Dear Mr. Lamb:  
  
Subject:  Manuscript ID cjz-2023-0032 entitled "Assessing health and fitness correlates for endangered mountain caribou demographically supported by maternal penning  
  
Thank you for your patience, I realize that a decision on your work has taken a long time.  One of our reviewers who was very keen to evaluate your work ran into serious health issues and this took time to sort out.  However, I think you have received two very thoughtful and in my view, highly useful reviews.  Based on those and my reading, in its present form, your manuscript is not acceptable for publication.  However, both reviewers DO feel that there are considerable highly useful data in your work and are keen to see it again.  Major revisions, as detailed in the enclosed reviews, have been recommended - The review comments are included at the bottom of this message.  I do agree with #2 that considerable reorganization would greatly improve the focus and clarity of your MS.  I strongly encourage you to think about this.  As an example of how I look for focus, I am on a personal warpath against the phrase "little is known" as a justification for a study.  I used to let a lot of those go when I started out as an editor of CJZ, but no longer.  Give us a REAL reason for doing your study! Little is known, so what?  Little is known about how many blades of grass there are in my lawn.

1. We’ve added more structure to the intro and better justified the “why”. We edited the intro a fair bit, but did not do a full rewrite given R1’s positive view on it “The introduction was thorough and provided a solid background on the subject.”. The added details and hypotheses should help.

For my part, I have already written about including information about collaboration with First Nations.  I ask that you be more explicit about animal care approval.   Aside from all the reviewer comments about clarity, I have two writing suggestions.  I have a pet peeve with "...utilized".  This is simply an "impressive" way to say use.  Simpler is clearer.  I ask you to adjust your use of "weight".  This is a strange word used incorrectly by many scientists.  We do weigh things but it is to estimate mass which is reported in kg or g.  Weight has units of Newtons and is a force.  See: Lidicker WZ 2008. Mass or weight: Response to Murray (2008) and Chardine (2008) Auk 125:744.  Finally, I ask that you take a close look at Monckton et al. 2020; recently published in CJZ. <https://cdnsciencepub.com/doi/pdf/10.1139/cjz-2020-0027>.  This paper has prompted us to update our instructions to authors re how the species under study are reported.

1. Changed all utilized to used, changed all weight to mass (had it right in figure though!). All species common and binomial names are consistently reported.
2. We initially added a positionality statement to explain the lack of First Nations involvement, but in the end a member from each Nation was able to read the paper and provide comments. Both of these individuals have been part of the project since its inception and have helped conceptualize and manage the project. We have included them as co-authors and thus have representation from both West Moberly and Saulteau First Nations. Both individuals were authors on (Lamb et al. 2022).

**Reviewer: 1**  
  
Comments to the Author  
I have reviewed the manuscript, “Assessing health and fitness correlates for endangered mountain caribou demographically supported by maternal penning”. The manuscript assesses the health of southern mountain caribou temporarily held in a maternal pen to increase growth of the population and compares health metrics between penned and animals not-penned and between those that reproduced successfully and those that did not. The manuscript is well-written overall and contributes to the literature on caribou health as health indices and baselines are lacking for several groups of this species, particularly for free-ranging populations.

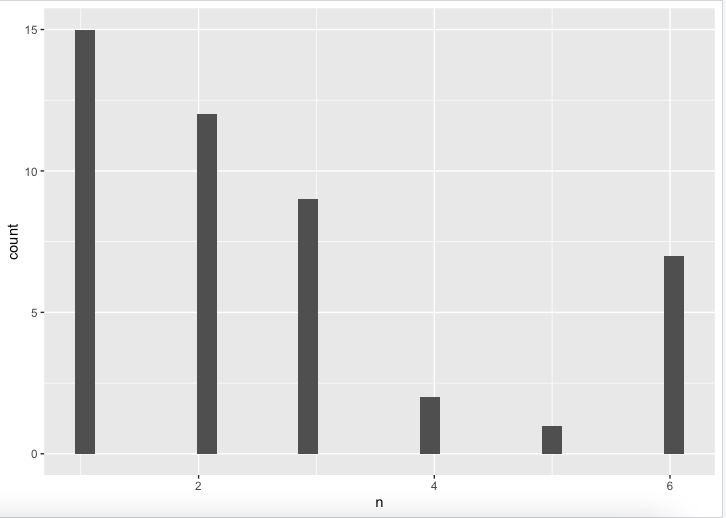
1. Thank you!

The introduction was thorough and provided a solid background on the subject. Some additional detail is needed to describe the sample collection in the Methods section, including the drug dosage given to the animals, centrifuge speed and centrifuge model used and how long the samples were centrifuged. From what vein was the blood collected from and what needle and syringe size were used? For the serum, plasma, buffy coat, and red cell components, mention the type of blood tube or vacutainer that each of these samples were collected. Lines 167-168 mention that blood was centrifuged within one to two days of capture. Mention whether the blood was kept on ice or refrigerated during the time period prior to being centrifuged or if it was kept at room temperature?

1. Done

As far as the statistical methods, I was curious as to whether adding a random intercept for individual animal was considered to account for repeated observations of individual animals? It also was unclear as to how pregnancy was assessed. I may have missed it in the methods, but was it from a pregnancy test or determined from whether a calf was born dead or alive?

1. Good question. We did try individual random effects early on, but there was no support for this approach and we did not continue testing it. Although there are repeat captures (n) of the same individuals (i.e., 15 we only caught 1x, 12 only 2x, etc. see plot below), we think overall the limited numbr of repeat captures and the fact that 33% of individuals were only captured once and 58% of individuals were captured two or less times limits the ability for a random intercept of individual to provide additional information for the model. As an example, we had support for a random effect of year on trace nutritents. Adding a random effect of individual provides no additional information to the model and the nutritents we examined (Zinc, Selenium, and Manganese, an anova analyses provided no support that adding individual random effects increased model fit to the data (p>0.78).

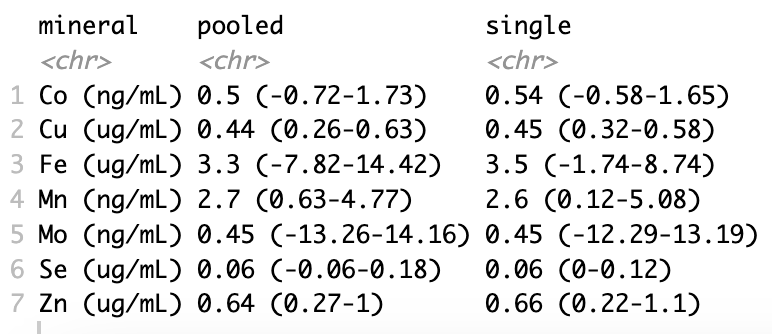


Another aspect to consider that I did not see mentioned was that trace mineral levels can vary depending upon season collected. Was this considered when comparing trace mineral levels to the Bondo et al. (2019) study? It should be mentioned in the methods whether the samples being compared for this study and the Bondo et al. (2019) study were collected during the same season. If they were not, then that could be discussed as a limitation.

1. Our samples were collected in the same season (winter) and Bondo et al. (2019). Bondo et al. (2019) collected their samples between 17 December 2012 to 1 April 2013. We primarily captured caribou in March of each year between 2014-2021, but also caught some animals (<5%) prior to March in December–February.
2. We’ve added the following to the end of the sample collection methods “Blood and hair samples from ONCP and boreal caribou were also collected in winter, providing reliable comparisons between areas.”

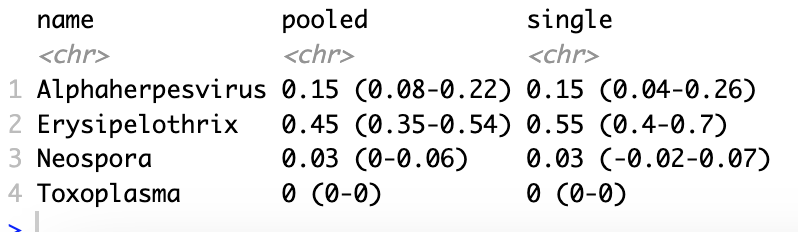
Also, when comparing the overall trace mineral levels of the Klinse-Za herd and other health indices, including seroprevalence of pathogens, with the Bondo et al. (2019) study, another limitation of the direct comparison is that the Klinse-Za baseline levels pooled results from multiple years and multiple individuals whereas Bondo et al. (2019) included samples collected during only one year and individual animals were sampled only once. This should also be mentioned in the discussion as possible limitation with direct comparison.

1. This is a good point. We redid the summary stats using the pooled results across multiple years and individuals (pooled) versus only collected once per individual at first capture (single). The results are qualitatively the same, and statistically inseparable.
2. We have added the following at the begging to address this concern and added a table into appendix D showing pooled vs single results: “The health metrics were collected multiple times on some individuals due to being captured in more than one year. We assessed the sensitivity of our results to summarizing health metrics across all captures which would include multiple records for some individuals (pooled) or just using a single measure for each individual during their first capture. Overall, there was little qualitative, and no statistically significant, difference in the results from these two methods and we retain the results from the pooled dataset (Appendix D).”



If seroprevalence of pathogens overall for the Klinse-Za herd included all repeat observations of each individual, potential effects of clustering at the individual animal level would likely affect the overall seroprevalence. This should be further discussed as a limitation when comparing overall seroprevalence results between this study and the Bondo et al. (2019) study, which determined seroprevalence of various pathogens during only one year.

1. As above, we redid the analyses with single or pooled observations. The results are basically the same, except for Erysipelothrix, which is higher when single is used. Given that we observed this pathogen to come and go within an individual we feel that our pooled data across years gives the best estimate at the population level. In either case, the results are statistically indistinguishable.



The manuscript was informative, comprehensive, and thorough. The results section seemed lengthy and could potentially be reduced by making the wording more concise if possible. For the seroprevalence of pathogen results, could these values be incorporated into Table 1 with the sample sizes? Then the sample sizes of trace minerals and other health indices presented in figures elsewhere could potentially be removed from Table 1 if they are presented in the figure captions. There was some material in the results section describing additional statistical details that seem like they could be either stated more concisely or consider putting those details in the methods.

* 1. The table requested by the reviewer can now be found as Table 1.

When reporting seroprevalence in tables or figures (Figure 8), the 95% CI should be included. If comparing seroprevalence to other studies and stating whether one value is higher or lower than another, the 95% CI of the other studies should also be included. If a statistical test is not done to compare the results, then it should be stated that it is being determined whether one value is higher or lower than another by whether the confidence intervals overlap.

1. 95% CI’s added for this, and comparison, studies.

Other comments include generally minor comments to improve clarity. Some overall comments include that sub-population and herd was used inter-changeably, which could be confusing. Some of the citations in the text were in the incorrect format and should have been cited as Author et al. (2002) rather than (Author et al. 2002). When the figures with multiple figures were referred to in the text, the corresponding letter of the figure was not referenced, which made it confusing for the reader to interpret the results. For Figure 2A, Figure 4A, Figure 5A, and others, the captions should specify what the error bars represent. Full scientific names of the pathogens should be included in the text and in italics. Rather than using hyphens to separate number ranges, and en dash should be used.

1. Changed herd to subpopulation throughout
2. Fixed citations
3. Added letters to figures, and specified what error bars meant
4. Changed ranges to en dash throughout

Line by line comments are below.  
  
  
Line 23-24: Suggested change to reduce words and to provide a more clear objective of the study rather than saying “little is known about their health”: “Southern mountain caribou are endangered and could benefit from an integrated approach to wildlife health because their health status is unknown”.

1. Done, changed as per the reviewers suggested text.

Line 24-25: Suggest rewording to improve clarity to something like: “Here, we assess the health of southern mountain caribou temporarily protected by a maternal pen, which was an Indigenous-led conservation initiative to increase population growth of caribou.”

1. Done, changed as per the reviewers suggested text.

Line 27: State what herds or sub-populations these 46 animals were from.

1. Done, added: “We collected health metrics from 46 female Klinse-Za caribou between 2014-2021”

Line 29-31: This was a little confusing because comparing the Klinse-Za caribou herd with other sub-populations was not mentioned in previous sentence as an objective.

1. Added this comparison the above sentence: “We collected health metrics from 46 female Klinse-Za caribou between 2014-2021 and compared health metrics between penned and non-penned animals, between successful and unsuccessful reproductive attempts, and between other subpopulations. Results suggest that Klinse-Za caribou were generally healthy relative to neighboring subpopulations and that repeat capture and penning did not create accumulated health issues.”

Lines 31-33: To make this more clear recommend rewording to, “We provide evidence linking trace nutrients and measures of stress to reproductive success but find no evidence for relationships between reproductive success and exposure to pathogens or biomarkers of inflammation.

1. Done, changed as per the reviewers suggested text.

Line 43: change “people” to “humans”

1. done

Line 45: change “people” to “humans”

1. done

Line 60: insert “of” before “moose, deer, and elk”

1. done

Line 68: Unsure if “individual well-being” is needed here since that term is not defined and it is unclear how that would be measured. Wildlife health can broadly include several aspects, so maybe it can be implied that health could also include individual well-being?

1. Agreed, changed to “While the direct causes of caribou population declines are well understood, the influence of habitat loss and high predator densities on caribou health, and resulting population-level demographics, are unclear”

Line 89: Suggest adding “populations” after “caribou”

1. done

Line 92: Unclear what is meant by Northern USA. Does this mean Alaska or does it mean the northern contiguous states, such as Washington, Oregon, Michigan, and Maine? Maybe be more specific and name the northern regions of the US that it includes?

1. Replaced “Northern USA” with “northwest contiguous USA”

Line 103: Suggest changing “one day to support a hunt” to “support a hunt in the future”

1. Done, changed as per the reviewers suggested text.

Line 119: Combine this paragraph with previous paragraph since it is only one sentence long.

1. Done

Line 122: Should this be interactions or associations? If interactions were not analyzed statistically, associations might be a better word.

1. Changed to associations.

Line 133: Remove “more” as it is unspecific.

1. removed

Line 137: Insert comma after “(McNay et al. 2022)”

1. done

Line 152 Appears to be a typo. Remove “At capture”

1. removed

Line 154: Change reference format here to: “as described in McNay et al. (2022)” rather than “as described in (McNay et al. 2022)”. Change formatting throughout when cited this way.

1. done

Line 156: Consider saying “approximately the same number” instead of “approximately similar”

1. Done, changed as per the reviewers suggested text.

Line 157: Change “we left in” to “in the remaining free-ranging population”

1. Done, changed as per the reviewers suggested text.

Line 158: Change “grew” to “increased”

1. done

Line 158-159: Confusing as worded. Change to something like, “Initially most marked animals were brought into the pen, but as the free-ranging population increased, the number of samples from adult females in this population increased as well.”

1. Changed to “Initially most marked animals were brought into the pen, but as the overall population increased, the number of marked adult females in the free-ranging population increased”

Line 159: What is meant by the sample of free-ranging females? Were these free-ranging females actually sampled in some way (e.g. marked individuals)? Or were they unmarked and does it mean that there were potentially more samples that could be collected from these individuals?

1. Changed to “Initially most marked animals were brought into the pen, but as the overall population increased, the number of marked adult females in the free-ranging population increased”

Line 169: Reference (Figure 1) here to show location of these sub-populations.

1. Done

Line 171: move “between 1998 and 2013” after “captured” in line 170. Be consistent with either using a dash or “and” between date ranges.

1. Done.

Line 174: Confused by wording. “Samples from six caribou subpopulations…were subsampled.” Is sub-sampling the correct word? Were sub-samples collected from the samples collected? Or does it mean that not all individuals in population were sampled? Reword to clarify.

1. Done

Line 176: change “currently is” to “is currently”

1. Done

Line 177: change “experiencing” to “exposed to”

1. Done

Line 178: Change wording to remove “don’t exist”. Suggest: “Given that there are currently no established values for optimal parameter ranges for most caribou health metrics, we...”

1. Done, changed as per the reviewers suggested text.

Line 205: Rather than saying… “Please refer to…”, suggest, adding in more detail and maybe saying, “Procedures for capturing caribou, care while in captivity, and monitoring radio-collared caribou complied with guidelines established by the Canadian Council on Animal Care (2003, 2017), with standards for live animal capture and handling and monitoring established by BCMOELP (1998). All activities were approved under BC Wildlife Act Permits FJ14-93094, FJ18-421458, FJ21-623574, FJ22-682329 and FJ22-655188). Additional details are provided in Appendix A.

1. Done, changed as per the reviewers suggested text.

Line 211: I think the Table 1 reference would fit better at the end of the sentence after “pathogen exposure.”

1. Agreed, moved.

Line 240: Change “it’s thought” to “it is suspected”

1. Done

Line 252: Here it says that individual and sex analysis was done on fecal samples, but in line 204, it says that all samples were genotyped to identify sex. Should line 204 also say that samples were genotyped to identify individuals as well?

1. Done

Line 255: Change “in a recent studies” to “in a recent study”

1. Done, changed as per the reviewers suggested text.

Line 268: Change to “active infection, disease, or pathology”

1. Done, changed as per the reviewers suggested text.

Line 276: rather than saying “the paucity of free-ranging samples”, would it be better to state why there was a paucity such as that their capture was difficult and costly?

1. Added a reason: “the paucity of free-ranging health samples as a result of primarily capturing animals for the pen in early years, which expanded to capturing free-ranging animals as the population increased”

Line 290: Unclear what a monitoring year is as animal-years were used in line 293.

1. Changed to animal-years

Line 294: Change “remaining results” to “all other results”

1. Done, changed as per the reviewers suggested text.

Line 297: This seems like a lot of detail here for the results section. Consider putting this portion in discussion as a limitation. “Since the samples are collected prior to penning and often reflect the conditions experienced by the female the minutes/hours before capture in most cases  (blood), the days before capture (fecal pellets), or during the previous summer and fall (hair). For females that have been previously penned, a portion of the hair growth would have happened while in the maternal pen the previous summer.”

1. We ended up keeping this as is, because R2 was very enthusiastic about this section as is.

Line 32: Consider changing “We tested for correlations between multiple health metrics” to “We tested for correlations between the health metrics”

1. Done, changed as per the reviewers suggested text.

Line 305: Change format of reference here to: Newby and DeCesare (2020).

1. Done

Line 314: Change format to (Puls 1994; Figure 2, Table 2).

1. Done

Lines 320-322: Reference which Figure letter or letters this statement is referring. This statement is a little unclear from looking at the figure because Figure 3a has 3 categories and only pregnant caribou are mentioned in the text. It is difficult to see the statistical differences by looking at Figure 3. Could statistical differences be indicated in the Figure using an asterisk? For this analysis, was pregnancy determined using a pregnancy test, or was it determined by whether or not a calf was produced, alive or stillborn? This should be clarified in the methods. Also, in this comparison, “Pregnant caribou had higher levels of zinc, iron, and cobalt in their blood serum collected in March of that year”, it needs to be specified which group or groups they are being compared to? For example, “Pregnant caribou had higher levels of zinc, iron, and cobalt in their blood serum collected in March of that year than caribou that were not pregnant”

1. Figure letters added. We think the asterisks on the figures would likely really clutter the figure, we were thinking the error bars should suffice. Pregnancy info added.

Line 324: See comments from line 320-322 and specify which group this is being compared and reference figure letter. Also, consider marking statistical differences with a symbol or letter in the figure.

1. Done, and asterisks replied to above.  
     
   Line 325: Reference particular figure letter this is referring.
2. Added, B.

Line 346: Figure 7 is referred to before Figure 5.

1. Agreed, Fig 7 is now Fig 4.

Line 347: specify on first mention what SE abbreviation stand for. Assuming it is standard error.

1. Added: “standard error [se]=”

Line 353: remove “in the data” to make more concise.

1. Replaced with “for analysis”.

Line 359: Is abbreviation for “se” different than SE abbreviation used previously?

1. No, same, made all the same now.

Line 406: Figure 6 font seems smaller here.

1. Fixed.

Line 405-406: This paragraph should be combined with previous one as it is only two sentences long.

1. Combined

Line 411: change “start” to “begin”

1. done

Line 412-414: This sounds like methods as worded. Try to reword with results to fit better in this section.

1. Changed to: “We did not find evidence that sex influenced FGM levels (sex(male): β=9.9 (se= 11.9), p=0.83) after controlling for year, day of year, location, and the interaction between day of year and location, thus we pooled male and female samples for analysis.”

Line 421-423: Is this shown in figure somewhere? If so, figure should be referenced here.

1. Added in reference to Fig 4.

Line 430: remove “across” before years

1. done

Line 431: Include 95% CI when reporting prevalence.

1. done

Line 433: Also include 95% CI of prevalence in other studies so that comparisons can be made easier, especially if it is going to be said that one is higher or lower than the other based on whether confidence intervals overlap and they were not statistically compared.

1. Done, note that 95CI overlap doesn’t necessarily imply lack of significance. <https://towardsdatascience.com/why-overlapping-confidence-intervals-mean-nothing-about-statistical-significance-48360559900a>.

Line 435: Report 95% CI here as well.

1. done

Line 443: Change “who” to “which”

1. done

Line 456: Change “came back negative” with “tested negative”

1. Changed to “provided negative results”

Line 460: Unclear what is meant by “seropositive disease” since seropositive animals don’t necessarily have disease. Change to “seropositivity”

1. done

Line 483: The term “generally healthy” is hard to describe scientifically, so recommend replacing this terminology with another term that is more measurable or saying generally healthy, based on the health metrics analyzed in this study,

1. Agreed, changed as follows: “Our results suggest that Klinse-Za caribou are generally healthy—based on the health metrics analyzed in this study—compared to nearby subpopulations that are less disturbed or live in different ecosystems, and relative to available reference values (Puls 1994)”

Line 485: “Health concerns” sounds subjective. Consider rewording to something like, “We did not detect any negative effects on the health metrics from maternal penning or repeat captures.”

1. Done, changed as per the reviewers suggested text.

Line 532: remove comma after food

1. done

Line 533: Change “repeated” to “repeat” to be consistent.

1. done

Line 578: Full scientific names of these pathogens should be included here.

1. Done (the other reviewer requested this as well)

Line 580: insert “caribou” after “boreal”

1. done

Lines 617-619: This sentence reads as though restating the results. To make more concise, integrate this better with the discussion material.

1. We’ve shortened the sentence to make more concise. It now reads as follows. It is somewhat restating results, but sets up the following interpretation: “Compared to free-ranging caribou, we found that the penned females had significantly higher fecal nitrogen in April, but that difference became insignificant by June or July. We interpret this to…”

Line 628: Change “Not surprisingly” to “Unsurprisingly”

1. Done.

Line 633: change “harming” to “not negatively impacting”. Rather than saying “health” of caribou, would reword to say, “health based on the metrics collected in this study” since health is difficult to define and can include additional variables not measured in this study.

1. Agreed, changed to incorporate both these points: “This study provides evidence that maternal penning and repeat captures are not negatively impacting the health of caribou based on the metrics collected in this study and provides baseline knowledge for mountain caribou health parameters”

Reviewer: 2  
  
Comments to the Author  
Review of CJZ-2023-0032: Assessing health and fitness correlates for endangered mountain caribou demographically supported by maternal penning  
  
Dear Authors,  
  
Having participated in a similar maternal penning project for caribou in the Yukon some years ago, and currently working on trace minerals in caribou diets, I read with great interest your work on caribou health metrics in relation to the Klinse-Za maternal penning project. I agree that a greater focus on integrated health measures of wild populations is informative, especially for populations in decline. I also agree that assessing the sub-lethal impacts of intensive interventions (such as maternal penning) are an important research pursuit. Thank you for doing this work.

That said, I cannot recommend your manuscript for publication at this time. My general and detailed comments regarding areas of concern are outlined below and revolve around both the content and presentation. Please consider my detailed comments a start, as I believe that the manuscript will need to be more focused and better organized based on the comments and suggestions below.  
  
Overall, I found your manuscript difficult to follow. There is a lot (too much?) going on: (1) various, and perhaps, disparate, health measures provided, (2) comparison of penned and unpenned animals, (3) influence on reproduction, and (4) comparisons among populations and sub-populations. I am sure that other readers will have great difficulty discerning WHY the work is of interest, WHAT the specific aims are, and most importantly, HOW all of the pieces are linked together.  
  
Moreover, I found that much of the data reported does not directly link to the title, which suggests a focus on determining the effects of maternal penning on health. The authors need to both condense and clarify the existing text as well as make the aims and methods much clearer at the outset. A major rewrite to improve the logical flow is required. Considerable work is needed to tie together the various threads of the manuscript. One possibility for consideration is to remove aspects of the work that do not pertain more directly to maternal penning, such as comparison with other populations and leave these for another manuscript, but that may not be necessary - just an option.  
  
Best of luck with revisions. I hope to soon see your work published.  
  
Sincerely,  
  
Thomas Jung  
Whitehorse, Yukon  
  
General Comments:  
  
The Abstract is vague and unclear. Needs rewritten to be much more specific as to what was measured and the results. Refrain from saying the animals were “healthy” as your data is specific to trace minerals and stress and other measures. Be careful of overextending your data in the Discussion.

1. We’ve refined language around health based on the helpful suggestions of R1, which have made our statements more accurate. For example: “Based on the health metrics considered, Klinse-Za caribou were generally healthy relative to neighboring subpopulations and that repeat capture and penning did not create accumulated health issues.”

The Introduction is lacking. The Introduction needs a major overhaul (rewrite) to better set up the study for the reader. For instance, I was surprised that there was no mention of the health metrics you study in the Introduction – this needs to be rectified. Additionally, if the study is focused on the effects of maternal penning on health metrics then you need to clearly outline for the reader what maternal penning is, and why it is used as a conservation measure – be sure to cite Adams et al. (2019) which was the first maternal penning project for caribou. In short, I believe that the Introduction could be drastically improved by condensing text related to the overall conservation concern over caribou and focusing more on (1) the aim of the study, (2) the specific metrics you measure, what we know about them, and how they are important to population ecology, (3) how maternal penning may effect your health metrics, including specific hypotheses.

1. Health metrics and hypotheses added, maternal penning primer in methods, Adams citations added, see below in detailed reponses

Regarding the Omineca sub-populations that were contrasted with the Klinse-Za, you need to make a stronger case for WHY these caribou were a useful contrast to your main study population. Are they comparable?

1. Done

Perhaps the entire manuscript would be easier to follow if it was structured more explicitly by question – for instance, (1) effect of maternal penning, (2) influence on reproduction, and (3) comparison with other caribou populations. To be effective, this reorganization should happen from start to finish, with a particular emphasis from the Methods through to the Discussion. Secondary headings may help in that regard. The current organization based on health metric is hard to follow, at least for me. Additionally, this may be useful to summarize in a new table?

1. We have added hypotheses and reworked the flow to address this. We note R1’s positive view on the intro: “The introduction was thorough and provided a solid background on the subject.” So did what we could to refine the intro while still retaining the aspects that R1 liked. The added details and hypotheses should help.

The figures are overwhelming and need to be condensed to the most relevant information. The rest should be moved to supplemental materials. More detailed comments provided below.

1. Text size increased to make figures more legible. There is overall a large amount of data, health metrics, and caribou sub pops considered here. We chose not to over simplify things and instead let the reader see the data and the multiple comparisons.

Finally, and this may be quite self-serving, even though I largely enjoyed the Discussion, it was almost singularly focused on the Klinse-Za maternal penning project without reference to earlier findings from similar projects, where available. Some examples of where connections to the literature (i.e., Adams et al. 2019) may be useful are provided below.

1. added some more citations throughout.

Detailed Comments:  
  
Line 1: The title is awkward, please rephrase

1. Changed to “Assessing the Health-Fitness Dynamics of Endangered Mountain Caribou and the Influence of Maternal Penning”

Line 23: Replace “Southern mountain caribou” with “Caribou in at the southern extent of their range in the mountains of western North America (hereafter, southern mountain caribou)”

1. Changed to “The southern mountain caribou, found in the western mountains of southern Canada, are currently facing significant threats. Among the southern mountain caribou population, the central group of caribou is considered endangered, necessitating an integrated approach to wildlife health…”

Line 25: “assess the health” This is pretty broad. Please be specific to the particular metrics that you have collected data.

1. We’ve reworded the abstract and now explicitly list the metrics “The health metrics included trace mineral levels, cortisol levels, biomarkers for inflammation, and pathogen prevalence.”

Line 28: “between successful and unsuccessful reproductive attempts” Awkward and unclear. Do you mean reproductive and non-reproductive females? If so, please be clear and explicit.

1. Changed to “reproductive and non-reproductive females”

Line 30: “generally healthy” Vague. Please be specific.

1. We’ve been more specific now by including reference to the health metrics we collected “Based on the health metrics considered, Klinse-Za caribou were generally healthy relative to neighboring subpopulations and that repeat capture and penning did not create accumulated health issues.”

Line 37: Capitalize “Rangifer” and add “tarandus”

1. done

Line 50: This is not accurate. Caribou have been the sharp focus of many studies of their “health”, including several with a One Health framework. Instead, discuss here the interest in understanding caribou health both for conservation of the species and from the One Health perspective, citing some of the many studies on caribou health.

1. We disagree that this statement is not accurate and instead suspect the reviewer has misinterpreted the statement. In the previous paragraph we define the integrated health/one health paradigm “This integrated approach is often referred to as One Health, which acknowledges that wildlife, humans, and environmental health are intimately connected and creating positive outcomes for one supports the other”
2. The line the reviewer contends is not accurate states “One subspecies that has suffered from a recent lack of integrated approaches to health is the woodland caribou”. We are not referring to just the study of their health, but rather their actual integrated/one health. It is measurable across the range of woodland caribou that there are severe issues with caribou populations, the state of their habitat, and the peoples who have long relied on these caribou and the land feel the ramifications (Muir and Booth 2012; Parlee and Caine 2018; Cunsolo et al. 2020; Johnson et al. 2020; Nagy-Reis et al. 2021; Lamb et al. 2022)

Line 51: delete “the”

1. done

Line 52: “across the forested landscapes in northern North America”. Yeah, but they occur in many non-forested habitats. Its really that they are located south of the Arctic tundra. Please rephrase.

1. Changed to “Woodland caribou are distributed across the forested landscapes south of the arctic tundra in northern North America, and have been central to many northern Indigenous Peoples’ culture and food security for millennia”

Line 56: “wolves, cougars, and wolverine” Scientific names are required here. Same for “moose, deer, and elk” on Line 61.

1. Done.

Line 62: “surging” is too dramatic. Suggest simply “increasing”. Same with “severely” on the next line.

1. Changed to increasing and removed severely. The surging was just an effort to reduce 2x increasing in 1 sentence: “Predator populations also increased in response to these elevated prey densities, altering the predator-prey dynamic that caribou evolved under”

Line 85: Perhaps replace “sudden” with “persistent”?

1. Removed modified completely and will just call it a disease outbreak “but in one example Tryland et al. (2019) linked a disease outbreak in semi-domesticated reindeer in Sweden…”

Line 88: “white-tailed deer” Scientific name required here.

1. done

Line 92: Replace “Northern USA” with “northwestern USA”

1. Changed as follows: “This endangered group of caribou is composed of 38 subpopulations, once distributed between southwestern Canada and the northwest contiguous USA (Environment Canada 2014).”

Line 99: Delete “cultural practices such as”

1. Removed and slightly rephrased as follows: “As a result of the decline of southern mountain caribou, Indigenous Peoples who have long lived amongst abundant populations of caribou have voluntarily curtailed or completely stopped hunting caribou; an infringement of the treaty rights to a subsistence livelihood promised by Canada (Lamb et al. 2022).”

Line 100: “; an infringement of the treaty rights to a subsistence livelihood promised by Canada”. Suggest deleting this. It is editorializing. I do not believe that it is necessary, and perhaps not accurate either.

1. We will respectfully keep this. The statement is supported by the Lamb et al. (2022) which details the infringement: “The Commissioners for Treaty 8 (Laird et al., 1899) reported “we had to solemnly assure [the First Nations] ... that they would be as free to hunt and fish after the treaty as they would be if they never entered into it. We assured them that the treaty would not lead to any forced interference with their mode of life.”.
2. Also see (Lamb et al. 2023).

Line 115: By “involved” I assume you mean “intensive”. If so, please exchange those words for clarity.

1. Changed to intrusive: “Given the intrusive nature of maternity penning, we sought to identify any effects this management effort might have on caribou health”

Line 119-122: These aims are vague and need to be fleshed out with accompanying hypotheses or predictions.

1. We have completely reworked this section to add more information and hypotheses: “We assessed caribou health using a suite of heath metrics including trace mineral levels, cortisol levels, biomarkers for inflammation, and pathogen prevalence. We compared these health metrics between penned and non-penned animals, between reproductive and non-reproductive females, and between other subpopulations. In this study we attempt to: 1) assess the potential impacts of maternal penning and repeat captures on caribou health, 2) characterize the current health of Klinse-Za caribou in relation to nearby subpopulations and published references ranges, and 3) evaluate associations between individual health and reproduction for Klinse-Za caribou. Overall, we assess the hypotheses that caribou health,as indexed by our health metrics, 1) will not be negatively impacted by maternal penning because although penning is invasive, the animals are fed and protected from predators and these aspects of the pen benefit caribou health more than the negative impacts from capture and captivity, and 2) will produce more calves than unhealthy caribou due to having more fat reserves to produce and support healthy calves.”

Line 125: This sentence is far too wordy. Please condense.

1. Removed multiple words. It now reads: “The study is focused on the Klinse-Za caribou subpopulation in north-eastern British Columbia, Canada (Figure 1).”

Line 136: I believe that this sub-section should be re-written in past tense.

1. Agreed, done

Line 153-156: Condense to “We captured adult female caribou in March of 2014-2021, via aerial net gunning, as described by McNay et al. (2022). Calves of both sexes were sometimes caught by hand and brought into the maternal pen with their mothers.” I assume the calves were caught by hand.

1. Changed based on R1 comments to: “We primarily captured caribou in March of each year between 2014–2021, but also caught some animals (<5%) prior to March in December–February. Capture was conducted by aerial net gunning, as described in McNay et al. (2022). Adult female caribou were the target of most captures, but calves of both sexes were sometimes brought into the maternal pen with their mothers.”
2. Calves were not caught by hand because they were pretty big at that point. They were mostly netted.

Line 161: “veterinarians on the capture team” Another example of wordiness. Reduce to “we”

1. Changed to we.

Line 162: Add from where the blood was collected – which for caribou is typically the juglar or the vein behind the knee in the back legs…

1. Added “30 millilitres of blood collected from the jugular vein”.

Line 164: What were the categories for the qualitative assessment. Provide references.

1. Done

Line 165: “ultrasound” of what? Add back fat with the units (mm). Provide citation.

1. Cc
2. Done

Line 166: Add “, using a X mm biopsy punch”.

1. Done

Line 161-166: Key point – tell us WHY you collected these samples specifically. That is, what will they tell you about the health of the captured animals???

1. See lab methods section and Table 1

Line 167: Replace “one to two days” with “1-2 days”

1. done

Line 168: Delete “blood components (i.e.,” Wordy.

1. done

Line 170: “nearby” is vague. Please be specific as to how close were these caribou populations.

1. We cite Figure 1 in this sentence which shows all populations relative to Klinse-Za in the inset map

Line 175: Comparison groups in what sense? Do you expect them to be different in the hair and fecal measures? If so, why? What does is this comparison between populations supposed to tell us?

1. The following sentences explain the comparison and why “The ranges of the ONCP subpopulations during the study years were relatively less disturbed than the Klinse-Za is currently, providing a chance to contrast these animals’ health metrics with those of caribou exposed to lower levels of anthropogenic disturbance. Given that there are currently no established values for optimal parameter ranges for most caribou health metrics, we compared the health metrics of penned caribou to surrounding subpopulations, including the ONCP subpopulations as well as previously published data from boreal caribou in BC”

Line 176: “relatively less disturbed” Another vague term. What does this mean, specifically?

1. Changed as follows: “The ranges of the ONCP subpopulations during the study years had less industrial impacts than the Klinse-Za, providing a chance to contrast these animals’ health metrics with those of caribou exposed to lower levels of anthropogenic disturbance.”

Line 197: “Crews accessed all locations by helicopter and hiked in to hand-collect the pellets that appeared freshest.” Lots of unnecessary detail.

1. Removed. We note that the reviewer is looking for a mix of additional detail via many comments suggesting the methods are vague, while also criticizing when too much detail is provided. We are working to strike the right balance during this revision.

Line 197: How did you determine the “freshest” pellets. See our paper Jung & Kukka 2016 Wildlife Biology – appearances can be deceiving as pellets quickly become dessicated in some habitats. Also, during much of your collection period pellets are clumped once northern cervids after green up and they have a lot more moisture in their diet.

1. As per the previous reviewer comment about too much unnecessary detail we have removed this sentence.

Line 200: Replace “We brought an ice-filled cooler on board to keep samples as cold as possible until they could be frozen that evening” with “Pellets were frozen within hours of collection.”

1. Done

Line 210: “(BCHRP;(Schwantje et al. 211 2014, Bondo et al. 2019)).” Messy.

1. It’s just the reference manager. These all get sorted out in copy editing. If we start manually editing the references the links will be broken.

Line 210: Here, we finally are starting to learn what health metrics you are assessing. This should come much earlier in the Introduction.

1. Done, added to end of intro: “We assessed caribou health using a suite of heath metrics including trace mineral levels, cortisol levels, biomarkers for inflammation, and pathogen prevalence. We compared these health metrics between penned and non-penned animals, between reproductive and non-reproductive females, and between other subpopulations”

Line 213: “For a more detailed background on individual metrics, see (Schwantje et al. 2014)” Sorry, not good enough. This is the crux of the whole study so you need to at least briefly discuss why these metrics are useful. This needs to be upfront in the Introduction. Additionally, Schwantje et al. (2014) is not in the primary literature and may be difficult to source.

1. Removed this sentence seeing as we detail each metric in this section.

Line 215: “We selected the tests that, based on current best knowledge, could help provide information related to animal survival and reproductive success” HOW? You need to flesh this out rather than just make an open-ended statement such as this. Please make these linkages for each health metric you used explicit, preferably in the Introduction. This is key to provide the context for the utility of your study.

1. Added a line in the intro and then additional detail in the methods. We tried to make links between each of our health metrics and effects on survival and reproduction.

Line 217: “We collaborated with several laboratories across Canada to run the different physiological assays (see Appendix B).” Unnecessary detail. Delete.

1. Removed

Line 226: Replace “cow” with “adult females”

1. Done

Line 249: “we contracted the services of Wildlife Genetics International ([wildlifegenetics.ca](http://wildlifegenetics.ca)).” Delete. Later you should say that the work was done in a commercial lab (Wildlife Genetics International, Nelson, BC, Canada).

1. Removed

Line 269: The analyses subsection needs to be more explicit about what data were used to test each of your hypotheses/aims and which tests were used in each case. Currently this section is quite vague and I don’t know what you did for each planned comparison/test. Its not reproducible science as written.

1. Added hypotheses and clarified results, but also sensitive to places where both reviewers simultaneously wanted more info in the results but also less elsewhere. We are trying to walk the line of enough information but not too much. Overall the full analysis is on github and can be fully reproduced by anyone that was interested.   
     
   Line 288: Delete “and outcomes”
2. Done

Line 290: Replace “at least one, and up to six,” with “1-6”. Please also provide the mean +/- SD

1. Changes, and added the mean +/- SD

Line 291: Most years is vague. Can you state specifically how many years?

1. Simplified to “We also captured females without translocation into the pen, and in some cases health samples were also taken from these animals (n=18 individuals, 22 animal-years).”

Line 295-297 and Lines 297-300: Indeed. This is critical. Thank you for mentioning this early.

1. Thanks

Line 299: The blood would represent the stress level after capture if the blood was taken >3 min after capture…

1. Removed, and we are using the serum so its less immediate anyways.

Line 312-314: Belongs in the Discussion.

1. Removed

Line 405: This is the only mention of this aspect, I believe. Really interesting, but disjunct. Either make it explicit in the aims and methods, or delete.

1. Made explicit in intro as a goal of the study—to assess if repeat capture stressed animals out.

Lines 412-414: Move to Methods?

1. Agreed, moved and rephrased “To assess whether we could pool sexes for FGM analysis, we assessed FGM levels for animals of known sex from the free-ranging population and tested whether fecal nitrogen differed by sex, after controlling for day of year, location, their interaction, and a random intercept for year.”

Lines 437-438: Move to Discussion?

1. These comparisons also seem appropriate in the results seeing as the comparisons were an explicit goal of the study

Lines 452-453: Move to Discussion?

1. These comparisons also seem appropriate in the results seeing as the comparisons were an explicit goal of the study

Line 456: Replace “all came back” with “were”

1. Changed to “Tests for Toxoplasma on 100 samples from 40 females across seven years all provided negative results, hence we did not further analyze these data.”

Line 457-459: Move to Discussion?

1. These comparisons also seem appropriate in the results seeing as the comparisons were an explicit goal of the study

Line 463: A citation is needed here.

1. Added: “Kappa values measuring the balanced accuracy of the confusion matrices ranged from -0.01 to 0.06, confirming the lack of an effect (McHugh 2012, Figure 8C).”

Line 471-475: This is not necessary here and could be deleted for concision.

1. Removed.

Line 481: I don’t think you really assessed in depth the impact of repeat captures on caribou health. If so, you need to flesh this out in much more detail in the Intro, Methods, and Results.

1. Fair, we have refined this wording throughout

Line 483: What is a “healthy” caribou? Hard to say. Better to say that they presented with better measured health metrics than nearby subpopulations.

1. Agreed, changed to “Our results suggest that Klinse-Za caribou are generally healthy—based on the health metrics analyzed in this study—compared to nearby subpopulations that are less disturbed or live in different ecosystems, and relative to available reference values (Puls 1994).”

Line 484: This is not supported by your data or analysis. An overextension. Differences between caribou subpopulations may be for a number of reasons, such as the local biogeochemistry or predation pressure, not only human or landscape disturbance. Delete.

1. Predation pressure in woodland caribou is generally strongly correlated with human and landscape disturbance (Serrouya et al. 2021). We were looking to see if KZ caribou would have poorer overall health based on the metrics we assessed compared to the caribou in these more intact ranges, which we didn’t find.

Line 486: “repeat captures”, seed comment for Line 481.

1. See response to Line 481

Line 489-506: Major comment --- This is a really strong part of your work that gets a bit loss due to the organization of the manuscript. Interesting findings!

1. Thanks!

Line 532: Delete the extra comma.

1. Done

Line 539: well-being

1. changed

Line 550: This is likely more local biogeochemistry than “mountain versus boreal”.

1. Added biogeochemistry: “The mountain subpopulations generally had higher levels of selenium and molybdenum than boreal subpopulations, perhaps due to differences in the nutrition and biogeochemistry in mountain habitats in central BC versus the boreal habitats of northeast BC (Denryter et al. 2022).”

Line 591: insert “for example,” before “Joly et al.”

1. Done.

Line 619: Indeed. Adams et al. also noted the “boost” in nutrition as a result of high-quality food for penned animals.

1. Added

Line 629: Include Adams et al. here. Also for Line 635.

1. Added on 629. Not appropriate for 635 as 635 is looking forward into the future “As penning-type measures continue to be considered in the suite of recovery actions for caribou” and Adams et al. does not indicate that more penning should necessarily be done, except in rare cases. From their abstract they seem overall luke warm on it: “However, based on the Chisana program and 3 subsequent efforts elsewhere, improvement in population trends have been modest at best and come at a high financial cost. Given the necessity of maximizing penning effort, maternal penning may have a role in addressing conservation challenges for some small caribou populations that are stable or slowly declining, but its application should be primarily driven by objective assessment of the likelihood of improving population trends rather than popularity relative to other management options.”
2. The Boutin and Merrill (2016) directly assesses future options for caribou recovery.

Line 630: “how habitats and management interventions” Vague and a possible overextension of your data. Please be specific here.

1. Fair, removed habitats and changes management interventions to maternal penning.

Line 632: Consider my earlier comments about “repeat captures”

1. See response to Line 481

Line 633: “not harming the health of caribou” Far too broad – overextension of your data. Your results are only specific to the metrics measured. It is critical to rephrase.

1. Refocused to just consider the health metrics we used: “This study provides evidence that maternal penning and repeat captures are not negatively impacting the health of caribou based on the metrics collected in this study and provides baseline knowledge for mountain caribou health parameters.”

Lines 638-640: Yeah, but I do not believe that a population requiring maternal penning – where the goal is maximizing fitness for conservation purposes - would be an ideal subject for this type of experimentation. Better done on captive animals in zoos or other facilities. Reconsider this recommendation as being your parting thought.

1. We respectfully will leave this in, we don’t believe the risks would be high. There are benefits to assessing limitations in free-ranging animals.

Line 642: Please include me as a reviewer.

1. Added

Line 750: There are many issues with the references in the Literature Cited. A very careful review and edit is required to format this section. For instance, capitalization and italicization needs to be corrected for most. Several are incomplete (e.g., Lines 757, 760, 764, 766, 789, 791, 804, 805, 822, 825, 833, etc.

1. Added more details where needed.

Table 2: delete “in NE BC” say this in the table caption. Also, there is some instances of inconsistency in the number of significant digits across rows that needs corrected.

1. Fixed – added NE BC into the text of the results.

Figures 2-8: There is a lot going on in this figures, and so many panels per figure makes it difficult in many cases to see the small font text. Reduction in the number of panels is suggested. Some suggestions for each figure are provided below. Several should be moved to supplemental materials.

1. There is a lot of data in the manuscript and to ensure readers have access to the type of data, its distribution, and relative comparisons, we wanted to display is all efficiently.

Figure 2: Perhaps panel B for Figure 2 is unnecessary and can be summarized in the text and the panel be moved to supplemental information?

1. We chose to include B to significantly reduce the amount of text that would be needed to sufficiently describe these pairwise comparisons.

Figure 3: Again, panel B is an oddball here. Given the blood serum was collected before the penned animals were penned (at capture in March) this is an invalid comparison. Delete panel B. The other two panels should be separate figures as they are very different comparison.

1. Agreed, removed panel B and used last years’ location where appropriate. This was an oversight in how we worded it. Thanks for catching

Figure 4: Same comment about panel B as for Figure 3 – invalid comparison because serum was collected prior to penning. Delete.

1. See above.

Figure 5: This may work as one figure (or six!), but font is too small.

1. Font increased for all figures where possible and labels shorted where possible to allow for further increases in font

Figure 6: Can be two separate figures?

1. Could, but the total # of figures would be getting quite high then. We’ve pooled these to reduce total # of figures. Technically A suffers from the same Panel B critique in Fig 3 and 4 above. Could remove A.

Figure 8: I am not at all clear as to what panel B is telling us. Delete? The other two panels could/should be separate figures as well.

1. Caption: “B) all other subpopulations pooled and compared to Klinse-Za seroprevalence in a linear model, 95% confidence intervals shown.”

Appendix A: Delete the multiple sentences in the second paragraph on wolf control as I do not believe they are pertinent to this manuscript.

1. Wolf reductions did occur in KZ and given the sensitivity around animal care etc for these activities (Brook et al. 2015; Harding et al. 2020), we will keep it in to be complete.

Appendix B: Replace “Neospora candium” with “Neospora caninum”

1. Done

Appendix B: A reference or two for each of the items in the Methods column would be appropriate and useful.

1. We did not do this, as these methods are well described here and should be replicable as presented given that we have listed the lab, material, method, and equipment used.

Appendix D: Replace “cow” with “adult female” in the caption.

1. Done.

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