The Bay Institute
Defenders of Wildlife
Natural Resources Defense Council
Pacific Coast Federation of Fishermen's Associations
Golden Gate Salmon Association

By email and hardcopy

November 9, 2017

Felicia Marcus, Chair
c/o Jeanine Townsend, Clerk to the Board
State Water Resources Control Board
P.O. Box 100, Sacramento, CA 95812-2000

RE: COMMENTS ON THE FINAL PHASE 2 SCIENTIFIC BASIS REPORT

Dear Chairperson Marcus,

This letter is submitted as the comments of the Bay Institute, Defenders of Wildlife, the Natural Resources Defense Council, the Pacific Coast Federation of Fishermen's Associations, and the Golden Gate Salmon Association regarding the State Water Resources Control Board's (SWRCB's) October 2017 Final Scientific Basis Report in Support of New and Modified Flow Requirements from the Sacramento River and its Tributaries and Eastside Tributaries to the Delta, Delta Outflow, Coldwater Habitat, and Interior Delta Flows (Final Report).

The final Report appropriately recognizes that the current Bay-Delta WQCP is inadequate to protect the estuary ecosystem because it fails to provide adequate flow and other requirements to protect native species, habitats and ecological services. For the most part, the Final Report adequately and accurately documents the compelling and extensive scientific evidence for significantly improving flow conditions in order to preserve and restore fish and wildlife beneficial uses and public trust resources.

In response to comments by TBI et al and others, the SWRCB included further documentation and analyses of the flow needs of estuarine species and the population benefits of flow augmentation for these species in the final Report. The final Report is an even stronger document as a result of these analyses; nonetheless, it still underestimates flow needs and population benefits for some species, in part because it has not yet set clear, measurable and adequate biological and ecological targets.

We offer some initial recommendations, in the final section below, for how in the Phase 2 SED the SWRCB can identify defensible targets and better estimate flow needs and population benefits.

Narrative and numeric objectives

The narrative objectives for Sacramento River inflows, interior Delta flows, and Delta outflows appropriately reference supporting viable populations of native fish (and other aquatic organisms, in the case of Delta outflow) as a threshold of protection. The term "viability" could be narrowly construed to mean the ability of a population to persist and avoid extinction. However, it is critical to note that this is not the only threshold for fish and wildlife beneficial uses that water quality objectives must meet or exceed. The narrative criteria should be revised to ensure that these populations are supported at levels that protect and maintain public uses of these resources, as required by the Public Trust doctrine and by the federal Clean Water Act's goal to make all waters of the United States "fishable."

Therefore, the numeric objectives for Sacramento River and eastside Delta tributary inflows, interior Delta flows, and Delta outflows must reflect flow conditions that support both viability and sustainable public trust uses. This means not only setting the percentage of unimpaired flow in the inflow and outflow objectives at a level that achieves these thresholds, but also, as we pointed out in our previous comment letter, entails setting requirements for interior Delta flows that are more protective than the minimum protections currently mandated under the state and federal Endangered Species Acts.

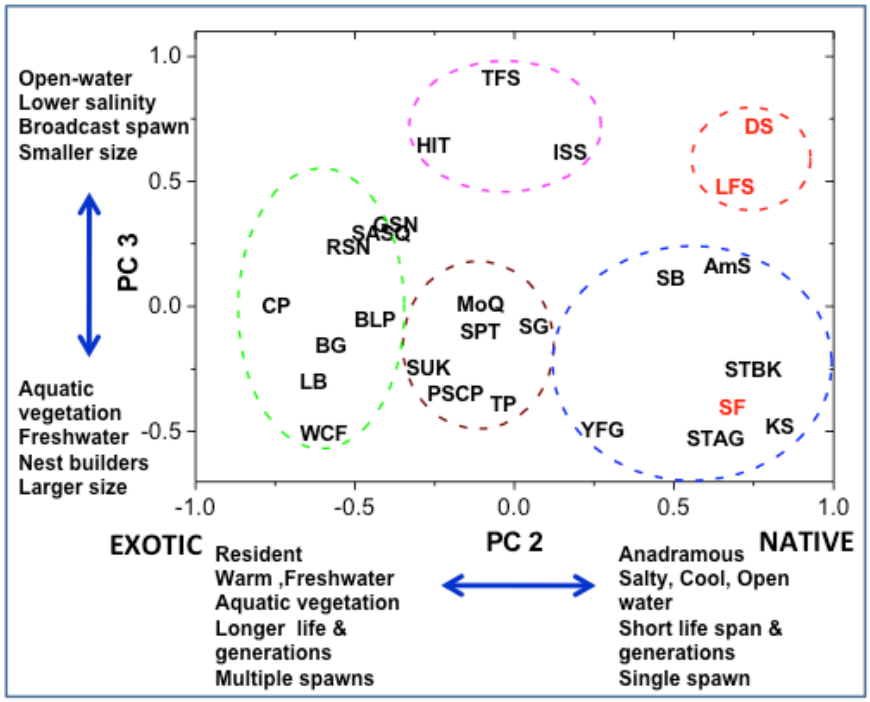
We also note that the numeric Delta outflow objective is essentially equivalent to the numeric Delta inflow objective. However, the narrative Delta outflow objective addresses a broader suit of species (estuarine and anadromous, fish and invertebrates) and ecosystem values (habitat and food web attributes) than the narrative Delta inflow objective (this is true for both the proposed Sacramento River inflow objective in the final report and the proposed San Joaquin River inflow objective in the revised draft Phase 1 SED). Under the SWRCB's proposed approach, a numeric Delta outflow objective could be set that represents the level of protection associated with the beneficial uses and public trust resources associated with Delta inflow and not with the broader uses and resources associated with Delta outflow. This underscores the need to establish a numeric Delta outflow objective that (i) defines the exact outflow requirements that must be met at downstream compliance locations and (ii) is controlling when Delta inflow might be less than the amount needed to achieve the narrative and numeric Delta outflow objectives.

Benefits of an unimpaired flows approach

The final Report clearly and accurately describes the ecological consensus that native species and desirable ecosystem processes are best supported by flow regimes that simulate natural runoff patterns in their timing, magnitude, and inter- and intra-annual variability. (The Report also correctly points out that man-made modifications to the

Central Valley hydrologic system – for example, impassable dams and engineered flood bypasses – may require deviation from "natural flow regimes" in particular cases). In addition, the Report contains an excellent description of the value of a flow regime that tracks "unimpaired hydrology". The Report clearly documents the damage to public trust resources from the severely modified flow regimes that occur throughout the Bay-Delta watershed.

In addition to the benefits to individual species of a flow regime based on unimpaired hydrology described in the Report, it should be emphasized that such flow regimes will tend to benefit the entire native estuarine community and will tend to disadvantage non-native species that are not adapted to the unimpaired timing and variability of freshwater flows in the Central Valley. Moyle and Bennett (2008) and Moyle et al. (2010) recognized functional groupings of species that respond similarly to changing conditions. The figure below shows the results of a multivariate (principal components) analysis that incorporated life history traits and habitat preferences for 26 species. The analysis identified five clusters that segregated native from non-native species based on life history attributes (PC2) and prevalence in open-water vs. aquatic habitats with vegetative structure (PC3). These results suggest that outflow prescriptions are likely to affect the different species assemblages disproportionately and over different time scales; outflow regimes that mimic historic natural patterns and habitat restoration that encourages native species will most likely discourage exotic species. Thus, the unimpaired outflow approach described in the final Report (with the addition of a relatively short temporal averaging window, as described above) provides a solid basis for transitioning management from a focus on single-species into a more comprehensive, ecosystem-based approach.



Species	Code
Delta Smelt	DS
Longfin Smelt	LFS
Chinook Salmon	KS
Sac splittail	SPT
Striped Bass	SB
Sac Hitch	HIT
Sac Sucker	SUK
Tule Perch	TP
Prickly Sculpin	PSCP
Am. Shad	AmS
White Catfish	WCF
Largemouth Bass	LB
Bluegill	BG
Redear Sunfish	RSN
Golden Shiner	GSN
Bigscale Logperch	BLP
Inland Silverside	ISS
Common Carp	CP
Threadfin Shad	TFS
West. Mosquitofish	MoQ
Shimofuri Goby	SG
Yellowfin Goby	YFG
3-spine Stickleback	STBK
Staghorn Sculpin	STAG
Starry Flounder	SF
Sac Pikeminnow	SASQ

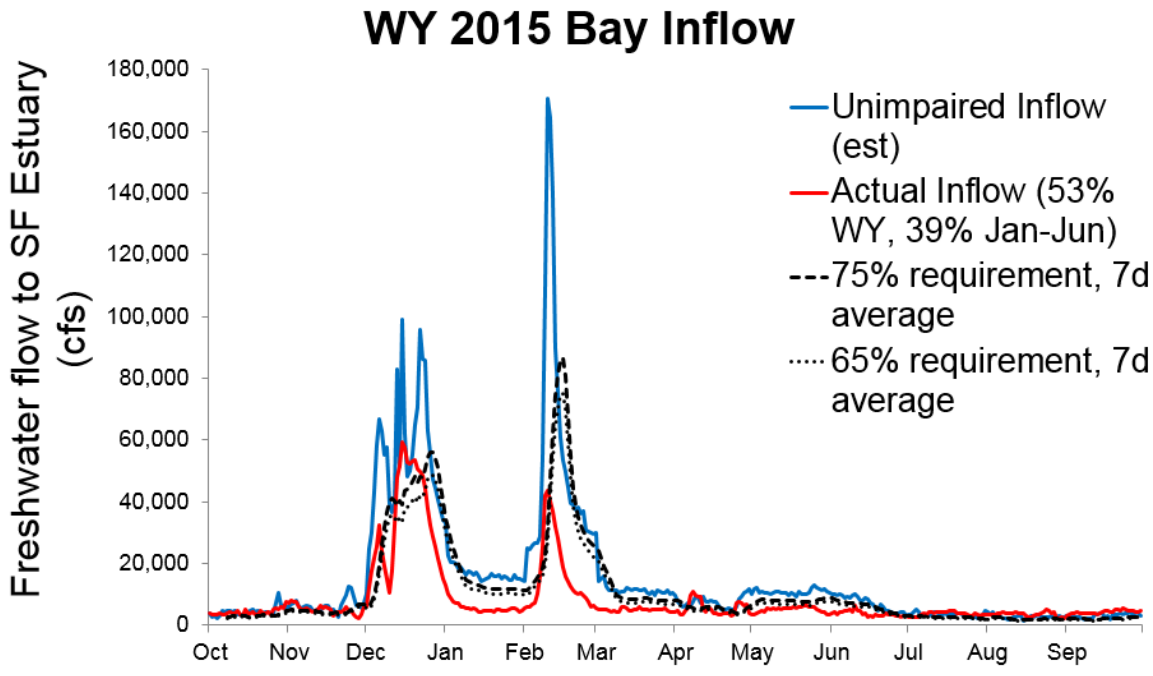
From: Moyle & Bennett 2008, Future of the Delta Ecosystem and its Fishes Appendix D, Comparing Futures, PPIC & UC Press

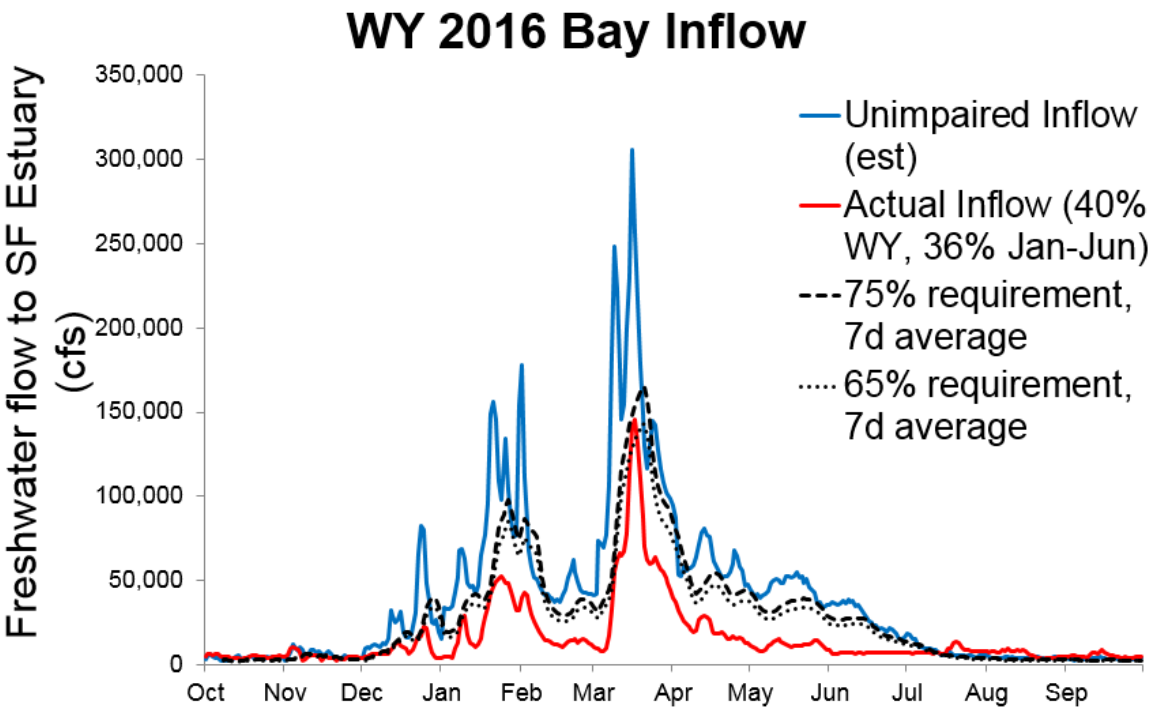
One area where the final Report does not provide enough information is regarding how the required percentage of unimpaired flow should be "delivered" to the river and estuary ecosystems through time. This temporal component of the flow objectives is absolutely essential to ensuring that flow patterns better reflect natural timing and variance of flows; as the Report correctly notes, timing and variability are crucial elements of the flow regime in producing desired outcomes. The new flow objectives should be based on a trailing seven-day averaging of unimpaired flow at the rim stations, similar to the approach taken in Phase I, or shorter averaging period to provide for more variable flows. In the event of outages or delays in data availability, filling in missing days with flow

from adjacent days (by interpolation or extrapolation) or adjacent streams (by % change) usually results in a valid preliminary estimate of unimpaired flow.

The final Report calls for reasonable and necessary "sculpting" of the flow regime to allow for maximizing environmental benefits on an opportunistic basis. We agree to a certain extent, but are concerned that the SWRCB's description of flow sculpting is too open-ended. The SWRCB should develop clear and enforceable criteria that define the maximum amount of flow sculpting or shifting of flows that can occur, that limit flow sculpting to within defined target periods, that prohibit shifting outside those periods and that require documentation regarding the scientific basis for finding that sculpting or shifting will maximize ecosystem benefits. Again, the importance of matching the timing and variability of flows to those which native species are adapted (and to which non-native species are not adapted) cannot be overstated. Flow impairment significantly alters the frequency, timing, and magnitude of flood events, particularly small to moderate floods. The Science Report does not adequately discuss the impact of water resource development on flood frequency or the impact on the duration and attenuation of floodplain inundation. Instead of resulting in naturally varying flood flows, the high runoff in wet years often leads to uniform prolonged winter and spring flood releases with little variability and with abrupt changes in flow as runoff recedes. It is important that shaping of flood flows maintain the characteristics of the natural hydrograph where feasible.

A requirement based on a trailing 7-day average unimpaired Delta outflow (for example) calculated in this way would result in the following hydrographs for 2015-2016 (65% and 75% of unimpaired Delta outflow is used in these examples). In 2016, the highest peak flow required under a 65% UIF was achieved; however the rest of the Jan-Jun period would have required additional releases. In 2015, higher flows would have been required for most of the Jan-Jun period. For both the 65% and 75% scenarios, the 7-d required line is usually below the 1-d unimpaired line; therefore most of the time reservoirs would simply release a larger proportion of inflow. Releases from storage would only be required briefly following high inflows due to the 7-day averaging.


WY 2015 Bay Inflow
Freshwater flow to SF Estuary (cfs)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Unimpaired Inflow (est)
Actual Inflow (53% WY, 39% Jan-Jun)
75% requirement, 7d average
65% requirement, 7d average


WY 2016 Bay Inflow
Freshwater flow to SF Estuary (cfs)
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Unimpaired Inflow (est)
Actual Inflow (40% WY, 36% Jan-Jun)
75% requirement, 7d average
65% requirement, 7d average

Population benefits of flow augmentation for estuarine species

The SWRCB's 2010 Delta public trust flow criteria report clearly stated that "(t)he best available science suggests that current flows are insufficient to protect public trust resources" (p. 2); it also assembled the best scientific information available at that time to support this finding and to identify flows that would be sufficient to protect these resources. The current Scientific Basis Report reiterates this finding that current flows are insufficient and provides additional and updated scientific information that in effect support the validity of the flow criteria in the 2010 report.

The 2010 flow criteria report also noted that its findings were based on the assumption that flows are the primary action taken to support public trust resources, and that implementing non-flow measures may reduce the volume of freshwater flows needed to produce the required ecological and environmental effects. However, the SWRCB was able to use the best available scientific information in the 2010 report to credibly and transparently identify scientifically justified flow levels that were capable of protecting these resources and producing these effects. In contrast, it is not currently possible to identify non-flow measures that are capable of achieving these same outcomes with anywhere near the same degree of certainty or scientific documentation. Therefore, the flows associated with changes in population viability (i.e., abundance, distribution, and survival) of estuarine species in the 2010 flow criteria represent the best attempt to date to define the most effective management regime to restore and maintain fish and wildlife beneficial uses and public trust resources.

However, neither the 2010 report nor the final Scientific Basis Report goes far enough in providing a robust framework for defining the biological outcomes that represent protection of fish and wildlife beneficial uses and public trust resources and thus ultimately drive management regimes, whether using flow or other measures.

As noted above and in previous comments, the WQCP POI should include SMART targets that will serve both to evaluate proposed actions (flow and non-flow; voluntary or regulatory) and to guide adaptive management to better protect fish and wildlife beneficial uses and public trust resources. Just as the narrative objectives must ensure that these uses and resources are supported at levels that protect and maintain public uses of these resources, as required under the Public Trust doctrine and by the federal Clean Water Act's goal to make all waters of the United States "fishable", the SMART targets that define attainment of the narrative objectives must be derived from a methodological foundation that addresses these broader thresholds of protection, rather than (i) the minimum needed to avoid extinction or (ii) the average of recent conditions (which are acknowledged to be unacceptable).

The use in the final Report of population targets from the 2010 flow criteria report to identify appropriate flow levels is inappropriate, given the caveats stated above, and is actually inconsistent with the methods and intent of the 2010 report. For example, the

final Report uses a population index for Starry Flounder of 293 and bases its flow recommendations for Starry Flounder on a period of time when the abundance index was close to this number. But the 293 target level represents the median level in the 29 year abundance record that existed at the time of the 2010 flow criteria report (p. 82). Given that the final Report itself identifies this population (which supports recreational and commercial fishing; Ralston 2005) as having suffered a prolonged decline (pp. 3-81 through 3-82), it makes little sense to set the median value during the period when a significant decline occurred, as the target for protection of this resource. Furthermore, it is circular to base the recommended flow regime for protection of this flow-dependent resource on the median population target because that approach is bound to suggest that intermediate flow levels *observed during the period that this species was declining* are adequate to maintain the public trust value of this resource. Not surprisingly then, the final Report identifies a flow target for Starry Flounder that (i) represents flows that were typical during the very period in which Starry Flounder and other Bay-Delta estuarine species were declining, and (ii) is much lower than those identified in the 2010 flow criteria report (e.g., p. 82).

In taking this approach, the final report appears to accept as irreversible the very steep decline in productivity of this species (Ralston 2005). There is no basis for assuming that productivity and abundance of Starry Flounder or other species cannot achieve levels observed prior to the late 1980s. As noted in our previous comments, the final Report's interpretation of Kimmerer (2002) is erroneous. That paper did not prove that flow-abundance relationships showed step-change declines or that such step-changes occurred in response to food web effects related to the *Potamocorbula* invasion; it merely showed that patterns in the flow abundance relationships of some (but not all) species were compatible with a hypothesis of food web alteration. This compatibility notwithstanding, it is highly unlikely that the *Potamocorbula* clam invasion drove decline of Starry Flounder, which are known to forage on clams (Orcutt 1950); the lack of support for this claim (which the final Report repeats) is illustrated by the lack of response to the clam invasion by *Crangon* shrimp, also a probable prey item for juvenile Starry Flounder. In addition, while a step-change decline was detected in the Starry Flounder's flow-abundance relationship after 1987, Kimmerer (2002) did not test for alternate timings of the step changes he reported and subsequent studies have found little evidence for a widespread change in flow-abundance relationship tied to the *Potamocrobula* invasion (Thompson et al. 2010; Nobriga and Rosenfield 2016).

The flow target identified for bay shrimp (*Crangon*) populations in the final Report is another example of how its methodology sets too low a bar for protection. The report (p. 3.10.4.1) uses three approaches to estimate flows necessary to protect *Crangon* (another organism for which there are both commercial and recreational fisheries). The first approach is to use the flow-abundance relationship to identify the March-May flow value that will produce the median abundance identified in the 2010 flow criteria report. Footnote 26 (p. 3-88) incorrectly characterizes an abundance index of 103 as a "goal" for Crangon shrimp. This number was identified in the 2010 flow criteria report as the

median for the period of record – this was not identified as, nor was it intended to serve as, a population target for this important element of the estuarine food web. The second approach – identifying the median flow over the period of record -- is largely redundant of the first. Not surprisingly these approaches generate flow targets that are typical for the period of record. As with Starry Flounder, it makes little sense to identify flow conditions that are already typical (based on the median abundance of a focal population) in an ecosystem that all the available science indicates is not supporting either that population or broader public trust values; this approach is particularly difficult to square with repeated statements of the need to improve productivity in the estuarine food web that are found in both the final Report (see especially, throughout Chapter 4) and the 2010 flow criteria report. If those statements are to be taken seriously, then the SWRCB should be trying to increase abundance and productivity (e.g., frequency of population growth) for invertebrate species, like *Crangon*, that form the foundation of the vertebrate food web.

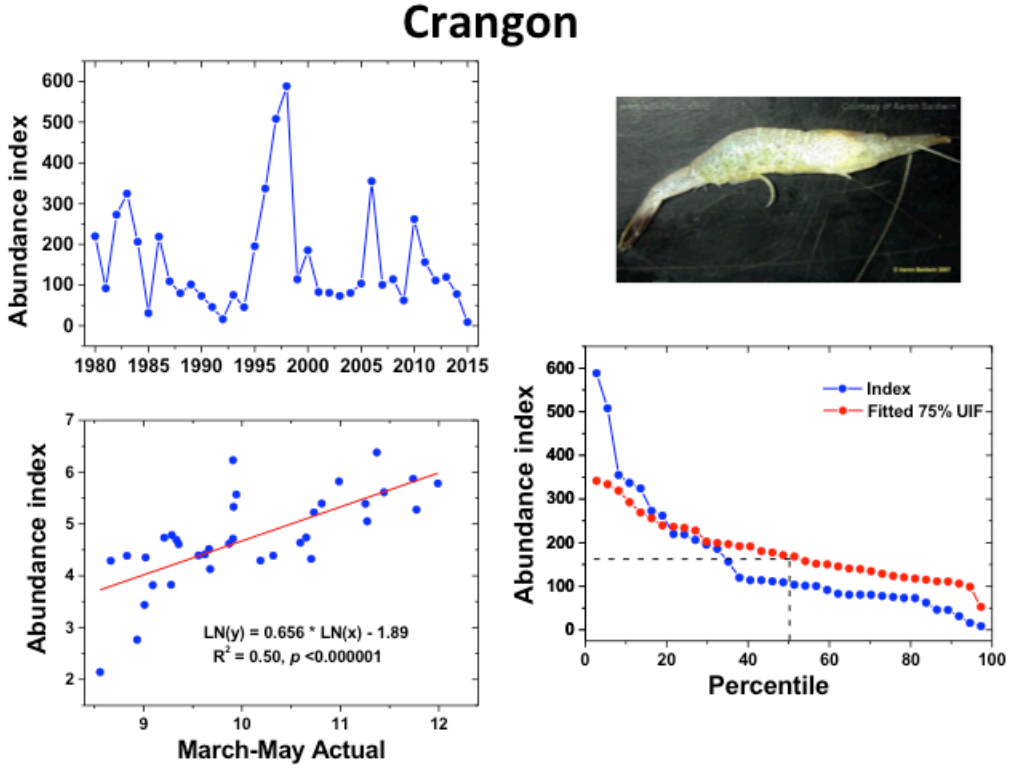
The 2010 flow criteria report fulfilled the California Legislature's charge to the SWRCB to develop new flow criteria for the Delta ecosystem necessary to protect public trust resources. Those flow criteria represent the best findings regarding what protecting public trust resources means. In other words, since 75% of unimpaired Delta outflow represents the flow regime that the SWRCB found would be fully protective of the public trust (in the current landscape), then the population-level outcomes expected under a 75% UIF flow regime (using statistical or other known relationships with flow) must therefore represent our best definition of full protection of those public trust resources affected by Delta outflow.

Therefore, we use the relationship between recommended Delta inflow and outflow criteria in the 2010 flow criteria report and estimates of population abundance for affected target species to identify desired biological outcomes for these species. To be clear, we do not imply that these outcomes must arise from provision of flows alone; rather, we are using the known relationships between flow and ecological outcomes to develop targets for protection and restoration of fish and wildlife beneficial uses and public trust resources that the SWRCB should adopt, and to which adaptive management should be tied, regardless of the means by which the targets are attained.

To illustrate our approach, we present the abundance distribution for Crangon shrimp that would be expected (based on flow abundance relationships for current Delta geometry and habitat availability) under a 75% March-May unimpaired flow regime. Specifically, we calculated the relationship between annual Crangon shrimp abundance indices from the Bay Study's midwater trawl and Delta outflow from March-May of the same year (we believe that these are the same data that were used to generate this relationship for the final Report's analyses of *Crangon* shrimp). The relationship is highly significant, has not changed through the period of record, and explains about 50% of the variation in Crangon abundance across years (see figure below). We then used estimates of 75%

March-May unimpaired flows (CDWR, 2016)[1] as inputs into the Crangon flow-abundance regression. The results, which represent expected population abundance of Crangon shrimp had March-May outflows been 75% of UIF during the period of record, were represented in an exceedence plot in the figure below. The 50% exceedence value (about 170) represents about a 37% increase in the median abundance of Crangon shrimp that we should expect if future flow and non-flow conditions provide levels of protection for this species that are equal to those we would expect under today's conditions with 75% unimpaired outflows. In addition, this technique provides valuable insights into the distribution of *Crangon* abundances under different hydrological conditions. This is much more informative than simply having one target value (e.g., the median). The SWRCB can use this wider array of abundance targets to identify different types of adaptive management response. For example, if *Crangon* shrimp populations fall below the median target (170) in more than 50% of years (perhaps based on 5-6 year running average), this might trigger (i) a review of the POI and/or (ii) specific actions identified in the POI that would be taken if *Crangon* abundance falls below 170 in any one year, because such levels should be extraordinarily rare if adequate requirements are in place.

[1] Use of the DWR flow data should be caveated by concern over the report's approach to natural flows. While the DWR report made advances in the analytical assessment of natural flows, overall it is not a credible document, because it is inconsistent with historical observations and has notable shortcomings in its analysis of the historic landscape and ecology.


Crangon
Abundance index
600
500
400
300
200
100
0
1980 1985 1990 1995 2000 2005 2010 2015
Abundance index
7
6
5
4
3
2
LN(y) = 0.656 * LN(x) - 1.89
R² = 0.50, p <0.000001
9 10 11 12
March-May Actual
Abundance index
Index
Fitted 75% UIF
0 20 40 60 80 100
Percentile

Thank you for considering our comments on the final Phase 2 Scientific Basis Report. We look forward to working with the Board to ensure that Phase 2 results in strong and timely new flow objectives that reverse the current degradation of and provide broad ecosystem protections for the Bay-Delta estuary. Please contact us if you have any questions regarding these comments.

Sincerely,

Gary Bobker
The Bay Institute

Rachel Zwillinger
Defenders of Wildlife

Doug Obegi
Natural Resources Defense Council

Noah Oppenheim
Pacific Coast Federation of Fishermen's Associations

John McManus
Golden Gate Salmon Association

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