

## ***Interactive comment on “Reconstructing the natural hydrology of the San Francisco Bay-Delta watershed” by P. Fox et al.***

**P. Fox et al.**

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Comment 1. This paper builds on exciting work that has been done reconstructing the primeval ecology of California’s Central Valley. Their technical work in that regard seems relatively strong to me, although they focus on flows rather than salinity. We have much documentation, contained in the same fundamental work they cite often in support of vegetation mapping etc. (Whipple et al. 2012), which document substantial salinity changes. Early explorers often speak of drinkable water in places which are now usually too salty for agriculture and the upstream invasion of marine fouling organisms that coincide with changes in upstream flows. This increase in the eastern limit of salt water intrusion may be attributable in part or in whole to changes in bathymetry,

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but the authors should address it in more detail.

Response: As highlighted by the reviewer, our work builds on the Delta-centric pre-development landscape work of Whipple et al. (2012). Our work has a broader geographic scope, covering the entire Bay-Delta watershed, and attempts to characterize natural hydrology based on the pre-development landscape. As noted in our manuscript, we are currently working on several collaborative efforts, some of which examine Delta salinity under natural conditions. In fact, Ms. Whipple is on the project team of one of our cited efforts (Fleenor et al. 2014). While we agree with the reviewer that salinity is an important consideration, it is outside the scope of this work. We do not propose changes to the manuscript.

Comment 2. The discussion of current regulatory and management and their conclusions about how their results pertain to regulation and management strike me as far off the mark. The paper would be greatly improved if they restricted themselves to discussing how their work expands on the earlier historical ecology work by adding in a flow and water demand dimension.

Response: We believe that discussion of current regulations and management is germane to the relevance of our work and propose no changes to the manuscript.

Comment 3. If they wish to discuss management implications, then they must move away from 82 year averages, and address the variability which is the hallmark of California climate. When the valley was entirely inundated as it was in 1862, or even when just the floodplains were activated, as still regularly happens, provides a very different set of expectations about the demands of vegetation in dry years. In our fourth year of substantial drought, I think it is clear to all that water demand and use is an issue that is poorly reflected in long term averages like the authors use. To address the issues they raise in their conclusions demands an exploration of how the variability around that mean has changed. The authors do little in that regard, but offer many critiques of present water management strategies. Thus, their results do not justify their

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conclusions.

Response: We agree with the reviewer that limited conclusions can be drawn from long term averages and that inter-annual variability of natural flow should be explored. The manuscript's conclusions and recommendations address this important issue directly, acknowledging the limitations of long-term averages and noting that collaborations are underway to quantify inter- and intra-annual variability of natural outflow. No changes to the manuscript are proposed.

Comment 4. In both their introduction and conclusions they claim that outflow as the only thing that has been addressed in environmental protection. They overlook the \$2 Billion work Sac Regional Sanitation District has been required to undertake; work which Stockton earlier undertook because their sewage is inseparable from their drinking water intake. Similarly, the drinking water requirement at the intake for Contra Costa Water District has long been the most frequent control of outflow. The authors also overlook the 8000 acres of habitat restoration in the Biological Opinion for Delta Smelt, and the 60000 acres proposed in the Bay Delta Conservation Plan. These are legal requirements that directly address the ecological needs of the species they cite and are major investments independent of flow. Their statements to the contrary are incorrect.

Response: It was not the intent of the authors to suggest that current environmental protections in the Bay-Delta watershed have been limited to flow measures. We will review the manuscript to modify any such offending language and will include text that acknowledges key non-flow related measures and regulations that have been implemented.

Comment 5. Finally, they present a 'natural' vs present-day comparison, but everything about regulations that are on the books relate to much more recent baselines; the anti-degradation of the Clean Water Act take 1972 as the baseline against which protection is to be assessed. By that time all the physical changes in the delta had already

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occurred. Similarly the ESA protective targets all aim for conditions/abundances of the 1960s/1970s. Those baselines all suggest that what is required is a comparison of how outflows have changed in the last 50 years. No one involved in regulation or restoration is targeting the forest primeval. It is noticeable that they cite nothing, except an advisory report required to only address how much water is needed to protect fisheries, in support of their claim that only outflow is regulated. That is because their claim is false.

Response: The authors do not disagree with the reviewer's comments regarding baselines used in current regulations. While these baselines may provide a convenient basis for setting regulations, these baselines provide limited scientific insight into the functions provided by flows to the native fisheries of the Bay-Delta ecosystem and the role of anthropogenic disturbances on the decline of these fisheries. As stated in the manuscript, the California State Water Resources Control Board is considering the use of unimpaired flows as a metric to preserve natural variability in the system, which suggests a baseline earlier than the 1960s/1970s. No changes to the manuscript are proposed.

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