal, whereas the effectiveness of smaller habitat polygons is considered to be more sensitive to such alterations.

This table is not meant to conflict with any legal objectives or measures established through orders; legal requirements supersede this management plan.

[46] Rice, 2009.

Table 9. Risk matrix related to physical disturbance of habitat (i.e., vegetation removal) in proximity to important mountain goat habitat.

	Risk of removal of > 25% vegetation cover		
Important habitat	**High risk**	**Moderate risk**	**Low risk**
UWR > 500 ha	< 100 m	100–200 m	> 200 m
UWR < 500 ha	< 200 m	200–500 m	> 500 m
WHA	< 300 m	300–500 m	> 500 m
Escape terrain[a]	< 300 m	300–400 m	> 400 m
WHF licks	< 300 m	300–500 m	> 500 m
Travel corridors[b]	< 100 m	100–300 m	> 300 m

[a] Chadwick 1983; Fox 1983; Schoen and Kirchhoff 1982; Fox *et al.* 1989; Haynes 1992; Gross *et al.* 2002; Poole and Heard 2003; Taylor *et al.* 2006; Taylor and Brunt 2007.
[b] Corbould *et al.* 2010.

The levels of assumed risk predicted here do not reflect impacts that may result from the timing of habitat alteration or the implications of access as a result of the habitat alteration, as described in the relevant sections of this plan.

The relative impact of vegetation removal will also depend on the spatial distribution of such removal. Concentrated vegetation removal adjacent to important habitats may have a disproportionate impact on habitat effectiveness. It is recommended that professional judgment be used in determining the relative impact on mountain goat habitats on a case by case basis when undertaking any vegetation removal adjacent to these areas. Decisions related to development activities should also include landscape-level considerations (e.g., connectivity, disturbance) and the cumulative effects of different land use activities on mountain goat habitat effectiveness.

5. **Apply management tools and mitigation techniques consistently to all development:** Management of important mountain goat habitat and mitigation of potential impacts to this habitat is governed through different legislation for different industries; as a result, management is not consistently applied throughout the province or among development industries. Important habitat that is identified should remain sufficiently effective to maintain function for goats. Mitigation techniques, guidelines, and other management intended to achieve this should be consistently applied to all sources of disturbance.
   - All designations made under the *Forest and Range Practices Act* and the associated General Wildlife Measures should be applied consistently to other activities that might impact mountain goat habitat.
   - Existing habitat management tools should be used to ensure that habitat effectiveness is maintained (e.g., *Forest and Range Practices Act* and *Land Act* tools). Tools should be chosen to address the most likely threat to disturbance.
   - Guidelines to mitigate impacts of development on mountain goats should be based on available information and science, and applied consistently to sources of disturbance.
   - Ministry of Environment should prioritize the review and comment on development proposals in mountain goat habitat, and mitigation of impacts to important mountain goat habitat should be more formally included in resource use decisions.

4.4.2 Population / harvest management recommendations

Issues and information relevant to mountain goat population/harvest management are summarized here:

- Harvest of adult females has a large negative influence on population trend and sustainable harvest;
- Because of less obvious differences in mass and horn size, it is more difficult to identify males and females in the field than other ungulates;
- Hunter education, primarily methods to identify sex in the field and the importance of females to the population, is important in reducing female harvest;
- Resident hunter effort towards mountain goats has declined over the past 10 years, apparently because of fewer hunters, while the number of non-resident hunters has remained relatively constant over time;
- Compulsory inspection reporting and the Big Game Harvest Questionnaire appear to effectively track the harvest and hunter effort;
- Inventory across the broad range of mountain goat distribution in British Columbia is costly and difficult to conduct;
- Distribution of mountain goats may be declining along portions of the southern distribution in the province;
- There is weak evidence of density dependence in native mountain goat populations, but it appears to occur in introduced populations; and
- Sustainable harvest rates of native populations of mountain goats are low, likely in the 0–4% range, and are influenced by population size and proportion of females in the harvest.

Specific recommendations

1. **Do not harvest populations with less than 50 adults:** Modelling by Hamel *et al.* (2006) concluded that even without hunting, mountain goat populations in Alberta comprised of 25 individuals have, on average, a 50% chance of extirpation within 40 years; the risk of extirpation for 50 animals is two-thirds lower. This has led to a recommendation that mountain goat populations with fewer than 50 animals should not be hunted (Glasgow *et al.* 2003; Hamel *et al.* 2006; McDonough and Selinger 2008), a conclusion supported by modelling by Hatter (2005). Washington recently increased this minimum from 50 to 100 (Washington Department of Fish and Wildlife 2008; Rice and Gay 2010). Toweill *et al.* (2004) recommended hunting only populations with > 50 adults (not individuals), but provided no basis for this recommendation. However, removal of kids from the calculation of population size for harvest would add a measure of conservatism to the figure and reduce among-year variance in population size, since kid survival is lower and more variable than adult survival (Festa-Bianchet and Côté 2008).
   - Unless new research, monitoring, or other information suggests otherwise, populations in British Columbia of less than an estimated 50 adult (non-kid) mountain goats should not be hunted.
   - All hunted populations of an estimated 50–100 adults should be monitored at least every 3 years to ensure sustainable harvest.
   - Small, accessible herds should be monitored for signs of overharvest using site-specific compulsory inspection harvest data and more frequent surveys.

- Before implementing or re-opening a hunting season within a managed unit, the population estimate for that unit should be > 50 adults, and should be based on inventory data.

2. **Set harvest rate based on estimated population size:** Evidence, primarily from western Alberta, suggests that native populations of mountain goats cannot sustain more than 1–3% harvest rate (based on total estimated population size and assuming a harvest focussed on adult males) (Côté and Festa-Bianchet 2003; Glasgow *et al.* 2003; Gonzalez-Voyer *et al.* 2003). Modelling conducted by Hatter (2005) suggested a sliding scale of higher sustainable harvest rates with larger population size. While most jurisdictions attain a harvest rate of < 2%, many aim for a higher harvest rate (up to 4–5%), in large part because of built-in conservative estimates of population size (often total count, not estimates, are used; McDonough and Selinger 2008), a mandated focus on avoiding female harvest, and frequent monitoring (Toweill *et al.* 2004). Ideal information to monitor population health and to ensure sustainable harvest management of a population of mountain goats would include regular inventories with sightability correction, accurate harvest data that include sex and age, hunter effort and success information, detailed composition data, and indications of trends in potential predators. Less data available should result in more conservative objectives for harvest. At a minimum, harvest data and hunter effort and success need to be monitored population by population to identify populations where the harvest may not be sustainable.
   - The British Columbia harvest rate should be a maximum of 3% of total estimated population size, following current recommendations to allow for reduced harvest rates (< 1–2%) for smaller populations, those with more accessible, disturbed, and/or heavily harvested segments of the population, or those with a greater proportion of females in the harvest (Table 4).
   - Following the precautionary principle harvest rates should be reduced by 1–2% to a more conservative rate if inventory data are dated if it is not possible to conduct inventories every 5–6 years, if hunter data suggest reduced hunter success, if increased females are in the harvest, or if there is uncertainty with the estimate (Table 4; Hatter 2005).
   - Isolated populations should be managed more conservatively than those that have good connectivity with adjacent populations.

3. **Base harvest rate on the managed unit:** Management of mountain goats must occur at a scale that is appropriate. Identification of distinct mountain goat populations is essential, otherwise overharvest may occur on easily accessible herds within a management unit (Festa-Bianchet and Côté 2008). It is often difficult to identify discrete populations in areas of continuous, high-elevation habitat. Current examination of mountain goat genetics (A. Shafer *et al.*, University of Alberta, unpublished data 2009) may assist population determination at broader scales and identify genetic variability of populations, but may not be useful at the finer scales required for management. Managers may need to manage on a herd-specific basis using precise geographical boundaries where access is easy (Côté and Festa-Bianchet 2003).
   - In areas of isolated populations with relatively little exchange with adjacent populations, then the isolated population should be considered as the unit of management (mountain goat population unit). By default, if regular (e.g., seasonal) exchange of individuals with adjacent populations is not verified by documented use of trails or marked animals, then

the population should be considered as discrete, with implications to minimum population size and harvest management (see above).

- In areas of more continuous distribution, the unit of management can be set in a manner that gives primary consideration to access (i.e., herd vulnerability), and population estimates.
- Where harvest is concentrated on an accessible herd or area within a larger population, the area should be considered as a management unit and managed accordingly.
- Some managed units with no harvest should be considered, which can be used to encourage viewing and public education, and as benchmark populations for conservation and scientific interest.

4. **Minimize female harvest:** Evidence suggests that a high proportion of females in the harvest can have implications to population viability and sustained yields, which becomes more acute with smaller populations (K.G. Smith 1988; Hatter 2005; Hamel *et al.* 2006; Festa-Bianchet and Côté 2008). Modelling suggests sustainable harvest rates decline when females comprise > 30% of the harvest for large populations, or > 25% for smaller populations (Hatter 2005). Although the female harvest in British Columbia has declined in the past three decades (Figure 8), there are still areas of high female harvest. Alberta used a double-quota system where if more than one-third of the harvest within a management unit is females, the season may be closed for one or more years to allow the population to recover (Glasgow *et al.* 2003). Alaska uses a point system of mountain goat management that essentially restricts (penalizes) harvest within a management unit if females are harvested (McDonough and Selinger 2008; K. White, pers. comm. 2008). Other jurisdictions do not permit harvest from larger groups or adults accompanied by kids (Toweill *et al.* 2004).
   - Effort should be directed towards reducing and eliminating the female harvest to the extent possible. The Ministry of Environment should consider increasing efforts to provide hunter education on sex identification in the field, by providing mandatory training for all hunters and guide outfitters that hunt mountain goats. This might include use of a brochure on sex identification in the field, free distribution of the mountain goat identification DVD currently in place (Duncan Gilchrist Productions), and use of web-based resources for sex identification.
   - British Columbia should consider implementing a weighted harvest system where the allowable harvest is influenced by the sex of animal being harvested. In this system, the harvest would be reduced for that managed unit if > 20% of the annual allowable harvest or > 30% of the actual harvest is female. In essence, females in the harvest would be assigned a higher weight than males, and under circumstances of excessive female harvest methods to reduce the female harvest should be adopted. Smaller populations with high female harvest should be treated with more aggressive management.
   - Ministry of Environment should consider the following regulation: it is unlawful to kill a female mountain goat accompanied by a kid or a female mountain goat in a group that contains one or more kids.
   - Ministry of Environment should consider consulting with stakeholders on possible ways to minimise harvest of females.

5. **Improve the accuracy of sex identification during compulsory inspections:** Compulsory inspections in British Columbia are primarily conducted by contractors. Currently, only the horns of harvested mountain goats are required for inspection. Determination of sex from the horns of younger animals can occasionally be problematic (B.L. Smith 1988).
   - Ministry of Environment should consider amending the parts required for compulsory inspection of mountain goats to include a positive identification of sex of the harvest animal. These might include a portion of the hide with evidence of sex attached.
   - Ministry of Environment should ensure that compulsory inspection contractors receive adequate training to identify sex of harvested mountain goats.

6. **Conduct adequate inventory to base harvest management decisions:** Parts of British Columbia have dated, poor, or no inventory on mountain goats, especially in some northern and many coastal areas. With the current level of inventory in these areas, the probability of detecting localized loss of mountain goats is low and local goat censuses are needed unless harvest is deemed to have little impact on population numbers. Aerial inventory data are best used as an indicator of population trend (Gonzalez-Voyer *et al.* 2001; Poole 2007b), and as such ideally require repeated surveys to provide meaningful data. Although aerial helicopter surveys are the standard in most areas of the province, they may not be applicable to all areas, especially those where mountain goats spend much of their time in more forested habitats. Ideal survey intensity would vary with the degree of risk managers are willing to accept that a decline (or increase – lost hunting opportunity) would not be detected. A 1- to 3-year survey interval is recommended in Alberta (Glasgow *et al.* 2003), and a 3- to 4-year interval appears to be used in Alaska, with a focus on areas of higher hunting pressure (McDonough and Selinger 2008).
   - Survey methodology should be rigorous and consistent within broad areas of the province. Standardized methodology would enable density calculations within census zones that may be applicable across wide geographic areas.
   - Survey effort should be calculated and survey details well documented, to allow wider temporal and spatial trends to be determined.
   - Ground-based composition surveys may provide more accurate classification data if all components of the population are sampled equally.
   - If resources are not available to provide monitoring at least at 5- to 6-year intervals, then harvest rates should be adjusted to be more conservative.

7. **Caution use of transplants where appropriate:** Transplants of mountain goats have been moderately successful within British Columbia (Table 3), and can be considered as an appropriate tool to be used. The Ministry of Environment has draft transplant (translocation) policy and procedures in place that function as a risk assessment and must be done to reduce the risk to donor and recipient herds (Teixeira *et al.* 2007). Primary considerations include:
   - The cause of the initial decline in numbers needs to be identified and addressed.
   - Where appropriate, transplant should be considered in the following priority: (1) vacant historical ranges that are still capable of supporting mountain goats, (2) augment existing imperilled herds, and (3) supplementation of existing herds that are below their range capacities.
   - Before transplant, a detailed and thorough site selection process is needed that would include historical use, initial reason for decline, forage quality and quantity, escape

terrain, expected population size, interspecific competition, winter conditions, access and connectivity with other populations/ranges (Glasgow *et al.* 2003). A list of potential transplant sites could be developed.

- If possible, health assessments of both donor and recipient (if appropriate) herds, including genetics, should be completed prior to animal movement.
- The potential effects of stress on translocated animals should be fully addressed, as stress (subclinical or the additive or accumulative effect of successive stressors) can cause high levels of mortality in such situations (Teixeira *et al.* 2007).
- Transplanted goats should be monitored post release for at least several years using VHF or GPS collars to determine the short- and long-term survival, causes of mortality, and the relative success of the operation.

4.4.3 Disturbance management recommendations

Issues and information relevant to mountain goat disturbance management are summarized here:

- Mountain goats appear to react to human disturbance, especially helicopters, to a higher degree than most ungulates; and
- There is conflicting data whether mountain goats can habituate to predictable, continuous, non-threatening stimuli; much human disturbance to mountain goats is unpredictable and discontinuous. Intense single disturbances and chronic stress from repeated disturbances can be expected to produce short- and long-term health effects on populations.

Specific recommendations:

1. **Use helicopter disturbance setbacks based on science:** Mountain goats appear to react to human disturbance to a higher degree than most ungulates, and appear to react strongly to helicopters. Recommended distances that helicopters should not approach mountain goats vary. Côté (1996) and Festa-Bianchet and Côté (2008) recommended a 2000-m buffer zone around alpine areas and cliffs known to support mountain goat populations, and that during any infringement on this zone, helicopters should maintain > 300 m above ground level. U.S. Forest Service requires aircraft maintain a 500-m minimum vertical distance from all observed goats (Goldstein *et al.* 2005). Observations in northern British Columbia support the 2000-m buffer with a 600 m height over ground level maintained (Foster and Rahs 1983), or, in Alberta, a 1000-m buffer and restrictions to overflights of > 460 m (Harrison 1999). A literature-based analysis in the Yukon also suggested a 2000-m buffer (Frid 1997). In southern British Columbia, Gordon and Wilson (2004) recommended that helicopter activity < 1500 m from occupied mountain goat habitat be managed to reduce behavioural disruptions. The Northern Wild Sheep and Goat Council (NWSGC) indicated in a position statement that helicopter activity should not occur within 1500 m of occupied/suspected nursery group or crucial winter range habitats during critical periods (Hurley 2004). Critical periods are generally considered to be winter – November 1 to April 30 – and during kidding/early rearing – May 1 to July 15.

In several jurisdictions, straight-line buffer distances from winter range, pre-kidding, kidding, and post-kidding areas are recommended or required for helicopters.[47] Alberta has developed guidelines that only permit industrial activity, ground or air based, within 800 m of identified critical mountain goat (and sheep) ranges between July 1 and August 22 (Alberta Fish and Wildlife Division 2001). This is designed to avoid disturbance during the spring parturition season, land use conflicts with hunters in alpine areas, and stresses on animals during winter. Overflights by both helicopters and fixed-wing aircraft must be > 400 m above alpine terrain within mountain goat and sheep range. No legislation regulates commercial/recreational heli-tourism activity in Alberta, although seasonal and minimum flight distance (1300–2000 m) guidelines are negotiated with local companies (J. Jorgenson, pers. comm. 2009). The Alaska Department of Fish and Game recommends following the NWSGC buffer distance of 1500 m, and federal agencies (U.S. Forest Service and Bureau of Land Management) recommend 1500 ft. (~460 m) (K. White, pers. comm. 2008). Guidelines for backcountry tourism and recreation in British Columbia recommend a minimum 1500 m distance to prevent changes to the behaviour of animals unless an alternate strategy is proposed and some sort of monitoring is conducted (B.C. Ministry of Environment 2006). Recommendations for heli-logging operations near designated mountain goat winter range within British Columbia vary among areas and are often negotiated outcomes (e.g., the Kispiox, Kalum, and Nass Timber Supply Areas specify 2000 m for heli-logging operations during winter; the Fraser Timber Supply Area specifies 500 m for heli-logging and restricts operations to non-winter periods).

In summary, many authors recommend a 2000-m buffer zone around mountain goat habitat (Foster and Rahs 1983; Côté 1996; Frid 1997; Wilson and Shackleton 2001; Festa-Bianchet and Côté 2008), while others recommend a 1500-m buffer (Gordon and Wilson 2004; Hurley 2004; B.C. Ministry of Environment 2006). These buffers are often assigned to occupied/suspected nursery group or crucial winter range habitats during critical periods (Hurley 2004), but are also recommended "around alpine areas and cliffs known to support mountain goat populations" (Côté 1996) and "for all mountain goat habitat" (Festa-Bianchet and Côté 2008). Côté (1996) further suggested that during any infringement on this zone, helicopters should maintain > 300 m above ground level. Other recommendations for vertical separation range from 400 to 600 m (Foster and Rahs 1983; Harrison 1999; Alberta Fish and Wildlife Division 2001; Goldstein *et al.* 2005). The timing of helicopter logging operations (winter versus summer/fall), method (conventional vs. helicopter), or distance (within 2000 m) can also affect disturbance of seasonal mountain goat habitats (Gordon and Wilson 2004).

These specific recommendations[48] apply consistently to all forms of helicopter activity within the province:

- For all areas of British Columbia, 2000 m horizontal distance[49] setback and 400 m vertical separation are recommended from all mountain goat habitat (Foster and Rahs

[47] Wilson and Shackleton, 2001.

[48] These "recommendations" should not be confused with "legal requirements" made under various regulations. In all situations, when proposing activities in or adjacent to mountain goat habitat, people operating in the area must exercise due diligence to understand management objectives.

[49] The horizontal distance recommendation may be reduced where topographic features (e.g., mountains) prevent "line of sight" viewing to the area of mountain goat habitat (e.g., Frid 2003). Reductions may be accomplished through development of mitigation strategies.

1983; Côté 1996; Frid 1997; Wilson and Shackleton 2001; Festa-Bianchet and Côté 2008) and to be applied year round.

- Where any form of helicopter disturbance to mountain goats is an issue and action plans are developed, proponents should include mitigation strategies to address: the timing of operations, intensity, type of helicopter, and duration of helicopter activity when operations may affect mountain goats (i.e., within 2000 m). These action plans should consider using the framework developed by the IUCN for assessing threats to determine conservation actions (B.C. Ministry of Environment 2010).
- If flights < 2000 m horizontal distance or < 400 m vertical separation are necessary within mountain goat habitat, the following mitigation strategies to minimize disturbance should be considered: use of topographic barriers to separate helicopters from mountain goats; keep helicopters below mountain goats if possible; avoid flying directly towards, hovering near, or landing near mountain goats; and minimize the number of flights and time spent within disturbance space (Wilson and Shackleton 2001).
- Although little empirical data are available about the effects of fixed-wing overflights on mountain goats, concerns exist about the amount of disturbance. Until better scientific data are available, as a precautionary approach the restrictions noted above for helicopters should apply equally to fixed-wing aircraft (2000-m horizontal distance setback and 400 m vertical separation; adopt mitigation strategies where appropriate).

2. **Minimize industrial disturbance:** Many types of ground-based resource extraction, including oil and gas activities, and timber and mineral extraction, have the potential to disturb mountain goats. Most of these activities are mechanized in nature and require heavy equipment for sustained periods of time. In most cases ground access to mountain goat habitat is limited, and mountain goats appear to react less strongly to ground-based disturbance compared with aerial disturbance (Côté 1996). Few concrete recommendations to reduce industrial disturbance (other than those directed at aircraft) are provided in the literature, in large part because of a lack of empirical data. Most recommendations pertain to buffer zones (400- to 1600-m range) adjacent to mountain goat habitat, especially during critical periods (winter, kidding/early rearing, and mineral lick use), or suspension of operations within critical mountain goat habitat during winter (1 Nov. – 30 Apr.), and kidding/early rearing and mineral lick use (1 May - 15 July; Haynes 1992; Lemke 1999).

These specific recommendations apply consistently to all forms of industrial activity within the province:

- Maintain a 500-m buffer zone adjacent to important mountain goat habitat (winter range, kidding/early rearing, mineral lick use areas, and connecting trails) during winter and the kidding/early rearing and mineral lick use periods (1 Nov. – 30 Apr., and 1 May – 15 July, respectively), where no logging, wells, pipelines, road building, trail development or other industrial activity takes place (Fox *et al.* 1989; Haynes 1992; Lemke 1999).
- Within canyon-dwelling populations, industrial developments and activities should occur > 2000 m from the canyon rim, or in low-use (marginal) habitats (Foster and Rahs 1985). Access corridors, noise and activity levels should be further controlled during critical winter (1 Nov. – 30 Apr.) and kidding/early rearing (1 May- 15 July) periods.

3. **Minimize recreational disturbance:** Backcountry tourism and recreation can result in disturbance or displacement of mountain goats. Recreation varies from highly mechanized transportation (e.g., snowmobiles, snowcats, and ATVs), to generally less threatening human-power pursuits (e.g., hiking, ski touring, ice-climbing; Varley 1998; Canfield *et al.* 1999). To minimize impacts, British Columbia adopted guidelines to restrict motorized ground-based activities in open areas in relation to large mammals within 500 m line-of-sight, and non-motorized ground-based activities in open areas in relation to large mammals within 100 m line-of-sight (B.C. Ministry of Environment 2006).

These specific recommendations apply consistently to all forms of recreational activity within the province:

- During the designated winter (1 Nov. – 30 Apr.) and kidding/early rearing periods (1 May – 15 July), ground access should be restricted within 500 m of mountain goat habitat by motorized activities (snowcats, snowmobiles, ATVs, etc.), and by 100 m by non-motorized activities (ski touring, ice climbing, etc.) (Lemke 1999; B.C. Ministry of Environment 2006).
- In their review of the effect of recreation on ungulates in Montana, Canfield *et al.* (1999) suggested ways of reducing human disturbance on winter and summer ranges:
    - Route facilities, trails, and/or roads away from mountain goat winter range, kidding/early rearing ranges, and mineral lick areas;
    - Establish and only use designated travel routes to make human use of areas as predictable as possible; and
    - Identify potential conflicts and develop mitigative strategies.

4.4.4 Access Management Recommendations

Issues and information relevant to mountain goat access management are summarized here:

- Progressive increases in access within unroaded drainages are thought partially responsible for historic and, in some cases, current declines in mountain goat populations.
- Resource road development is the main source for industrial and recreational access in the province.

Specific recommendations:

Managing access in and near mountain goat habitat is complex, largely because of the many diverse resource development industries with different government ministries responsible for managing their land use practices. Disturbance and risk to mountain goats can increase as a result of increased access. Issues and recommendations related to disturbance and risk have been previously discussed.

1. **Reduce the amount and persistence of roads in and near mountain goat habitat:** Changes to habitat that facilitate access and disturbance can displace mountain goats from preferred habitats (Pendergast and Bindernagel 1977). For example, forestry development near mountain goat habitat may increase human access, leading to frequent disturbance and subsequently lower use by mountain goats of otherwise suitable habitat (Hengeveld *et al.* 2004). Mountain goats are susceptible to overharvest (Côté and Festa-Bianchet 2003; Hamel

et al. 2006), which is facilitated by increased access. Effects of road-building are mostly indirect because increasing road density is correlated with other human-induced stressors, including disturbance (from the ground), hunting pressure and forest harvesting. Proximity of roads to mountain goat habitat is the most important determinant of hunting pressure; hunters are generally deterred from hunting > 2 km from roads (Hengeveld *et al.* 2004).

- When industrial activity is required within 500 m of mountain goat habitat, all structures including roads should be temporary in design. Roads should be strategically located to facilitate effective removal wherever possible.
- Within 2 years after completion of industrial development activities, all temporary roads or structures adjacent (< 500 m) to mountain goat habitat should be permanently decommissioned (made unusable to off-road vehicles) to restrict vehicular traffic (Haynes 1992; Lemke 1999).
- Where roads could remain in place for an extended period of time, access control measures should be considered.

2. **Consider changes in access in harvest management decisions:** Human access into mountain goat habitat can have implications to population abundance and persistence. Many interior populations and some coastal populations are believed to have declined through the 1960s and early 1970s, in large part due to overharvest resulting from increased access within previously unroaded drainages (Phelps *et al.* 1983). Even now, harvest of mountain goats is generally concentrated in areas of easiest access.
   - Hunting allocations and regulations must be responsive to changes in the degree/ease of access due to land development in a given management unit or population. Harvest management should be reviewed in any cases when access changes within 2 km of mountain goat habitat.
   - Where concerns exist, consider closing access to recreational motor vehicle use into or near mountain goat habitat through the *Wildlife Act*.

3. **Consider the cumulative effects associated with access and integrate access management for all resource and recreational activities:** The potential impact to mountain goats from the recent increase in access through new resource development activities, such as independent power projects, wind power, pipelines, and other large-scale developments, is not well documented. However, these projects almost always require increased primary road access, often with additional development of spur roads and transmission corridors. In combination with other impacts, these projects can be expected to incrementally increase human disturbance. The cumulative effects of such developments on mountain goat habitat viability and disturbance are unclear. In general, there is a relative lack of integrated access management for resource development and recreational activities. Access from both resource development and recreational activities can increase impacts to mountain goat populations.
   - Fully assess mitigation strategies to reduce the impacts of increases in and persistence of access into and near mountain goat habitat associated with resource development activities.
   - Access management should be integrated for all forms of resource development and recreational activities.

- Communication among resource ministries should be improved by early involvement of all affected ministries, to promote a common understanding of all new forms of access into mountain goat habitat (i.e., all resource development activities) and to develop coordinated opportunities for resource managers to recommend potential mitigative measures to decision-makers.
- New tools should be developed and implemented to reduce the amount of new access and recreational use when upgrading existing roads (including temporary forest roads).

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Appendix A. International Union for the Conservation of Nature (IUCN) threat assessment for mountain goats in British Columbia (2009).

Condensed version of the IUCN Threats assessment (Salafsky *et al.* 2008) for mountain goats in British Columbia. A more detailed version has been provided to the B.C. Conservation Data Centre (http://www.elp.gov.bc.ca/cdc/index.html).

Threat[a]		Impact calculated	Scope	Severity	Timing
1	Residential & commercial development	Low	Small	Extreme	High
1.3	Tourism & recreation areas	Low	Small	Extreme	High
2	Agriculture & aquaculture	Low	Small	Slight	High
2.3	Livestock farming & ranching	Low	Small	Slight	High
3	Energy production & mining	Medium	Large	Moderate	High
3.1	Oil & gas drilling	Low	Small	Serious	High
3.2	Mining & quarrying	Low	Restricted	Moderate	High
3.3	Renewable energy	Medium	Restricted	Serious	High
4	Transportation & service corridors	Low	Restricted	Slight	High
4.1	Roads & railroads	Low	Restricted	Slight	High
4.2	Utility & service lines	Low	Restricted	Slight	High
4.4	Flight paths	Low	Small	Unknown	High
5	Biological resource use	Medium	Pervasive	Moderate	High
5.1	Hunting & collecting terrestrial animals	Low	Pervasive	Slight	High
5.3	Logging & wood harvesting	Low	Small	Serious	High
6	Human intrusions & disturbance	Medium	Pervasive	Moderate	High
6.1	Recreational activities	Medium	Pervasive	Moderate	High
6.3	Work & other activities	Low	Large	Slight	High
7	Natural system modifications	Low	Small	Slight	High
7.1	Fire & fire suppression	Low	Restricted	Slight	Negligible
7.2	Dams & water management/use	Low	Small	Slight	High
8	Invasive & other problematic species & genes	Medium	Large	Moderate	High
8.1	Invasive non-native/alien species	Low	Small	Moderate	Moderate
8.2	Problematic native species	Medium	Large	Moderate	High
10	Geological events	Low	Small	Slight	High
10.3	Avalanches/landslides	Low	Small	Slight	High
11	Climate change & severe weather	Low	Pervasive	Slight	Moderate - Low
11.1	Habitat shifting & alteration	Unknown	Unknown	Unknown	Unknown
11.3	Temperature extremes	Low	Pervasive	Slight	Moderate - Low

[a] Classification of Threats adopted from IUCN-CMP (Salafsky *et al.* 2008).

Appendix B. Discussion of boxes and linkages associated with the Conceptual Ecological Mountain Goat Model (Figure 4).

Habitat Features

Natal Range

- May be spatially associated with **winter range**
- **Predation risk** is influenced by location (i.e., typically remote and rugged terrain) and integrity of preferred habitat

Winter Range

- May be spatially associated with **natal range**
- Abundance, distribution and suitability influences **energetic condition** during a critical period (i.e., providing abundant preferred forage, snow conditions that minimize costs associated with mobility)
- **Predation risk** is influenced by location (e.g., elevation, availability of escape terrain), the integrity of preferred habitat, and the state of adjacent non-goat habitat

Early Spring Green-up Habitat

- Important for restoring **energetic condition** after winter
- **Predation risk** is influenced by the location (e.g., elevation, association with escape terrain) and integrity of preferred habitat

Summer-fall Habitat

- Forage availability affects **energetic condition**
- **Predation risk** in summer-fall is influenced by the location (e.g., high elevation, coincidence of suitable forage and escape terrain) and integrity of preferred habitat

Traditional Trails

- Trails allow movement among important habitat features: **natal range, winter range, early spring green-up habitat, summer-fall habitat,** and **mineral licks**
- Movement between habitat features expose mountain goats to **predation risk**, particularly at low elevations
- **Predation risk** along preferred trails is influenced by their location and integrity

Mineral Licks

- Influence **energetic condition** by providing essential minerals
- Location of licks influences the **predation risk** mountain goats are exposed to when in the area
-

Stressors

Fire Suppression

- Forest in-growth can reduce the suitability of **early spring green-up habitat** and **summer-fall habitat** by reducing forage abundance

Resource Extraction

- Industrial forestry and mineral exploration/development can reduce the suitability of **natal range, winter range, early spring green-up habitat, summer-fall habitat, traditional trails,** and **mineral licks**

Winter Severity

- A severe winter can reduce the availability of suitable **winter range**
- Severe winter conditions can affect **energetic condition** by increasing metabolic costs

- April-May snow conditions might be particularly important

Energetic Condition

- Influences vital rates: **adult female survival, kid production, recruitment** and **adult male survival,** and susceptible to **pathogens.**

Disturbance

- Disturbance of mountain goats resulting in displacement from preferred habitats can reduce the effectiveness of **natal ranges, winter range, early spring green-up habitat, summer-fall habitat, traditional trails,** and **mineral licks**
- Disturbance can also affect **energetic condition** by increasing metabolic costs through reduced feeding and ruminating efficiency and increased locomotion
- Disturbance can directly affect **predation risk** by reducing vigilance and increasing exposure to injury

Predation Risk

- Affects vital rates: **adult female survival, recruitment,** and **adult male survival**

Hunting Mortality

- Affects vital rates: **adult female survival** and **adult male survival**
- Includes sport hunting, subsistence hunting, and poaching

Pathogens

- Parasite loads and infectious diseases (viral and bacterial) affect **energetic condition**

Inbreeding Depression

- Created via feedback with vital rates (**adult female survival, kid production, recruitment,** and **adult male survival**) by reducing vigor in small populations

Vital Rates

Adult Female Survival

- Affects **kid production** and contributes to **population size**

Kid Production

- Affects **recruitment** and contributes to **population size**

Recruitment

- Contributes to **population size**

Adult Male Survival

- Adult male abundance can affect **kid production** and contributes to **population size**

Appendix C. Recommended management actions.

Recommended management action	Conservation Framework action group[a]	Threat or concern addressed[b]
Objective 1. To effectively maintain suitable, connected mountain goat habitat		
1. Review, update, and validate/refine habitat suitability modeling	Habitat Protection	Knowledge gap
2. Inventory habitat used by mountain goats	Habitat Protection	Knowledge gap
3. Identify habitat connectivity	Habitat Protection	Knowledge gap 11.2 and 11.3
4. Apply consistent habitat guidelines for mountain goats	Habitat Protection	1 thru 8
5. Apply mitigation techniques consistently to all development	Habitat Restoration	3, 5.3, 6.1, 6.3
Objective 2. To mitigate threats to mountain goats.		
Disturbance Management:		
1. Use helicopter disturbance setbacks based on science	Species & Population Management	3, 5.1, 5.3, 6.1, 6.3
2. Minimize industrial disturbance	Habitat Protection; Habitat Restoration	3, 5.3, 10.3
3. Minimize recreational disturbance	Habitat Protection; Habitat Restoration	6.1
Access Management:		
1. Reduce the amount and persistence of roads in and near mountain goat habitat	Species & Population Management	3, 5.1, 5.3, 6.1, 6.3, 8.2
2. Consider changes in access in harvest management decisions	Review Resource Use	5.1
3. Consider the cumulative effects associated with access and integrate access management for all resource and recreational activities	Habitat Protection; Species & Population Management	3, 5.1, 5.3, 6.1
Objective 3. To ensure opportunities for non-consumptive and consumptive use of mountain goats are sustainable		
1. Do not harvest populations with less than 50 adults	Review Resource Use	5.1
2. Set harvest rate based on estimated population size	Review Resource Use	5.1
3. Base harvest rate on the managed unit	Review Resource Use	5.1
4. Minimize female harvest	Review Resource Use	5.1
5. Improve the accuracy of sex identification during compulsory inspections	Review Resource Use	5.1
6. Conduct adequate inventory to base harvest management decisions	Species & Population Management	Knowledge Gap
7. Caution use of transplants where appropriate	Species & Population Management	5.1

[a] Data source: B.C. Ministry of Environment (2010).
[b] Data source: IUCN threats noted in Appendix A.

Appendix D. Glossary of terms.

Bachelor groups: include only adult males, mostly 3 years and older (Festa-Bianchet and Côté 2008).

Demographic stochasticity: the variability in population growth rates arising from random differences among individuals.

Dispersal: the movement an individual animal makes from its place of birth to the place where it reproduces.

Escape terrain: generally steep slopes usually ≥ 40º or ≥ 84% of shear or broken cliffs where most mammalian predators would be unable to access. Rock is the main substrate for escape terrain, but for populations living along river valleys, steep mud and clay banks often are used.

Extirpated: no longer exists in an area.

Habitat effectiveness: an area's actual ability to support mountain goats given the quality of the habitat and other factors, such as the extent of human disturbance.

Kidding/early rearing areas: the general area where kids are born and spend the first 4–6 weeks post-partum.

Identified mountain goat habitat: areas of mountain goat habitat established under the Government Actions Regulation, including areas described in wildlife habitat features or wildlife habitat areas.

Migration: movement back and forth between seasonal (often summer and winter) home ranges.

Mountain goat habitat: all habitat occupied by mountain goats during any portion of the year, including seasonal ranges (i.e., winter range, summer range, natal areas), traditional travel routes connecting these ranges, and seasonally important habitat features, including mineral licks and traditional trails to licks. Important mountain goat habitat is habitat occupied by mountain goats that has a higher functional importance for survival; includes (but is not limited to) winter range, kidding/early rearing areas, connectivity corridors, and mineral licks.

Natal area: areas used by parturient females to give birth and spend their first few days in isolation, generally between mid-May and mid-June. Natal area can also refer to a general area where a mountain goat was born (in the sense that an emigrant would go from its 'natal area' to somewhere else).

Nursery groups: include females of all ages, kids, and males up to 4 years of age (Festa-Bianchet and Côté 2008).

Parturition (birthing) site: where nannies give birth and spend their first few days in isolation with their young. Also generally known as the kidding area.

Population: a biological unit where it is meaningful to speak of a birth rate, a death rate, a sex ratio and an age structure in describing the properties of the unit (Caughley 1977); a discrete group of potentially interbreeding individuals in a given locality. Distinct populations of mountain goats can be surmised within individual mountain blocks or groups of mountain blocks where regular exchange is known or suspected can be considered to be relatively discrete. But because of difficulties accurately identifying distinct populations of mountain goats within often continuous habitat, we use the term "population" relatively loosely to refer to the managed unit of mountain goats for harvest (which can include no harvest). The term "herd" is generally used synonymously with "population" (Côté and Festa-Bianchet 2003; Festa-Bianchet and Côté 2008).

Precautionary principle: selection of actions that pose low risk to the current and future status of wildlife populations, and taking necessary action despite uncertainties around current conditions and/or outcome.

Sightability correction: acknowledging that animals are invariably missed during surveys, an adjustment for sightability is often applied to the number of mountain goats observed to estimate the total number within the census zone. These are often developed using marked animals to develop logistic regression models.

Summer range: areas used by mountain goats during summer (variable between areas and years, but generally from June to September).

Sustainable harvest rate: the level of harvest that will not compromise the viability of the mountain goat population, and that will benefit users now, while maintaining potential to meet needs of future generations.

Viable population: a population that maintains its genetic diversity and potential for evolutionary adaptation, and is at minimal risk of extinction from demographic fluctuations, environmental variations and potential catastrophe.

Winter range: areas used by mountain goats during winter (variable between areas and years, but generally from November to April). Summer and winter range extent and use may differ between bachelor and nursery groups and between coastal and interior goats.

Appendix M

esa ECOSPHERE

Wolverines in winter: indirect habitat loss and functional responses to backcountry recreation

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Citation: Heinemeyer, K., J. Squires, M. Hebblewhite, J. J. O'Keefe, J. D. Holbrook, and J. Copeland. 2019. Wolverines in winter: indirect habitat loss and functional responses to backcountry recreation. Ecosphere 10(2):e02611. 10.1002/ecs2.2611

Abstract. Outdoor recreation is increasingly recognized to impact nature and wildlife, yet few studies have examined recreation within large natural landscapes that are critical habitat to some of our most rare and potentially disturbance-sensitive species. Over six winters (2010–2015) and four study areas (>1.1 million ha) in Idaho, Wyoming, and Montana, we studied the responses of wolverines (*Gulo gulo*) to backcountry winter recreation. We fit Global Positioning System (GPS) collars to 24 individual wolverines and acquired >54,000 GPS locations over 39 animal-years during winter (January–April). Simultaneously, we monitored winter recreation, collecting ~6000 GPS tracks (~200,000 km) from backcountry recreationists. We combined the GPS tracks with trail use counts and aerial recreation surveys to map the extent and relative intensity of motorized and non-motorized recreation. We integrated our wolverine and backcountry recreation data to (1) assess patterns of wolverine habitat selection and (2) evaluate the effect of backcountry recreation on wolverine habitat relationships. We used resource selection functions to model habitat selection of male and female wolverines within their home ranges. We first modeled habitat selection for environmental covariates to understand male and female habitat use then incorporated winter recreation covariates. We assessed the potential for indirect habitat loss from winter recreation and tested for functional responses of wolverines to differing levels and types of recreation. Motorized recreation occurred at higher intensity across a larger footprint than non-motorized recreation in most wolverine home ranges. Wolverines avoided areas of both motorized and non-motorized winter recreation with off-road recreation eliciting a stronger response than road-based recreation. Female wolverines exhibited stronger avoidance of off-road motorized recreation and experienced higher indirect habitat loss than male wolverines. Wolverines showed negative functional responses to the level of recreation exposure within the home range, with female wolverines showing the strongest functional response to motorized winter recreation. We suggest indirect habitat loss, particularly to females, could be of concern in areas with higher recreation levels. We speculate that the potential for backcountry winter recreation to affect wolverines may increase under climate change if reduced snow pack concentrates winter recreationists and wolverines in the remaining areas of persistent snow cover.

Key words: functional response; *Gulo gulo*; habitat model; indirect habitat loss; winter recreation; wolverine.

Received 19 December 2018; accepted 11 January 2019. Corresponding Editor: Eric M. Gese.

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Introduction

Fostering societal appreciation for the conservation of nature partly relies upon individuals connecting to nature during leisure activities, which includes participating in outdoor recreation activities (Teisl and O'Brien 2003, Gifford and Nilsson 2014). Snow-based recreation during the winter is an important component of that outdoor recreation. In recent years, technological advancements in over-snow equipment including more powerful snowmobiles and lightweight backcountry ski gear provide increasing opportunity for winter recreation enthusiasts to access previously remote backcountry landscapes and have resulted in an increase in human presence in a landscape that has previously been de facto winter wilderness. Indeed, backcountry winter recreation has become valuable both economically and culturally for many small communities (Scott et al. 2008).

Unfortunately, recreation activities can negatively impact landscapes and the wildlife that reside in them (Steven et al. 2011, Sato et al. 2013, Larson et al. 2016). The most commonly reported wildlife responses to recreation are behavioral and physiological, including elevated stress hormones and avoidance or displacement from areas of disturbance (Harris et al. 2014, Arlettaz et al. 2015, Larson et al. 2016). Avoidance of disturbed areas may lead to indirect habitat loss (Patthey et al. 2008, Polfus et al. 2011, Coppes et al. 2017*b*), the impacts of which could be compounded during winter seasons if animals face increased energetic demands for thermoregulation and travel over snow with limited food supplies (Telfer and Kelsall 1979, Parker et al. 1984, Neumann et al. 2009). Habitat displacement and indirect habitat loss from winter recreation activities have been documented in a few montane and alpine species. In Europe, for example, high elevation forest grouse (*Tetrao* sp.) are negatively impacted by backcountry winter recreation including habitat displacement as well as energetic and physiological effects (Patthey et al. 2008, Braunisch et al. 2011, Arlettaz et al. 2015, Coppes et al. 2017*b*). Many species of large herbivore (e.g., red deer, *Cervus elaphus*; mountain caribou, *Rangifer tarandus caribou*; bighorn sheep, *Ovis canadensis*; mountain goat, *Oreamnos americanus*; moose, *Alces alces*) have exhibited negative physiological or behavioral responses including indirect habitat loss through avoidance of motorized and non-motorized winter recreation (Seip et al. 2007, Neumann et al. 2009, Courtemanch 2014, Richard and Cote 2016, Coppes et al. 2017*a*, Lesmerises et al. 2018). Although useful, many of the previous studies assessing the effects of winter recreation on wildlife have been limited spatially and temporally, and most were focused within a single study area and on a single form of winter recreation (Larson et al. 2016). As backcountry winter recreation grows in intensity and spatial extent, coupled with the potential concentration of activities due to climate change-driven reductions in snow area and season (Dawson et al. 2013, Rutty et al. 2015), there is a growing need to understand the impacts of recreation on wildlife species, and particularly on those that are sensitive, snow-associated, and occupy alpine habitats.

Large carnivores are globally threatened and have experienced negative effects of human-caused habitat loss and fragmentation throughout their range (Ripple et al. 2014). In North America, the Rocky Mountains represent a large carnivore hotspot (Noss et al. 1996, Laliberte and Ripple 2004), where some species are restricted to high elevation habitat. The wolverine (*Gulo gulo*) is limited to northern latitudes across its circumpolar distribution and is closely associated with snow and boreal forests, subalpine or alpine habitats (Magoun and Copeland 1998, Aubry et al. 2007, Copeland et al. 2010). Consequently, there is high potential for overlap and interactions between wolverines and backcountry winter recreationists because they both frequent similar areas, that is, areas with deep and persistent snow. Wolverines are also a species of conservation concern throughout much of their expansive range, further highlighting the importance of assessing interactions between wolverine and winter recreation.

Wolverines may be vulnerable to direct and indirect impacts of recreation during winter, as they naturally occur at low densities, have low reproductive rates, and remain active through the winter (Hash 1987, Persson 2005, Persson et al. 2006, Copeland et al. 2017). There has been no effort focused on understanding wolverine responses to winter recreation, though some research suggests they are sensitive to human activities and infrastructure (May et al. 2006, Krebs et al. 2007, Stewart et al. 2016, Heim et al. 2017). Females enter reproductive dens within deep snowpack during the winter recreation season with kits born in mid-February to early March, and they occupy these dens through late April or mid-May (Hash 1987, Magoun and Copeland 1998, Persson et al. 2006, Copeland et al. 2010, Inman et al. 2012*b*). The potential impact of backcountry winter recreation to denning females is of primary concern (Carroll et al. 2001, May et al. 2006, Copeland et al. 2007, Krebs et al. 2007). In Canada, wolverine status was changed to Special Concern in 2014 with increased winter recreation use combined with sensitivity of denning females among the considerations (COSEWIC 2014). In the United States, wolverines are being considered for listing under the Endangered Species Act, with the most recent status review (U.S. Fish and Wildlife Service 2013) indicating a lack of evidence to assess potential effects of winter recreation.

Understanding the responses of elusive, low-density wildlife species to relatively novel human uses such as backcountry winter recreation require innovative approaches that capture the spatio-temporal variability inherent in human activity and the responses of animals to this disturbance (Tablado and Lukas 2017, Squires et al. 2018). Over six years, we monitored the movements and habitat use of wolverines in four different study areas in the Rocky Mountains of Idaho, Wyoming, and Montana. Simultaneously, we tracked and monitored winter recreation to characterize the spatial extent and relative intensity of recreation across the landscape. We predicted that wolverine responses to winter recreation would be influenced by the type, spatial extent, and intensity of the recreation. We developed resources selection analyses to both understand wolverine habitat selection within home ranges and to test wolverine responses to winter recreation. These analyses allowed us to evaluate the potential for indirect habitat loss due to winter recreation (Johnson et al. 2005, Polfus et al. 2011, Hebblewhite et al. 2014). While resource selection analyses provide an estimate of average responses, they tell us little about how wolverine responses may change based on the level of exposure to winter recreation (Mysterud and Ims 1998, Hebblewhite and Merrill 2008). Functional responses in habitat selection can provide important insight concerning behavioral changes in animals as they experience differing levels of a resource or disturbance (Hebblewhite and Merrill 2008, Moreau et al. 2012, Holbrook et al. 2017). We tested for functional responses in habitat use of wolverines by evaluating how wolverines changed their use of increasingly recreated areas. The goals of our research were threefold (1) characterize fine-scale (i.e., third-order home range scale, Johnson 1980) habitat use and selection of male and female wolverines; (2) assess the importance of motorized and non-motorized winter recreation in influencing wolverine habitat selection and predicted use; and (3) test whether the responses of wolverines to winter recreation were dependent upon the relative intensity of the recreation within individual home ranges.

Methods

Overview

We fit GPS collars on wolverines to monitor responses to winter recreation and other resources in mid- and late winter (January–March) and concurrently sampled the spatial patterns of winter recreationists. We developed wolverine resource selection functions (RSF) with a use: availability design to estimate the relative probability of selection (Manly et al. 2002, Johnson et al. 2006, McDonald 2013) including models with and without winter recreation covariates. Based on the selected models, we assessed the effect of winter recreation on wolverine habitat selection and evaluated indirect habitat loss from winter recreation. Finally, we tested whether wolverines showed functional responses to winter recreation based on the relative intensity of winter recreation to which they were exposed. We used ArcGIS (ArcGIS Desktop: Release 10.1–10.5; ESRI, Redlands, California, USA) and R (R Core Team 2016) for data management and analyses.

Study area

Our research included four study areas spanning >1.1 million ha in Idaho, Wyoming, and Montana (Fig. 1) which we refer to as the:

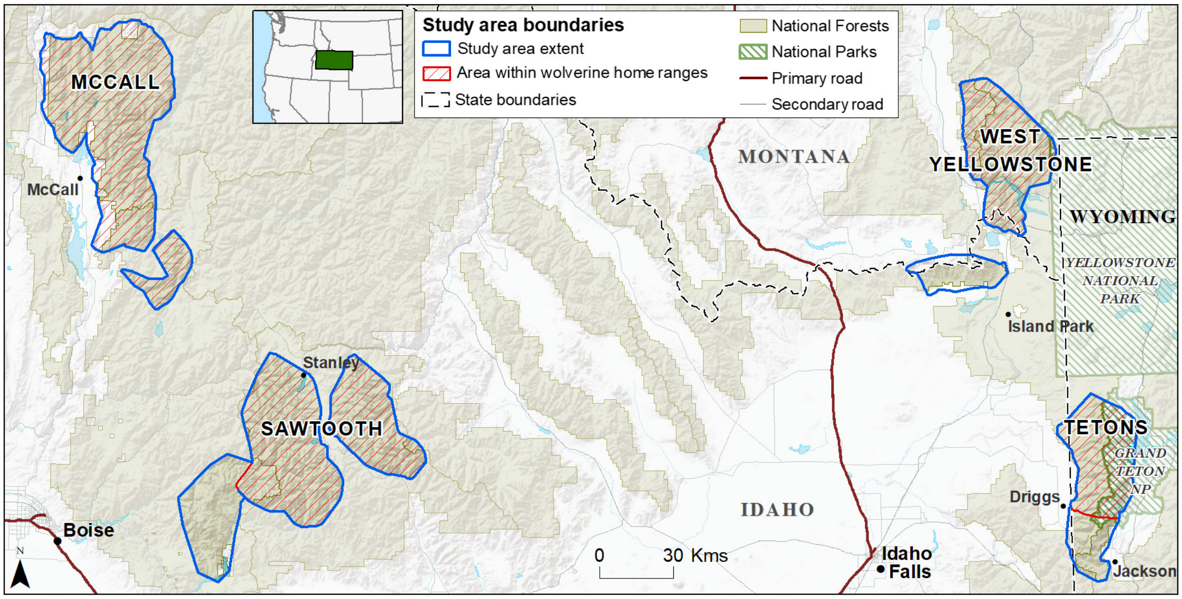

Fig. 1. Four broad study areas (McCall, Sawtooth, West Yellowstone, and Teton) for examining effects of winter recreation on wolverines (*Gulo gulo*) in Idaho, Montana, and Wyoming, USA, during 2010–2015. The study area boundaries in blue identify the outer extent of wolverine home ranges monitored throughout the study, while the red hatched areas indicate additional areas where camera and live-trapping for wolverines occurred without the identification of wolverine presence. Winter recreation sampling occurred in all study areas.

McCall study area (Payette NF, northern Boise NF); Sawtooth study area (including portions of the Sawtooth NF, southern Boise NF); West Yellowstone study area (including portions of the Caribou-Targhee NF, Custer-Gallatin NF, and Beaverhead-Deerlodge NF), and the Teton study area (including portions of the Caribou-Targhee NF, Bridger-Teton NF, and the Grand Teton National Park). Each study area was a popular backcountry winter recreation destination with backcountry snowmobiling, skiing, or both occurring in the range of wolverines. Each study area also contained large areas without intense winter human activity. Study areas were primarily U.S. Forest Service lands, but also contained a mix of other state and federal land designations. Topography was mountainous with alpine dominated by rock, ice, and low-growing herbaceous vegetation, transitioning into more open conifers with open rocky or subalpine shrub, grass, and herbaceous vegetation. Mid-elevation vegetation was dominated by coniferous forests, with interspersed deciduous tree and shrub communities. The lower boundaries of the study areas were defined by the lower limits of wolverine use, typically near the lower limit of forested habitats, with rare agricultural and sagebrush steppe near these margins.

Infrastructure supporting backcountry recreation varied across the study areas. All study areas had maintained parking areas for backcountry access at trailheads or along plowed roads, and some study areas had a network of groomed snowmobile trails. Within wolverine home ranges, roads were almost exclusively secondary roads that were not plowed for vehicle travel though some were groomed for snowmobile use. The few plowed roads occurred near home range boundaries. All roads were snow-covered during our study, and motorized and non-motorized recreation use was allowed on most roads regardless of whether they were groomed for recreation use. Winter recreation activities varied in the number of recreationists and types of recreation, and each study area had a unique combination of backcountry recreation including snowmobile, ski (including snowboards), snowmobile-accessed ski/board (hybrid), cat-ski, heli-ski, and yurt-supported ski. The McCall, Sawtooth, and Teton study areas also had developed ski resorts which allowed for backcountry or out-of-bounds skiing.

Wolverine capture and monitoring

Between 2010 and 2015, we captured wolverines from early January through April using modified box traps built from logs (Lofroth et al. 2008) baited with road-kill deer or trapper-caught beaver and a skunk-based lure. Each trap was equipped with a satellite device that notified us when the trap was triggered (Vectronics trap transmitters TT2, TT3; Vectronic Aerospace GmbH, Berlin, Germany), as well as a VHF-based trap trigger (Telonics trapsite transmitters, TBT series; Telonics, Mesa, Arizona, USA); traps were visited immediately if triggered and maintained every 3–5 d. Traps were closed late February to late March to avoid capturing a reproducing female and re-opened in late March through April for collar removal. Wolverines were anesthetized using a 10 mg/kg ketamine hydrochloride and 0.075 mg/kg medetomidine mixture (Fahlman et al. 2008) delivered by a jab stick. A GPS collar (either WildCellSL collar from Lotek Wireless, Newmarket, Ontario, Canada, or Quantum 4000 collar from Telemetry Solutions, Concord, California, USA) was attached and programmed to collect a location every 20 min on weekends (Saturday, Sunday) and mid-week (Tuesday, Wednesday), which we expected to differ in intensity of human use. Collars were modified with a cotton strip designed to rot away within 4–6 months if we were unable to recapture the animal. Trapping and handling procedures were approved through the University of Montana Institutional Animal Care and Use Committee (IACUC; Permit #055-10MHECS-113010) and the National Park Service IACUC under a research permit (GRTE-2015-SCI-0003). We also obtained research permits through Idaho Department of Fish and Game (IDFG Scientific Research Permit #091210) and Wyoming Game and Fish (WGF Collection Permit #33-928). We monitored the status of wolverines through aerial telemetry flights, including location, denning status, survival, and confirming collar function.

Resource selection function analyses

Resource selection functions compare covariates at used GPS locations with random locations (putatively available) to identify covariates that are used disproportionately more (i.e., selected) or less (i.e., avoided) than available or proportional to availability (lack of selection: Manly et al. 2002). We used general linear mixed-effects models with a logit link function (GLMM) and animal-year as a random effect to control for repeated sampling of individuals (Gillies et al. 2006). The mixed-effects RSF model therefore takes the form:

$$w(x) = \beta_1 x_{1ij} + \beta_2 x_{2ij} + \beta_3 x_{3ij} + \cdots + \beta_n x_{nij} + \gamma_{0j} + \varepsilon_{ij} \quad (1)$$

where x_n are covariate values for location i of animal-year j with the fixed regression coefficient β_n; γ_{0j} is the random intercept for animal-year j and is ε_{ij} is the residual variance within each animal-year. Logistic regression (Hosmer et al. 2013) was used to fit the exponential approximation to an inhomogeneous spatial-point process model, but without the intercept because in used-available designs the true amount of non-use is unknown (McDonald 2013). Thus, the resultant probability is best considered a relative probability of selection or use (Boyce et al. 2002, Lele et al. 2013). Animal and random (available) locations were attributed with the environmental and winter recreation covariates (see *Environmental variables, Winter recreation sampling and mapping*), which were then standardized ((value − mean)/SD) to support model fitting and allow for comparisons between model coefficients (Hosmer et al. 2013).

Location data and winter season home range analyses

We defined available habitat by estimating winter season home range or seasonal use area boundaries using a local convex hull non-parametric kernel method (Getz et al. 2007) with a fixed "*k*" number of nearest neighbors. We buffered boundaries by the sex-specific median step length (331 m for females, 441 m for males) to account for habitat immediately available to the animal. We included an individual animal-year for each wolverine with ≥5 weeks of GPS monitoring for any given winter. Data for individuals that exhibited localized or home range-type movements but were monitored for <5 weeks were withheld for model validation; subadults exhibiting exploratory or dispersal type movements were removed from all analyses. Within each home range, we estimated available habitat with random locations generated at a ratio of 2:1 random:use with random locations forced to be ≥30 m apart.

The time wolverine spent under snow and structures resulted in low GPS fix-rates and potential behavioral or habitat-induced bias (Frair et al. 2004, Nielson et al. 2009, Mattisson et al. 2010). To account for behavior-based missed locations, we developed a modification of Knopff et al. (2009) to identify clusters of wolverine locations based on their spatial (within 25 m of each other) and temporal (within 24 h of each other) proximity. Missed locations were associated with a known cluster site if the location before or after the failed GPS attempt was within a cluster, and the cluster centroid was imputed for their location (Frair et al. 2004). Locations <100 m of an active trap site were censored given the effect of baited traps.

Environmental variables

We evaluated land cover, topographic, snow, climate, and anthropogenic covariates (Appendix S1: Table S1) that may be important predictors of wolverine resource selection at the third order. First, we identified the spatial scale at which each potential covariate was most strongly selected by wolverines (DeCesare et al. 2012; Appendix S1: Table S1). Second, we screened covariates for collinearity ($|r| \geq 0.6$), and the covariate with the lowest univariate Akaike's information criterion (AIC) was retained (Hosmer et al. 2013). We also evaluated potential interactions. Finally, we evaluated covariates for potential non-linear relationships using general additive models (Hilbe 2015) and by testing potential non-linear models, keeping the form of the covariate with the lowest AIC (Hosmer et al. 2013). This resulted in slope being included in a quadratic form.

Winter recreation sampling and mapping

We developed spatially explicit maps of winter recreation by sampling backcountry recreation using three methods: GPS tracking of volunteer recreationists (Olson et al. 2017), infra-red trail use counters, and aerial surveys. We combined spatial information from GPS tracks with counts of recreational use from trail counters to develop maps of winter recreation intensity. We used the aerial surveys to validate recreation maps (Appendix S2).

To collect GPS tracks of recreation, we sampled recreationists at known recreation access points during mid-week (Tuesday, Wednesday) and weekend (Saturday–Sunday) days from mid-January through mid-April. We sampled recreation systematically, not in proportion to recreation use at access points or across study areas. We asked recreation groups to carry one GPS unit (Qstarz International, Taiwan, ROC, model BT-Q1300, 1 location/5 s, position accuracy <10 m) per ≤4 people in the group, and we recorded the type of winter recreation and the group size per GPS unit. We also distributed GPS units to backcountry guide, heli-ski, and cat-ski operations, with guides carrying the GPS units and recording their group size. To estimate the number of recreationists accessing each study area, we installed infra-red trail counters (Trafx Research Ltd, Canmore, Alberta, Canada) at constriction points on backcountry snowmobile and ski/snowboard access routes. If the access route was used by both outgoing and incoming recreationists, the counts were divided by two to estimate the one-way traffic.

We developed maps of different types of backcountry winter recreation, including linear travel (primarily access routes along forest roads) and dispersed (off-road) use. We calculated the relative density or intensity of dispersed use (meters of track/100 m^2) based on the GPS tracks of recreationists. To account for differences in overall use within and between study areas, we weighted each GPS track based on the proportion of the estimated total recreation use it represented from each trailhead or access point, with total use estimated from the trail use counters associated with the access point (Appendix S2). The GPS tracks of recreationists that use motorized access (e.g., snowmobile, cat-ski, heli-ski) to undertake non-motorized activities were split into their motorized and non-motorized components. For heli-ski GPS tracks, we used only the non-motorized portions of GPS tracks and discarded the track associated with the helicopter transport; any helicopter-based disturbance was not accounted for in our analyses. To test for wolverine responses to spatial pattern and intensity of winter recreation, we developed maps of recreation that became candidates for inclusion as covariates in the wolverine habitat models: (1) the recreation footprint as a binomial characterization of recreation extent that includes road-based and dispersed recreation; (2) linear recreation along roads and groomed trails; (3) the relative intensity of all winter recreation; (4) the relative intensity of off-road or dispersed recreation (tracks >30 m from a road or groomed route) recreation; (5) the relative intensity of dispersed motorized; and (6) the relative intensity of dispersed non-motorized recreation (Appendix S2).

Model selection

To assess wolverine responses to winter recreation, we first developed RSFs (habitat models) based on environmental covariates not including recreation, which predicts potential habitat quality in the absence of recreation based on relative probability of use (Polfus et al. 2011, Trainor and Schmitz 2014). Then, we added winter recreation covariates to the potential habitat model(s) to test for responses of wolverines to different characteristics of winter recreation (e.g., recreation footprint, relative intensity, recreation type) and to identify the best model to predict "realized" habitat quality accounting for effects of winter recreation on wolverine habitat selection. We followed a two-step process to identify the environmental predictors of wolverine habitat use for all animals combined (global model), for females (female model), and for males (male model). To identify the most predictive of the potential covariates and covariate interactions, we used fixed-effect least absolute shrinkage and operator selection (LASSO) logistic regression (Tibshirani 1996, Reineking and Schröder 2006) implemented using the glmnet package in R (Friedman et al. 2010) for male, female, and global (male and female combined) models. We removed covariates that were not within the selected covariate set (penalty strength set within one standard error [SE] of the minimum cross-validated error; Friedman et al. 2010). In the second step, we used the covariates identified in step one to developed RSF global, female, and male models using GLMM with animal-year as a random effect using the lme4 package in R (Bates et al. 2015). To determine whether a single global model or separate sex-based models were supported, we compared the summed AIC scores of the male and female RSF models to the global RSF AIC; this is possible because the combined male and female data are exactly the full global data (Burnham and Anderson 1998). To include winter recreation effects, we then developed five additional RSF models that included the potential habitat RSF covariates and different combinations of the six winter recreation covariates from our winter recreation maps. We selected the model with the lowest AIC to best represent realized wolverine habitat use in areas that also have winter recreation. For the selected models of potential habitat and realized habitat, we used 10-fold cross-validation to assess the goodness of model fit (Boyce et al. 2002). We also validated the models using out-of-sample GPS location data from wolverine animal-years not used in the development of habitat models to determine how our models predicted the frequency of wolverine use (DeCesare et al. 2012, Holbrook et al. 2017).

Comparing potential and realized habitat quality

We estimated habitat degradation due to winter recreation by calculating the reduction in habitat quality between the potential habitat and realized habitat models (Johnson et al. 2005, Polfus et al. 2011, Hebblewhite et al. 2014). This may underestimate the influence of winter recreation on wolverines because we assume the influence of winter recreation is independent of environmental variables and did not confound modeled relationships. To assess this assumption, we calculated the relative percent change between the potential and realized environment coefficients and identified those covariates with greater than a 20% change in value (Hosmer et al. 2013: equation 3.9). If model coefficients were stable in the potential and realized models (<20% change), this suggests that recreation and the environmental covariates were not confounded.

Each model was mapped at a 30 m resolution, and mapped values were binned into 10 quantiles from low to high quality (i.e., relative probability of use). We classified habitat quality into three groups: (1) the top 30% of the area (bins 8–10) as high-quality habitat, (2) the next 30% (bins 5–7) as moderate quality habitat, and (3) the lowest 40% of habitat values (bins 1–4) as low-quality habitat. We did not include areas where gaps in winter recreation monitoring information did not allow us to predict the probability of use. Indirect habitat loss was calculated as the spatially explicit reduction in habitat quality when comparing the realized habitat maps to the potential habitat maps (Johnson et al. 2005, Polfus et al. 2011). We calculated the degree of habitat degradation by the number of classes reduced, with the most severe degradation indicated by high-quality habitat that is degraded by two classes to low-quality habitat.

Functional responses to winter recreation

We tested whether wolverines exhibited a functional response to the relative intensity of motorized and non-motorized dispersed winter recreation by evaluating how habitat use of recreated areas changes with availability of these areas. If there is no functional response, habitat use of recreation changes in proportion to availability, while deviations from proportional use indicate a functional response (Holbrook et al. 2017, 2019). We calculated the mean recreation intensity at used (animal) and available (random) locations for each animal-year home range and used these data in the following model:

$$U_{R_i} = \beta_0 + \beta_R(A_{R_i}) \quad (2)$$

where R indicates the recreation type (motorized or non-motorized); U_{R_i} = the average recreation intensity at used locations of each animal-year i; β_0 = y-intercept, β_R = slope of the functional response; and A_{R_i} = the average recreation intensity at available locations within the home range of animal-year i. The null expectation is $\beta_R = 1$ (proportional use), while $\beta_R < 1$ indicates decreasing use and $\beta_R > 1$ indicates increasing use as availability increases. We limited the scope of our functional response analyses to wolverine responses to recreation type and intensity as the primary focus of this work; functional responses to other covariates may also exist.

Results

Wolverine trapping and location data

We captured and GPS-collared 24 individual wolverines (11 females, 13 males) over five years of live-trapping (Fig. 1). We did not capture any female wolverines in the Tetons study area. Each wolverine was monitored for 1–4 yr for a total of 39 animal-years. We obtained >5 weeks of data from 18 (10 females, 8 males) animals over 25 animal-years, averaging 2101 locations/animal-year between mid-January and end of March (Table 1). An additional nine animal-years (five female animal-years and four male animal-years) were used for model validation. The cluster analysis identified groups of animal locations with an average (±SD) distance between an animal location and the cluster center of 18 ± 24 m, and we estimated missed locations associated with a cluster as the cluster center. Raw fix-rates were 75.8%, yet 78% of failed GPS attempts were associated with clustered behavior and were thus imputed. Our corrected fix-rate was 94.7%, providing 53,301 locations used in the spatial modeling and 6603 for model validation. The average size of female winter home ranges was smaller than male winter home ranges (Table 1).

Recreation monitoring

Study areas had two years of GPS-based recreation tracking, infra-red trail use counts, and aerial surveys, though areas without successful wolverine identification may have had less effort. We recorded 5899 GPS tracks (i.e., trips by recreationists) of combined length of 198,019 km (Table 2). While we recorded a diversity of backcountry recreation types (Appendix S3: Table S1), snowmobiling was the most popular motorized backcountry recreation while skiing was the most popular non-motorized recreation. Over 90% of non-motorized recreation tracks were collected in the Teton study area, with localized areas of non-motorized recreation in other study areas (Table 2). Snowmobiling was a common recreation activity across all study areas, and snowmobile tracks were longer (average of 60 km) than ski tracks (average of 10 km); snowmobile tracks constituted 82% of our total track length. Heli-ski recreation only occurred within our Sawtooth study area, and cat-ski recreation was only present in the McCall study area. We established trail use counters at 25 sites. The total estimated recreation visits varied across our study areas from <7000 to >23,000 (Table 2). The proportion of recreationists sampled using GPS tracking also varied, based partly on the total recreation use and on localized access patterns, from 15% to 42% (Table 2).

Winter recreation occurred in 12.5% of our combined study areas (as shown in Fig. 1), and

Table 1. Summary of the male and female wolverines (*Gulo gulo*) Global Positioning System collar locations and home range estimates during winter seasons (2010–2015) in Idaho, Wyoming, and Montana as part of research examining wolverine responses to winter recreation.

Wolverines	Individuals	Animal-years†	Ave no. of locations ± SD	Location count range (min–max)	Ave home range (km^2) + SD	Min–Max of home range sizes (km^2)
Males	8	12	2590 ± 677	806–3778	1273 ± 471	401–2158
Females	10	13	1894 ± 547	1247–3079	289 ± 92	126–420

Notes: SD, standard deviation. Home range areas were estimated using a local convex hull non-parametric kernel method (Getz et al. 2007).

† Animal-years indicates the total number of winter seasons cumulatively monitored accounting for multiple seasons of monitoring of some individual animals.

Table 2. The number (%) of motorized and non-motorized recreation GPS tracks collected in our study areas, the annual average number of recreationists sampled (carrying or in a group with a GPS), the average annual trail use counts from infra-red trail use counters, and the estimated proportion of total use that we sampled (total people represented by GPS tracks/total use).

Recreation type	McCall	Sawtooth	West Yellowstone	Teton
GPS tracks, motorized	1620 (93%)	755 (54%)	386 (98%)	195 (8%)
GPS tracks, non-motorized	118 (7%)	613 (46%)	9 (2%)	2385 (92%)
Ave annual number of recreationists represented by GPS tracks	4125	2596	1389	3568
Ave annual recreation visits	16,173	6149	7215	23,387
Sampling effort	25.5%	42.2%	19.3%	15.3%

Note: GPS, Global Positioning System.

the spatial extent and relative intensity of both motorized and non-motorized winter recreation varied notably within and across individual study areas (Fig. 2). In all study areas except the Tetons, motorized recreation represented the majority of the recreated footprint. The lowest overall levels of winter recreation occurred across much of our Sawtooth study area with <5% disturbance from each of motorized and non-motorized recreation activities though recreation did have areas of high localized intensity (Fig. 2). The highest overall winter recreation levels were in the southern Tetons where we recorded >50% of this area with winter recreation, primarily as non-motorized winter recreation (Fig. 2).

The spatial extent and relative intensity of backcountry winter recreation also varied within and across wolverine home ranges (Fig. 2). Motorized recreation, on average (±standard deviation [SD]), occurred in 22% ± 19% and 14% ± 15% of female and male home ranges, respectively, but varied greatly from <1% to 50%. Non-motorized winter recreation covered <5% of home ranges on average, and two females were not exposed to non-motorized recreation. The male monitored in the Teton study area had more non-motorized recreation than all other wolverines. Within home ranges, average recreation intensity of motorized recreation ranged from 0.0 to 42.2 m tracks/100 m^2 and average non-motorized recreation intensity value ranged from 0.1 to 9.3 m tracks/100 m^2.

Potential habitat models: environment-only resource selection functions

The summed AIC score of the male and female potential habitat models (i.e., environment-only models) was notably lower than the AIC of the global model with ΔAIC of 1669, thereby justifying sex-specific models (Appendix S3: Table S1). The male model uniquely included covariates for distance to roads and the proportion of lower elevation grass and shrub land cover types. Alternatively, the female model included talus, persistent spring snow cover and forest edge:area covariates, which were not identified as important predictors of male habitat use. All covariates were

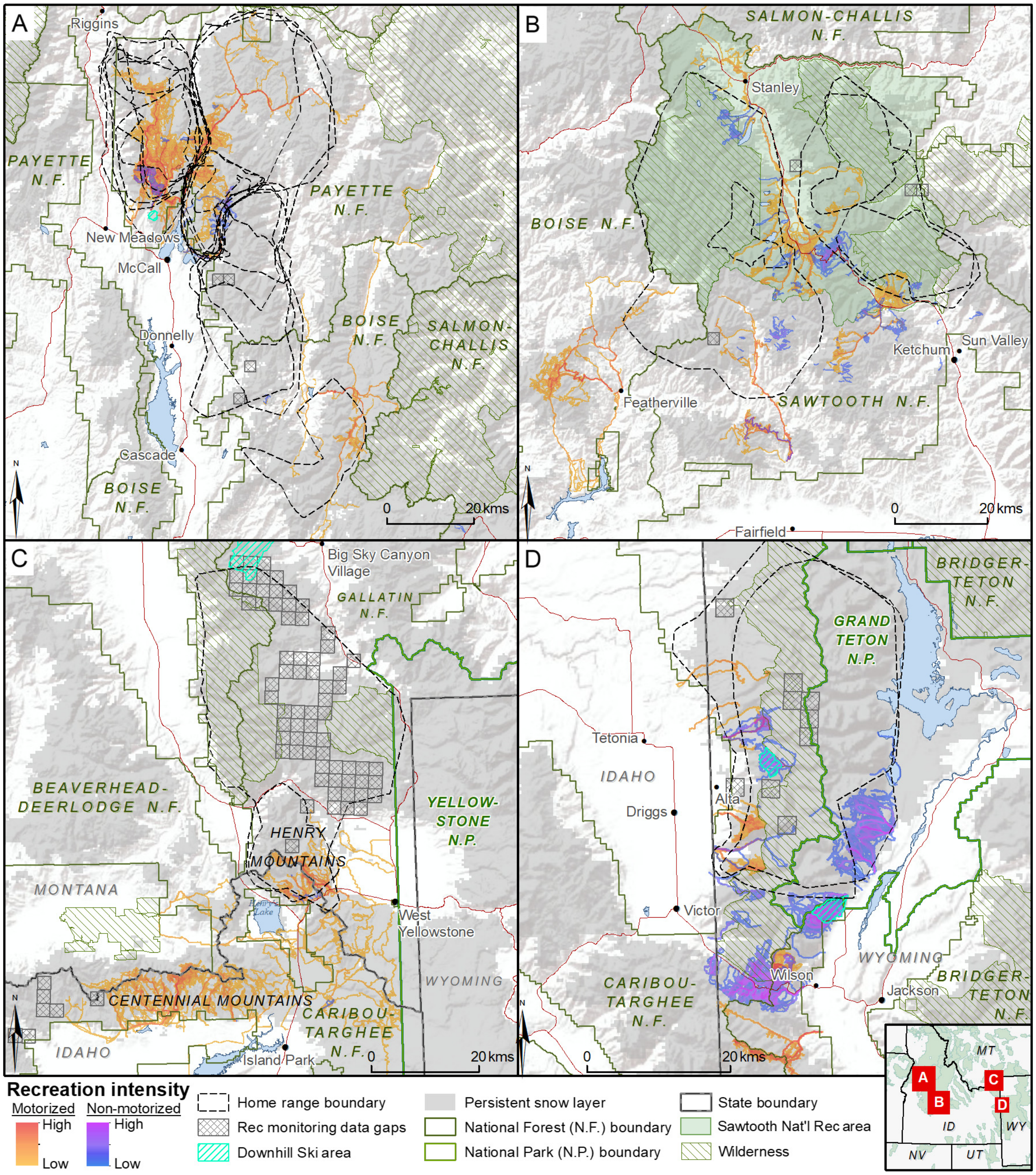

Fig. 2. Map of wolverine (*Gulo gulo*) winter home ranges (2010–2015) and estimated backcountry winter recreation relative intensity as estimated based on Global Positioning System (GPS) tracks collected from volunteer recreationists and used to develop recreation maps for each of the four study areas: (A) McCall; (B) Sawtooth; (C) West Yellowstone, and (D) Teton. Square or rectangular hatched areas indicate gaps in GPS track sampling based on aerial recreation surveys.

Table 3. Resource selection function models developed for wolverines (*Gulo gulo*) monitored in Idaho, Wyoming, and Montana as part of research investigating wolverine responses to winter recreation (2010–2015).

Models†	Variables	Male ΔAIC	Female ΔAIC
Model 1: Female Potential Model	Topographic position index + slope + slope^2 + fir forest + distance to edge + talus + riparian + montane shrub and grass + solar radiation + forest edge:area + spring snow	NA	537.79
Model 1: Male Potential Model	Topographic position index + slope + slope^2 + fir forest + distance to edge + distance to roads† + riparian + montane shrub and grass + foothill open + solar radiation	41.71	NA
Model 2: Potential Model + Rec 1	Model 1 + winter recreation footprint	43.2	286.96
Model 3: Potential Model + Rec 2	Model 1 + distance to linear recreation + dispersed motorized footprint + dispersed non-motorized footprint	355.71	266.1
Model 4: Potential Model + Rec 3	Model 1 + relative intensity of all winter recreation	0	181.44
Model 5: Potential Model + Rec 4	Model 1 + distance to linear recreation + relative intensity dispersed recreation	283.5	60.82
Model 6: Potential Model + Rec 5	Model 1 + distance to linear recreation + relative intensity of dispersed motorized recreation + relative intensity of dispersed non-motorized recreation	249.55	0

Notes: AIC, Akaike's information criterion. Model 1 for male and female are the environment-only models. Models 2–6 use the environment covariates identified in Model 1 and winter recreation covariates to assess the responses of wolverines to different characteristics of winter recreation. Models 2–6 were developed separately for males and females. NA indicates not applicable.

† The realized models (Models 2–6) for males included recreated roads in the recreation covariates so the distance to road covariate in the Male Potential Model was redefined as distance to unrecreated roads in these models.

statistically significant. The models shared several covariates including topographic position index (TPI), quadratic form of slope, distance to forest edge, solar insulation and the percent cover of forest, riparian, and montane open cover types (Appendix S3: Table S1).

Model coefficients were standardized, allowing for within-model comparison and ranking of β coefficients for relative importance (Appendix S3: Table S1). Both sexes showed strong selection (ranked first in β coefficient importance) for drainage bottom topography ($\beta_{female} = -0.31$, SE = 0.01; $\beta_{male} = -0.42$, SE = 0.01) as indicated by the negative coefficient for TPI, and avoided steep slopes indicated by the negative coefficient of slope^2 ($\beta_{female} = -0.27$, SE = 0.01; $\beta_{male} = -0.17$, SE = 0.01). Both sexes showed selection for areas near forest edge ($\beta_{female} = -0.21$, SE = 0.01; $\beta_{male} = -0.16$, SE = 0.01), avoided higher elevation shrub and grass ($\beta_{female} = -0.09$, SE = 0.01; $\beta_{male} = -0.06$, SE = 0.01), and selected for riparian areas ($\beta_{female} = 0.07$, SE = 0.01; $\beta_{male} = 0.11$, SE = 0.01). Male and female wolverines displayed some notable differences in their resource selection patterns. Males strongly selected fir-dominated forests (ranked second in importance; $\beta_{male} = 0.37$, SE = 0.01), selected for areas close to secondary roads (indicated by a negative scaled RSF coefficient: $\beta_{male} = -0.2$, SE = 0.01), and avoided lower elevation shrub and grass habitats (ranked lowest in importance; $\beta_{male} = -0.06$, SE = 0.01). Alternatively, females selected for talus ($\beta_{female} = 0.13$, SE = 0.01), for higher forest patch edge:area ratios ($\beta_{female} = 0.12$, SE = 0.01) indicating smaller, more fragmented forest patches, and for areas with persistent spring snow ($\beta_{female} = 0.09$, SE = 0.01). Areas of high solar insolation were avoided by females ($\beta_{female} = -0.15$, SE = 0.01) but selected by males ($\beta_{male} = 0.13$, SE = 0.01).

Cross-validation of female and male potential habitat models had similar Spearman rank correlations (r_S) of 0.92 and 0.91, respectively. Out-of-sample data validation similarly showed strong validation (female $r_S = 0.86$, male $r_S = 0.95$).

Realized habitat models: environment and winter recreation resource selection functions

Of the six models developed for male wolverines, Model 4 (combined recreation intensity) had the lowest ΔAIC (Table 3) and defined our realized habitat model for male wolverines (Appendix S4: Figs. S1–S4). There was a significant avoidance of areas with higher recreation

Table 4. Standardized model coefficients betas, standard errors (SE), and importance rank for male and female wolverine (*Gulo gulo*) resource selection function models including environment and winter recreation covariates, based on wolverine Global Positioning System collar data collected in Idaho, Wyoming, and Montana (2010–2015).

	Female model 6			Male model 4			Male model 6		
Variables	β	SE	Rank	β	SE	Rank	β	SE	Rank
Distance to edge	−0.21	0.01	4	−0.16	0.01	6	−0.16	0.01	4
Distance to unrecreated roads†				−0.22	0.01	4	−0.10	0.01	9
Fir forest	0.05	0.01	14	0.36	0.01	2	0.41	0.01	2
Foothill shrub and grass				−0.06	0.01	11	−0.05	0.01	11
Forest edge:area	0.12	0.01	9						
Montane shrub and grass	−0.06‡	0.01	13	−0.06‡	0.01	10	−0.04	0.01	12
Riparian	0.08	0.01	11	0.11	0.01	8	0.11	0.01	8
Slope	−0.07‡	0.01	12	0.25	0.01	3	0.22	0.01	3
Slope^2	−0.25	0.01	3	−0.16	0.01	5	−0.16	0.01	5
Solar insolation	−0.15	0.01	6	0.13	0.01	7	0.13	0.01	7
Spring snow	0.14‡	0.01	7						
Talus	0.13	0.01	8						
Topographic position index	−0.32	0.01	1	−0.42	0.01	1	−0.41	0.01	1
Distance to recreated roads	0.08	0.01	10				0.02	0.01	13
Intensity of all recreation				−0.06	0.01	9			
Dispersed motorized recreation intensity	−0.31	0.02	2				−0.07	0.01	10
Dispersed non-motorized recreation intensity	−0.19	0.01	5				−0.15	0.02	6
Intercept	0.17	0.04		0.07	0.03		0.07	0.03	
Random effect		0.13			0.11			0.11	

Notes: Female Model 6 and Male Model 4 were identified as the best models based on Akaike's information criterion values, while Male Model 6 provides male responses to specific recreation types. The random effect standard deviation is shown. Blank cells indicate covariates not identified for inclusion in the specified model. The ranked importance of each covariate indicated based on the absolute value of the standardized coefficient. Negative beta values indicate selection for lower values of the covariate.

† Includes roads without documented winter recreation use, with recreated roads represented in the recreation covariates.

‡ Coefficients show >20% change compared to the equivalent coefficients in the potential habitat model.

intensity (β_{male} = −0.06, SE = 0.01) though the overall importance of this was relatively low (ranked 9 out of 12 covariates) compared to other coefficients in Model 4 (Table 4). Ten-fold cross-validation of this model showed high support for the model (r_S = 0.91), and the out-of-sample male locations also validated very well (r_S = 0.90).

The best-supported habitat model for female wolverines was Model 6 (Table 3; Appendix S4: Figs. S5–S8), with three significant (*P*-value < 0.01) winter recreation covariates: distance to linear recreation, intensity of dispersed motorized recreation, and intensity of dispersed non-motorized recreation. Beta coefficients of Model 6 show females strongly avoided dispersed motorized winter recreation (β_{female} = −0.31, SE = 0.02), and this covariate is the second ranked covariate (Table 4). Females also strongly avoided dispersed non-motorized winter recreation (β_{female} = −0.19, SE = 0.01; ranked fifth in importance). Females avoided areas near recreated roads and groomed routes as indicated by the positive coefficient (β_{female} = 0.08, SE = 0.01), and this covariate ranked 10 out 14. Similar to the male model, both the cross-validation and out-of-sample model validation showed strong support (r_S = 0.91, r_S = 0.83, respectively).

Model 6 did not provide the best overall predictor of male resource selection, but it allowed us to evaluate male wolverine responses to different forms of winter recreation (Table 4). All covariates in Model 6 were significant (or nearly so) in predicting male wolverine habitat use (Table 4). Similar to females, males avoided areas of dispersed motorized recreation (β_{male} = −0.07, SE = 0.01), dispersed non-motorized recreation (β_{male} = −0.15, SE = 0.02), and areas close to recreated roads and groomed routes (β_{male} = 0.02, SE = 0.01) but the relative importance of winter recreation to males was less than for females. The importance of dispersed motorized recreation to male wolverine resource selection ranked 10 out of 13, while avoidance of dispersed non-motorized recreation was similar to females at a rank of 6. Avoidance of linear recreation by male wolverines was marginally insignificant ($P = 0.056$) and of lowest importance (Table 4).

Indirect habitat loss

Comparing the potential (Appendix S3: Table S1) and realized (Table 4) habitat models coefficients, there is very little evidence of confounding between the environmental covariates and the winter recreation covariates. Nine of the 12 environmental covariate coefficients in the female wolverine models were stable when comparing potential and realized models, including the top 7 ranked covariates (Table 4). Similarly, 9 of the 10 male model environmental coefficients were stable between models (Table 4).

Winter recreation resulted in indirect habitat loss of moderate and high-quality wolverine habitats as measured by areas transitioning to a lower class when comparing the realized habitat map to the potential habitat map (Fig. 3). On average (±SD), 14.1% ± 9.4% of female habitat and 10.9% ± 4.1% of male habitat was degraded to lower habitat classes, ranging from <10% to >70% within individual home ranges. This represented an average (±SD) area degraded by winter recreation within home ranges of 42 ± 36 km^2 for female wolverines (average home range 289 ± 92 km^2) and 118.2 ± 55.6 km^2 for males (average home range 1273 ± 471 km^2). Both the amount and severity of indirect habitat loss were related to the relative intensity of winter recreation within home ranges. The incremental effect of higher levels of winter recreation was large across home ranges with relatively low winter recreation levels (i.e., substantial habitat loss for each unit of recreation intensity), but the amount of indirect habitat loss tended to plateau across home ranges with the highest levels of recreation use (Fig. 4A). Female wolverines experienced more degradation to high-quality habitat, represented by a reduction in high-quality habitat to low-quality habitat (change of two classes; Fig. 4B). An average of 9.6% of available female high-quality habitat was degraded to low quality across the study area, while only 0.2% of available high-quality habitat for males was reduced to low quality.

These responses translated into more pronounced indirect habitat loss for females compared to males within the same landscapes. For example, a male and female that resided in the same landscape had similar average recreation intensity within their respective home ranges (Fig. 3). The female experienced indirect habitat losses of 36% and 38% of her high and moderate quality habitats, respectively, and 21% of the high-quality habitat was predicted to be degraded to low-quality habitat. In contrast, the male experienced predicted habitat degradation to 20% of high and moderate quality habitats, with only 0.9% of high-quality habitats predicted to be degraded to low-quality habitat.

Functional responses to winter recreation

Wolverines displayed negative functional responses in habitat use as the intensity of both motorized and non-motorized winter recreation increased. Use of areas with motorized recreation decreased as the average intensity of motorized recreation increased (Fig. 5A) within male and female home ranges, with slopes of 0.22 ($R^2 = 0.40$) and 0.38 ($R^2 = 0.72$), respectively. Similarly, both males and females showed negative functional responses to non-motorized winter recreation, even at the relatively low intensities of this recreation type. Habitat use of areas with non-motorized recreation declined as the availability of these areas increased within wolverine home ranges (Fig. 5B), with slopes significantly <1: 0.32 ($R^2 = 0.89$) and 0.10 ($R^2 = 0.13$) for males and females, respectively. The male functional response was driven by the high average intensity of non-motorized recreation that one male (2 animal-years) experienced in the Tetons. If the Teton animal was removed, male wolverines did not show a significant functional response to non-motorized winter recreation (Table 5). Additionally, the low R^2 of the female functional response to non-motorized recreation indicates high variation and a comparatively weak relationship.

Discussion

We found that male and female wolverines showed some notable differences in the select-

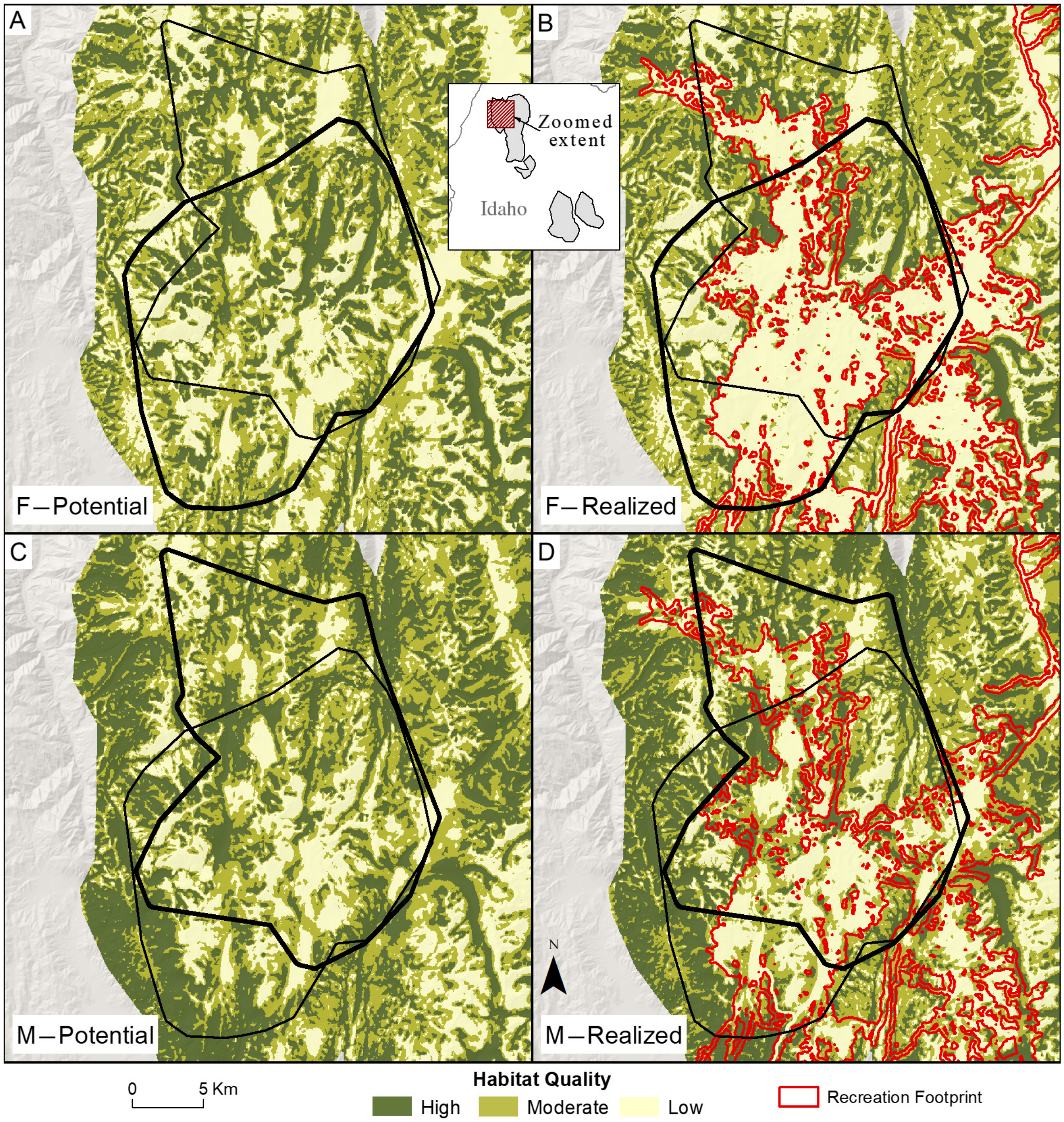

Fig. 3. Example maps of potential winter wolverine (*Gulo gulo*) habitat predicted by the potential model in the left-hand panels for females (A) and males (C) in a portion of the McCall, Idaho, study area. The right-hand panel maps the realized habitat models and shows the habitat quality for females (B) and males (D) when winter recreation is included in the habitat model. The bold black lines are the home range boundaries for the animal-year indicated and the thinner black line identifying the overlapping animal of the other sex to facilitate comparing between the upper and lower panels. The red lines indicate the outline of the winter recreation footprint.

ion for environmental covariates and that their selection for these covariates appeared to be independent of the potential effects of winter recreation. The realized habitat models that included winter recreation further showed that male and female wolverines responded negatively to increasing intensity of winter recreation within home ranges. Dispersed or off-road

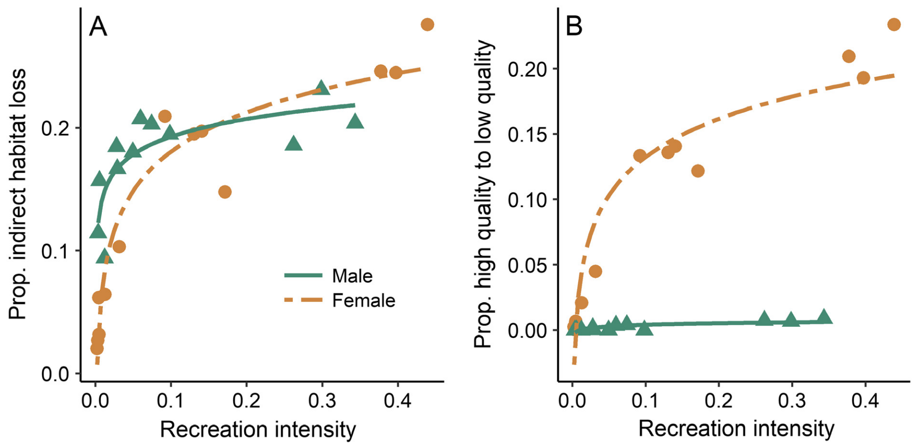

Fig. 4. The proportion of habitat degraded (A) and the proportion of habitat severely degraded (B) across home ranges of male (N = 12) and female (N = 13) wolverines (*Gulo gulo*) with varying levels of winter recreation intensity. Degradation is defined by the proportion of high and moderate quality habitat that degrades by at least one class (A; female R^2 = 0.93, male R^2 = 0.64), while severe degradation is measured by the proportion of the degradation that is high-quality habitat dropping two classes to low-quality habitat (B; female R^2 = 0.93, male R^2 = 0.44).

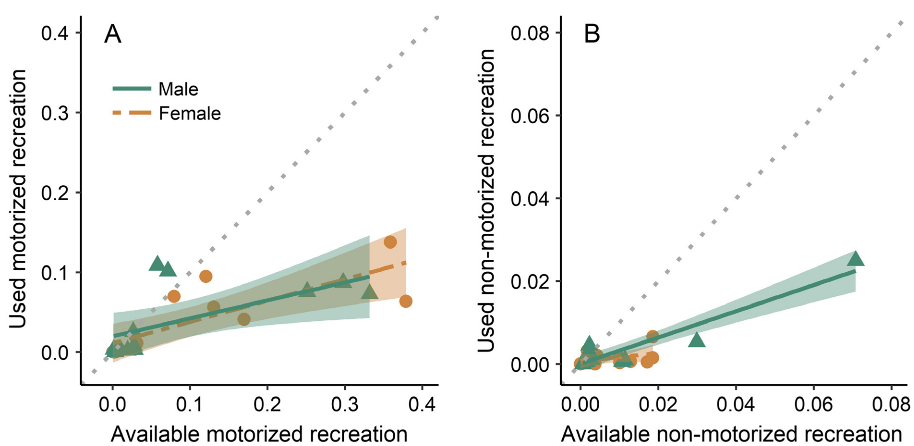

Fig. 5. Functional responses of male and female wolverines (*Gulo gulo*) habitat use to the available relative intensity of (A) motorized (male N = 12, female N = 13) and (B) non-motorized (male N = 12, female N = 11) winter recreation in individual home ranges. The y-axis shows the average relative intensity of recreation at wolverine locations for each monitored wolverine, and x-axis shows the average recreation intensity within the animal home range. The dotted 1:1 slope line indicates the null expectation of random use. Responses below the 1:1 line indicate that use is lower than expected based on availability.

recreation activities elicited a stronger response than recreation along roads and groomed routes, with females showing more sensitivity to disturbance than males. The functional responses to dispersed recreation, particularly to motorized dispersed recreation, suggests that avoidance results in potentially important indirect habitat loss when a significant portion of an animal's home range receives recreation use, as it is exactly those animals exposed to higher levels of recreation that are most strongly displaced from these areas. Wolverines exposed to lower levels

Table 5. Functional responses of male and female wolverines (*Gulo gulo*) to dispersed motorized (male N = 12, female N = 13) and non-motorized (male N = 12, female N = 11) winter recreation measured as the proportional use of recreation intensity compared to the average recreation intensity across home ranges of individual animals.

Model	Male β_0	Male β_R (95% CI)	R^2	Female β_0	Female β_R (95% CI)	R^2
Motorized	0.02	0.22 (0.05–0.40)	0.40	0.01	0.38 (0.24–0.51)	0.72
Non-motorized	0.00	0.32 (0.25–0.39)	0.89	0.00	0.10 (−0.05–0.24)	0.13
Non-motorized, removing the Teton male	0.001	0.06 (0.17 to −0.05)	0.07	NA	NA	NA

Note: Null expectation is H_0: $\beta_R = 1$, with $\beta_R < 1$ indicating increasing avoidance of recreation with increasing availability and $\beta_R > 1$ indicating increasing selection with increasing availability. NA indicates not applicable.

of winter recreation exhibit weaker avoidance based on the functional responses, which should result in relatively less indirect habitat loss. Also, the weak avoidance of areas near linear access used by winter recreationists suggests wolverines may be less sensitive to these linear disturbances.

Wolverine habitat selection

Previous habitat analyses in the Rocky Mountains for wolverines have been mainly at the first- or second-order of selection (Aubry et al. 2007, Copeland et al. 2007, 2010, Fisher et al. 2013, Inman et al. 2013), identifying characteristics that predict the distribution or presence of wolverines. These efforts have indicated that wolverine are found at higher elevations (Copeland et al. 2007, 2010, Krebs et al. 2007, Inman et al. 2013), in areas associated with late spring snowpack (Aubry et al. 2007, Copeland et al. 2010, Inman et al. 2013), and in alpine and subalpine habitats (Aubry et al. 2007) with higher topographic ruggedness (Krebs et al. 2007, Fisher et al. 2013, Inman et al. 2013) compared to the broader landscape. In contrast to the broader association to more rugged terrain, our analyses at the third order showed wolverines select less extreme topography characterized by concave or drainage bottoms (negative coefficient of TPI and slope covariates) within their home ranges. Additionally, our analyses showed selection for riparian habitats and forested edge habitats, which may represent good travel paths or more productive habitats (Scrafford et al. 2017) within a generally low productivity, high elevation landscape.

We expect that the habitat selection of our females was influenced by reproductive denning as 7 of 13 female animal-years represented denning females. Wolverine reproductive dens, particularly in the southern portion of their distribution, have been linked to deep and persistent snowpack and high structure such as talus boulders (Magoun and Copeland 1998). We found areas that support persistent spring snow as well as talus habitat were selected by female wolverines. In addition, females also selected for cold areas (negative solar radiation covariate), which also would support the selection for areas with persistent snow. Female habitat selection is complex, including characteristics that may be linked to some of the coldest and snowiest habitats as well as characteristics that may represent some of the more productive areas. Indeed, Krebs et al. (2007) proposed female selection was driven by a multitude of factors including food, predator, and human avoidance.

Influence of winter recreation on wolverine habitat

Wolverines maintained multi-year home ranges within landscapes that support winter recreation and some resident animals had >40% of their home range within the footprint of winter recreation. This suggests that at some scale wolverines tolerate winter recreation. However, within home ranges, wolverine avoided all forms of winter recreation and showed increasing avoidance of areas as the amount of off-road winter recreation increased, resulting in indirect habitat loss or degradation of moderate- or high-quality habitats. Krebs et al. (2007) also found that wolverines, particularly females, avoided areas with winter recreation. Habitat displacement from winter recreation activities has been documented in other montane and alpine species. Endangered mountain caribou (*R. tarandus caribou*) in southern British Columbia have been displaced from high-quality winter habitat due to high levels of snowmobile recreation (Seip et al. 2007). In the Teton Mountains of Wyoming, backcountry ski recreation resulted in a 30% loss of high-quality winter habitat to bighorn sheep (Courtemanch 2014), and mountain goats avoided otherwise high-quality habitat associated with a developed ski area near Banff, Alberta (Richard and Cote 2016). Additional responses to winter recreation include changes in movement rates and temporal patterns, as was found in Canada lynx (*Lynx canadensis*) in response to winter recreation (Olson et al. 2018).

It can be challenging to identify animal responses to existing anthropogenic infrastructure and disturbance given the limited ability to control for these factors. One approach is to develop models that capture theoretical situations of no disturbance and compare these models to realized models that include the disturbance effect, which is the technique previous studies have used. For instance, Polfus et al. (2011) compared habitat models with and without human infrastructure covariates to assess indirect habitat loss to northern woodland caribou in northern British Columbia. Using a similar approach, Hebblewhite et al. (2014) modeled Amur tiger (*Panthera tigris altaica*) habitat with and without human-related covariates to evaluate anthropogenic habitat degradation. Patthey et al. (2008) used a regression approach to predict the potential abundance of capercaillie (*Tetraago urogallus*) if alpine ski recreation developments were not present, which they compared to the actual population estimate to assess the effects of winter recreation on the endangered Eurasian grouse.

Applying this approach to wolverines, we demonstrated that winter recreation had a stronger influence on female wolverine habitat selection than the habitat selection of males, as was also found by Krebs et al. (2007). Scrafford et al. (2018) also found that females are more sensitive than males to disturbances from industrial activities. Avoidance of areas with winter recreation degraded an average of 14% of moderate and high-quality female wolverine habitat, with 10% of high-quality habitat degraded two habitat classes to low quality. An average of 10% of male wolverine moderate- and high-quality habitat was degraded, and <1% of high-quality habitat degraded to low-quality habitat. While wolverine home ranges may be notably large, we expect female home ranges, in particular, represent the minimum spatial requirement necessary to provide the resources for the individual as well as offspring and kin as expressed by the resource dispersion hypothesis (Macdonald and Johnson 2015, Copeland et al. 2017). Rauset et al. (2015) found that wolverine reproductive success is related to habitat quality within their home ranges, suggesting factors that cause habitat degradation for reproductive females could translate into reduced fitness. A series of studies on mule deer responses to oil and gas development in Wyoming found avoidance of habitat surrounding oil and gas wells translated directly to declines in population size, empirically linking avoidance of habitat and fitness consequences (Sawyer et al. 2009, 2017). We did not have the information required to assess demographic or fitness effects of winter recreation on wolverine.

Our approach to estimate the indirect effects of recreation on habitat quality assumes independence between recreation and other environmental covariates. Our evaluation suggests minimal bias based on (1) our efforts to screen collinear, and hence, confounded variables in the development of RSF models, (2) the stability of the majority and most influential coefficients when comparing potential and realized models, and (3) 77% of our wolverine locations were outside the winter recreation footprint where confounding would not have affected the coefficient estimates for the potential model. Nevertheless, despite these precautions and caveats, our approach explicitly underestimates the potential effect of recreation on wolverines if recreation activities negatively influenced how wolverines used other environmental covariates.

Responses to recreation type

Male and female wolverine avoided both motorized and non-motorized winter recreation and avoided recreation occurring on and off roads. Females showed the strongest avoidance of off-road motorized winter recreation, which was the second most important predictor of female habitat use in areas where this recreation occurred, and they show a functional response of increasingly strong avoidance as exposure to dispersed motorized recreation increases within their home range. Dispersed or off-road motorized winter recreation also represented the largest proportion of the recreation footprint across our study areas, as well as occurring at much higher intensities than non-motorized recreation. These characteristics of dispersed motorized recreation and female response to it likely result in higher levels of indirect habitat loss experienced by females with higher levels of motorized recreation within their home range than our averaged population model indicates.

Both male and females also showed a strong avoidance of areas with dispersed non-motorized recreation, though these areas were limited within home ranges (<5% of home ranges affected on average). We recorded the highest and most extensive backcountry non-motorized recreation in the Teton study area, but we only captured one male wolverine in this study area. He exhibited strong avoidance of non-motorized recreation and was influential in our functional response analysis (Table 5). This suggests that the strength of avoidance exhibited by male wolverines to non-motorized recreation might depend on the intensity of recreation within their home ranges, similar to the functional response of female wolverines to dispersed non-motorized recreation. Given our limited sampling of male and female wolverines exposed to higher levels of backcountry non-motorized winter recreation, it would be useful to perform additional monitoring in areas with abundant backcountry, non-motorized recreation.

Research examining wolverine responses to human infrastructure has suggested wolverines avoid roads, roaded areas, and development (May et al. 2006, Fisher et al. 2013, Inman et al. 2013, Stewart et al. 2016, Heim et al. 2017, Scrafford et al. 2018). Within home ranges and during winter when roads are covered in snow, we found human use of roads may be more important than the existence of the road itself in determining wolverine responses. Male wolverines were found closer than expected to unused roads but both male and female wolverines avoided areas near roads and groomed routes with winter recreation. Recent research in northern Canada also found that both males and female wolverines avoided active winter roads and that their movement rates increased with increased traffic volume (Scrafford et al. 2017, 2018). In our research, the avoidance of recreated roads was significant but relatively weak compared to avoidance of off-road recreation areas, suggesting that spatially predictable or confined recreation travel patterns may be perceived by wolverines as less risky. Harris et al. (2014) also reported less disturbance to northern ungulates from road-based recreation as compared to recreation that is unpredictable in space or time.

Cumulative impacts of climate change and winter recreation

Both wolverines and backcountry winter recreation are expected to be affected by climate change, potentially resulting in a funnel effect where the overlap between winter recreation and wolverine distribution increases as they both respond to declining snow extent, depth, and the snow season. In the southern portion of their North American range, wolverines appear to be tightly linked to the area defined by the presence of persistent spring snow (Aubry et al. 2007, Copeland et al. 2010, Inman et al. 2013). The underlying ecological requirements that drive this close relationship may include denning requirements (Magoun and Copeland 1998, Copeland et al. 2010), a dependence on scavenging large ungulate carcasses effectively preserved within and under the snowpack (Mattisson et al. 2016), caching food (Inman et al. 2012*a*), and competitor or predator avoidance (Mattisson et al. 2016). Heim et al. (2017) suggested that the association of wolverines to persistent spring snow makes them vulnerable to climate changes, and McKelvey et al. (2011) predicted a 67% loss of wolverine habitat in the western United States by 2059 due to loss of snowpack.

The demonstrated loss of snow pack and reduced length of winter (Mote et al. 2005) may also have profound impacts for winter recreation in the future (Bowker et al. 2012, White et al. 2016, Wobus et al. 2017). While the reductions in winter length are predicted to cause a decline in per capita participation in winter recreation, human population growth may counter these declines and most projections of winter recreation are stable or increasing (Bowker et al. 2012, White et al. 2016, Wobus et al. 2017). Winter recreationists will likely need to adapt when and where they recreate to adjust to shortened snow season and reduction of winter recreation areas due to snow loss (Dawson et al. 2013, Rutty et al. 2015). Winter recreation may become more concentrated and intense in both space and time (Dawson et al. 2013, Rutty et al. 2015), especially during the mid- to late winter period when snowpack is predicted to be the most consistent (Mote et al. 2005). This is also the time period when female wolverines are entering reproductive dens. Predictions of winter recreation distribution and intensity would likely suggest even more severe indirect habitat loss than our current assessment indicates. Our results underscore the importance of managers to consider growth of the recreation industry concurrent with declining habitat for winter recreation, which could exacerbate conflicts between recreation and wildlife.

Conclusion

Balancing the many positive benefits of outdoor recreation with the impacts it may have on natural systems is a growing field of study. Our research into the effects of backcountry winter recreation on wolverines represents information at spatial and temporal scales rarely achieved in other disturbance research. Habitat quality has been linked to reproductive success in wolverines (Rauset et al. 2015), and sufficiently high levels of indirect loss of high-quality habitats through disturbance would affect the reproduction and survival of animals. However, thus far we do not have the information to assess the population level effects of winter recreation on wolverines. Here, we have shown significant avoidance by wolverines of areas used by backcountry winter recreationists and that this results in habitat degradation, particularly for female wolverines. Given the low density and fragmented nature of wolverines in the contiguous United States, impacts to the relatively few reproductive females should be of concern.

Our results suggest that winter recreation should be considered when assessing wolverine habitat suitability, cumulative effects, and conservation. We found that the effects of winter recreation on wolverine habitat are dependent upon the intensity of recreation and that winter recreation patterns are highly variable at the scale of wolverine home ranges such that some animals may experience higher levels of indirect habitat loss while adjacent animals may experience little. Our research provides land managers with a more detailed understanding of important habitat characteristics used by wolverines and should inform management of wolverine habitats across the extensive landscapes they use. These backcountry landscapes represent critical habitats for wolverines, important and highly valued areas for people to connect with nature, and are economic drivers for the small communities that surround them. Solutions to finding a balanced approach to sustaining the diverse values of these wild landscapes require creative approaches and collaboration between land managers, stakeholders, and wildlife professionals.

Acknowledgments

We thank Ana Egnew, Diane Evans Mack, Lisa Nutt, Mark Drew, Rob Cavallaro, Robin Garwood, and the many additional agency personnel who assisted us from the Payette, Boise, Sawtooth, Bridger-Teton and Caribou-Targhee National Forests, Idaho Department of Fish and Game, Nez Perce Tribe and Wyoming Game and Fish. Funding, equipment, and logistical support for the project were provided by the U.S. Forest Service, Liz Claiborne Art Ortenberg Foundation, Round River Conservation Studies, Idaho Department of Fish and Game, The Wolverine Foundation, Idaho State Snowmobile Association, Idaho Falls Zoo, Sawtooth Society, Defenders of Wildlife, and the University of Montana. Businesses also provided logistic support including Brundage Mountain Resort, Jackson Hole Mountain Resort, Grand Targhee Resort, Sun Valley Heli Ski, Teton Backcountry Guides, and numerous local businesses in the towns of Cascade, Driggs, Fairfield, Island Park, McCall, Stanley, Sun Valley and Victor in Idaho and Jackson, Wyoming. We are indebted to our many hard-working field technicians and volunteers. We also thank the thousands of volunteer recreationists who carried and returned GPS units. We thank Lucretia Olson, Dennis Sizemore, and three anonymous reviewers for reviewing earlier versions of this paper.

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Supporting Information

Additional Supporting Information may be found online at: http://onlinelibrary.wiley.com/doi/10.1002/ecs2.2611/full

Appendix N

Seeing the Forest and the Trees

Assessing Snowmobile Tree Damage in National Forests

A Report by Winter Wildlands Alliance

November 2009

Typically, when land management plans address the environmental impacts of snowmobiles, the focus is on air quality, noise and wildlife impacts. Little has been documented regarding the impacts of snowmobiles on vegetation.

Recently, Winter Wildlands Alliance, a national nonprofit organization that promotes human-powered winter recreation, learned that the US Forest Service, as part of forest re-vegetation surveys, has gathered data documenting tree damage caused by snowmobiles in the Gallatin National Forest near West Yellowstone, Montana. The tree damage data show that in addition to well-documented impacts on air quality and endangered lynx, caribou and other animals, snowmobiles may be more directly and immediately impacting the health of forests. Simply put, USFS data demonstrate snowmobiles are chopping the tops off of trees, possibly in significant numbers.

As part of ongoing efforts to evaluate regeneration and thinning needs, the Gallatin National Forest (GNF) conducted regeneration transect surveys of previously logged timber stands. These surveys are required by NFMA (the National Forest Management Act), and look for a variety of damage types and causes, including insect-, disease- and human-caused damage. Through a Freedom of Information Act (FOIA) request, Winter Wildlands Alliance acquired and analyzed the Gallatin National Forest regeneration survey data collected through 1996, when funding cuts curtailed regular survey efforts.

Forest Service surveyors were asked to identify and quantify tree damage observed. Snowmobile damage wasn't difficult to identify—surveys often include notes such as "Broken tops from snow machines."

Gallatin National Forest surveys show that between 1983 and 1995, snowmobiles damaged between 12 and 720 trees per acre in the approximately 72,393 acres of harvested areas studied on the 1.8 million-acre Gallatin National Forest. Tree damage caused by snowmobiles was specifically noted on 366 acres, or 0.5% of areas surveyed.

The rate of tree damage throughout unsurveyed areas of forest may be even higher. The Gallatin's surveyed only areas that had been logged, which is a small portion of the overall acres used by winter recreationists. Surveyed sections were not necessarily heavily used by snowmobiles, though three mentioned the presence of snowmobile trails in the stand. Given that GNF snowmobile use has increased since surveys stopped in 1996, it's almost certain that additional surveys focusing on tracts used by snowmobiles would demonstrate even greater impacts. The three stands surveyed with the highest rates of tree damage had snowmobile trails within the tracts (see chart below).

Tree damage not only hurts the environment, it wastes taxpayer money. The areas surveyed by the GNF were re-planted by the Forest Service after logging. Allowing damage to continue unchecked disregards the investment we taxpayers have made into our natural resources. USFS policy should protect its investment in renewable forest products, not allow it to be destroyed by careless recreationists.

While this Forest Service data covers only one national forest, it clearly shows that the potential for tree damage from snowmobiles is significant across all Snowbelt forests and points to the need for better management of over-snow vehicles. Given the potential for snowmobiles to cause damage over many acres and miles of forest per day, prudent management policy would prohibit unmanaged and off-trail over-snow travel in forested areas to reduce or eliminate future tree damage, and protect important natural resources and taxpayer investment.

Summary of tree Survey Data Provided by USFS

Timber Stand Number	**Area name**	**Year logged**	**Year inventoried**	**Acres**	**Avg # damaged trees per acre**	**Total number of trees damaged**
07-01-04-005	Little Teepee Creek Drainage	1969	1995	122	140	17,080
07-03-02-062*	Horse Butte Road*	1992	1995	15	514*	7710*
7-04-05-063	Madison Arm	1991	1995	12	5	60
7-07-02-037	Unknown	1960s	1983	68	23	1564
7-07-02-038*	Unknown*	1960s	1983	100	652*	65,200*
7-08-03-038*	Cream Creek*	1986	1995	60	725*	43,500*
	**surveys note the presence of a snowmobile trail in this stand*				**Total damaged trees**	**135,114**

Appendix O

G 7/26/17

SKIP BRANDT, FIRST DISTRICT
KOOSKIA, IDAHO

MARK FREI, SECOND DISTRICT
GRANGEVILLE, IDAHO

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BOARD OF IDAHO COUNTY COMMISSIONERS

July 25, 2017

Cheryl Probert
USFS Forest Supervisor
Nez Perce-Clearwater National Forest
903 3rd Street
Kamiah, ID 83536

RE: Forest Plan Revision-Wild and Scenic River Suitability Evaluation Process

Dear Cheryl;

We have concerns with the number of river segments (approximately 100) currently being proposed as eligible under the Wild and Scenic River Eligibility evaluation process. This is a significant increase over previous Eligible River evaluations.

Wild and Scenic River designations can and have unexpected and significant impact on Idaho County. Just in the recent years, we have experienced some of those impacts. The transportation on Highway 12, the ability and efficiency of salvaging timber from wildfires, livestock grazing, and restrictions on outfitters and guides have all had negative impacts documented recently in Idaho County.

We are concerned that the protection of these eligible river segments may be more restrictive than rivers actually designated as Wild and Scenic. When the adjacency provision of the Wild and Scenic Rivers Act is applied, these approximately 100 river segments could adversely affect the majority of the National Forest Land in Idaho County.

For these reasons, we believe that it is important that the Forest completes the Suitability Evaluation during the current Forest Planning process. We believe the Suitability process would eliminate most of these rivers, thus eliminating unnecessary and burdensome regulations on the land.

We look forward to working with you and your team in making river recommendations from which you will make the Suitable determination under the Wild and Scenic Rivers Act and in accordance with FSH 1909.12.

Sincerely,

R. Skipper Brandt

Mark Frei

Denis B. Duman

R. Skipper Brandt, Chairman

Mark Frei

Denis Duman