



September 16, 2009

Bay-Delta Conservation Plan Steering Committee
c/o Hon. Karen Scarborough, Undersecretary of Resources
1416 Ninth Street, Suite 1311
Sacramento, CA 95814

RE: Draft Near-Term Operations Analysis

Dear Members of the Steering Committee:

We are writing to memorialize and expand on the concerns we have raised regarding the recent "Draft Proposed BDCP Near-Term Conservation Measures for Hydrodynamic Modeling and Analysis" prepared by SAIC (SAIC proposal) for the BDCP Steering Committee. Specifically, we are concerned that some of the measures to be analyzed in the SAIC proposal:

- would be less protective than the current Biological Opinions.
- would be less protective than the current SWRCB water rights permits.
- are neither near-term nor operational in nature.
- are highly uncertain and impossible to evaluate quantitatively.
- are not based on the best available science or are simply not well-developed.

In summary, we question the usefulness and appropriateness of analyzing a proposal for near-term operations which appears to be significantly less protective than existing federal and state requirements for water project operations, and we believe that any alternatives to existing requirements to be analyzed should include either those actions with a high degree of certainty regarding effects on covered species or those actions to be implemented as experimental or demonstration projects using an adaptive management approach based on clearly articulated targets, testable hypotheses, and best available scientific information, a threshold not met by the SAIC proposal. For these reasons, we do not support analyzing the SAIC proposal as part of the BDCP effects analysis. Instead, the analysis of near-term operations should:

- focus on the effect of existing regulatory protections on covered species.
- only consider operational measures (?) that are more protective than existing requirements (i.e., meet the NCCPA and Section 10 standards).
- only consider non-operational alternatives as research, experimental or demonstration projects for adaptive management purposes or those deemed to have a high degree of certainty associated with their expected outcomes.
- be contingent on the development and use of performance targets and metrics.

We discuss our concerns in greater detail below:

1. The proposed measures appear to be less protective than the RPA's included in the Biological Opinions currently in place.

The BDCP is tasked with developing a plan that meets the recovery standard of the Natural Communities Conservation Planning Act and Section 10 of the federal Endangered Species Act, a standard which clearly exceeds the “avoid jeopardy” requirement of the smelt and salmon Biological Opinions. Unfortunately, the SAIC proposal would weaken or eliminate a number of existing protections included in the federal ESA Biological Opinions for the delta smelt (smelt BO) and Chinook salmon, steelhead, sturgeon, and orca whales (salmon BO), including:

- Late fall / early winter export limitations to protect migrating salmon.
- Old and Middle River (OMR) flow requirements.
- San Joaquin River inflow and Vernalis flow requirements.
- Fall X2 requirements.

Late fall / early winter export limitations to protect migrating salmon: Kimmerer (2008) reported that the proportion of juvenile Chinook salmon emigrating through the Delta that were lost at the CVP and SWP export facilities was directly related to export rates. The majority of juvenile salmonids migrate through the Delta during the winter and spring (November-May; Salmon BO p. 633). More than a quarter of the winter-run population migrates through the Delta during the November-December period. Based on this, the salmon BO requires that exports be reduced during the November-April period whenever real-time salvage of salmonids exceeds specified trigger levels. The SAIC proposal (Measures #2, 3, 28, and 29) would weaken these protections by eliminating all restrictions on exports in November and assuming a lower level of protection (i.e., higher allowed export rates than predicted by the analyses in the salmon BO) in the December-April period.

OMR flow requirements to protect salmon and smelt: Multiple analyses have shown that: a) OMR flows are strongly correlated to export rates; and b) the numbers of fish

(including delta smelt, longfin smelt, and Chinook salmon) lethally entrained at the export facilities are directly related to OMR flows and/or export rates. Both the salmon and smelt BOs require that OMR flows (and export rates) be managed to reduce entrainment. Using data and analyses from recent historical conditions, predicted that during the winter months “OMR flow would generally be expected to be in the range of -2,000 cfs to -3,500 cfs” (Smelt BO, pp 281-282). Similarly, the smelt BO analyses predicted springtime OMR flow requirements would range from -2,000 to -3,500 cfs (Smelt BO, p. 360 and p. 363). The SAIC proposal’s Measures #2, 3, and 29 assume export levels and/or OMR flows that are less protective than these levels. In addition, Measures 1-3 are based on DWR’s Potential Entrainment Index (PEI), an approach that was proposed by DWR to the USFWS during the BO process, reviewed by the fishery agencies, and rejected as being inadequately protective of both fish and critical habitat.

San Joaquin River flows, VAMP export reductions, and San Joaquin River flow to export ratio requirements: The survival of juvenile salmon migrating from the San Joaquin basin is adversely affected by low San Joaquin River flows, high export rates, and low San Joaquin River flow to export ratios. The SWRCB (in D-1641) requires that San Joaquin River flows be enhanced and export reduced to effectively provide for a San Joaquin River flow to export ratio of greater than 2. The Salmon BO requires generally higher San Joaquin River flows and greater San Joaquin River flow to export ratios. The SAIC proposal’s Measures #2, 3, 12, 28, 29) would substantially weaken current protections by allowing export levels higher than currently specified by the VAMP and eliminating minimum requirements for San Joaquin River flow to export ratios currently required by the Salmon BO (pp. 641-645).

Fall X2 requirement for protection of smelt: Feyrer et al. (2007, 2008) reported that the quantity and quality of delta smelt rearing habitat during the fall and resultant delta smelt population abundance the following spring were related to the amounts of freshwater outflow from the Delta (measured as X2), which during this season were usually a function of CVP and SWP operations. The smelt BO requires that September and October X2 be maintained at or downstream of 74 km and 81 km in wet and above normal years, respectively. The SAIC proposal’s Measure #6 would weaken this protection by restricting its implementation to reservoir releases of “excess” flood flows (which are highly unlikely to occur during this season) and requiring no impacts on water supply.

The SAIC proposal also omits certain operational areas covered in the BOs and other existing requirements. For example, Measure 12 would replace the San Joaquin River “inflow to export” ratio, included in the BOs as a protection for steelhead, with weakened OMR flow requirements described above. This omits an entire class of protections and one for which there is good evidence regarding efficacy (CDFG 2008). Similarly, there is no mention at all of upstream carryover storage requirements and procedures for maintaining EOS storage, as described in the salmon BO. This operational parameter is intended to provide substantial protection to winter-

run, spring-run, and steelhead spawning habitats, and its absence from the SAIC proposal is inexplicable.

In addition, some of the habitat restoration proposals identified in this near-term operations package as “alternatives” are required under the existing BOs. For example, the Yolo Bypass / Fremont Weir measures (Measures 9 and 15) could satisfy the requirements of the salmon BO, although they would need to be strengthened to specify floodplain inundation through April and they would need to be implemented to a large extent by 2013. The salmon BO also specifically requires the Fremont Weir fish ladder, modifications of Lisbon Weir, and Lower Putah Creek improvements. It allows for modifications of either or both the Sacramento or Fremont Weir. These measures also require creation of substantial new floodplain habitat (a target of 17,000 to 20,000 acres, excluding tidally influenced areas, with appropriate frequency and duration, and restoration of “significant acreage” by 12/31/2013).

Finally, it needs to be noted that it is necessary to fully and accurately describe the measures contained in the BOs and water rights permits in order to analyze their effects, let alone compare them to some alternative approach. For example, the duration of and triggers associated with each measure in the BOs should be provided. In addition, a number of measures in the BOs are mischaracterized, including Measure 12 (San Joaquin inflow:export ratio and minimum Vernalis flow requirements), Measure 6 (Fall X2 proposal also can apply in November and December, depending on hydrology), and Measure 17 (which actually refers to requirements of Measure 12, Measure 18, and Measures 2-3). Furthermore, some components of the SAIC proposal (e.g., Measures 4 and 5) are actually measures required under D-1641, or the alteration (or weakening) of such permit terms. The table inaccurately lists them as not being required by the BOs, whereas full compliance with D-1641 is the baseline for OCAP and therefore D-1641 is explicitly incorporated into the BOs. (It is also unclear whether the SAIC proposal intends to exclude other elements of D-1641 such as VAMP from being part of BDCP’s near-term operations). These mischaracterizations must be corrected prior to the start of any analysis, comparative or not.

2. The proposed measures would also be less protective than currently required under the SWRCB water right permits for the federal and state water projects.

The measures in the SAIC proposal would also weaken the protections for covered species contained in State Water Resources Control Board (SWRCB) Water Rights Decision 1641 implementing the Bay-Delta Water Quality Control Plan’s February - June Delta outflow objectives. Measure #5 of the SAIC proposal would modify the existing SWRCB outflow objectives by managing the position of the low salinity zone (X2) “...as an average over the 5-month-period (Feb-Jun).” The current SWRCB standard is designed to produce a response in the position of the salinity field as measured over a monthly averaging period. Mathematically speaking, the impact of allowing a longer averaging period for meeting X2 requirements will be to increase the variance in Delta outflow (and X2 position) during the averaging period. Whereas there has been discussion about increasing the variance in X2 position within and

across years, there is no indication that increasing variability in Delta outflow or the position of X2 *during the winter-spring period* improves conditions for covered species; therefore, the consultant's expected benefits and outcomes of modifying D-1641 requirements to allow for a longer averaging period are completely unsubstantiated.

The most likely outcome of the change from a monthly averaging period to a 5-month averaging period is that estuarine habitat will be degraded. Numerous studies demonstrate that populations of covered species and their prey are correlated with winter-spring Delta outflows and negatively correlated with winter-spring X2 position (e.g. Stevens and Miller 1983; Jassby et al. 1995; Kimmerer 2002, 2004; Kimmerer et al. 2009; Rosenfield and Baxter 2007). The operational effect of the proposed alternative will be to reduce Delta outflow such that X2 is located further to the east during most of the winter and spring as the water agencies wait for late-season rainfall or use late-season reservoir releases to produce a more westerly X2. A number of analyses have used a 5-month average for X2 in order to demonstrate the overall X2: abundance relationship, although many of these analyses have used different months for different species. For instance, at least one paper (Rosenfield and Baxter 2007) relates January-March Delta outflow (a strong correlate and driver of X2) to abundance of one of the covered species (longfin smelt). To somehow assume that a 5-month average of X2 is the most relevant biological metric for estuarine species populations is not corroborated by the analyses. In most cases, the averaging period analyzed was likely chosen to capture (a) differences in the temporal pattern of outflow between years (avoiding year-to-year variance in the monthly pattern of outflow) and (b) differences among species in the time period with which Delta outflow (or position of the low-salinity field) has its effect. In other words, the 5-month average metric used in many analyses of fresh water flow: abundance relationships reflects convenience to researchers and correspondence to the current regulatory regime, not a special ecological property of the 5-month average.

Any proposals for near-term operations should be intended to improve upon the biological response targeted by current SWRCB requirements. Averaging the position of the low-salinity field over increasingly larger time-steps moves the analysis in the wrong direction, i.e., a weaker response. Analyzing near-term operations that move winter-spring X2 further to the west more consistently than called for by D-1641 and/or those that allow X2 to respond to natural hydrology over a shorter time step (e.g. weekly or bi-weekly averaging) would be of more utility as such measures would more closely mimic conditions under which populations of covered species evolved.

3. The SAIC proposal includes measures that are neither near-term nor operational in nature.

The "near-term operations" package should include only the operational requirements that will be implemented at the start of the BDCP "near-term" period. Non-operational measures will also be evaluated as part of the overall near-term conservation strategy, but their presumed effects on operational measures are highly conjectural (see below) and likely to occur at a meaningful and measurable scale only after the conclusion of the near-term period.

A number of non-operational actions have potential value in conserving or restoring covered species, and detailed planning, permitting, and implementation of these actions should begin quickly in order to test and increase intended benefits for covered species and other ecosystem elements. However, many of these non-operational measures will take decades to plan, implement, and assess, and their inclusion in the SAIC proposal is inappropriate. Indeed, some might not be implemented at all (or their effects understood) during the near-term period. For example, measures such as HRCM 4 (“Restore at least 5,000 acres of tidal habitat within the Cache Slough complex”) and HRCM9 (“Restore at least 7,000 acres of tidal habitat in Suisun Marsh”) require significant planning and permitting and will require decades to fully implement. Post-restoration site evolution to a condition that supports covered species populations will require additional time. Documenting and understanding the actual benefits of these actions (which are quite uncertain, according to the recent DRERIP scientific review) can only occur after the projects have been fully implemented for several years. There is every reason to implement these conservation measures on a *trial, experimental, or demonstration* basis during the near-term period. Assuming an adequate performance monitoring and evaluation framework is in place, the information generated by these projects can inform adaptive management decision making to refine the long-term conservation strategy and help to document the benefits and costs of these ideas prior to full-scale implementation. To include them as measures which are intended to augment or replace operational requirements is inappropriate.

4. The SAIC proposal includes measures that are highly uncertain or impossible to evaluate quantitatively.

A basic problem with including non-operational measures in a near-term operations proposal because of their presumed effects on operational parameters and/or covered species is that the impacts of the former (whatever their merit) and the presumed interactions are often not readily quantifiable. There is no way to currently assess the benefits of many of these proposed non-operational measures to a level of detail where they will be comparable to the operational measures they are intended to augment or replace. For instance, while actions like OSCM4 (“Reduce the load of agricultural pesticides and herbicides entering Delta waterways from in-Delta sources”), OSCM5 (“Reduce the loads of toxic contaminants in stormwater and urban runoff”), and OSCM13 (“Remove non-native submerged and floating aquatic vegetation) are potentially valuable conservation measures (with risks identified in the DRERIP scientific review), there is no way to assess their quantitative impacts on *any* of the covered species because the best available science does not provide a means of performing such an evaluation.

Measure 1 of the SAIC proposal would alter the OMR flow requirement in the BOs to include triggers when south Delta turbidity >12 NTU in Old or Middle River or pre-spawning adult delta or longfin smelt are observed in SWP or CVP salvage on 3 consecutive days. We understand that this “near-term operations package” is “*intended to assist in modeling and analytical purposes*”; however, it is not at all clear that evaluation of this measure can be performed as the only available evaluation tools are those that are proposed as part of the measure. This measure will “...implement short-term reductions in exports to avoid movement of adults into the

southern Delta based on predictions of delta smelt modeling and PEI" (*emphasis added*).

Evaluating this measure using the very tools it is supposed to employ is not a scientifically valid approach. The models mentioned are in a developmental stage, have not been peer-reviewed to our knowledge, and, in any case, cannot be used to evaluate their own performance.

Measures 2 and 3 include several actions that have unknown (and largely unknowable) benefits. For instance, Measure 3 includes a provision to install behavioral barriers at the Head of Old River, Georgiana Slough, Turner Cut, and Columbia Cut. There is no evidence that these new engineering projects will work as intended, no verifiable way of evaluating them, and no way of comparing their impact to the flow restrictions they are designed to replace. Behavioral barriers are of little use in protecting larval fish (as this measure is intended to do) because larval fish have extremely limited swimming ability. Indeed, the existing behavioral barriers at the south delta export facilities are believed to allow passage of large numbers of larval Delta smelt and longfin smelt - yet the performance of the existing screens in protecting larval life stages has not been evaluated. Given this, it is difficult to imagine a credible evaluation of a hypothetical barrier, much less a suite of barriers.

Similarly, there are several proposals to install barriers to fish migration in the Delta to direct fish away from points of entrainment, including the Two Gates proposal. The Two Gates proposal was initially presented as a demonstration or research project with the intention of gathering data about its beneficial and negative impacts. This action was described as a research project because there are no data to support its efficacy (or to measure its potentially damaging effects). The only way to "evaluate" the performance of these gates at this time is to make assumptions about fish behavior and employ hydrodynamic modeling. While these tools would help create a fully developed *hypothesis* about the function of the gates, they are not in themselves a test of the hypothesis and cannot produce an analysis of effects. To include this project (or any of the other fish migration barriers) as a near-term measure that augments or replaces operational measures rather than as a research or demonstration project is not appropriate because the effects of this action are unknown and unknowable at this point. Simply put, hypotheses, hydrodynamic modeling results, and simplistic assumptions about fish behavior do not suffice as "evidence" that can be the basis of an effects analysis to determine near-term permit requirements.

Proposals OSCM4 and OSCM5 in Measure 3 are generally desirable actions and are unlikely to harm covered species; however, there is no evidence of the population level impact of most toxic substances on covered species. There is not even sufficient population-level evidence to form a professional judgment about the quantitative impact of these actions to covered species' populations. While these actions should be immediately implemented and their effects measured, there is simply no way to compare their anticipated effect to the measurable impact of OMR flow requirements in the Biological Opinion. Another desirable action (OSCM 10 -- Reduce non-native introductions from recreational watercraft) has nothing to do with reducing current impacts to covered species and there is absolutely no way of determining the *avoided negative impact* to the different covered species that results from not introducing an invasive species.

A qualitative evaluation of non-operational measures would likely be a useful amendment to a quantitative effects analysis that assesses the benefits to covered species of operational measures. The point to be emphasized here is that it is not currently possible to evaluate whether these various non-operational actions will compensate for and exceed the level of protection for covered species provided under existing regulatory protections that would be weakened or eliminated under the SAIC proposal.

5. The SAIC proposal includes measures that are not based on the best available science or are simply not well developed.

The SAIC proposal includes a number of measures based on untested or rejected assumptions and whose benefits are highly conjectural. How the proposed changes to existing regulatory protections ignore or misinterpret the best available science is discussed above. Some additional examples follow.

Measure 1 of the near-term operations package was assessed and rejected recently by the USFWS during the development of the smelt BO. SAIC should describe and document any new science that has been produced subsequent to issuance of the BO which would support re-evaluation of this measure.

The results of the recent, partially completed DRERIP scientific review of draft BDCP conservation measures reveal that many of the non-operational components of the SAIC proposal carry potentially significant and widespread risks for covered species. A subsequent phase of the DRERIP review process (not yet conducted for BDCP) would compare the anticipated benefits and risks associated with actions to recommend whether they should be implemented and, if so, at what scale. It is likely that a number of non-operational measures would either not be recommended for implementation or be recommended only as research and demonstration projects if the DRERIP process was completed. For instance, one component of Measure 2 (OSCM 13 --Selective removal of invasive plants) was found to have potentially significant *negative* impacts for all covered species and, at best, “minimal” impact on longfin smelt, an intended beneficiary of this action (other species might realize a “medium” impact from this action). Similarly, OSCM14 (increase the harvest of non-native predatory species) was found to have potentially significant negative impacts to all covered species while producing low magnitude benefits (at best) to migratory salmonids; certainly this approach has not been successful in restoring salmonids in other places where it has been implemented (e.g. Columbia and Snake River). Furthermore, we know of no scientific support for the assertion that the habitat restoration proposals called for in proposed actions HRCM 4 and HRCM 9 will increase Delta smelt *spawning* habitat (the requirements for successful Delta smelt spawning habitat being unknown) or that Delta smelt populations are limited by lack of spawning habitat (though this seems unlikely given that the recent declines in this species are not correlated with recent declines in physical habitat). Both of these variables would need to be understood in order to predict impacts of the proposed actions.

Finally, some measures in the SAIC proposal appear to have little to do with the impacts to be mitigated and would therefore not improve protections. For example, creating a mark-select fishery will do little to address any operational deficiency in upstream spawning and rearing habitats. Based on this year and last, allowing more adults to return to upstream spawning habitats has had limited benefit if the spawning and rearing habitats are too hot to support successful incubation and rearing. SAIC should document the new scientific information that would justify the inclusion of these measures in the analysis. Similarly, some measures are mismatched to the impact with which they are associated. For example, in the September 2 version of the “near-term operations” package¹, Measures 14-16 include provisions to: “reduce illegal harvest of Chinook salmon, Central Valley steelhead, green sturgeon, and white sturgeon in the Delta” (OSCM16), “reduce losses of wild stocks of Chinook salmon to commercial fishing and recreational fishing through a mark-select fishery” (OSCM19), “reduce the effects of predators on covered fish by conducting localized predator control at locations where predation mortality is high”. None of these measures have anything to do with the category “Upstream Actions” (as the table lists them) or the RPA’s they are intended to augment or replace (e.g. Clear Creek, Shasta Operations, and Red Bluff Diversion Dam Operations, respectively). Reducing “predation” on adults or outmigrating juveniles (whether illegal or legal human catch or loss to other predators) does not address the need to improve upstream habitat conditions for spawning, incubation, and early rearing. For example, the cancellation of the commercial Chinook salmon fishing season for the past two years has not, in any way, affected the availability of suitable Chinook salmon or steelhead spawning habitat upstream – indeed, the reduction in fishing pressure was, at least partially, in vain because spawning conditions upstream were not adequate to support successful incubation and rearing of juveniles. We are, of course, in favor of reducing illegal harvest (“poaching”) of covered species, but the implication that this will mitigate for poor spawning, incubation, and juvenile rearing conditions is simply misguided.

Conclusions and recommendations

We recommend the following approaches to analyzing near-term operations as most likely to ensure a successful, scientifically sound, and permissible BDCP:

1. The Reasonable and Prudent Alternatives (RPAs) in the smelt and salmon BOs represent the most scientifically defensible, best articulated, and most fully peer-reviewed set of measures available to avoid jeopardy to those endangered species to be covered under the BDCP permit. In contrast, the changes to operational requirements under the BOs and D-1641 and the non-operational measures contained in the SAIC proposal are not scientifically justified or fully articulated and have not been extensively reviewed. The analysis of near-term operations and other measures would be most useful by focusing on further evaluating the effects of the RPAs on the full suite of covered species.

¹ At least two versions of the “near term operations package” were produced in very short order – one on 9/2/09 and one on 9/3/09. It is not clear which one, if either, is closest to the final “near term operations” package.

2. Alternatives to the RPAs should only be considered for further analysis as near-term conservation measures if they will provide a level of protection greater than that needed to avoid jeopardy under the BOs (in other words, if they meet the higher recovery standard of the NCCPA and Section 10 of the ESA) and if securing that level of protection is at least as certain as the benefits associated with implementing the RPAs (in other words, benefits should not simply be predicted based on hypothesis formulation or modeling exercises alone).

3. Alternatives to the RPAs that may have potential value but whose benefits are highly speculative should be evaluated as research, experimental or demonstration projects. At a minimum, the analysis should capture both the anticipated phased implementation of these projects and the expected timing of benefits. It is highly likely that few of these projects – even the most worthwhile and successful – will provide demonstrable benefits during the near-term period. Near term jeopardy cannot be traded for longer term benefits, as the Ninth Circuit has made abundantly clear.

4. Adequate analysis and selection of conservation measures for both the near-term and long-term periods is largely dependent on the development and application of clear and measurable performance targets and metrics. These targets and metrics define the desired outcomes for covered species at both the level of the BDCP as a whole and individual conservation measures, yet the effort to identify targets and metrics continues to lag behind the analysis of conservation measures themselves. In addition, adaptive management and phased implementation of conservation measures is contingent on the ability to evaluate whether these measures are providing the desired population, community and ecosystem level benefits to covered species and to guide the refinement and modification of the long-term conservation strategy. Performance targets and metrics must be pursued more aggressively in order to ensure their use in the analysis and selection of all conservation measures and inclusion as appropriate in proposed permit terms and conditions.

Sincerely,

Ann Hayden
Environmental Defense Fund

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Defenders of Wildlife

Literature Cited

- Baker, P.F. and J.E. Morhardt. 2001. Survival of Chinook salmon smolts in the Sacramento-San Joaquin Delta and Pacific Ocean. In R.L. Brown (ed.) Fish Bulletin 179 Contributions to the Biology of Central Valley Salmonids Vol. 2:163-182. California Department of Fish and Game, Sacramento, California
- Jassby, AD, W.J. Kimmerer, S.G. Monismith, C. Armor, J.E. Cloern, T.M. Powell, J.R. Schubel, T.J. Vendlinks 1995. Isohaline position as a habitat indicator for estuarine populations. *Ecological Applications*. 5:272-289.
- Kimmerer, W.J. 2002. Effects of freshwater flow on abundance of estuarine organisms: physical effects or trophic linkages? *Marine Ecology Progress Series* 243:39-55.
- Kimmerer, W. 2004. Open Water Processes of the San Francisco Estuary: From Physical Forcing to Biological Responses. *San Francisco Estuary and Watershed Science* [online serial]. Vol. 2, Issue 1 (February 2004), Article 1.
<http://repositories.cdlib.org/jmie/sfews/vol2/iss1/art1>
- Kimmerer, W.J. 2008. Losses of Sacramento River Chinook Salmon and Delta Smelt (*Hypomesus transpacificus*) to Entrainment in Water Diversions in the Sacramento-San Joaquin Delta. *San Francisco Estuary and Watershed Science*. Vol. 6, Issue 2 (June), Article 2.
- Kimmerer, W.J. and M.L. Nobriga. 2008. Investigating Particle Transport and Fate in the Sacramento-San Joaquin Delta Using a Particle Tracking Model. *San Francisco Estuary and Watershed Science*, Vol. 6, Issue 1 (February), Article 4.
- Kimmerer, W.J., E.S. Gross, M.L. Williams. 2009. Is the response of estuarine nekton to freshwater flow in the San Francisco Estuary explained by variation in habitat volume? *Estuaries and Coasts* (*published online only at the time of this writing*).
- CDFG 2008. San Joaquin River salmon population model. Presented by D. Marston and A. Hubbard. SWRCB SJR Flow Workshop Sept. 17, 2008.
http://www.waterrights.ca.gov/baydelta/docs/sanjoaquinriverflow/dfgpresentation_salmon.pdf
- Rosenfield, J.A. and R.D. Baxter. 2007. Population dynamics and distribution patterns of longfin smelt in the San Francisco Estuary. *Transactions of the American Fisheries Society* 136:1577-1592.
- Stevens, D.E. & L.W. Miller. 1983. Effects of river flow on abundance of young chinook salmon, American shad, longfin smelt, and delta smelt in the Sacramento-San Joaquin River system. *North American Journal of Fisheries Management* 3:425-437.