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Subject:	updated draft red flag comments on Feb 27 BDCP effects analysis and other issues
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All - draft being shared with the NGOs attached. This isn't final, but now contains most of the substance, including the key technical issues pertaining to the effects analysis, that will be in the final version. Mike

P.s. Sending this from home because the work server is down.

Draft FWS red flags for March, 2012

Issue 1: Incomplete conceptual foundation for the Effects Analysis

The Analytical Framework fails to convey a clear vision for how the various plan elements fit together to form a conservation plan. Throughout Chapter 5, the word "uncertainty" is used as a term of convenience to support future "adaptive management" of BDCP actions that have little present-day science support, but that are central to the Preliminary Proposal (e.g., habitat for flow trade-off, predator suppression, nuisance vegetation suppression). In other places, the same term is used as a weapon in an attempt to discredit established scientific knowledge (e.g., fish-flow relationships). The BDCP Independent Science Advisors and the National Research Council review panel have both commented on the inherent uncertainty in the scientific understanding of the Bay-Delta ecosystem (and our knowledge of how the ecosystem might respond to BDCP implementation). The use of the word "uncertainty" needs to be used objectively and consistently. The value of a conservation measure will vary in space and time as a function of particular environmental and biological interactions. Many of the current conservation measures are overly simplified and superficially analyzed, and thus appear to us to be overly optimistic in concluding there will be benefits all of the target fish species everywhere they are applied.

An ecological effects analysis might be best grounded in an adequate description of the natural communities historically present within the restoration area of interest. In this way, movement towards or away from the "desired ecological condition" can be monitored, measured, and assessed. This "natural communities-based approach" is currently being used to inform at least one Delta restoration project/management plan (the Solano Open Space Foundation Rush Ranch Management Plan). We recommend building a familiarity with that plan as a foundation for understanding ecosystem and ecological change for the BDCP. Having an explicit idea of what the BDCP is building will be helpful for planning the correct restoration/enhancement alternatives and for assessing progress towards improving ecological functioning as the BDCP evolves. This broader view of what the ecology of the eventual BDCP-Delta will look like is missing from the current Plan and from this appendix. This is somewhat puzzling since the Conceptual Foundation and Analytical Framework was discussed as serving this function for the entire Effects Analysis. Adequate follow-through using this approach would greatly improve Chapter 5 and its associated appendices.

A key missing piece from the Analytical Framework document is how the Effects Analysis will be framed in the context of fish population dynamics.

There is clear evidence that most of the covered fish species have been trending downward. The document should clearly and accurately lay out the foundations of each species' population dynamics (e.g., density-dependence, density-independence, trends in carrying-capacity, etc.) as mechanistically as possible and discuss how BDCP actions will influence these dynamics. Because the conceptual foundations presented in these documents do not frame the effects in the context of historical fish population dynamics and their causes, it is unclear how the net effects should be interpreted. Indeed, some of the net effects conclusions are almost certainly not credible.

Issue 2: Lack of resolution on foundational aspects of the Plan

Sufficiently specific biological objectives for the Plan have not been agreed upon. They are foundational for the FWS. Goals are general statements and for the most part, the BDCP goals are reasonably clear. In contrast, objectives provide targets that the Conservation Measures are designed to achieve, so they are an essential prerequisite to agreeing on initial operations, adaptive limits, and other BDCP components. Consequently, adjustment to reflect analysis of the implications of the final, specific objectives will be one of the tasks ICF will have to undertake before the appendix is complete. With allowance for uncertainty, the objectives must be SMART (specific, measurable, achievable, results-oriented, time-bound) to ensure that they function as quantitative benchmarks for measuring the success of the Plan.

Initial water operations have not been defined and agreed upon. The initial water operations are foundational to all parties. Initial operations that are expected to achieve BDCP objectives and contribute to recovery of delta smelt and longfin smelt are essential if the BDCP is to be permitted as an HCP. The initial operations need to be coupled with a fully developed adaptive management program to ensure that operations continue to support recovery moving forward.

Adaptive limits to water operations remain unresolved. The adaptive limits to water operations have not been agreed upon, and they are foundational for all parties. The adaptive limits are intended to provide "sideboards" within which water operations may be managed during the life of the permit. As we have said, the limits must be expressed in terms of specific individual operational criteria that are biologically relevant to achieving the goals and objectives of the BDCP. They cannot be formulated in terms of water project impacts or "blocks of water" that might be available for conservation purposes.

An adequate governance plan for BDCP implementation remains unresolved. The BDCP has draft governance proposals, but though foundational for all parties, no structure has been agreed to as yet. The BDCP puts considerable emphasis on a future adaptive management process to guide BDCP implementation through many of the issues we discuss in this document. Thus, the FWS, NMFS, and DFG need to have full input into a robust, local adaptive management process that can efficiently facilitate tough decisions that may have significant costs. Without these features, adaptive management is very likely to fail.

Issue 3: The analysis and interpretation of BDCP are hindered by indeterminant model baselines

A key point of continuing analytical confusion is the use of multiple baselines. The current set-up for the BDCP employs two 'base case' model runs (EBC1 and EBC2). The EBC1 does not include the full suite of elements in the current FWS and NMFS OCAP RPAs; thus it has no relevance in an ESA context. Nonetheless, Chapter 5 frequently reports the results of Preliminary Proposal modeling against this irrelevant base case. The EBC2 attempts to include the RPAs in their present-day form, but it does not accurately capture them all. There are numerous cases in Chapter 5 where it is not clear what Project model result is being compared to which base condition. This generates confusion. The results will eventually need to include one model baseline condition that is fully vetted and agreed upon, is accurately based on the present RPAs, and is integrated with the climate change and sea level rise assumptions for the early and late long-term time frames. Conclusions stemming from comparisons of this baseline condition with expected project outcomes will need to be clearly presented.

CALSIM demand representation in 2060 studies should have some justification. Some explanation for, or error estimate of, assuming a 2020 level water demand for a 2060 climate change simulation should be made. Presumably portions of the State (Southern California, the American River Basin, etc.) are going to continue to grow through 2060. Some estimate in the change of cropping patterns over the 40 years (2020 – 2060) should also be made (or at least a write-up of why it cannot be made) should be included. Without clear resolution of this issue, it appears to us that the modeling may underestimate water demand in the late long-term. This has very important implications for the viability of the plan.

The proposed restoration in each ROA is only compared against the lands bounded within the ROAs, which themselves lie in larger regions. This comparison is meaningless – especially in cases like the east and south Delta ROAs, which are currently dry land. Mathematically, if a terrestrial habitat is subsequently flooded, the improvement for target fishes increases by an infinite percentage even if the habitat performs poorly because a habitat suitability index that is even a tiny fraction of 1 is still infinitely higher than zero, which is the suitability of dry land. Thus, habitat analyses need to be compared against currently available habitat acreages in the entire regions containing the ROAs, as well as Plan Area-wide totals, with river flow and climate changes incorporated, in order for the analyses to be meaningful.

Issue 4: Improper conceptual models and analysis of estuarine fish habitat

The objectives for restoring habitat addressed in the Chapter 5's Restoration Appendix are simply described, but difficult to achieve. The draft Appendix E states that BDCP's habitat restoration has two objectives[1]. The first is to "increase the amount of available habitat for covered fish species." This first objective is reasonable, but does not clearly articulate that new habitat needs to be *good* habitat. We know a lot about what determines habitat value to covered fish species. This knowledge is partly reflected in the habitat suitability indices developed in this Appendix, but often discounted elsewhere in the Chapter 5 documents. The habitat for BDCP target fishes, and all estuarine fishes for that matter, is fundamentally created by the interaction of tidal and river flows with the estuary landscape. The Preliminary Project intends to extract larger volumes of fresh water from the Delta against a backdrop of rising sea level and a re-design of the estuary landscape that will change tidal flows. The estuary has been 'asked' to sustain more and more freshwater export over time, and the Preliminary Proposal further increases exports. Whether this can be accomplished while simultaneously contributing to recovery of covered species is an open question of great importance. Fully acknowledging the interplay of freshwater flow and landscape would provide more accurate and defensible conceptual models as starting points for the Effects Analysis as a whole. Department of Interior guidelines on the use of Adaptive Management would also be helpful to include when discussing decision-making in the face of future project-related uncertainty.

The second objective is "to enhance the ecological function of the Delta." The second objective is not clear or well worded. The Delta has more than one "ecological function" and of those multiple functions, the primary one the BDCP is concerned with can be simply stated: to enhance ecological services that increase target fish

[1] We note that these "objectives" are more akin to goals. They are not specific enough to function as objectives in the manner we described above.

species biomass; in other words, to contribute meaningfully to restoring the covered fish species.

There have been several large-scale, unintentional or quasi-intentional "wetland restoration projects" in the Bay-Delta since 1920. These include Franks Tract in the 1930s, Mildred Island in the early 1980s, Liberty Island in the latter 1990s, and Napa River marsh in the past decade to name a few. There is also the seasonal fish habitat generated by large-scale floodplain restoration along the lower Cosumnes River that started in the mid-1990s. The draft appendix never mentions these events or synthesizes what is known about them. This is a critical aspect of the analysis, and needs to be done credibly. This is especially true because these "unintended experiments" provide clear lessons in what we may expect in various restoration scenarios. A close look at the estimated elevations of restored habitats shows that much of the acreage is not at intertidal elevation and thus will not readily produce the dendritic channel mosaics on a tidal marsh plain that are frequently espoused for their fish production benefits in references cited throughout the draft appendix. Particularly by the late long-term, there is a lot of subtidal habitat types in the model outputs. We do not know if unintentional habitat restorations that have occurred have increased the productivity of the Delta beyond what it would have been without them. In a reductive sense they might have – because productivity is just production can be nothing more than creation of biological carbon per unit of time. However, it is very clear that these and other "wetland restorations" have not noticeably increased the capacity of the Delta to produce the BDCP covered native fishes. As doing so is a real goal of the BDCP, this is a matter of great concern.

The documents continue to downplay Bay-Delta hydrodynamics as system-wide drivers of ecosystem services to the San Francisco Estuary. While climate and associated hydrology affect the magnitude of watershed runoff, system hydrodynamics downstream of the big dams (e.g., exports, OMR flows, X2, gate operations, etc.) are largely driven by water operations and influence the habitats and population dynamics of listed species. It is critical that the BDCP effects analysis identify modifications that will importantly alter hydrodynamics, and forthrightly address the many important aspects of the dependency of the ecosystem and its constituent species on flow. Flows are widely regarded as the "master variable" that determines the abundance and distribution of many aquatic species. Alteration of flows (in full consideration of timing, magnitude, variability) is a critically important cause of stress to the fishes and food web that have adapted to the tidal and freshwater mixing environment that is the Bay-Delta ecosystem. In addition, some of the other stressors listed and assumed to be addressed through the conservation measures are either directly or indirectly influenced by Delta inflows and outflows.

Until the roles of flows and flow alteration are properly developed in the effects analysis, the analysis will remain inadequate and potentially misleading.

The LSZ is a dynamic habitat defined by the tides and flow that requires appropriately tailored conservation strategies. It is widely recognized that estuarine habitat suitability is driven by the interaction of a flow regime over a brackish, tidally influenced landscape. Changing this interaction by reducing outflow can set a series of ecosystem changes in motion that degrade expected ecological services. In the Bay-Delta, both the flow regime and the landscape are highly altered and the BDCP proposes to alter them further. It is well established that variation in Delta outflow or X2 is correlated with many important ecosystem processes and the abundance or survival of estuarine biota. It is also well established that the most important mechanisms for each species vary. Chapter 5 attempts to dilute this scientific understanding by claiming that the *mechanisms* for the flow effects on fisheries resources are not well-understood. This is not helpful. The phenomena of species-flow responses are well-known, and a complete mechanistic understanding of why those responses exist is not needed as a prerequisite to predicting the consequences of changes to Delta inflows and outflows. (The use of phenomenological relationships to predict effects is widespread elsewhere in the effects analysis.) To the contrary, because the most important benefits flow provides to individual species *are* known to occur in different places via different mechanisms, flow standards are often the only way to assure protection of all of the relevant ecological phenomena.

The Low Salinity Zone (LSZ) is the primary habitat for delta smelt and the primary rearing habitat for larval longfin smelt and juvenile-adult splittail. The Preliminary Proposal modeling indicates that Delta outflows during February-June will more frequently be near the minima required by the SWRCB under D-1641. This will represent a substantial negative project effect on longfin smelt. The effects analysis and net effects analysis only partly address this issue, reporting that BDCP is expected to provide a large, positive impact to food resources and an almost equally large, negative impact to "transport flows". There are multiple mechanisms by which Delta outflow can affect longfin smelt recruitment: transport flow is only one of them. It seems likely this mechanism was highlighted because it can be managed via gates or other engineering solutions. The other mechanisms for which there is stronger scientific support are kinetic energy mechanisms (low-salinity zone habitat area and retention from gravitational circulation in the estuary). Problems reduced outflow create in these areas do not have reasonable engineering solutions, and at present appear to be manageable only via outflow. Thus, although the potential impact is reported, the analysis is too narrowly focused.

Both projected sea level rise and the Preliminary Proposal are also anticipated to cause the average location of X2 to move upstream during the summer and fall. The modeling indicates that intra-annual variability would be lost for several months in the late summer and fall in all water year types; even wet years would functionally become dry years for a third of delta smelt's life cycle. The effects analysis acknowledges this result as well, but the net effects concludes that habitat restoration and food web enhancement will greatly offset this loss of habitat as we presently understand it. The conclusion is in part speculative and in part does not reflect current scientific understanding.

This has several implications for delta smelt. First, under the preliminary project delta smelt habitat would less frequently lie in Suisun Bay and Marsh during summer-fall. The habitat suitability modeling shows that this would limit the capacity of tidal marsh restoration in the Suisun region to contribute to delta smelt production. Second, lower summer outflows would increase the length of time that seasonal delta smelt habitat constriction occurs and overlaps with physiologically stressful water temperatures. This means that more food production would be required to maintain current delta smelt growth and survival rates, even in areas where temperatures remain suitable. In areas where temperatures exceed physiologically suitable levels during the summer (~ 24 C), no amount of food production would increase growth or survival rates. Third, the restricted distribution of delta smelt during most summers and essentially all falls would increase the chance that a localized catastrophic event could pose a serious threat to the survival of the delta smelt population.

Turbidity is also an extremely important component of delta smelt habitat suitability. Section C.4.1.4 ("Turbidity") states: "[f]irm conclusions regarding changes in turbidity in the BDCP Plan Area are difficult to make." The document then goes on to make them without providing a persuasive rationale. The Sacramento River is the most important contributor of sediment to the Bay-Delta. According to the Effects Analysis it contributes an estimated 80% of its load during high flow events. The North Delta diversions have the ability to take up to 15,000 cfs during high flow events. For a 70,000 cfs event, this could be 20% of the Sacramento River water including its suspended sediment load. The effects analysis makes no attempt to analyze how much sediment loss per year that would represent and whether it would change the ratio of supply to loss of sediment from the estuary. The same calculations should be done for the south Delta to give the results full context.

In summary, the Effects Analysis does not appropriately deal with critical issues involving the role of the Low Salinity Zone as habitat for longfin smelt and delta smelt. Until it properly addresses the right questions regarding flow, LSZ location, and turbidity, the analysis and net effects cannot be relied upon.

There is no reason to expect SAV will not proliferate in the South Delta ROA, nor is there a reason to expect a meaningful increase in south Delta turbidity if vegetation could be successfully controlled. We do not think there should be an a priori assumption that SAV can be controlled in an ecologically safe manner in the east, central and south Delta. These are comparatively low turbidity, high vegetation areas already. There is nothing in the Preliminary Proposal that proposes to dramatically change channel geometry, increase SJR flows, or increase sediment inputs that could be expected to change the turbidity of the entire southern half of the Delta.

Chapter 5 is deficient in its descriptions of channel margin, riparian, and floodplain habitat restoration outside of Yolo Bypass. The Yolo Bypass tends to benefit native fishes because (1) it floods frequently with major inundation events; (2) it floods during times of year that BDCP target fishes can use it; and (3) upon drying it leaves very little permanent habitat for non-native fishes to colonize and reproduce in, because most non-native fishes are late spring/summer spawners. The ICF analysis claims proposed restoration of floodplains along the San Joaquin River will produce native species benefits similar to those demonstrated for Yolo Bypass. However, the predicted flood recurrence interval is not reported. The San Joaquin River is a very highly regulated river that only rarely goes into flood stage and only *extremely rarely* goes into flood stage for extended periods including the spring when major native fish benefits might be realized. It seems likely that the largest benefit of San Joaquin River 'floodplain' restoration would generally be terrestrial habitat; there might be no aquatic benefits sometimes for years on end. Hence it is true benefits are produced – for terrestrial species. Similarly, the Sacramento River from Sacramento to about Rio Vista is highly constrained by levees and has very strict flood control capacity requirements enforced by USACOE. The effects analysis does not describe how this constrained reach of the river can support the proposed changes, where they will be, and an assessment of their feasibility.

The modeling shows a gain of shallow, intertidal habitats in the Plan Area by the early long-term, which is a goal of the BDCP. However, it also shows that there is a net loss of intertidal habitat and a large increase in deep water habitat by the late long-term. The Bay-Delta is not currently limited in terms of deep water habitats, so a late long-term increase in the depth of restored habitats is not a desirable outcome. This is another example wherein benefits based on the proposed habitat acreages may be unreasonably optimistic.

Increased residence times and reduced flushing of the Delta by Sacramento River water appear likely to result in interior-delta channels that are further

dominated by agricultural runoff, invasive submerged aquatic vegetation, warmer temperatures and increased algal productivity with associated dissolved oxygen swings. These environmental conditions favor non-native/invasive species (e.g. *Egeria densa*, largemouth bass, water hyacinth, *Microcystis*) and disfavor native fishes. The Delta is already more biologically similar to a lake than it once was, due to the historical accumulation of human modifications. We expect that by reducing Delta inflow, the BDCP will facilitate the spread of habitat conditions that are unfavorable to delta smelt, and other target fish species' survival and recovery.

Lastly, the literature on the topics of invasive weed control, predator control, and re-establishment of ecological function is equivocal. The expectation that restoration efforts depending on weed control, predator control, and other untested measures will succeed appears optimistic at best.

Issue 5: The BDCP's net effects conclusions rest on an equivocal food web conceptual model

The FWS agrees that the pelagic food web that historically supported greater abundance of estuarine fishes including longfin smelt and delta smelt has been impaired and that its restoration is a key component of a conservation strategy for the Bay-Delta. However, food limitation is a ubiquitous feature of ecology in the Bay-Delta. It affects non-native species as well as the BDCP target species. Thus, the issue is not really "food limitation" *per se*. Rather, the issue is food web pathways and the number of steps in a food chain between primary producers (plants) and the BDCP covered fishes. For the smelts, the desired food pathway would be dominated by this short food chain: diatoms → calanoid copepods and mysids → low-salinity zone fishes. The short food chain outlined above dominated the historical low-salinity zone food web. Longfin and delta smelt are highly dependent on it (and minor variations of it). The other BDCP target fishes also use it, but have more generalized diets that often include benthic organisms and riparian and floodplain insects. The draft appendix has a very long section on food web changes when a simpler summary of the major points would be more effective.

The focus of food web restoration in the effects analysis is on floodplain and tidal marsh restoration. The production of diatoms *may have been limited* by disconnecting floodplains from their rivers and by reclaiming tidal marshes. These are the primary hypotheses behind the BDCP habitat restoration conservation measures. However, the two best-substantiated drivers of diatom suppression are overbite clam grazing and ammonium concentrations in the Estuary. The suppression of diatoms is hypothesized to have provided a competitive advantage to lower quality primary producers and primary producers like SAV and Microcystis that have virtually no food web value to the BDCP target fishes. This change in the base of the food web has reduced the amount of fish production that can be supported by the historical diatom-based food chain, and forced the fish to rely on other longer and more energy-limited food pathways. Longer food chains are less productive, and do not support as many fish. Because splittail and young Chinook salmon are the covered species that most extensively utilize floodplains and the interior channels of tidal marsh networks, they should be expected to gain the greatest food web benefits that restoration of these habitats can provide. However, this is not what the net effects concluded. Rather, it suggested that habitat restoration would provide greater benefit for the smelts despite their limited overlap and more restricted diets.

In summary, shortcomings in the effects analysis caused by mischaracterizing major limits on phytoplankton production and the extent to which native fishes will use restored habitat renders the analysis neither credible nor consistent with best available science. Correcting these faults could have a major effect on the design of the project.

Issue 6: The Effects Analysis relies on selective use and interpretation of biological models

The effects analysis did not use the available splittail life cycle model at all to support its net effects conclusion. There is a published stage-based life cycle model for splittail where the effects of various environmental variables were examined for their effects on long-term trajectory of population abundance. This model helped frame the preferred time-interval for floodplain activation necessary to ensure splittail persistence in the Central Valley. This available approach to an Effects Analysis for a listed species of native fish was not discussed in the present Effects Analysis Appendix.

The effects analysis did not use the best available longfin smelt statistical models to support its net effects conclusion. The newest published statistical analyses of longfin smelt are quasi-life cycle models that account for prior abundance and spring flow influences (among other factors) on this species. These models were discussed and discounted as not being ‘life cycle models’. Whether or not they are life cycle models is unhelpful: they are the best available scientific tools to evaluate project effects on longfin smelt. The older regression models that were used in the effects analysis are published, but can easily be shown not to perform as well statistically as the newer models. They also average the flow influence on longfin smelt across half a calendar year, which may affect conclusions about the reduction in springtime outflow seen in modeling outputs for the Preliminary Proposal.

The effects analysis continues to insist on an analytical approach that does not reflect the best available science. The current Draft Effects Analysis (as of September 13, 2011) downplays the potential effects of entrainment to the delta smelt population: (e.g., Section B.1.1.1), "[H]owever, analyses to date have not found correlation between entrainment and population level responses of delta smelt (e.g., Kimmerer 2008, Baxter et al. 2010)." The delta smelt population is now at historically-low abundance and population losses due to entrainment may have significant population affects depending on their magnitude and frequency. While it is true that some regression-based analyses have failed to reveal an export affect to the delta smelt population, other methods have described a role between exports and population affects to delta smelt (Thomson et al. 2010; Deriso and Maunder 2011; Kimmerer 2011). Furthermore, there are issues related to the adequacy of available data that have limited the performance of these and other models in answering entrainment questions, but none of these issues is adequately addressed. Kimmerer (2011) demonstrated that entrainment losses on the order estimated in Kimmerer (2008) can be "…simultaneously nearly undetectable in regression analysis, and devastating to the population."

We think that Maunder and Deriso (2011) is a useful modeling framework to explore hypotheses about what drives delta smelt abundance. However, there is a long list of caveats, assumptions, and issues raised by the published model that limit its usefulness in analyzing actual project proposals. Our concerns revolve around several issues. First, we are concerned that the model has serious identifiability problems, as we discussed in our technical comments last fall. Second, the model uses the official DFG Fall Midwater Trawl Abundance indices for delta smelt, but does not use the official DFG Summer Townet Survey or 20 mm Survey abundance indices. The rationale for this is not explained. The model results assume a form of density dependence between generations that we do not think is supportable. This affects the set of plausible mechanistic explanations for what factors might have affected delta smelt reproductive success over the past several decades. Third, most of the explanatory power in the model appears to be due to (1) fitting empirical relationships among successive abundance indices and (2) a few covariates based on derivations that are not adequately explained. Fourth, the published version of the model used data through 2006. The model was updated for the Effects Analysis to include data through 2010. When this was done, the model fit deteriorated dramatically relative to what was reported in the published paper. In short, the intent of the modelers – to fit a phenomenological statistical model to heterogeneous historical data – may have hamstrung the model as a tool for predicting the future, including the effect of operations outside the envelope of historical experience. Fifth, and last, as consideration of the carefully processed variables used in the Maunder-Deriso model illustrate, the quality and applicability of available historical data are variable. It is important for the Effects Analysis to acknowledge that some data that may prove to be critical to effectively modeling delta smelt or longfin smelt dynamics have been collected only recently. Potential limitations to the ability of retrospective studies to tease out important ecological relationships should be forthrightly explored.