



Editorial Board  
*Science*

16 April 2023

Dear Dr. Wible,

On behalf of my coauthors, I am pleased to submit a revised version of our manuscript titled Braiding Endangered Species Laws and Indigenous Rights for Meaningful Species Recovery. I would like to express my sincere appreciation for the thorough review provided by the reviewers and the editors. The provided comments and suggestions have been invaluable in improving the quality of the manuscript.

In response to the reviewers' feedback, we have made several revisions to the manuscript, including:

1. Adding a section to SI #1 on the USA Endangered Species Act and an entirely new SI (#2) focused on calculating caribou harvest rates and community meals.
2. Acknowledging that full recovery may not always be possible for some species (such as plains bison) and provide alternative options.
3. Increasing Figure 2 to a higher resolution and smaller spatial extent.
4. Minor wording throughout to increase clarity and address minor reviewer comments.

We believe that these revisions have strengthened the manuscript and addressed the reviewers' concerns. Thank you for considering our revised manuscript, and we look forward to hearing from you soon.

Sincerely,

Clayton T. Lamb, PhD, University of British Columbia

## Reviewer Responses

### Reviewer: 1

The authors have written a very valuable and important manuscript in regard to North American threatened and endangered species policy and law. The authors provide three case-studies (woodland caribou, American bison, and Pacific salmon) demonstrating the need for reformation of endangered species policy in both Canada and the United States. The most important arguments within the manuscript center on Indigenous rights (both due to Treaty law and cultural significance), and how minimum viable population recovery does not satisfy these rights. The authors make a compelling argument that is extremely important for the future of threatened and endangered species policy.

#### Major Comments

Thank you to the authors for providing a very well-written manuscript, with few (if any) grammatical errors. This manuscript adheres to Science's "Mission", by being influential within the overarching field of wildlife management and if published, will significantly advance scientific understanding (by way of policy change).

As this is a "Policy Forum" manuscript, I understand that much of the inherent discussion is somewhat opinion based. However, at various points in the manuscript, there is omission of opposing perspectives. This can undoubtedly be rectified, and I have included areas in the Specific Comments section on where I believe this is warranted.

The arguments for policy change (i.e., increasing species' populations to culturally significant levels) are broadly important for the wildlife management field, but also socially and politically relevant as these policy changes may also influence Indigenous rights on numerous fronts. As stated earlier.

Figures are professional, with one small issue that I will address in Specific Comments.

Reference list is relevant and limited to 15 citations.

Supplementary material is appropriate and should remain included.

We thank the reviewer for this thorough and positive review. We address the inclusion of opposing views below.

1. Abstract—I agree with the authors that caribou, bison, and salmon are likely keystone species, but with no mention of this in the manuscript it seems out of place to add it in the abstract. I would suggest changing to 'culturally-important' or 'high-profile' as written in the main text, or make a mention of keystone species with a citation within the main text.

We have removed keystone and replaced with 'culturally-important'.

2. Main Text—Page 4, Paragraph 2 – When talking about “impeding Indigenous peoples from carrying out cultural practices”, I would suggest strengthening this statement by adding something to the effect of – “cultural practices and food sovereignty”.

Agreed, we have edited this sentence to now read as *“We focus on three high-profile species in North America—caribou, bison, and salmon—which have formed central aspects of Indigenous peoples’ diet, culture, and seasonal movements since time immemorial. In each case, the decline of these species impeded Indigenous peoples from carrying out cultural practices and exercising food sovereignty”*.

3. Page 5, Paragraph 1- Remove ‘But’ in “But Indigenous Knowledge provides”

Agreed and removed.

4. Page 5, Paragraph 2 – I would suggest a citation (method) of some sort (Western or Indigenous) on how you came up with ~3 caribou for sustainable harvest. Many readers will not be wildlife professionals.

Agreed. We have now added a new section in the SI to address how we arrived at how many caribou could be harvested per year. This section of the SI reads as follows:

***“Supplementary Material 2: Caribou harvest calculations:***

*We approximated the number of caribou that could be sustainably harvested each year from the 2021 Klinse-Za subpopulation and future potential population sizes. These calculations are meant to contextualize the link between population size, annual harvest, and food sovereignty. These calculations were done through a Western lens and do not necessarily reflect the harvest views or plans of West Moberly First Nations or Sauteau First Nations.*

*There were 114 caribou in the Klinse-Za subpopulation in 2021. The subpopulation has been increasing at ~12-14% per year since 2013 (7). An annual harvest rate of 3-4% was deemed sustainable (bull only) for increasing caribou subpopulations in British Columbia (8). Using the conservative end of the harvest spectrum (3%), we estimated that 3 bull caribou could be sustainably harvested each year.*

*We then estimated the number of meals that these caribou could provide. A bull caribou provides about 100 lbs of meat (9). Assuming a standard meat portion size of 6oz (0.38 lbs), and accounting for the 1,270 people that compose Sauteau First Nations and 366 that compose West Moberly First Nations, one meal for everyone would require 621 lbs of meat. Thus, approximately six bull caribou would need to be harvested to provide a single meal for each community member.”*

5. Page 6, Paragraph 1 – The section where authors are discussing the number of caribou that could be sustainably harvested (1 meal to 15) fails to explain why 15 meals for each individual is that much more culturally significant than 1 meal for each individual; provide the argument why there should be more harvest (tribal gatherings, community connectiveness, etc.).

Agreed, we also added the following to the revised Supplementary Material 2 “... *A single meal of caribou for all community members would likely be a strongly symbolic and joyous celebration. But a single meal would not provide a meaningful contribution to food security nor reconnection to harvesting practices by the community due to only 3 animals available for harvest each year. We are not able to prescribe, at this time, what an optimal harvest to satisfy all cultural needs would be, but we can approximate the meals, hunting opportunity and caribou needed to facilitate more. The “sea of caribou” that were once present in Klinse-Za cannot be directly translated into a number to satisfy most western ways of thought, but we can translate this number into a minimum number of caribou that might garner such a description. A few thousand caribou across the ~6,500 km<sup>2</sup> herd area, that moved in congregated herds, would likely begin to appear like a “sea of caribou”, and would be consistent with historical records for mountain caribou in British Columbia (10). We redid the harvest calculations above to estimate the hunting, cultural, and sustenance opportunities provided by this larger caribou abundance. Using ~3,000 caribou as the projected abundance, we estimate that ~90 caribou could be harvested annually, providing hunting opportunities for many more Indigenous community members (i.e., creating and sustaining cultural knowledge) and ~9,000 lbs of meat. This meat would provide ~24,000 meals or ~15 meals for each community member annually. This is not necessarily the prescriptive target from the community perspective, but the increased abundance of caribou provides increased hunting opportunity, more meat, and more meals. Collectively, increases in culturally-important species can support more community gathering, connectedness, and rekindling of important cultural practices such as caribou hunting.*”

6. Page 7, Paragraph 1 – Indigenous peoples are excluded from hunting bison in an example provided. Without context, the reader does not know if this means Indigenous people are excluded from all bison hunting, or just from the National Park. I would suggest including the reason exclusion from this park is of importance or providing the caveat that Indigenous peoples harvest bison in other regions.

We’ve added a sentence caveating that harvest does occur outside National Parks, but even there, rights remain curtailed. For example, in the Management Plan for the Aishihik Wood Bison Herd in Southwestern Yukon (4) **Under the Umbrella Final Agreement wood bison are considered a transplanted species and as such, Yukon First Nations do not have subsistence hunting rights.**” A combination of the limited distribution of bison outside of national parks and colonial influence on Indigenous Rights continue to influence the harvest of this species. Sentence in paper: “*Despite this example of MVP recovery, Indigenous peoples are often still prevented from harvesting bison, for example, in Canada’s Wood Buffalo National Park. Although limited harvest occurs outside National Parks, subsistence hunting rights remain curtailed in many areas*

*(4). Thus, wood bison recovery highlights the continued mismatch between MVP recovery and culturally-meaningful recovery of wood bison.”*

7. Page 9, Paragraph 2 – “Full Recovery” does not seem like a logical recommendation for species such as bison which the authors argue have clear recommendations to list as endangered. I don’t think it is appropriate for me to suggest that the authors change the scope of their recommendation here, but for United States’ (likely Canadian as well) wild bison populations, there is simply not enough habitat or connectivity (e.g., plains conversion to production agriculture, urbanization, transportation infrastructure) for wild bison to persist in historic abundance or distribution when considering their natural history and grazing strategies. Because bison are one of your case-studies, I think it is important to recognize the shortfalls of this target so that opponents of a change in policy cannot single this section out. Unless the authors are arguing for the removal of ALL of these barriers to bison habitat and connectivity, which I don’t believe they are, I would suggest rewording some of this section to include caveats where full recovery is likely not possible.

Agreed, this is a helpful point and we deeply appreciate the reviewer’s perspective on the intentions of our work – which is to support more effective science and conservation based policy. We have now added sentence as follows: *“Full recovery will remain challenging for some species, such as plains bison, due to the conversion of their historic habitat to agriculture, urbanization, and transportation infrastructure. In such cases, a modified recovery target based on remaining or restorable habitat may be required, along with consideration of policy tools such as reparations.”*

8. Figure 2—Due to the large range of Y-values for American bison, I think it would be beneficial to add values to the 1890 (n=200) and 2022 (n=30,000) figure (or at least put it in the caption). If a reader simply looks at this figure, they may be led to believe bison are extinct (if they don’t look at the supplementary material), based on the location of the dots on the bison figure.

Agreed, we have added labels for the smaller abundances of each species.

9. I cannot tell in my version of the figure (a little blurry), but it appears there is almost no current wild populations of bison in the US. I think I can make out a single spot in Yellowstone, but there are definitely more locations of wild bison on public lands in the US; I know for certain that there are bison in Montana at the American Prairie Reserve (non- profit) and in South Dakota at Custer State Park, Wind Cave National Park, and Badlands National Park (all public lands).

We have remedied this issue on a few fronts.

We have increased both the size of the maps, zoomed in on the central area, and increased their resolution.

We are using the current bison distribution from the 2017 IUCN status assessment. We were directed to this product by the IUCN Bison Specialist Group Vice Chair, Dustin Ranglack. It seems this distribution only considers the free-ranging bison as of 2017. The bison herds referenced by the reviewer appear to be legitimate conservation efforts for bison, but they are still maintained within a fully fenced area, and are thus not defined as free ranging wild populations.

For example, on the American Prairie Reserve's website they state: *"The American Prairie herd is dispersed across several properties, and graze vast properties enclosed by modified wildlife-friendly fences. We are required by the Bureau of Land Management and State of Montana to pay the same Animal Unit Month (AUM) fees and taxes as any other producer does to graze livestock. Even though bison are classified as livestock, we follow bison management philosophies that prioritize allowing bison to play their natural ecological role to the extent possible. We use low stress handling techniques when handling bison and handle bison only when necessary."*

We are not aware of another map (i.e., shapefile) that would accurately encompass both free-ranging bison and those behind fences. To address the reviewers' comment we have added the following to the figure caption: *"Data sources for distributions detailed in Appendix 3. Bison distribution only considers free-ranging populations, not those fully enclosed by fencing"*

10. Table S1—In the table I was provided, in the N column I believe there are errant 0's below estimates. This is likely that the column is too narrow and forces the 0 to a new row.

Resolved by widening columns.

11. Overall Recommendation—As stated earlier, this manuscript adheres to Science's "Mission", by being influential within the overarching field of wildlife management and if published, will significantly advance scientific understanding (by way of policy change). This manuscript is novel and has the opportunity to be impactful by providing recommendations for policy change in relation to Indigenous peoples and endangered species policy and law. Policymakers can look to this article when making decisions about the sufficient recovery of culturally important wildlife species. Indigenous food sovereignty, cultural relationships, and most importantly (in terms of policy and law) legal obligations to tribal communities should shape the future of policy for these and other endangered species. I thank the editor and the authors for allowing me to review this influential policy manuscript. I recommend that this article be published with minor revisions and hope that my review will only improve the contribution.

Again, we would like to share our appreciation for the quality and helpfulness of this review.

## Reviewer: 2

Comments extracted from PDF:

12. Fig 1: I really like this Figure as a visual representation at the onset. Very good.

Thank you for this positive feedback.

13. Page 3: "tend" is a little strong given the number of insects and plants that are not charismatic. Saying they tend to focus on rare species is a given. ESA species are probably rare outside a narrow range. Would we want them to ignore a rare species? Is ESA allowing non-glamorous species to go extinct? It kind of sounds like that's what is implied. It's mostly litigation driven and FWS/NOAA does not choose. I disagree they focus on glamor species.

We have removed "rare" and agree with the reviewer that is an inherent property of threatened and endangered species.

Regarding our statement that "Recovery efforts tend to focus on charismatic species", as far as we are aware this statement is true generally, and in both the US and Canada. We base our statement on a number of metrics including the disproportionate focus on mammals, relative to their prevalence and conservation risk, in endangered species listings (5–7), funding (8, 9), and recovery plans/actions (6). A review of the ESA found that: "with few exceptions, a taxonomic bias was detected in the recovery process that favored animals over plants, vertebrates over invertebrates, and birds and mammals over fish and herpetofauna" (10). Indeed, looking at the supplemental materials of Gerber et al. (2016), suggests that, compared to plants, mammals make up a disproportionate amount of the 'overfunded' species (28%), compared to only making up 9% of the adequate and underfunded species (11)\*. Finally, the species recovered under the ESA tends strongly towards mammals, birds, and flowering plants, while only mammals and birds are disproportionately represented in compared to the number of species listed (12), suggesting that mammals and birds are contributing disproportionately to metrics of successful recovery.

\*Summary of funding for mammals vs plants from supplementary material in (11):

- i. Overfunded 7 mammals: 18 plants. 28% mammal
- ii. Adequate 5 mammals: 49 plants. 10x plants 9.2% mammal.
- iii. Underfunded 60 mammals: 581 plants 10x plants 9.3% mammal.

14. SM1: It seems like the authors would discuss ESA in USA at this point similar to Canada and SARA

Agreed - we have now added a section on the ESA in **Supplementary Material 1**. It reads as follows: "**United States-** The US Endangered Species Act (ESA) (13) recognizes the importance of Indigenous peoples' use of and connections with wildlife and requires federal agencies to consider the potential impacts of ESA actions on tribal lands, resources, and cultures. Recovery plans developed under the ESA can include measures that support sustainable Indigenous use of a species while still achieving the species' recovery objectives. Regarding species abundance targets under recovery plans, the ESA requires that recovery plans include "objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this section, that the species be removed from the list" of endangered or threatened species (16 U.S.C. § 1533(f)(1)). The criteria for delisting a species must be based on the "best available scientific and commercial data". The ESA does not specifically require that species abundance targets under recovery plans consider restoring abundance to pre-colonial levels that would fully support Indigenous ways of life. In practice, this translates to recovery objectives that are consistently below historic levels (14). The ESA does require that recovery plans be developed "with the cooperation, to the maximum extent practicable, of all Federal and State agencies and all persons interested in participating in the development and implementation of



*such plans, including Native Americans" (16 U.S.C. § 1533(f)). This last provision recognizes the important role that Indigenous peoples can play in species conservation and recovery and provides opportunities for their input into recovery plans. However, in practice, this duty to consult with all stakeholders and rightsholders—Indigenous peoples, private land owners, industries, etc.—often results in recovery targets that may be more modest than pre-colonial abundances (14) and what might be required to sustain practices such as harvest and exercising of food security."*

15. SM1: Environmental Justice issues related to ESA and Tribes is a rich topic. Much more information could be provided if the authors wished to go that direction. The Federal ESA nexus to tribal lands through Bureau of Indian Affairs causes tribal actions to fall under Section 7 instead of Section 10. Thus, Tribes pay a higher price and a much heavier burden than private landowners where listed plants are ignored unless they are in a jurisdictional Federal wetland. That's just one example. BIA is treated the same as any other Fed bureau under ESA, yet its Mission is Trust and Congressional dollars are provided via a Trust responsibility as stated in the BIA Mission. Yet, they are treated as any other Fed land. Secretarial Order 3206 has Conservation Standards that should be met before restricting tribal activities. One standard basically says, "look elsewhere if possible to accomplish the purpose of the restriction". This cannot happen when FWS/NOAA continue to use tribal lands as part of their baseline assessment for all ESA actions.

The reviewer makes an important point about the complex relationship between environmental justice issues related to the Endangered Species Act (ESA) and Indigenous communities. The reviewer points out that the Bureau of Indian Affairs (BIA) is treated the same as any other federal agency under the ESA, despite its mission to provide trust responsibilities to tribes. As a result, Tribes pay a higher price and a much heavier burden than private landowners where listed plants are ignored unless they are in a jurisdictional Federal wetland. Additionally, Secretarial Order 3206 has conservation standards that should be met before restricting tribal activities, but FWS/NOAA continues to use tribal lands as part of their baseline assessment for all ESA actions.

While environmental justice is an important issue, it may be beyond the scope of the current paper, or at least not within the available word limits. We have cited an important paper exploring environmental racism at the intersection of Indigenous rights and endangered species in the main paper (e.g., see work by Muir and Booth (2012)). The paper (15) examines the impact of coal mining on the caribou population and Indigenous communities in northeastern British Columbia, Canada, using an environmental justice framework. The authors argue that the current approach to caribou recovery planning and mining development is unjust, as it disproportionately affects Indigenous communities and fails to consider the interests of the caribou population. They call for more equitable and participatory decision-making processes that prioritize the protection of vulnerable communities and conservation of critical species and ecosystems. Readers can find some more information on environmental justice here, and we hope to expand on this important topic in future publication with fewer word constraints.



16. I found this to be a very interesting paper. I feel like the general point re recovery of species to culturally-meaningful targets is clearly important. It seems wrong, for example, that Indigenous harvesting and other stewardship is not directly included in recovery efforts as a default. I have also been told by Indigenous colleagues that low populations of certain species are a violation of Treaty Rights. This corresponds with one of the major points in the paper.

Thank you – we appreciate hearing that this aspect of the message aligns with what you’ve heard from Indigenous colleagues.

17. However, I do think there is a big issue with the current version. Specifically, I don't think the case studies illustrate the breadth of the problem. More importantly, I don't think the solutions to the problem are fully articulated. A few examples of additional culturally-significant species that I am aware of are: American eel; Pacific abalone; Florida manatee; black ash; ginseng and many other plant species that are medicines; wolverine; and various turtle species. Of course, this is just a few. I cannot speak to Indigenous perspectives, but will note that I have heard Indigenous friends and colleagues state that all species are important. Sadly, some species have probably passed tipping points that would make recovery extremely difficult. Some are on the verge of extinction. I don't think choosing just a few of them would be appropriate or just.

We did not intend to suggest that the 3 species we highlight in this paper are the only species of concern, or that are facing similar challenges. We have added the following before we detail each case study species to reduce further confusion: *“The species we highlight here are only a few of the culturally-important species that are now in a state of diminished abundance (16).”* We also cite a recent paper just published in PNAS (16) on Biocultural species that demonstrate the breadth and range of species that might also have fulfilled culturally-important roles across the globe.

18. Thus, bringing all culturally-important species to historical levels is would require monumental effort. I think meaningful change on the necessary scales would require action that is far beyond what legislation such as the ESA or SARA could achieve. Land use policies on "private" and "Crown" or "State" land and ocean resource management policies would have to drastically change. Infrastructure such as hydro dams and roads would need to be removed in many places. Using SARA or the US ESA as mechanisms for this would be rather like using a shovel to move a mountain. The structure of the legislation (including authority, exceptions, governance structures, timelines etc.) is just not compatible, in my opinion. My guess is that such a new vision at a national scale might require constitutional change. For species threatened by climate change, it would require concerted action both in Canada/US and beyond their borders. I don't think that the scale of the problem should prevent action, and I really liked the positive results in a couple of the case studies. I just feel that the paper would need to fully articulate both the scale of the problem and potential solutions. I could not see how the case studies would translate more broadly, without a clearly laid-out pathway for legislative change. Perhaps more clearly linking the case study solutions with broader solutions would work?

Based on this comment and similar comments by Reviewer 1, we’ve contextualized full recovery to acknowledge limitations. In the concluding paragraphs when we talk about full recovery and the IUCN green list, we’ve now added the following caveat: *“Full recovery will remain*

*challenging for some species, such as plains bison, due to the conversion of their historic habitat to agriculture, urbanization, and transportation infrastructure. In such cases, a modified recovery target based on remaining or restorable habitat may be required, along with consideration of policy tools such as reparations.”*

We believe this caveat is important to ensure policy makers understand that we also see there are limits to full recovery, while also maintaining the need to maximize recovery and reimagine the future of recovery where possible. Indeed, some previously unlikely restorative options such as removing hydro dams and roads are now being actioned. This practice is not yet necessarily widespread but is occurring in north America to improve conditions for salmon (17) and caribou (18). Thus we believe that including these challenging but 'monumental' changes illustrates that while this reviewer's point that the scale of the problem is potentially massive, meaningful changes have been put into place already and we only see these efforts expanding under the current re-centering of Indigenous led conservation efforts.

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