## Response to Reviewer 1 General Comments, by paragraph:

The authors extend their thanks for the thorough and thoughtful review of this manuscript.

1. The authors extend their thanks for the thorough and thoughtful review of this manuscript.
2. We have revised the text such that the abstract and practitioner points convey the same information. We have also added text in the introduction summarizing the large body of literature on Functional Flows. (see also response to Detailed Comments, Pg 4 line 40)
   1. In the methodology,
      1. we have added detail and justification for the chosen fish population metrics.
      2. We have added a collinearity screening analysis to address correlation between flow metrics.
      3. We have included additional statistical methods (namely, predicting two different ecological units using MARSS and lasso) in supplementary material and added justification for the selected statistical method.
   2. In the introduction and discussion, we have added more information addressing other studies and their findings on salmon flow requirements, and added text analyzing our salmon flow requirement findings in this context.
3. The authors appreciate these comments and believe addressing them will meaningfully improve the robustness and clarity of the manuscript.

## Response to Reviewer 1 Detailed Comments:

Abstract: We removed the text “method for empirically deriving hydrologic metrics” and have added a sentence clarifying which hydrologic metrics were found to be most important in the predictive model for each species. In methods we clarified which metrics were newly derived for this study.

Practitioner Points: We have aligned the Practitioner Points more clearly with the abstract and added a clarifying sentence as specified here.

Introduction:

* Pg 4 line 40: in the introduction, we have added citations to the following pieces of functional flows development:
  + Foundational work on natural flow regimes (Poff et al 97) and ecological responses to altered flow regimes (Poff and Zimmerman 2010)
  + Indicators of Hydrologic Alteration (Richter 1996)
  + Ecological Limits of Hydrologic Alteration (Poff et al 2010)
  + Functional Flows Approach (Yarnell et al. 2010; Grantham et al. 2020)
  + California Environmental Flows Framework (Yarnell et al. 2015; Grantham et al. 2020; Patterson et al 2020; Stein et al 2021)
* Pg 5 line 33:
  + This section has been revised such that the sentence “Hydrologic predictors range widely” has been moved to the supplement. In this section of the introduction we have added citations to the IHA metrics and ELOHA approaches and cited the three papers as suggested (Richter et al. 1996, Poff et al. 2010, McManamay et al 2013).
  + The lack of key citations in the Functional Flows literature is an oversight; thank you for the opportunity to correct this (see response to comment on Pg 4 line 40).
  + We would like to clarify our reasoning in response to this comment:
    - Comment*: “On page 6, there is a discussion of what an ideal framework would be to translate relationships between flow and ecological response to water management actions and decisions. This is specifically what the Functional Flows approach and the related CA Eflows Framework describe and do”*
    - Revised manuscript: “*An ideal framework for supporting decision-making would involve two key steps, firstly connecting land and water management actions to flow changes ("management-to-flow"), and secondly connecting flow changes to ecological responses ("flow-to-ecology")*”
    - In our understanding, the functional flows framework addresses neither of these steps.
      * It does not predict flow changes due to management actions (at least not in the same way as a physically-based hydrologic model, which is our expectation for this study)
      * It does not *predict* quantitative ecological changes due to flow changes; rather it quantifies the flow phenomena *known to affect* the ecosystem.
    - We remain confident that the approach in this study represents a new contribution distinct from the existing functional flows framework.
  + At the end of the first section of the introduction we have added questions that currently persist that this study will address.

Methods

* Pg 7:
  + We have included fish sampling locations on the site map and clarified references to reports describing the fish sampling and monitoring of multiple life stages over the past two decades.
  + We have indicated a key reach that typically becomes dewatered in a dry year on the study map, and added text referencing it when discussing coho spawning preferences.
  + We have moved and shortened the history of management text as suggested and/or moved this text to a supplement.
* Section 2.2.2: We have added text and the suggested citations highlighting that coho over-summer in streams and that this places constraints on habitat suitable for rearing.
* Section 2.2.4:
  + We have added text highlighting that coho spawning is also influenced by which reaches have continuous summer flow.
  + The number of metrics (88) in the original manuscript was greater than the 24 in Yarnel et al. 2020/Patterson et al. 2020 due to 1) some functional flows being included twice, during two different life stages, and 2) a conservatively wide range of flow thresholds for river reconnection timing metrics. We have revised the analysis to include only three flow thresholds, and the number of metrics has been further reduced by the collinearity screening exercise.
  + Additional text has been added explaining the rationale for river reconnection threshold inclusion.
* Page 15 line 10 – a discrete definition of these metrics, and clarification regarding years when connectivity is never lost, has been added to this section.
* Page 15 line 16 - This was an oversight, and we thank the reviewer for highlighting that the correct metric for the presence of scouring flows is Peak\_Dur\_2. Since it is redundant, we have removed the “days greater than 90th percentile” metric from the analysis.
* Page 15 lines 32-35 – The number of flow thresholds has been reduced, and a collinearity screening exercise was incorporated into the analysis, and the statistical analysis rationale has been expanded.
* Figure 5 – The coho life periods have been revised and illustrated in the new Fig. 2. Selection of flow thresholds has been moved to the Methods.
* Section 3.2 – Additional text and references have been included to clarify these data sources.
* Section 3.3 – Supplemental Table 2 was included as an excel file and it might have become poorly formatted when it was converted into a proof for revision. We apologize for this oversight. It has now been included as 12 subtables in the Supplement.
* Section 3.3.1 and Page 21 Line 6, 13-14, and subsequent – We agree that this “Brood Year” and “Rearing Year” terminology was confusing and have revised it as reflected in Fig. 2.
* Section, 3.3, like section 3.2, needs more clarity – the statistical methodology has been expanded, and model selection rationale has been clarified.
* Section 3.4: We have improved the analysis by screening the hydrologic predictors for collinearity (|R| greater than 0.7) and selecting a subset predictors to represent hydrologic conditions in all seasons while minimizing redundancy in the predictor data.
* Section 3.5: This section on the ecological response selection was combined with the section describing ecological monitoring data (Section 3.2).
* Sections 3.6 through 3.7: the statistical methodology has been expanded, and model selection rationale has been clarified.

Results

* Section 4.1, Fig 6: Some metrics with no major changes over time were included (i.e. wet season median baseflow) to provide some context that while dramatic changes are occurring in the flow regime, some quantifiable phenomena are remaining the same over time. We have ensured the names of these metrics are the same as in the literature and ceff.ucdavis.edu.
* Section 4.2: Agreed, the flow-ecology relationships are very multifaceted, and thus better reflected by multi-parameter statistics. We therefore included this first-pass analysis to compare the individual influence of distinct flow metrics. The analysis has been expanded to include spawner abundance as a predictor.
* Pg ? lines 47-51: the statistical methodology has been expanded, the predictor and response data has now been transformed to facilitate better inter-predictor comparisons, and model selection rationale has been clarified.
* Pg 33, line 9-10: We have included a collinearity screening exercise in the revised manuscript.
* Next paragraph: this predictor has been eliminated from the new analysis.
* Tables 5 and 6, and Sect 4.4.1, 4.4.2, and 4.4.3: These results have been updated, and reinterpreted in the discussion.

Discussion

* Sect 5.1: Agreed. We have included additional statistical modeling techniques and structures, and added more text comparing the various modeling options.
* Sect 5.2: This was informed by an incorrect understanding of “scouring flows” and has been removed from the interpretation.
* Sect 5.3: We have included a collinearity screening exercise in the revised manuscript, and reinterpreted these results.
* Sect 5.4: We have included a new interpretation of this question after revising our analysis, with a more nuanced understanding of which species’ smolt production is more sensitive to flow (relative to biotic factors like spawner abundance).
* Sect 5.5: We have reframed the discussion to avoid predicting numerical quantities of fish using flow metrics.

Conclusions

* Hypotheses to be explored: Central scientific questions have been included earlier in the manuscript, at the end of the first section of the introduction.
* Pg 44 line 12-13: The main conclusions have been revised after the reanalysis.
* First sentence, last paragraph: management actions have been included as causal factors in the results and discussion.

## Response to Reviewer 2 General Comments

The authors extend their thanks for the review of this manuscript.

A new statistical method (MARSS) has been included in the revised manuscript as well as LASSO, for comparison purposes, and additional text has been added to describe the rationale as to why these two methods were used in this modeling exercise.