Response to Reviewers

# Reviewer 1

*Response to "standardized interactions observed between smolts and Bull Trout varied among deployments"; Didson sonar placement details are insufficiently described to allow a more comprehensive understanding of site conditions relative to observations, recommendations and subsequent analysis - i.e. velocities, stream depths, or additional factors that might be considered when reflecting on results. Presented as a proof of concept on a limited study duration as this one might suggest that additional time and resources are needed to meet full publication - this currently would seem to be within an extension note type of publication.*

Author response: We have reframed our manuscript to reflect that our study should be considered as a Management Brief – presenting our findings and study design as a proof of concept and framework for other systems.

*Line 36: might be good to articulate "broader scale" - assume this is elsewhere?*

Author response: Thank you for the suggestion. We have clarified “broader scale” to reflect observations from previous telemetry studies in the same system

*Line 136: generally identifiable - given piscavore rainbow occur in Chilko is there further comment that could be provided on the ability to provide frequency of occurrence or distinction of species - i.e. acknowledgement of uncertainty, reconciled against video and Didson timestamps?*

Author response: We have provided further comment on the occurrence of smaller sized fish observed via DIDSON. Furthermore, we provide a relative estimate of uncertainty with respect to individuals observed that may not have been from Bull Trout by comparing the empirical cumulative density function of measured DIDSON Bull Trout lengths and minimum size estimates of Bull Trout in the same system obtained via hook-and-line sampling (Kanigan 2019).

# Reviewer 2

*Lines 91 – 94: The 2 objectives are redundant. Recommend rewording to: “to investigate spatial and temporal differences in potential Bull Trout feeding activity relative to smolt density” Or “determine if Bull Trout activity is synchronized with Sockeye Salmon migrations.” I prefer the latter.*

Author response: Thank you for the suggestion. We have since reframed the objectives of this study and have reworded the redundant objective.

*Supplementary Figure: A photo of the counting fence set up at site would be helpful to readers to understand how constricting the fence may be and where the array was set up relative to the fence*

*Lines 113 and 116: Include distance between fence and array*

*Lines 121-123, Table 1: The detection window area for the second deployment at UF is much smaller than during the first deployment and all other locations. Why was the detection window changed between deployments of UF and could this inconsistency impact your conclusions?*

Author response: We have assessed the potential for biases resulting from differences in detection window area and believe that inconsistencies are negligible. If this inconsistency were to impact our conclusions, we would expect to find a larger proportion of zeros observed in the smaller detection window compared to the larger one. However, this was not the case when comparing between parallel sites (UF2021: 29.27 m2; UF272829: 9.87 m2). Specifically, UF272829 had a smaller proportion of zeros (0.12) compared to UF2021 (0.25). This information is now reflected in the manuscript.

*Lines 131-133 : What does “reacted to” mean? I assume you could visualize the cloud of smolts moving rapidly away from a larger shape? Please include more detail so these methods could be easily replicated by another researcher.*

Author response: We have clarified what “reacted to” means. Furthermore, we have attached supplementary videos to provide more detail on what constituted an interaction.

*Lines 135-137: “We measured...”. Did you measure Bull Trout as part of this study? If so, please add to methods and results. If not, please clarify. Provide specific size ranges of Mountain Whitefish and Rainbow Trout to strengthen your argument that larger fish were probably Bull Trout. Or, be more clear that you assumed larger fish (over a specific size, or characterized by a specific presentation in the video) were Bull Trout. Discuss this assumption and the implications in the discussion.*

Author response: We did measure Bull Trout as part of this study and have provided methods and results associated with these measurements. Unfortunately, we do not have specific size ranges of Mountain Whitefish and Rainbow Trout to strength our argument that larger fish were probability Bull Trout. However, using measurements of minimum Bull Trout length observed in the field via hook-and-line sampling (Kanigan 2019), we compared the lower bound of an empirical cumulative density function to understand the probability of observing a Bull Trout individual that was ≤ 41cm (about 19%) (minimum Bull Trout size as captured in the field). Note that this uncertainty estimate is conservative considering that Bull Trout of smaller length are very likely to exist in the Chilko system.

*Line 167: As you are investigating temporal patterns of Bull Trout activity relative to smolt migration, the fact that the fence is closed during the day is a pretty important element to the study design. Do you mean the fence is physically closed to migrating fish? If so, please add this to Paragraph 100-107 so readers can keep this in mind while considering the data. Could also clarify in Figure 3 – I’m not sure if smolt densities were naturally zero during the day or if the fence was physically closed. The only day time fence closure mentioned in Figure 3 was for N29.*

Author response: Thank you for pointing this out. We have clarified that the fence is closed during the day. Indeed, the fence is physically closed to migrating fish. We have since added this clarification to the requested paragraph and the figure caption. Furthermore, we have added points to Figure 3 to better convey periods where the counting fence was closed, which is also reflected in the figure caption.

*Line 182: Mean value is missing unit*

Author response: Thank you for pointing this out. We decided to remove mean values associated with this text for the purpose of clarity, considering that these values can be inferred from Figure 2.

*Lines 199-213: Although a significant relationship between diel cycle and interactions was found when the data were aggregated, follow-up analysis showed that this was only observed at the location upstream of the fish fence. Therefore, I don’t agree there is enough evidence to support the general conclusion that interactions increase during nighttime hours.*

Author response: We agree and thank the review for point this out. We have retracted our previous statement and indicated that this relationship only exists at deployment sites UF.

*Lines 225-231: Would also recommend monitoring Bull Trout x smolt interactions in systems with no fish fences.*

Author response: We appreciate the excellent suggestion – we have since added this to the requested paragraph, and have generalized this suggestion to predator-prey interactions, as opposed to just Bull Trout and smolts.

*Figure 1: One of the white triangles appears to be on land, is this correct?*

*Figure 2: Recommend color coding data from UF site versus all other sites so readers understand diel pattern was observed at UF site only.*

Author response: Thank you for the suggestion. We have color coded observations originate from the UF site to better articulate that the diel pattern was observed only at the UF site.

*Figure 3: Recommend using similar range for Y axes as much as possible, or at least group deployments with similar Y axes in the same row. Remove yellow line from N29, as fence was closed. Missing period of Bull Trout interactions in N2526.*

Author response: Figure 3 has been altered such that ranges for the Y axes are as similar as possible across group deployments. The missing period of Bull Trout interactions in N2526 are present because the DIDSON was not deployed during that period. Nonetheless, we have indicated and clarified this in the caption associated with Figure 3. We chose not to remove the yellow line from N29 to reflect fence closures and to keep Figures 3A-F consistent.

# Associate Editor

**Overview:** I don’t see a clear hypothesis being tested, nor uncertainty that you are resolving. Potentially cool work, but please put it in a specific context of a *problem* that you *solved.* As written and described, I don’t see much new knowledge here; bulls are known to be nocturnal sometimes, predators feed on available prey, we knew the diet of bulls near the counting fence was seriously on sockeye. What is the key point of this data/study? Where is the novel finding?

I think there is something here, but it needs significant re-crafting to focus on a problem/solution. Simply looking at the graphs, it looks like only one set of scans/counts can be used show an interesting pattern (Figure 3e). The other data is more or less fragmentary.

Find a clear test or problem, and re-work your data to answer that. Could be a neat little paper.

**Title:** consider stating key finding, rather than method, in a title. Makes it easier to attract interested readers.

Author response:

**Abstract:**

*L31- odd concept “uncertain if these predator-prey patterns exist at finer spatial scales” One would assume they must exist. Specifically, where is the uncertainty that you are resolving? And finer spatial scale is not your key finding. It was temporal scale.*

Author response: We have explicitly stated the uncertainty that our study resolves - whether Bull Trout from these studies were consuming smolts elsewhere before they were captured near the counting fence. We have also removed text that reference finer spatial scale.

*L38 – do you mean daylight risk? If predation is high at night, they haven’t avoided risk.*

Author response: Thank you for pointing this out. We have clarified this to reflect presumed minimized predation risk during the daytime

***Intro:***

*L68-69 – why do we need to know this information? So far, the whole intro is about Sockeye.*

Author response: We have removed this information and ancillary information on Atlantic Salmon for clarity, given the focus on Sockeye Salmon smolts.

*L70 – I appreciate your use of First Nations language as place name (well done!). Whose territory and language?*

Author response: Chilko Lake is under the territory of the Xeni Gwet’in first Nations and the first language of the Xeni Gwet’in is the Tsilhqot’in language. The text has been altered to reflect this – thank you for this point.

*L81 – circular argument. We don’t know smolts responded. Do they migrate in daylight everywhere without Bull Troutgner? You see night predation and migration. Do we have evidence of what caused which? Are smolts responding to something else? In my experience, Bull Trout can also be nocturnal in systems without prey fish. Picky point, but you’ve jumped to a conclusion, and should ponder alternates.*

Author response: We have changed the wording to reflect uncertainty in our statement, framing our previous statement as hypotheses rather than an assertion/conclusion

*L83 – still don’t know why this is important to your “problem – solution” questions.*

Author response: We agree that this statement is not important to the “problem-solution” question of our study. This has since been removed from the text. We have attempted to better articulate our “problem-solution” questions by reframing the objectives of the study.

*L85-91: methods are described before we know what question is being answered. It seems like this is a sonar project as its priority, rather than an “understand something important and useful about fish” project.*

Author response: We have significantly reframed our text to reflect our problem-solution question of our study to better accommodate this text. Specifically, we illustrate that the present study is a sonar project as its priority, and our aims are to: 1) ground-truth prior studies, and 2) develop a conceptual framework to observe predation events using passive acoustic imaging.

*L92-94 – state what you were trying to answer, or disprove. “Investigate” is too vague. Was the synchronicity in doubt? What is the value in showing non-synchronicity? It can be assumed that predators will hunt prey when the prey is available. Why do we need a study? Just ponder that and find an answer, and make it clear to the readers why this data/study matters.*

Author response: We have clarified this section. We now explicitly state the aims of this study and attempt to better convey the value of the study.

***Methods:***

*L136- any direct evidence of sonar images = bull trout?*

*L158 – was day just when sun in sky, or was twilight included? Hence, were interactions crepuscular, rather than purely nocturnal or diurnal?*

Author response: Interactions classified as purely diurnal and nocturnal. We have since clarified this in the text

*L144-148 – using quite two different sampling frames and correcting down to per m2 might be introducing bias. i.e., the small frame would have more zeros. Were the differences in large and small frame data checked for this bias?*

Author response: We believe that potential biases introduced from using two different sampling frames and correcting down to per m2 are negligible. Specifically, when comparing the proportion of zeros between the same sites (UF) observed with different areas (UF2021: 29.27 m2; UF272829: 9.87 m2), UF272829 had a smaller proportion of zeros (0.12), relative to UF2021 (0.25). This is now reflected in the manuscript

*L165-168 – Your point was to show bull trout feed at night, but you exclude most day data. Really? Explain why this is not a potential source of bias?*

Author response: The goal of this analysis was to assess degree of correlation between the number of Bull Trout interactions and smolt densities (i.e., to understand whether Bull Trout are responding to higher smolt densities). Nevertheless, we recognize that there is potential to bias our results by simply removing observations where smolts were not passing through the counting fence. Thus, we have removed this statement and re-ran our analyses to reflect this change. These changes did not result in differences in the interpretation of results.

***Results***

*L178 – lowest number of interactions, but no smolts on graph. If the smolts were absent, how did interactions occur? What other metric of smolt abundance is more useful?*

*Were there no bull trout below the fence? Figure 3c suggests so. Or where there no sockeye at the Narrows (fig 3f)*

Author response: Although no smolts were observed to pass through the counting fence during the daytime periods, we observed smolts milling below the fence, and thus, interactions could occur. At present, we do not have another metric of smolt abundance that may be more useful. We have clarified in the text that smolts can be present despite the fence being closed if they are downstream of the fence. We have also further clarified that the fence is closed during daytime hours.

With respect to Figure 3C, Bull Trout were observed below the fence. However, both Bull Trout and interactions occurred at low numbers compared to other sites and times during which the DIDSON was deployed. Furthermore, no Sockeye Smolts were observed at the counting fence during the period where the DIDSON was deployed at Narrows (Fig 3F), which is why smolt density estimates are reported as zeros.

*L182 – confused, based on methods statement. Did you use daylight data or partial daylight data, or what? You show daylight data.*

*The whole results section would be much clearer if you were testing a hypothesis, or describing a pattern in relation to a hypothesized patterns. As it reads, it is not very informative.*

Author response: We have deleted text associated with L182. We see the confusion here and realize that the same message can be conveyed via Figure 2. We have reframed our manuscript as suggested, in attempts to describe patterns associated with objectives we aim to carry out.

*L426 (caption) – what do n-values represent? I don’t understand that many “diel cycles” can be fit into 10 days in April.*

Author response: The number of observations made across 30-minute intervals/deployments throughout our study and are differentiated between daytime interactions and nighttime interactions observed. We have clarified this in the caption.

***Discussion***

*L200 – if this is a result, put it in that section and only discuss, not present. Or state it as an interpretation of previously shown graphs/data. And, to my eyes, only graphs a and e show that relationship. The others make you wonder “where were the bulls, where were the smolts?” I would be more interested in the pattern of increasing/decreasing smolts and bulls, and not a simple day/night comparison, with the day data being incomplete, and the night data actually quite thin (only one set of data shows pattern over day and night, = graph e.*

Author response: We have reframed sentences like as a discussion point rather than simply stating the results. Furthermore, we have provided additional comment on the lack of correlation at other sites, potentially resulting from aggregation of Bull Trout at the counting fence or suboptimal placement of the DIDSON and have provided suggestions for future research. We believe that the day night comparison still remains invaluable and have decided to keep it within the manuscript as it illustrates that the DIDSON is capable of observing fine-scale behavioral adaptions of fish.

*L205-208: sort of circular. You don’t present data to show bulls are diurnal at other times, without smolts. Did they respond by changing a normal pattern, or do bulls feed on prey when prey is available?* *And why does this matter? Predators eat prey when prey are available, and we already knew bulls eat sockeye. I’m having trouble seeing a novel finding here.*

*L214-232: Odd. We knew that bulls feed a lot near the fence, so what is the point of this paragraph?*

Author response: Although Bull Trout captured near the fence do indeed contain large numbers of smolts in their stomach, it is unclear whether these prey items originated from predation events at the counting fence or elsewhere. We have reflected this point throughout the manuscript, and thus believe it justifies retaining this section within the text.

*L233-240: not really necessary here. Not part of this study, not a data set easily collected by this methods, so...not relevant here. Unless I missed a point, so change my mind.*

Author response: We have removed this paragraph as we agree that this is not a data set easily collected by the methods used in this study.

*L251-252 – if this is the main conclusion (i.e., bulls feed more at the counting fence), how does it differ from Furey et al. 2016b? Why is this a new conclusion from your data?*

Author response: Our results differ from Furey et al. 2016b because conclusions drawn resulted from bioenergetic simulations and stomach content analyses. Thus, it is unclear whether diets of Bull Trout captured actually reflect predation events at the counting fence. We have carried this point throughout the manuscript to better communicate the novelty of the present study.