OCAP Biological Opinion Review Workshop
October 12 and 13, 2005
Putah Creek Lodge
UC Davis
WORKSHOP NOTES BY KRISTEN HONEY
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October 12

09:00 – Introducing the OCAP BO Review Panel and workshop ground rules – *Randy Brown, CBDA*

Randy (Scientific Advisor for the CALFED Science Program) explained that this workshop stems from a NOAA Fisheries request to CALFED to convene an independent review panel to examine the science and appropriate use of scientific information in the Biological Opinion (BO). This scope includes a review of the scientific basis of the Biological Assessment (BA) because the BA provides much of the data and foundation on which the BO was based.

Randy clarified the format of the workshop. He emphasized that this workshop is unique in that the panel and invited speakers will do the talking and that the attending audience will listen. This workshop is intended to be a transparent process, but not one that actively involves public participation, until the public comment period in the afternoon of the second day. During the public comment period tomorrow, stakeholders will have an opportunity to point out any science that may have been overlooked or misrepresented by the BO/BA documents, as well as comments on how the authors interpreted the science. The public comment period is not intended to be a trial or lobbying forum. In order to participate in the public comment period, individuals should speak to Randy for inclusion on agenda.

Frank Michney, from the U.S. Bureau of Reclamation (the Bureau) Regional Office in Sacramento, said that the Department of Interior withdrew from the workshop because:

(1) Existing litigation, and
(2) Changed focus, scope of concerns, and conclusions/recommendations the panel's charge.

Michney recommended that the panel not get into too much technical detail, but rather stay focused on the original charge from NOAA Fisheries when it asked CALFED to independently review the science that was used to write the BO and not spend much time on the BA prepared by the Bureau and cooperating agencies. Hopefully, this workshop will address these existing concerns about the science involved in the BO, with positive implications for both the litigation and the perceived change in focus, scope, and conclusions of the BO.

Randy again emphasized that this workshop will be an open process and that stakeholders will have access to all information. If stakeholders have specific questions or concerns

that they want addressed by the panel during this workshop, please send these questions/comments to Randy and we will forward them to the panel. Panel responses will be posted on the CALFED Science Program website (http://science.calwater.ca.gov). The rules of this workshop, however, remain the same: the panel and invited presenters will exchange information, but the public will have to wait till the second day to make any comments.

The six panel members then introduced themselves by name, affiliation, and research interests/strengths:

(1) **Jim Lichatowich** (panel chair): Private consultant (Alder Fork Consulting) in Columbia City, Oregon. Mr. Lichatowich has a M.S. in fisheries science and extensive experience with salmon life history research and applying this life history information to management of Pacific salmon.
(2) **Al Giorgi**: Dr. Giorgi has been conducting research on Pacific Northwest salmonid resources since 1982, with work on the Columbia River, Snake River, and Washington salmon issues. He is President and senior fisheries scientist at BioAnalysts, Inc.
(3) **John Williams**: Independent consultant based in Davis, CA and former executive director of the Bay-Delta Modeling Forum. Dr. Williams is also the author of the CALFED whitepaper on salmon and steelhead (currently under review).
(4) **Jim Anderson**: Dr. Anderson is an Associate Research Professor at the School of Aquatic and Fishery Sciences, University of Washington. In addition to researching Columbia River salmon, Jim is a member of the Environmental Water Account (EWA) Panel Review team and the Technical Recovery Team (TRT) for Central Valley salmon and steelhead. His work involves mathematical models, data collection, fish passage, and physiological and ecosystem responses to hydrological impacts.
(5) **Ken Rose**: An Associate Professor at the Coastal Fisheries Institute and Department of Oceanography & Coastal Sciences, Louisiana State University, Dr. Rose's research focuses on mathematical and computer modeling of fish population dynamics. He is a member of the CALFED Independent Science Board and EWA Panel Review.
(6) **Mike L. Deas** (not present during the morning session of the workshop, so biography introduction by Randy): Dr. Deas is a researcher at Watercourse Engineering, Inc., in Davis, CA. He works with temperature and operations models.

09:10 – Consultation under the ESA – *Penny Ruvelas, NOAA Fisheries*
Penny is the Regional Section 7 Coordinator for NOAA Fisheries Service, Southwest Region. Specifically, she works on the compliance, application, and review of BOs, especially those that are controversial or complex (OCAP is both).

Penny discussed interagency cooperation under the Endangered Species Act (ESA) Section 7(a)(2). First she articulated Section 7 definitions and guidelines to the panel. Section 7 states that:

> "*Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any*

> *endangered species or threatened species or result in the* destruction or adverse modification *of designated critical habitat*."

In fulfilling the requirements of this paragraph, each agency shall use the best scientific and commercial data available.

The BO mandate stems from Section 7(a)(2) under the purview of the Secretary of Interior or the Secretary of Commerce, depending on which species is listed. The language of the Section 7(a)(2) mandate is critical. The previous section, detailed in the above paragraph, deals with species recovery. Specifically for the OCAP BO, regulators must focus on two distinct standards within ESA: (1) jeopardy, and (2) adverse habitat modifications. For both of these standards regulatory agencies must use the best data available.

To meet these ESA standards, definitions exist. The "Jeopardy" Standard is defined as:

> "*Jeopardize the continued existence of: to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species*."

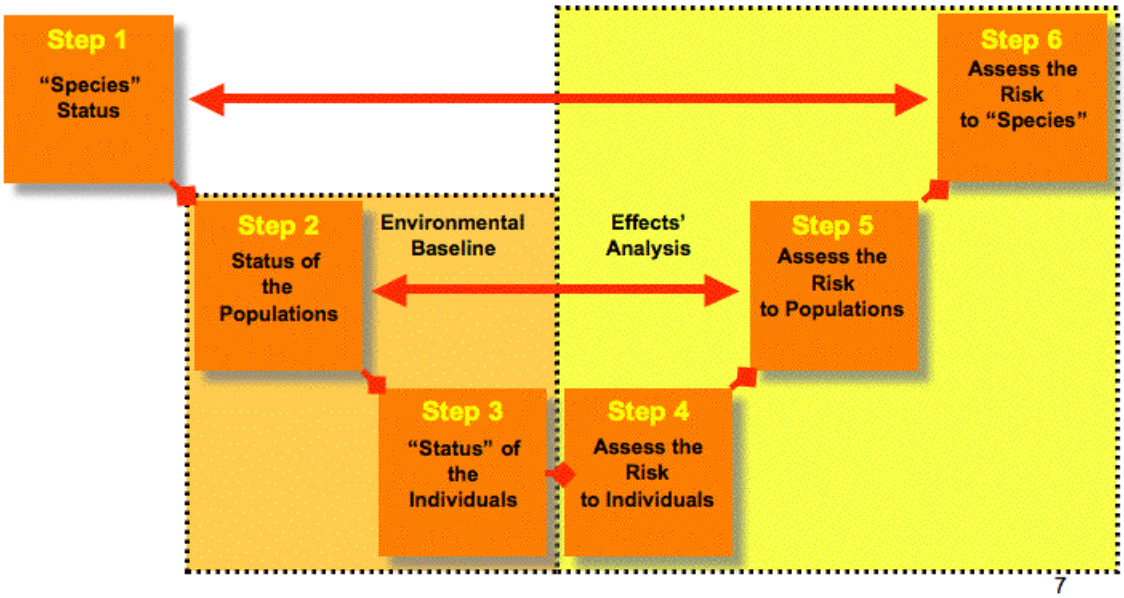
The definition of “destruction or adverse modification of critical habitat” in current Section 7 regulations state that the:

> *“direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical”*

However, this "destruction or adverse modification" definition has been invalidated by several court cases (in 5th, 9th, and 10th Circuit Courts) in recent years. In the interim, the Services use the language of the ESA itself to interpret the “destruction or adverse modification" standard. In other words, is there evidence of “direct or indirect alteration that appreciably reduces the conservation value of critical habitat. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical”

The conceptual model and analytical framework (see figures below) for Section 7(a)(2) jeopardy analysis rely on best available data. NOAA Fisheries refers to the analysis generally as “the jeopardy analysis” but this does not prejudge the outcome (i.e., the conclusion can be “is not likely to jeopardize”).

Conceptual Model for Jeopardy Analyses



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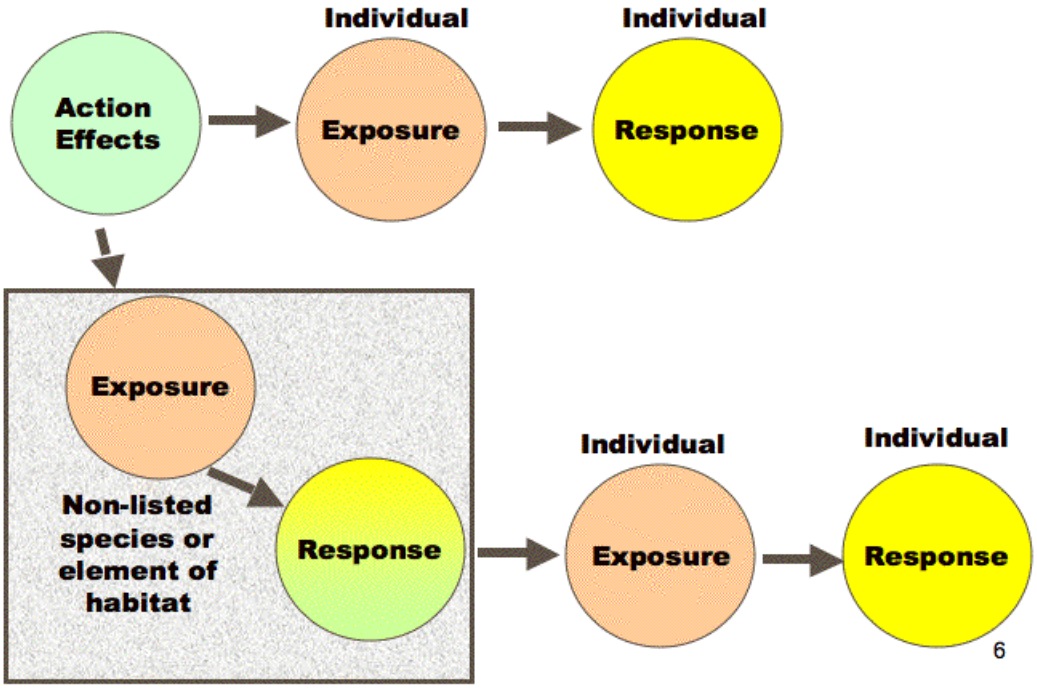
Basic Analytical Model



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Note: in the indirect pathway, the first response is shaded towards green to indicate that the response becomes a new stressor with associated exposure and response.

This same basic model applies to primary constituent elements of critical habitat as well.

Under Section 7(a)(2), each regulatory agency shall use the best scientific and commercial data available in fulfilling their regulatory requirements. These requirements are specified as: "each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of designated critical habitat."

Best available data is generally defined as data or evidence that are:

- Reliable
- Explicit
- Rational
- Objective

Best available data ranges from peer-reviewed papers to unpublished empirical information, as well as tribal information.

Under OCAP, NOAA Fisheries has been working with the Bureau to help ensure that Bureau actions will not jeopardize ESA-listed species. NOAA Fisheries gives the Bureau information and opinions about water operation actions, but ultimately, the Bureau makes the decisions.

It is important to note that key terms trigger an analysis to determine whether or not specific actions will reduce population viability (see the yellow highlighted text on the "Conceptual Model for Jeopardy Analysis" slide). More specifically, from a scientific perspective, we can think of probability of extinction or probabilities of persistence.

Granted, even within this probabilistic framework, definitions are still subjective. For example, the term "appreciably" in the Jeopardy standard is hard to define. How much is appreciably? This is subjective and NOAA Fisheries has to make a judgment call whether or not the impacts are "appreciably" given the situation and best available data.

(John Williams comment): For the continued existence of a species, jeopardy is not the exact opposite of recovery. Survival and recovery differ in their implications, but ultimately the end goal of ESA is to remove species from the list and ensure that the species is not suppressed so that it can begin journey to recovery. Correct?

(Penny Answer): In a Jeopardy analysis for survival, the regulators consider the same factors that they use to evaluate and promote species recovery.

(Kenny Rose): What if an action does not help with species persistence but does impede recovery, can that be considered Jeopardy under ESA?

(Penny Answer): The agencies need to make sure that we're not reducing the likelihood of both. Therefore, in most cases, if only impacting one (i.e., persistence or recovery), then it would not be considered Jeopardy.

Returning to her talk, Penny re-emphasized how the "destruction or adverse modification" requirement required by Section 7(a)(2) has recently been invalidated by the courts. Judges took issue with the survival standard language and the agencies are currently re-working this definition. Therefore, we cannot take this definition at face value. In the OCAP BO, the authors use a slightly modified version of this definition to focus on the conservation value of habitat to promote the recovery of species.

By focusing on Jeopardy (not habitat adverse modification), the Basic Analytical Model examines action(s) that has some impact on environment or individuals of a species of concern. These impacts may be direct or indirect through some intermediary. The Basic Analytical Model asks:what is the response of the individual? Given some exposure to stress/change, how will individuals respond? For example, will animals die, delay reproduction, increase fecundity, suffer from diminished habitat, or exhibit other responses?

Much of the BO focuses on the effects analysis of responses from individuals, given specific changes. The outline and structure in the BO present the status of the species and an environmental baseline. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation process. In other words, the BO examines the existing status of the species, populations, and individuals. It then looks at trends and future projections, including how proposed project operations will affect species abundance, diversity, birth rates, etc.

The effects analysis of the BO (the yellow box in the figures above) lays out the conditions with and the conditions without particular OCAP actions. It begins with an assessment of what the population is like today, and, if we proceed with OCAP, how will things change at the individual, population, and species levels?

(John Williams): Looking at the consultation handbook, it indicates that an analysis should consider not just continued operation of CVP but also new projects.

(Penny Answer): Yes, past operations of CVP is considered part of the past factors that lead to baseline status of the species. Going from today's baseline, the BO aims to look forward and to conserve this baseline status by mitigating potential direct, indirect, and cumulative effects.

Therefore, salmon migration is addressed and dealt with as part of the baseline. From this baseline, the BO examined the added impacts of additional Bureaus actions to the current population status. This included an examination of blocked passage issues.

The requirement for best available data is the responsibility of NOAA or the action agency, such as the Bureau in the OCAP review. The timeframe associated with Section 7 is 135 days to compile all the best available information. This is extremely short for such a huge project. Congress required this short timeframe so that agencies would provide NOAA (or the other regulatory agencies) with the best available information in a timely manner. The intent was for NOAA to have access to the best available information from all agencies at the beginning of the consultation process. Because of these time pressures and other practical considerations, the BA contributes a significant portion of all BO information and framing of scientific issues.

(John Williams): Given this mandated cut-off date in the BO development and this panel's charge, one challenge appears to be whether or not to use published or unpublished data. What exactly does available mean? Generally, the published literature is a couple years behind available information and working hypothesis. How do we work within this grey area? Due diligence?

(Penny Answer): It is the responsibilities of both agencies that write the BA and BO to look for best available, latest information, and scientific expert advice to clarify uncertainty. There are no current requirements to use only peer-reviewed information.

(John Williams): For example, if someone gives a talk at a CALFED Science Conference, should NOAA Fisheries follow up and use this information?

(Penny Answer): Yes, some kind of due diligence is expected. This type of information, as long as it is defendable science, should be used. To identify defendable science, the agencies must look for reliable, credible, rational, objective, and explicit standards in methods and/or survey conditions. Qualifying information can range from peer reviewed journal literature, to unpublished empirical data, to anecdotal (tribal) information—provided that NOAA Fisheries has evaluated the information and deemed it to be credible and the best available information under the circumstances.

(Jim Anderson): Would this include an analysis of strategies and life cycle models?

(Penny Answer): Yes, best available data include all of this, plus more conceptual and surrogate approaches to determine how species may respond to the effects of an action. Best available data do not need to be limited only to the specific species of interest, but can use surrogates. The specific requirements about how to determine best information is not explicit, but guidelines were developed in 1994. These guidelines, called the 1994 Interagency Cooperative Policy on Information Standards Under the Endangered Species Act (59 CFR 34271), say:

- “Biologists are required to gather, review, and evaluate information” from sources ranging between juried professional journals and anecdotal or oral information.

- Review is conducted to ensure that "any information used… is reliable, credible, and represents the best scientific and commercial data available."
- "Collect, evaluate, and complete all reviews of biological, ecological, and other relevant information within the schedules established by the ESA…"

Actions must follow ESA schedules. Federally mandated requirements apply to Section 7 listing, recovery planning, and habitat modification. Longer time frames exist for the ESA listing process, relative to Section 7, which allows for only 135 days.

As with the use of written/published evidence, remember the rules of a sound, well-defended argument: relevant, acceptable premises, sufficient premises to support the conclusion, and rebuttal to any disconfirming evidence or counter-arguments.

When in doubt, the authors of the BO/BA have several options to bridge gaps in knowledge or uncertainties. Specifically, they must:

- Clearly state assumptions, including:
    - Basis for reasoning
    - Use of available evidence with well-defended, supportable arguments (including available theory, inference from pattern, and appropriate surrogates)
    - Use of relevant processes
    - Address counter-evidence or rebuttals

Authors are expected to use inference and available surrogates for patterns observed. This is crucial both in the use of scientific data and in the assumptions we make when interpreting the data.

It is important to note that this BO process demands that we do not make a Type II error. We do not want to conclude that something will not lead to jeopardy, when in fact it will. Most scientists, however, want to avoid Type 1 error. However, when working with the ESA, this is reversed because the precautionary approach must be embraced to avoid Type II errors.

(Jim Lichatowich): Does this framing of assumptions and uncertainty apply to all areas addressed in the BO?

(Penny Answer): Yes, our responsibility is to be aware of the full body of literature and that some information may not support the BO interpretation, whereas some information may. Counter evidence can be included in the BO, but, generally, counterarguments and interpretations are not included. Rather, this information is captured in the administrative record. It is not deemed as critical to be in the main body of the document to support the BO conclusions.

(Jim Anderson): If this counter information is not recorded in the BO, then how is it in the record?

(Penny Answer): The records reflect the full analysis, survey, evaluation, and literature review. If the record is silent it can mean several things:
(1) We failed to see it, and should have been more aware of counter-evidence or alternate interpretations.
(2) We saw it and failed to address it, either intentionally or unintentionally.

Once completed and signed, the BO is considered to be a complete record. Anything presented as counter evidence cannot be included at this point because the record is now closed (unless consultation is re-opened).

(Jim Anderson): What is the process for when a record is deemed complete?

(Penny Answer): When a BO is signed, it becomes complete. Judges can rule BOs to be incomplete, even after the BO has been signed, if the judge feels that the document lacks sufficient information and detail. The records of the BO process include the project files, so it is relatively straightforward to keep track of the process, data sources, and various data interpretations evaluated in the BO writing process. These project files and record can become extremely large. For example, the OCAP record has over 500 documents. The panel has been given some excerpts and critical information, but not the entire suite of hundreds of documents.

(Jim Lichatowich): Do we have a list of entire record?

(Bruce Oppenheim): No, the panel has not yet received an index of the entire record. Such an index does exist and we can give it to the panel.

(Jim Lichatowich): This seems critical (at least obtaining the list, if not the documents themselves) for the panel to determine what contributed to the BO and then evaluate the quality of the contributing science.

(Bruce Oppenheim): We will check on it and try to give the panel this indexed list of the OCAP record.

(John Williams): More about our charge: some information seems to disappear from the BO discussion as the document progresses. Are we supposed to point that out? For example, the effects of hatchery production were discussed in BO, but as one reads through the BO, this discussion seems to disappear.

(Penny Answer): Typically, a BO will strive to compile information on the status and baseline, so an effects analysis will not address issues like hatcheries that are not part of proposed action. The BO integration and synthesis should bring everything together, including cumulative effects, on top of the existing baseline. At some level, this discussion should be included in the integration and synthesis, but this type of feedback is not really part of the panel charge. Rather, the panel should look at the information available and how well NOAA Fisheries used that information. The panel does not need to evaluate our final arguments and how we came to the final conclusions. Perhaps, if

some critical information was not available/ or was not included, it might effect our conclusions and should be brought to light by the panel. The focus of the panel, however, should remain on the overall scientific quality.

(Bruce Oppenheim): What John Williams is trying to point out is that the discussion of hatcheries was brought up, but the argument was not brought out in the integration and synthesis. This is an interrelated action to the OCAP. It was used, perhaps not just written down. Part of problem is that the Feather River Hatchery and its operation was included in DWR's FERC relicensing process, so, therefore this BO made a conscious decision not to go into the details of the FRH effects.

(John Williams): There still some confusion about what you want from the panel in terms of the depth of our analysis. The BO did not adequately address baseline challenges of hatchery, but should we emphasize this in our review?

(Bruce Oppenheim): I disagree and think that the BO does include hatchery in its baseline. The BO presents the hatchery, and hatchery related environmental concerns, throughout the whole consultation as part of its baseline. Everything is added on to this baseline, including the current situation with the hatcheries.

(John Williams): Similar concerns exist with dams blocking habitat.

(Bruce Oppenheim): In the BO baseline, dams are included in the present environment. From this baseline with the existing dams in place, we examine operations and look forward, not back in time, to predict the effects of actions.

(Al Giorgi): The BO final analysis should be developed so that effects will be added to a baseline. Therefore, the final BO analysis should include all of these issues in its foundation and then we add the Bureau's new proposal on top of this.

(John Williams): And this analysis has been done additively?

(Penny Answer): Yes, it is additive. We did not just evaluate the Bureau proposed actions in a vacuum, but examined the Jeopardy decision based on the difference between the baseline and project effects.

(Al Giorgi): If baseline conditions are Jeopardy, then what?

(Penny Answer): Baseline conditions cannot, by themselves, impose jeopardy. Jeopardy is related to government action, but this analysis can show that the species is in major trouble and that any additional impacts could be of major concern. This analysis needs to be built on top of the baseline in a cumulative, additive big picture way (unlike the judge ruling on Columbia River).

(Kenny Rose): So, this panel is not being asked to support BO conclusions, but just evaluate the science? This is easier charge!

(Bruce Oppenheim): There is one other assumption in this discussion: the previous OCAP opinion was a Jeopardy opinion, so then we went to the baseline (current operations). Reasonable and prudent measures were required to remove jeopardy. Because of prior OCAP and evaluation outcomes, the CVP was assumed to be a non-jeopardy operation. For this reason alone, baseline conditions alone cannot cause Jeopardy.

(John Williams): I'm still confused about using best available science. It seems that the panel is not supposed to evaluate whether or not the baseline section was done right or whether the outcome was appropriate. Rather, our charge is the analysis of the quality, quantity, and evaluation of the science itself—not how the BO turned out and how NOAA Fisheries used the science.

(Kenny Rose): There is a difference between biologically accepted science and using all "science." Are there examples of where people have drawn the line? One critical thing is that the panel may feel that there was some critical information that was not used. Where are the filters?

(Penny Answer): The BO is not expected to use all science, but the panel can evaluate if the BO authors summarize the science well. Did they use the latest or best results for their information?

(Kenny Rose): How about the notion of cutting edge science? It tends to be that the use of cutting edge science in a BO would be harder because you need to justify "accepted" science. Most cutting-edge research, however, is gray, whereas less insightful work may not be more widely recognized or accepted.

(Penny Answer): We need a practical approach. Everything needs to be defendable. If cutting edge research can be defended then use it, otherwise, be practical.

10:00 - Biology of the affected salmonids – *Bruce Oppenheim, NOAA Fisheries*

Bruce Oppenheim was lead author for the BO. In this talk, he provides a snapshot of how the authors looked at the biology of the species of concern during the time of writing in 2004. The state of science has evolved since 2004, so to understand the BO we need to step back and recognize that much of the information that informed the BO had just come out and was up in the air at the time. We need to examine the opinion, which came out in terms of critical habitat, within the context of evolving science.

The authors of the BO relied heavily on the NOAA Fisheries Biological Review Team's 2003 report for the best available scientific information.

Beginning in the Sacramento River with winter-run Chinook salmon, Bruce gave an overview of each of the species of concern. The history of winter-run shows some increasing trends in abundance (i.e., some recovery), but population levels are still below

draft recovery goals. The run does not appear spawning habitat limited, but it does consist of a single population below Shasta Dam.

Winter-run has made significant recovery since 1991, when biologists recorded the lowest number of returning adults (less than 200). Consequently, NOAA Fisheries developed the 1993 biological opinion, which was the first Jeopardy opinion for Central Valley salmon. The agency developed reasonable and prudent measures that are still being implemented. These actions, in conjunction with other conservation efforts and favorable ocean conditions, have helped increase winter-run abundance.

In 2004, NOAA Fisheries proposed upgrading the listing for winter-run from endangered to threatened status. Additional population boosting efforts include:

(1) Harvest restrictions, as well as habitat conservation measures taken through the Central Project Valley Improvement Act[1] (CVPIA).
(2) Artificial propagation at Livingston Stone National Fish Hatchery[2] (LSNFH) on the Sacramento River boosts the winter-run population by as much as 25%.
(3) Battle Creek restoration efforts by the CALFED Environmental Restoration Program (ERP).

The ERP efforts at Battle Creek should provide the opportunity to establish a second winter-run Chinook salmon population. Currently, only one population exists and it is located below Keswick dam. To enhance the probability of population persistence and spread the risk from random environmental effects across multiple regions, we want distinct populations. Under ESA however, NOAA Fisheries cannot use future actions or hopes for the establishment of new populations as a basis for regulatory decisions. Because a second population of winter-run Chinook has not yet been established, NOAA

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[1] CVPIA originates from one of the last actions of the 102nd Congressional session, when legislatures passed multipurpose water legislation, which was signed into law October 30, 1992. Previously referred to as H.R. 429, Public Law 102-575 contains 40 separate titles providing for water resource project throughout the West. Title 34, the Central Valley Project Improvement Act, mandates changes in management of the Central Valley Project, particularly for the protection, restoration, and enhancement of fish and wildlife.

Ten major areas of change include: 800,000 acre-feet of water dedicated to fish and wildlife annually; tiered water pricing applicable to new and renewed contracts; water transfers provision, including sale of water to users outside the CVP service area; special efforts to restore anadromous fish population by 2002; restoration fund financed by water and power users for habitat restoration and enhancement and water and land acquisitions; no new water contracts until fish and wildlife goals achieve; no contract renewals until completion of a Programmatic Environmental Impact Statement; terms of contracts reduced from 40 to 25 years with renewal at the discretion of the Secretary of the Interior; installation of the temperature control device at Shasta Dam; implementation of fish passage measures at Red Bluff Diversion Dam; firm water supplies for Central Valley wildlife refuges; and development of a plan to increase CVP yield (Source: USBR website).

[2] LSNFH is a small conservation hatchery, built in 1996 and operated by the FWS, is located below Shasta Dam. The purpose of this hatchery is to assist in the recovery of Sacramento River winter-run Chinook salmon. A specific number of adults is allowed to be captured at RBDD fish ladders and Keswick Dam and trucked to the hatchery for spawning. Typically this hatchery releases up to 250,000 winter-run Chinook salmon smolts into the upper Sacramento River above Red Bluff in late January or early February (Source: NOAA Fisheries website).

Fisheries could not rely on it as part of the BO for recovery of the population. As of today, having only a single population below Keswick dam is major concern.

The average cohort replacement rate for winter-run has increased over the past decade. The population appears stable at approximately 9,000 to 10,000 adult spawners. The draft recovery plan requires 10,000 female adult spawners, so our management efforts have achieved the halfway point. There is still a ways to go.

(John Williams): Winter-run is a good example because it consists of only one population. It seems very hard to say that species has recovered when only one population exists because random external drivers (e.g. catastrophic events) could suddenly extirpate the species. That is the baseline, but that limitation of one population does not seem to carry through into the final Jeopardy assessment.

(Bruce Answer): No, the constraints from having only one winter-run population does carry through in the BO because population viability becomes more important and impacted by dam operations if we only have the one population below Keswick dam. Other populations of salmonids (e.g. spring-run and steelhead) are not as dependent on dam operations as winter-run because their population habitat extends beyond the project area.

(John Williams): So, the BO is concerned about having only one winter run population in the baseline?

(Bruce Answer): Taking some recovery actions at Shasta is a given because it is in the baseline and includes Keswick dam and Shasta dam, the largest storage reservoir on the Sacramento River. It should be emphasized that since 1993, when NOAA Fisheries released its Jeopardy opinion for winter-run, the population has rebounded some. Fish numbers are now up to 10,000 individuals, from the historic lows of less than 200 fish over a decade ago. With this change, the bar has risen for management and water operations, in that the population can handle more impacts from actions. The situation is still tenuous, but we have a larger buffer zone in which to maneuver our management decisions and the resulting consequences.

(Jim Lichatowich): In the BO, when talking about spring-run and steelhead, you refer to favorable ocean conditions as factors contributing to this population rebound. For winter-run, however, the document did not explicitly make the same tie. Is winter-run different?

(Bruce Answer): No, it's the same for all the Central Valley salmonids. Ocean conditions did help winter-run, as have restrictions on ocean harvest. Perhaps NOAA Fisheries will lift some of those restrictions in the future because the populations are doing better.

(Jim Lichatowich): Did the authors of the BO try to separate out the population-level effects of ocean conditions versus inland operations/conditions?

(Bruce Answer): Wim Kimmerer (RTC, SFSU) attempted this analysis in an analysis that came out after the BO was published. Wim examined the population-level impacts from hatchery, Red Bluff Diversion Dam (RBDD), ocean harvest, and other factors. The BO, however, does not separate out which programs helped the winter-run population, relative to other changes.

(Al Giorgi): Are there specific quantitative criteria to establish Jeopardy or no Jeopardy in the BO?

(Bruce Answer): Yes, there are population estimates and projected future trends that use population growth rate to examine the probability of species recovery (i.e., lambda > 1). The BO uses this information to understand the winter-run cohort replacement rate. Similar information is not available for steelhead, but it is for winter-run and spring-run.

(Al Giorgi): I do not remember seeing it.

(Bruce Answer): It is in the synthesis.

(John Williams): In getting information out of the Federal Registrar, what will you do when an expert panel points out the danger if the biological recovery team over-interprets the increasing population numbers. It could be luck. If the biological recovery team and BO does not address or deal with underlying problems, is it within the charge of this panel to say, Bruce, pay more attention to external environmental drivers?

(Bruce Answer): Yes that is in your charge.

(Bruce continued his prepared talk) ACID ladder improvements have opened up new habitat for winter-run Chinook. The fish took advantage of it right away and have continued to shift into this new area. Current estimates suggest that 50-60% of winter-run adults now spawn above ACID.

CVPIA injects gravel almost every year into this reach, so gravel is not a limiting factor. There is enough spawning habitat for winter-run to reach recovery goal within this reach.

The aerial redd survey is a helicopter survey that shows numerous redds just below ACID. The redds in this region occur at high density.

The fish agencies have intense monitoring efforts for winter-run Chinook. They use aerial surveys, carcass counts, and redd surveys. Each of these methods has seen a shift upstream, closer to the dam, in fish distribution and redd distribution of winter-run.

The carcass surveys, started in 1996, are used to estimate adult winter-run abundance. Several population estimates come from these carcass survey counts, including something we call the Juvenile Production Estimate[3] (JPE). (The JPE is an annual

[3] Authorized take is based on an estimate of the number of juvenile salmon arriving in the Delta (i.e., the JPE). The JPE is calculated from a carcass survey-based estimate of the spawning population and survival

estimate of the numbers of winter Chinook smolts estimated to reach the Delta.) The carcass surveys reduce uncertainty in estimates of adult abundance and have been used for JPE estimates since 2000. (Before 2000, estimates adult abundance came from ladder counts at the Red Bluff Diversion Dam). The JPE influences the allowable take limit for Delta water projects operations, based on fish coming into the Delta each year.

For spring-run Chinook salmon, their overall abundance is low, but populations in tributaries have increased. Overall, the population exhibits broad fluctuations in numbers. The biological review team said that spring-run Chinook had a moderate risk of extinction. Several factors contribute to this conclusion. One historical factor is that dams have been constructed that cut off major populations from their historical habitat. Since these historical impacts have become part of the baseline, water temperatures and flows may be currently limit distribution and abundance.

Spring-run Chinook spawn in three tributary streams below RBDD (i.e., Butte Creek, Deer Creek, and Mill Creek). We have seen a shift in distribution from major rivers, like the upper Sacramento River and the Feather River, into the tributary streams. Tributary populations have increased, while mainstem Sacramento population has declined almost to nothing. In fact, the mainstem populations are essentially extinct through introgression with fall-run in the Sacramento and Feather rivers.

The carrying capacity levels in the tributary streams below RBDD may be near historical levels. Butte Creek, in fact, may be currently exceed its carrying capacity.

(John Williams): It seems as if the BO ignored this important shift from the mainstem rivers to the tributaries in its analysis and cumulative analysis. Should the panel highlight this shortcoming? Clearly, the identified information used in the BO shows change in the population, but the BO failed to further analyze this information or draw on it to develop its conclusions. Is this part of the panel charge to review the BO science?

(Bruce Answer): Yes, it is part of the panel charge.

The extinction of the upper Sacramento River population is probably due to operations and introgression with fall-run Chinook. What did the authors of the BO do about that? Nothing, although we recognized it. We tried to change operations at RBDD to help reduce temperatures in September, but in the final analysis these actions did not happen. The resulting effects on spring-run Chinook from RBDD will be discussed in more detail tomorrow. Now, we are only looking at flows, temperature, and gate operations at

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rates from early life stages. Authorized take by the SWP/CVP was historically based on loss of 1% of JPE, using the historical percentage loss. Managers later changed the authorized take level to 2% when genetic characterization showed that only about half of the "winter-run" take (identification based on size) consisted of true genetic winter-run fish. Further analysis showed that the brood year 2000 JPE estimate was based on a low estimate of spawning adult salmon from counts at RBDD in 2000 and likely underestimated the number of juvenile winter run salmon migrating in the Delta in 2001. Consequently, beginning with brood year 2001, JPE estimates shifted to carcass surveys for more accurate spawner escapement estimates. (Source: CALFED Summary Report from the 2003 Science Symposium on Environmental and Ecological Effects of Proposed Long-term Water Project Operations)

RBDD. The authors of the BO considered that the population in the mainstem was the current baseline condition and that this population is basically gone and we cannot change that. Given that we only have RBDD counts, it is hard to discern if spring-run Chinook exist in the mainstem because there are data discrepancies and concern about whether these counts accurate (i.e., count spring-run and not fall-run Chinook). Consequently, the BO authors did not put a lot of reliance on that data or focus on it too much in their analysis.

(John Williams): Should the panel point out that these surveys do not just catch spring-run, but also catch fall-run and winter-run?

(Bruce Answer): Yes, point that out.

So, for spring-run Chinook, we have all these small populations. They are doing pretty well overall. The table (below) shows the creeks that the authors of the BO used as an index.

California Dept. of Fish & Game
Native Anadromous Fish & Watershed Branch

GrandTab
Updated: 26-Apr-2004

SPRING-RUN CHINOOK SALMON POPULATIONS: Sacramento-San Joaquin River System

YEAR	Sacramento River Mainstem			Battle Creek	Clear Creek	Cotton-wood Cr.	Antelope Cr.	Mill Cr.	Thomes Cr.	Deer Cr.	Big Chico Cr.	Butte Cr.	Feather River			Yuba R.	Calaveras R.	TOTAL for RUN	YEAR
	Upstr. of RBDD 1/	Dnstr. of RBDD	TOTAL										In-river	Hatchery	TOTAL				
1960	a/							2,368				8,700		a/				11,068	1960
1961	a/							1,245				3,082						4,327	1961
1962	a/							1,692			200	1,750						3,642	1962
1963	a/				0			1,315		2,302	500	6,100	600		600			10,817	1963
1964	a/				0			1,539		2,874	100	600	2,908	b/	2,908			8,021	1964
1965	a/				0						50	1,000	738	b/	738			1,788	1965
1966	a/				0						50	80	297	b/	297			427	1966
1967	a/										150	180		146	146			476	1967
1968	a/				0						175	280		208	208			663	1968
1969	20,000		20,000		0						200	830		348	348			21,378	1969
1970	3,652		3,652					1,500		2,000		285		235	235			7,672	1970
1971	5,830		5,830					1,000		1,500	0	470		481	481			9,281	1971
1972	7,038		7,038					500		400		150		256	256		500	8,844	1972
1973	7,175		7,175					1,700		2,000	50	300		205	205			11,430	1973
1974	3,800		3,800					1,500		3,500	100	150		198	198			9,248	1974
1975	10,234		10,234					3,500		8,500		650		691	691			23,575	1975
1976	25,095		25,095									46		699	699			25,840	1976
1977	11,545		11,545					460		340	100	100		185	185			12,730	1977
1978	5,669		5,669					925		1,200		128	2	202	204			8,126	1978
1979	2,856		2,856									10		250	250			3,116	1979
1980	9,363	6 c/	9,369					500		1,500		226	400	269	669	200		12,464	1980
1981	20,655		20,655									250	531	469	1,000	200		22,105	1981
1982	23,156		23,156					700		1,500		534	90	1,910	2,000			27,890	1982
1983	3,854	1,793	5,647				59			500		50		1,702	1,702			7,958	1983
1984	7,823		7,823					191			0	23		1,562	1,562			9,599	1984
1985	10,200	2,713	12,913					121		301	0	254		1,632	1,632			15,221	1985
1986	15,948	6,110	22,058					291		543		1,371		1,433	1,433			25,696	1986
1987	10,911	1,460	12,371					90		200		14		1,213	1,213			13,888	1987
1988	9,601	266	9,867					572		371		1,290		6,833	6,833			18,933	1988
1989	5,131	0	5,131	7		0		563		84		1,300		5,078	5,078			12,163	1989
1990	3,896	302	4,198	2				844		496		250		1,893	1,893			7,683	1990
1991	766	59	825					319		479				4,303	4,303			5,926	1991
1992	371	0	371				0	237		209				1,497	1,497			3,044	1992
1993	391	0	391		1		3	61		259	38	650		4,672	4,672			6,075	1993
1994	862	0	862		0			723		485	2	474		3,641	3,641			6,187	1994
1995	349	77	426	66	2	8	7	320		1,296	200	7,500		5,414	5,414			15,238	1995
1996	378		378	34		6	1	253		614	2	1,413		6,381	6,381			9,082	1996
1997	126	2	128				0	200		466	2	635		7,017	7,017			8,448	1997
1998	1,115	0	1,115		47	477	154	424	1	1,879	369	20,259		6,746	6,746			31,471	1998
1999				70		102	40	560		1,591	27	3,679		4,534	4,534			10,803	1999
[2000]	252		252	40		120	9	544		637	27	4,118		3,657	3,657			9,404	[2000]
[2001]	956		956					1,104		1,622	39	9,605		2,468	2,468			15,794	[2001]
[2002]	483	0	483			125	46	1594		2185		8785		4189	4,189			17,407	[2002]
[2003]	0	0	0	94	25	46	73	1426		2759	91	4398		8662	8,662			17,564	[2003]

DATA FOR [YEARS IN BRACKETS] ARE PRELIMINARY.
1/ Red Bluff Diversion Dam.

a/ Estimated numbers are included with fall-run fish.
b/ Fish were transferred to upstream of Oroville Dam.
c/ Only fish taken into Tehama-Colusa Fish Facility.

In addition to the above tributaries, smaller creeks have seen an increase in their populations as well. Feather River trends are hard to distinguish. There is an early run within the fall-run Chinook ESU and the genetic data show that they have some shared genetic material from spring-run. In other words, Feather River spring-run Chinook appear totally mixed with fall-run. The BO does not consider the Feather River spring-run to be a viable population.

Butte Creek spring-run numbers have increased the most in the past few years. A large pool offers an over-summering location for spring-run. It is, however, highly susceptible to high temperatures and poachers. Fish in Butte Creek essentially hang on by a small margin. A one-degree increase in water temperature could kill many of these fish. Butte Creek has likely reached its carrying capacity, or close to it. The habitat quality of this region, however, did improve radically from passage improvement projects to open up historical habitat and remove irrigation dams.

(Al Giorgi): Does the BO evaluate and graph trends of spring-run ESU as one overall unit?

BO: Yes, but it is difficult because abundances vary, with fluctuations between 3,000-15,000 fish before Butte Creek. The numbers have shown an upward trend in the past couple years, but this trend depends on small tributaries that have over-summering cold water habitat for fish to survive the warm summer temperatures. Battle Creek, which lies above RBDD, is dependent on RBDD restoration in order for the Battle Creek restoration to be successful. Battle Creek restoration has not yet happened.

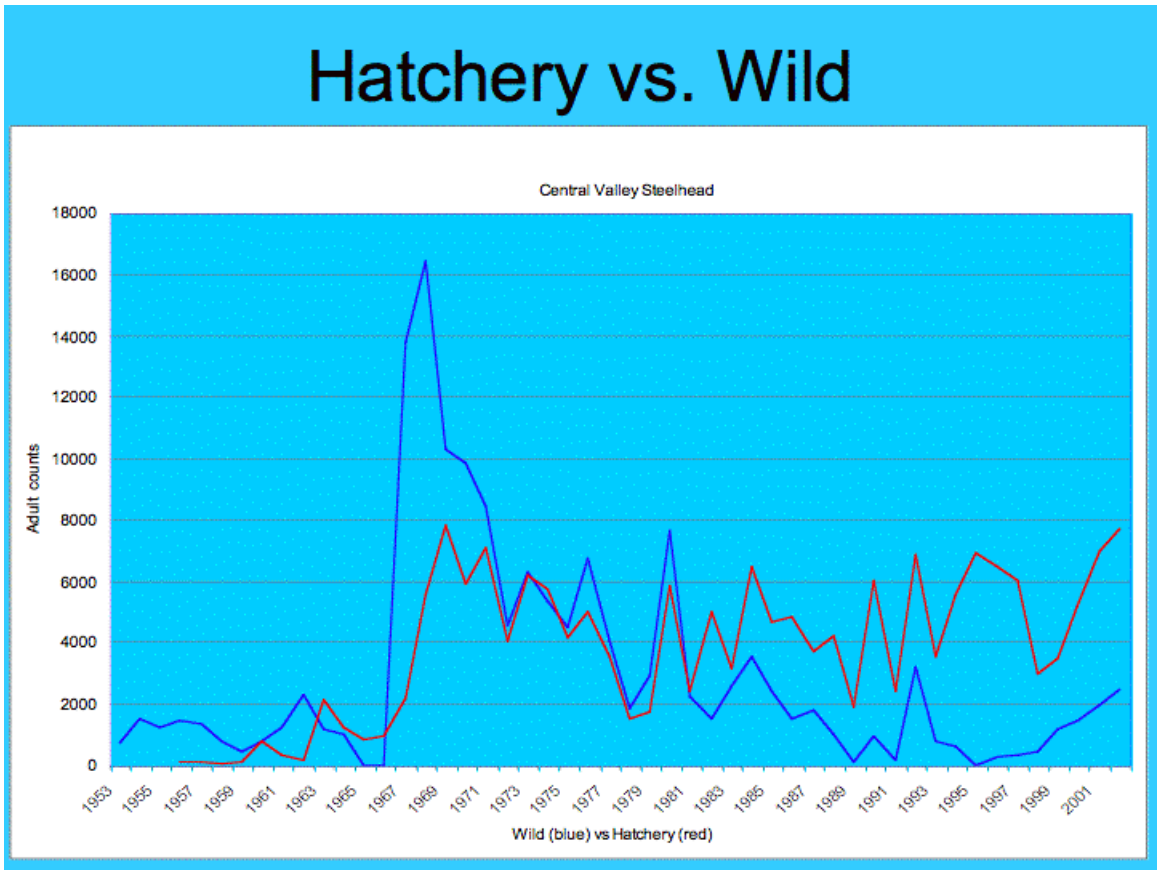
The situation for steelhead shows a continued population decline. There are two distinct ESUs of concern: the Central Valley steelhead and the San Joaquin River steelhead.

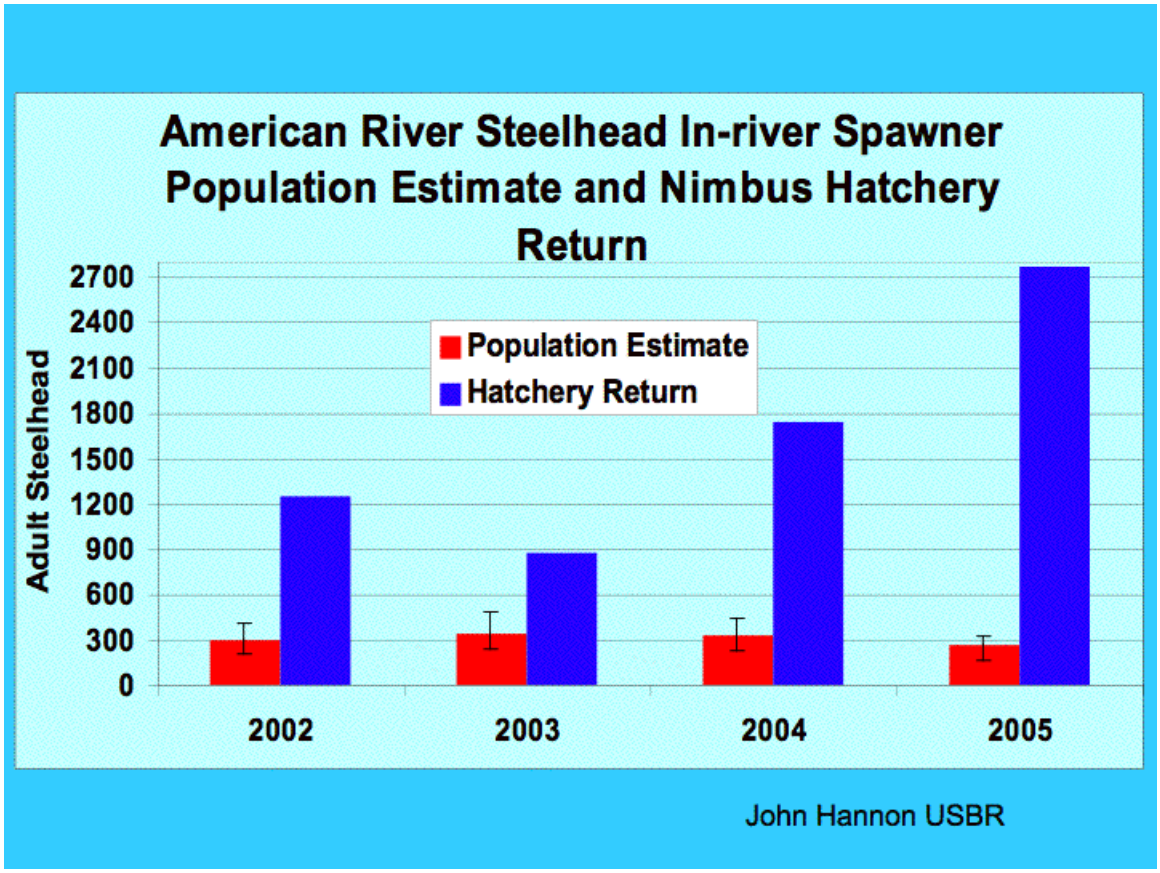
There is no ocean harvest on steelhead. The decline, however, is still going on. Therefore, there is likely some problem in the freshwater environment that limits the steelhead population. Steelhead do not have enough habitat below dams to support a large juvenile production. Hatchery production has taken over natural stocks. Dams have fragmented the distribution of steelhead. Dams fragment the spatial structure of steelhead habitat and have reduced core populations. There are even smaller dams in the tributaries. The Central Valley has lost its core steelhead populations in Sacramento River and Feather River because the fish cannot get above dams. An estimated 3,528 females live in the Central Valley. Nobriga and Cadrett 2001 estimate that approximately 3,000-300,000 juveniles enter the Delta annually. There is, however, not enough habitat below the dams to support over summering life stages

Hatchery production has taken the place of natural stocks

For the ESU of Central Valley steelhead (most above Sacramento, very few in San Joaquin), the biological recovery team listed this population as at a high risk of extinction. In 2004, when writing the BO, there was no designated critical habitat. This has changed. In the lower part of ESU in the San Joaquin River, some remnant populations exist. Three years of weir counts in the Stanislaus River have found only one adult wild steelhead. With rotary screw traps, less than 10 juveniles have been caught in Stanislaus River. The Mossdale Trawl typically catches less than 12 juveniles every year that actually exit the Delta through the San Joaquin River. Therefore, steelhead numbers are probably too small to accurately measure San Joaquin River steelhead. With unknown escapement estimates, we can only hypothesize that steelhead probably spawn with resident rainbow (i.e. from the Calaveras River).

Data plotting hatchery versus wild fish (see figures) show a decline in wild population, which is masked by production increases from hatcheries. Bruce noted that the data presented in this slide may be skewed because some monitoring efforts have increased since 1997 (i.e., the "trends" may appear to rise in recent years).





The American River data show the same thing: a steelhead population totally dependent on hatchery production. The American River hatchery contributes over 90% of all individuals. The hatchery uses out of basin stock, not genes from the ESU, so this American River situation is problematic. For the BO, in-river American River fish are part of the ESU, but that hatchery fish are not. Most of the steelhead, however, are descendents of hatchery fish. We are trying to protect the native wild steelhead, but the lines have been irreversibly blurred.

(John Williams): Shouldn't the BO be analyzing the effect of hatchery?

(Bruce Answer): Yes, but not in great detail, because each hatchery is subject to its own consultation and its own BO. The hatchery analysis will be addressed in greater detail in these future processes. Each individual hatchery program will be reviewed and at that time must look at the detailed impacts that its operations have on the wild population.

(John Williams): If existing information was not used in BO, should the panel point out these hatchery vs. wild sources?

(Bruce Answer): Yes.

No one has looked at genetics of the interim population (this would be an excellent study). Some fishermen say that there is a summer run of steelhead late in the season

(unclipped steelhead) that comes from the ocean. No one, however, has examined the genetics to figure out if these ocean populations may be connected and contributing to our species of concern.

As for the Southern Oregon/Northern California Coast Coho salmon population, it is also still declining. The biological review team listed Coho as likely to become endangered in the foreseeable future with a high risk of extinction. The low abundance of this population is approximately 6% of what it was in the 1940s. Approximately 93% of the fish today are of hatchery origin. The natural production of steelhead in the Trinity River is estimated at 582 (the 1991-2002 average).

Ocean harvest is restricted. All steelhead are tagged. With the 2000 ROD, NOAA Fisheries tried to implement increased flows in the Trinity River to benefit Coho Salmon. Trinity River is the only region in this ESU that uses any water from CVP contracts to export water to Central Valley. ROD implementation of increased Trinity River flows is expected to benefit Coho through improved habitat conditions

Still, however, the outlook is grim for Coho. It is missing entire brood years in its life cycle (i.e., entire year classes are extinct). Coho life history usually involves spawning and returning inland during the fish's third year, and some of these year classes are already missing.

The very small population of extant Central California Coast steelhead (not to be confused with Central Valley steelhead) also continues to decline. Only a small portion of the ESU is within the project area. Specifically, Green Valley Creek and Suisun Creek flow into Suisun Bay and may potentially affect the migratory corridor for fish going into stream. There are likely indirect and minimal impacts to migratory corridor through changes in salinity and inflow/outflow ratio.

(Al Giorgi): Regarding steelhead, the BO suggests that the resident forms in the ESU are flourishing, but the anadromous form is disappearing.

(Bruce answer) True, especially true in the anadromous forms in the San Joaquin River. Evidence from the Calaveras and Stanislaus rivers suggests that the anadromous fish are spawning with the residents. This is evidence for the" plasticity" of the steelhead and suggests that this resident component may be critical for the persistence of the species to utilize for reproduction. On the other hand, actions to recover winter-run has created has created a coldwater pool below Keswick Dam. We do not see steelhead utilizing these coldwater resources, even though the water temperatures are sufficiently cool (<56 deg in summer). Resident fish have found these cool waters and have apparently taken the place of anadromous fish. We are not monitoring the resident versus anadromous fish dynamics.

The resident form was originally proposed as part of the ESU, which is currently being contested. This is why the steelhead ESU has been extended to look at resident and

anadromous forms. NOAA Fisheries is examining this issue and make a decision by the end of this year.

(Kenny Rose): There is a separate BO for delta smelt. How can the panel evaluate the science of the OCAP BO without looking at the biology of delta smelt at the same time as salmon? When do we evaluate delta smelt science and get that information into the opinion?

(Bruce Answer): NOAA Fisheries could not combine delta smelt and salmonids into one BO. It is possible, but not easy, because there are tons of relevant information. Therefore, the agencies decided to create a separate BO for delta smelt and the OCAP. Even though the science and issues are interrelated, the authors tried to separate the information and keep opinion separate for delta smelt. The delta smelt BO emphasizes X2, but for salmonids there is not much of an X2 relationship. This panel does not have to deal with delta smelt.

(Jim Lichatowich): How much of the natural flow is going to be put back into the Trinity River?

(Bruce Answer): For two years before the BO process started, we implemented the increased Trinity River flows. The CALSIM model looked at the maximum levels extreme case flows. Currently, we are somewhere in the middle, with less water diverted to the Sacramento side.

One reason that the increase in flows has not been successful in the Trinity is because recent flows changed the river morphology and channel meandering. The upper Trinity River is very incised. These conditions limit habitat for the fish. By increasing flows, we may be able to improve temperatures, dissolved oxygen, etc. The goal and underlying assumption for NOAA Fisheries is not to change the Trinity River ROD flows, but rather to implement this opinion. Our thinking is that any effect on Sacramento side should be dealt with on the Sacramento side. In other words, keep everything within its own watershed.

(John Williams): How did NOAA Fisheries evaluate the effects of restoration program and ROD flows?

(Bruce Answer): We used the salmon mortality model developed in 1991, except that we revised the spawning distribution for each river using 2003 data.

(John Williams): Did NOAA Fisheries take a critical look at the model to test and calibrate it?

(Bruce Answer): No, we did not. One recent study just came out (it was released before the BO). It examined spawning habitat available to winter-run and concluded that there is enough habitat below dams to provide for a viable population.

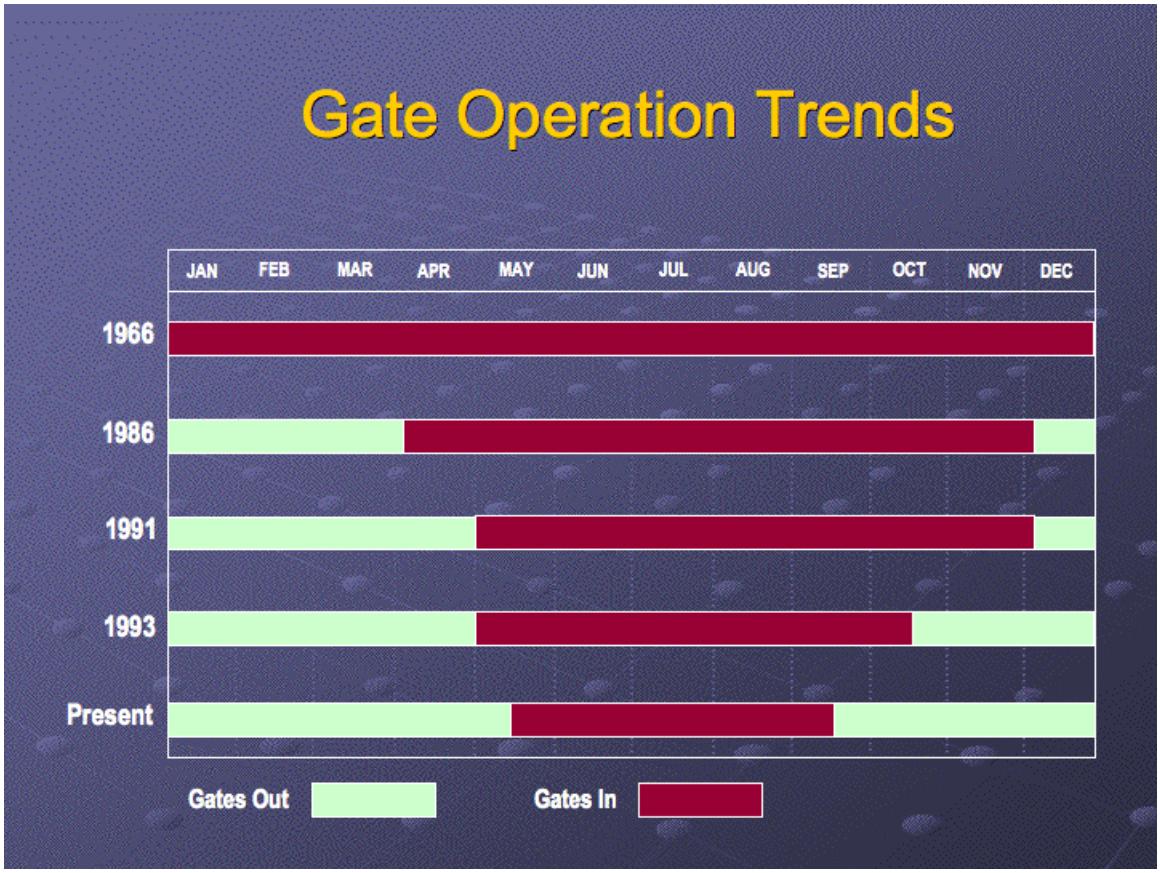
10:30 Break

11:00 - The Red Bluff Diversion Dam – Mike Tucker, *NOAA Fisheries*

Mike provided an overview of the structural and operational features of RBDD to contextualize its biological effects. RBDD structural features include 11 adjustable bottom-release gates, two main fish ladders, and one removable center fish ladder. The dam is made up of multiple gates in its center part. To adjust flow, operators can raise and lower the gates. At either end, of the dam are two fish ladders, one located on each bank with appropriately 300-325cfs flow capacity (including the traction flow built into the ladders). The center fish ladder has a flow capacity of approximately 125 cfs, so the total capacity of RBDD fish ladders is approximately 775 cfs.

The gates are adjustable and can open 2 ft or so. Sometimes they are completely closed. Gate operators vary where water comes out and how it flows through RBDD. They work to maintain an even, level head differential of RBDD. The level head differential is approximately 15 ft above that immediately below the dam. The operators work to maintain this differential..

Gate operation trends have changed through time. When the dam was first built, the gates were left in year-round with the exception of major flood events in winter. As fish populations declined and RBDD was implicated in impeding fish passage and spawning, the gates were periodically opened and a new management strategy developed. Current dam operations leave the gates in (closed) from May 15 through September 15. The river flows during this period are generally 10,000 to 15,000 cfs. The total attraction flow capacity for the three fish ladders at RBDD is much less, approximately 775 cfs



These May through September gate dates are mandated by regulatory requirements, although the exact timing can be adjusted slightly based on flow conditions.

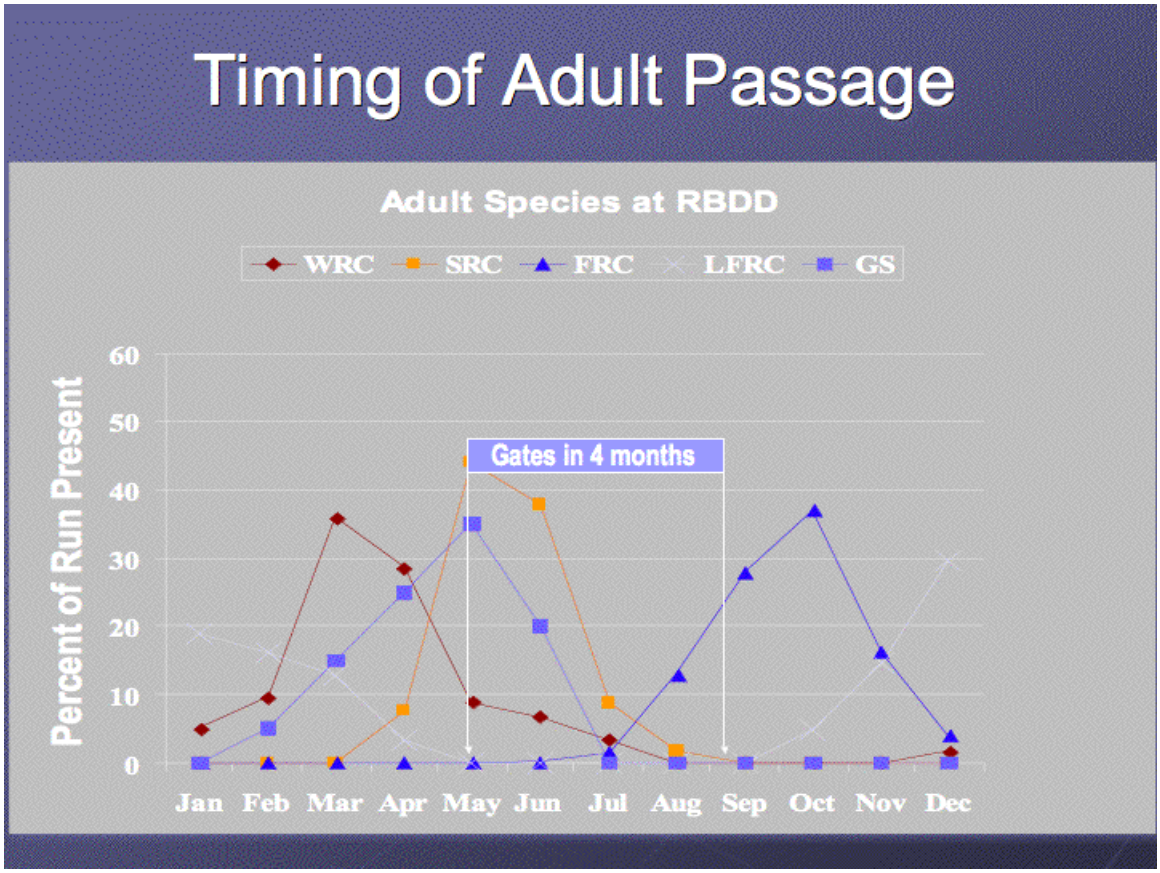
RBDD does exert biological effects on listed salmonid species because the dam impedes fish passage for upstream adults and downstream passage for juveniles. Geographically, the upstream area north of RBDD has been a major spawning region since Keswick was constructed.

Accessing this upstream area is hard for fish. The dam and its fish ladders are relatively old, and their performance has deteriorated with age. The Bureau found the hydraulic performance of the existing ladders to be less than optimum (1997) and the fish ladders to be inefficient in passing Chinook salmon (DFG 1998). The fish are attracted by flow (i.e., by the outflow from the fish ladders). This flow, however, seldom meets the 10% of total river volume necessary to provide adequate passage through the ladders (Katopodis 1992). The average river flow past RBDD during the current gates-in period is 11,000 cfs, yet the total capacity of all three ladders combined is only 775 cfs (Reclamation and TCCA 2002). To improve performance, RBDD installed new diffusers with more attraction, but the basic design of the fish passage ladders has not changed much. They are not the best.

Radio telemetry investigations conducted from 1999 to 2001, using adult fall-run Chinook salmon, found that delays in passage, under existing conditions at RBDD. These passage delays averaged approximately 21 days (FWS, unpublished data).
This investigation may have underestimated delay because the study was conducted during the May15 to September 15 operations period, so when the gates were raised on September15th, the fish could get by freely to the upstream area. For many spawners, the average 21-day delay ended only after the gates were raised on September 15th, suggesting that the results may be skewed.

Evidence of fish passage delay is visually apparent at RBDD. Migrating spawners can be seen swarming below the gates trying to move upstream. Many gates have pods of fish below them. The fish work into a gate, stop, retreat, rest, and repeat. It is obvious that the dam delays -- and possibly stops -- spawner passage. The gates most significantly impede winter-run passage, followed by spring-run passage, and then fall passage, and finally late-fall-run passage (see "Timing of Adult Passage" slide below).

This graph was not included in any of the documents provided to the panel, but Bruce Oppenheim will try to get the graph and its source data to the panel.



The percentage of adult fish affected by RBDD has been estimated for each of the runs (see slide). The data used to generate these percentages come from the timing of adult passage (above). The authors of the BO also considered the effects on the portion of the

population that needs to swim beyond RBDD to spawn. For winter-run Chinook, this is 100% of the population, but for spring-run it is less.

Summary of passage effects from RBDD based on historical run timing in the upper Sacramento River (Reclamation and TCCA 2002).

Life Stages affected by gates-in four months (May-September)	Adult spawning population estimated above RBDD	Adult migration delayed or blocked
spring-run Chinook salmon	10%	72%
winter-run Chinook salmon	100%	15%
steelhead	57%	17%

The majority of the data used to generate this table came from the RBDD EIS and EIR documents, which uses a combination of RBDD counts from the fish ladders before gate removal. For the fish passage improvement projects (FPIP) we convened many Central Valley fish biologists to look at all data and analyze what was most likely happening in regards to when fish would show up in tributaries below the dam. We used the best professional judgment and best professional analysis available to us.

(John Williams): This table summary of information has some filters and fillers.

(Mike Answer): Yes, we looked at fish that passed the dams with delays, so we probably were not looking at the entire passage period but at when the fish actually made it though RBDD. As for the adult passage situation, the percentage of fish that encounters RBDD dam when it is closed can be significant (see slide above). The study that examined RBDD passage effects was done on the actual runs, but fall-run Chinook was used as a surrogate for the listed species because the researchers did not want to deleteriously impact the species of concern. One assumption with this approach was that the listed species behave like fall-run Chinook.

Not many fish spawn in early September, but that is not the only defining characteristic of spring-run. The timing is still uncertain.

To access the Cottonwood Creek Watershed, salmonids need to pass by RBDD and survive water temperatures that push the physiological tolerances of the fish. Spawners delayed by RBDD may encounter thermal barriers to reaching the mouth of Cottonwood. Consequently, they may then be unable to make it to cold water to spawn. This region supports a large population, so a few thermal barriers can have huge impacts. This route to Cottonwood Creek habitat is the longest migration of any Chinook salmon (given current operations/rivers).

The consequences of delays in upstream migration at RBDD include:

- Increased energy expenditure during delays.
- Increased pre-spawning mortality.
- Decreased egg viability.
- Loss of tributary spawners due to formation of thermal barriers at creek mouths during delays at RBDD (spring-run).

Fish do continually attempt to work under and find their way around the dam. Flow coming under the dam appears to attract them. They need to find the fish ladders, but given their low attraction flows, this can be very difficult. Consequently, the fish potentially exhaust themselves and may decrease fitness.

RBDD impacts to out-migrating juveniles include the conditions below the dam - the white water can become extremely turbulent (e.g. 25-30 ft/sec) at times during the out-migration season. Juveniles are exposed to this fast and turbulent water when they pass under the dam.

The turbulence generated by the dam gates also provides a “feeding station” for predators to prey on downstream migrating fish. The juvenile salmon are disoriented and weakened from the turbulence, and striped bass wait below the dam to take advantage of the situation. Studies have shown that (especially in past) very high levels of predation occur below the RBDD. This appears especially true of the Sacramento pikeminnow and striped bass. A more recent study of RBDD with its gates in their current configuration, suggests that the predation mortality has been reduced substantially. Sacramento pikeminnows are probably held up in their own migration, now that there is no longer a permanent feeding station with the operable gates. There remains, however, a big problem—especially with bass. No striped bass are caught at RBDD before the gates are closed. Striped bass caught after the gates have been closed contain mostly salmon in their stomachs.

There is no estimate of the percentage of salmon mortality due to this predation or other effects of RBDD passage. In the past, people have referenced a high number (over 50%) originally proposed by Dave Vogel in 1994. This percentage is referenced in the BO, but it is based on permanently closed RBDD gates. The historical situation of closed gates created full-time feeding stations and increased predator populations in the area.

Predatory densities are no longer that high and predation levels are probably a much lower than the previously estimated figure, but estimates for current RBDD operations have not been made.

Estimates of direct salmon mortality from passing under the gates are low. Studies have examined scale loss, injury, and other potential physical impacts from going under RBDD, but found that they were not significant. The worst thing for the juveniles is the combination of their disorientation and the predators waiting for them on the downstream side.

The summary of passage effects for juveniles (see slide below) highlights a typographical error in the OCAP. In the OCAP, this chart says 9% and then later it says 39%. The actual number is 39%. Most of the fish that suffer from predation are very small fry. This makes intuitive sense because their migration peaks in late August to early September. However, with spring-run Chinook this is not the case because they are passing by RBDD at a different time.

Summary of passage effects from RBDD based on historical run timing in the upper Sacramento River (Reclamation and TCCA 2002).

Life Stages affected by gates-in four months (May-September)	Adult spawning population estimated above RBDD	Juveniles and smolts subject to predation
spring-run Chinook salmon	10%	~ 1%
winter-run Chinook salmon	100%	~39%
steelhead	57%	~ 36%

(Al Giorgi): Is there any evidence that predators are just farther downstream and still killing the smolts?

(Mike Answer): There were two downstream stations in this study (approximately 1 or 2 kilometers downstream). These sites were chosen because they had habitat for predators

(e.g. woody debris) and densities of predators at these downstream locations were much less than those found at the dam. These downstream locations appear significantly different from the dam situation (Tucker et al). A study compared Sacramento pikeminnow at RBDD with Columbia dams and found that the old RBDD densities of predators were higher or comparable to Columbia River conditions and that the new RBDD densities are much lower than the Columbia.

(Bruce Oppenheim): Quantification of those effects should be included. Important, but when he wrote the BO we did not have any quantification of delay in terms of mortality, percentage of eggs affected, etc.

(Mike Answer): There are no studies that give us any indication of these impacts. These elements are key. Water temps are relatively cool for adult holding below RBDD and there is habitat below RBDD, so how much of an impact is there by being delayed? Question of energy, timing changes, predation. In the OCAP BO we tried to look at the effect of being delayed and what does this mean?

(Jim Lichatowich): So if you do not know, how did the OCAP deal with this uncertainty?

(Mike Answer): Good Question. We did have uncertainty as to the effects of the delay were, but it was such a small percentage of the overall population, that it wouldn't matter too much. This increment of fish goes up there, this increment goes to the dam, this increment gets delayed, this increment is actually impacted. When examined at a population level, however, the impacts on this increment of fish was relatively small.

(John Williams): This is small when looking at individuals relative to all of Chinook, but is not this a fairly large percentage of spawners in the mainstem?

(Mike Answer): It is 100% of the mainstem, which includes four small populations. One small one at Battle Creek, one Clear Creek (major restoration going on and pop increasing), few other scattered streams). These are not main populations like Butte, Deer, and Mill Creeks where the populations substantial . We're probably talking about tens versus hundreds (or even thousands) of fish.

(John Williams): If the authors of the BO needed to analyze barriers to recovery, RBDD may be a barrier to recovery.

(Bruce Oppenheim): We assumed that the fish can get though and that they are not being killed by RBDD. Therefore, the effect is on the species' potential for recovery, but not directly on the population.

(John Williams): Any bio-energetic evaluation?

(Mike Answer): Have not done that. We looked for surrogate information on related species, but not much out there. Moreover, we probably have to study *in situ* because

RBDD conditions for this flow are unique: the flow looks deceptively good until right at the last second.

(Bruce Oppenheim): We did recommend that the Bureau fund additional studies to gather this information, part of the reasonable and prudent measures for BO.

1145 – Lunch

1245 – NOAA Fisheries' assessment of upstream impacts, *Bruce Oppenheim, NOAA Fisheries*

Historical perspective: four interim BOs have been written (3 months, 1 year, or 2 years) beginning in 2000. NOAA Fisheries also wrote a BO for winter-run Chinook, which was a long-term process. They tried to get into long-term issues and replace the 1993 document with this BO.

Information Available during the process of writing the BO included:

- Recent status reviews & BRT reports
- 7 draft biological assessments
- NEPA/CEQA docs: Trinity R SEIS, Lower American R EIS, Freeport EIS, draft Intertie, & draft SDIP
- Modeling: CALSIM, gaming 8500, DWR's spreadsheet of pumping changes, Water Forum modeling of B2, Particle Tracking
- Reports and agency technical memos

Tried to write BA as a collaborative approach with NOAA, FWS, USBR, and DWR. They met weekly and informally to come to grips about which projects were going to be consulted on, timeline, and what info was available.

For BA, had individual portions of document for OCAP. This is one large project. Each project usually has a NEPA and CEQA document (this is why some content, which is covered by these other document, is not covered in the OCAP). Draft documents of the Intertie were also available. The South Delta Improvement Plan (SDIP) was written around same time, so there were drafts and information available.

The BO authors relied heavily on models and modeling scenarios to develop the OCAP document. From the CALSIM model, they used daily operations modeling and biological data to look at various scenarios. This is called gaming. They looked at how large the Environmental Water Account (EWA) needed to be to biologically help fish populations. The Water Forum did one modeling run of B2 effects on the American River. DWR did particle tracking modeling.

Reports and agency documents from FWS, DFG, and other agencies were also available to and used by the BO authors.

Organization of impact assessment:

- Started upstream and worked down
- Looked at flows & water temperatures
- Biologist assigned to each river or project
- Individual response to impacts
- Combined effects from upstream & Delta to get population level response

Ten different people served as lead authors on various sections of the OCAP document. Then, Bruce Oppenheim synthesized the watershed reports and brought them together.

The BO uses combined effects from upstream and from the Delta to explore the population-level impacts of the ESA runs. The opinion is laid out as two opinions: (1) current operations (baseline) in 2001, and (2) early consultation: future projects that are likely to happen in the foreseeable future: Intertie (to connect SWP and CVP downstream of the pumps), the Freeport Project (screened diversion below Sacramento), water transfers (e.g., water contracts, EWA purchases, water moving from N to S), and renewal of long-term contracts. The early consultation was on the proposed 8,500 cfs at the SWP (approx 20% more than currently allowable under existing permits but they have the capabilities). SDIP consists of the barriers at the head of Old River, and the operable in-Delta water level barriers, long-term EWA, project integration where the SWP and CVP would share capacity or storage in reservoirs to improve flexibility; also the 2020 level of development.

Start with the Trinity River impacts:

- Assumed effects on winter-run would be have to be managed entirely by Shasta Reservoir (i.e. no more reliance on cold water from Trinity)
- Beneficial impacts to Coho salmon mainstem habitat from increased flows and lower water temperatures
- Less storage in Shasta due to higher Trinity releases and higher future level of demands. Therefore, less cold water available for Sacramento River fish.

Assumptions: not going to bring water from the Trinity River to cool down the mainstem Sacramento River, which has been the main mgmt technique in the past to keep temps low. On average a quarter million acre feet has been brought over from the Trinity. Losing this water is the number one impact to this operation. Assuming that those flows will benefit salmon so did not require additional water for winter-run. Not going to require the Bureau any additional water above what they were required in the ROD to support temperature control on the Sacramento River. There will thus be less storage in Shasta due to the change in transfers; plus higher future demands for water. Less flow (and cool water) will be available under the new OCAP.

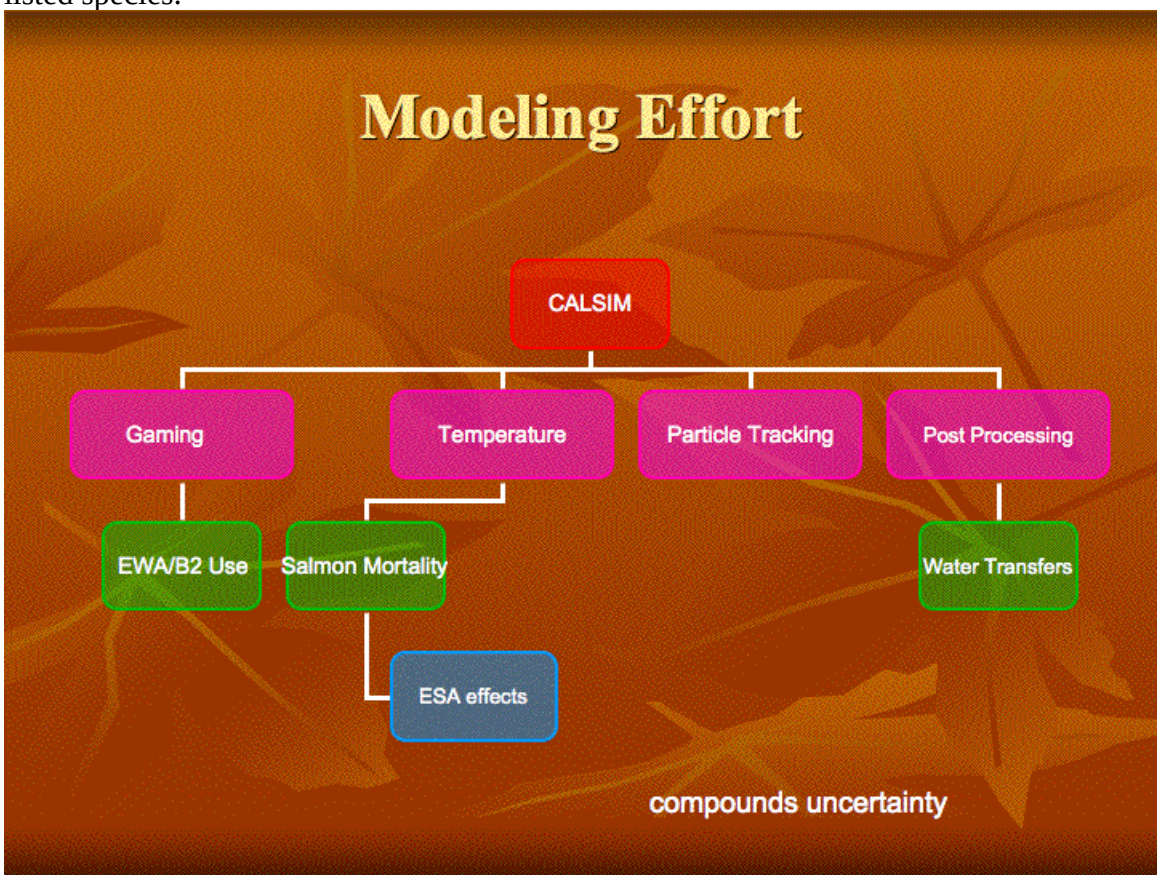
What flows do on the Trinity River: in wet years, springs have higher flows, create processes that create the natural meandering, cycling, etc. Increasing out migration flows, decreasing temperature thus hope to increase Coho numbers.

Trinity River Coho Salmon

- Higher flows in the wet years April – July

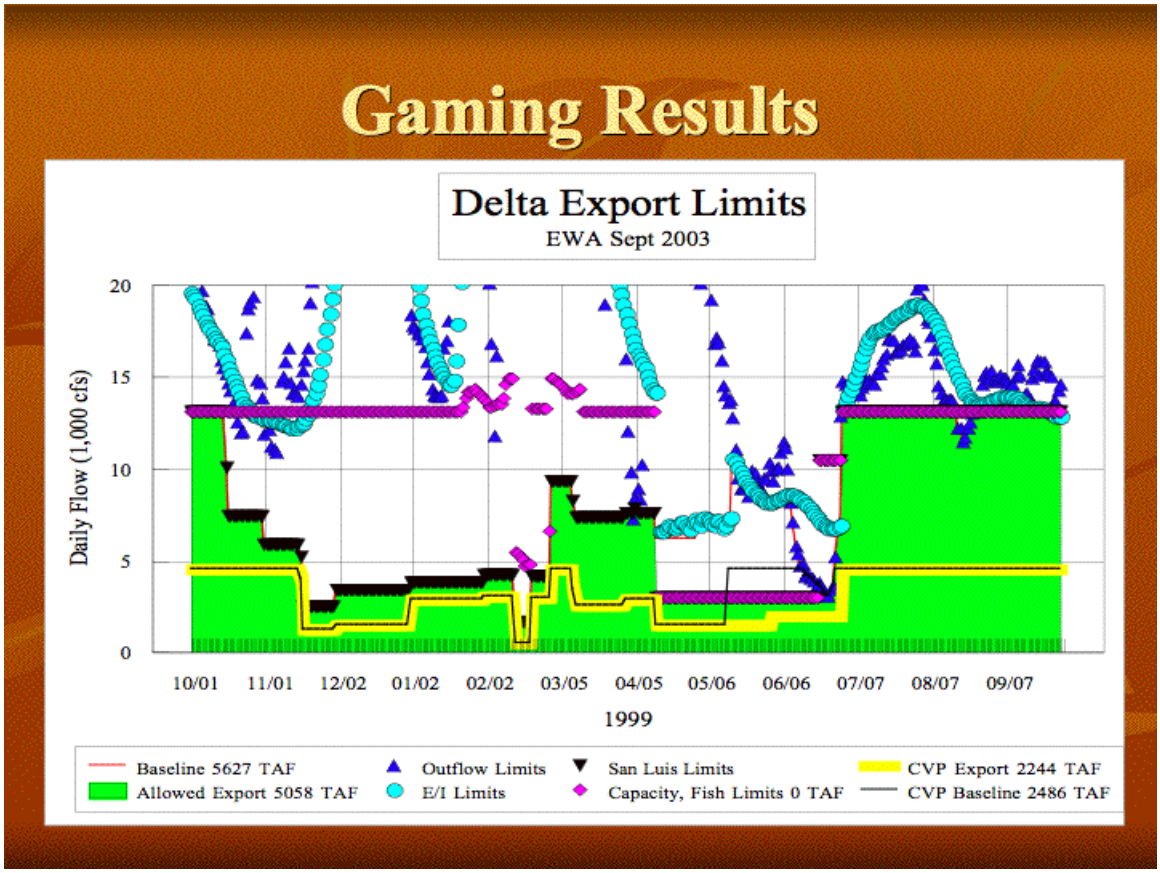
- More natural geomorphic processes
- Increased out migration flows
- Cooler temperatures April – July
- Net benefit to Coho recovery

The Modeling Effort schematic (see below) is the monthly planning model used for operations in the valley (CALSIM). The modeling effort began at the top-level CALSIM level and then moved to the second tier of effort, which included gaming, EWA, PTM, temp modeling, and post processing. The third order of modeling effort used a salmon mortality model (usually daily time step) using temperature to evaluate impacts to ESA-listed species.



In this process, the authors of the BO compounded the uncertainty inherent with many of the details coming from general/monthly models. It is difficult to determine uncertainty when the models build on each other.

Historical record goes back 72 years, but does not take into consideration climate change/variation based on future changes in California. One study showed a 1degree temperature increase in Shasta Reservoir over the past 50 years. One PTM showed gross movement of water through the Delta. Not so useful for salmon because salmon behavior is different from a neutral, buoyant particle. However, may be useful for early fry life stages. It is useful for looking at gross water movement in the Delta.



Example of gaming results (2003) are presented above. Used for EWA: summary for each water year type at a weekly time step with the operators and fishery folks in the same room and gamed that year. Ask operators how to model the reservoir and how fish agencies would have done exports to protect fish. Time scale: 3 days to 1 week (at most). The result helped us estimate real-time effects and to estimate the required size needed for EWA to make a difference. Restricted by when we can take fish actions and when we cannot (e.g. Limited by conditions export and flow conditions required as part of the Vernalis Adaptive Management Plan - VAMP). If the panels want explanation of gaming, need to refer to the Bureau

The nugget learned from this: how large does EWA need to be. VAMP is not shown in CALSIM since the detail is too fine for this model to capture (i.e., the scale of CALSIM cannot accurately capture the scale of the VAMP experiment).

Trying to go from monthly CALSIM to a daily time step. Trying to calibrate CALSIM on a daily time step; will also tell us about fish actions in a wet year, dry year, critically dry year. Capacities, limits, constraints on how to move/store water are all factors. Using CALSIM takes into account the daily ability of water operations for future scenarios. The goal is to extrapolate from the big picture of water operations to daily operations and fish impacts and impacts analysis.

CALSIM does not include environmental baseline. There is a run in CALSIM with and without EWA. Incorporated some of this into analysis for EWA. Had to put bookends on EWA for CALSIM.

Assumptions for CALSIM model include that operators get/give their full contract delivery (e.g., CVP contracts are at their full amounts in the future condition). This is an important assumption to note.

- Water service contracts at full build out for future 2020 condition
- We will need to Re-consult before 2020 due to changes in ESA (critical habitat, new listings, hatchery policy) and changes in operations (American R, 8500 cfs, restoring San Joaquin flows below Friant)

(Jim Lichatowich): Are those the full range of things that can initiate re-consultation?

(Bruce Answer): If there are significant operational changes or as new info becomes available we can use this information to request reconsultation.

Assume that our baseline is the current condition (2001 or study 3). Two studies done before that look at 1996 operations and water quality control plan and a study by FWS. Looked at EWA and B2 in its current condition and policies. Assume that the upstream reservoir linked to the habitat is available. Dams are part of the baseline. We only examined effects of operations after that.

The information available in 2004 is critical to understand. For feasibility reasons, NOAA Fisheries set the cutoff date for the BO, which was released on October 22, 2004. The Bureau initiated the release of new information in March 2004 and by June of 2004 there was another round of information to use for this BO. NOAA Fisheries continued to get info from the Bureau all the way into October, so NOAA Fisheries had to continuously change BO all the way though (which they did not want to have to do) to reflect this new data and understanding. In order to be able to finalize the BO document, NOAA Fisheries told the Bureau that all information, if it is to be included and evaluated in the opinion, must be submitted prior to October 22, 2004.

Sacramento River impacts include:

- Change in water temperature
- Change in spawning habitat
- Change in flows
- Carry-over storage reduced
- Flow fluctuations
- Unscreened diversions

Did the BO analysis of the changes listed since 1993 when winter-run was listed (e.g., the change in temperature compliance point, which is a big thing) change the document development process or opinion? The BO authors analyzed the historical record about how they had operated since 1993 when winter-run was listed. How did this change the

spawning distribution, change in spawning habitat, with the new ladders at ACID, plus the temp effect downstream of compliance point. Evaluated it at current level in 2003. Because of the change in temperature compliance point we:

- Reviewed historical record
- Analyzed available spawning habitat
- Updated spawning distribution with new in ACID ladders
- Determined temperature effects downstream of compliance point

Historical record shows that compliance point has been changed in every since 1993. Basically, moving upstream each year (see table slide below). Balls Ferry was the extreme. Before the temperature control advice, there was much greater uncertainty. The compliance point has always been a moving target. It is now adaptively managed by FWS, NOAA, and DFG as a collaborative effort. Together, they analyze monthly reservoir temperature profiles. We have not had a critical dry year since 1996 to test this approach. The compliance point is based on the amount of cold water in Shasta (physical considerations). The managers do both: they look at physical capacity (including the thermal profile of the water) and aerial surveys of fish spawning in the current real-time situation. Analysis takes into account that most fish spawn above Balls Ferry. Sixty percent of the fish were found above ACID. Fish are not dying, only losing a proportion that are exposed to higher temps, not the entire spawn. The management team takes the mortality rate into consideration too.

Historical Compliance Record

Table 9–8 Winter-Run B.O. Temperature Violations and Reinitiation Letters

Water Year	Water Year Starting Shasta Storage (taf)	End of April Shasta Storage (taf)	40-30-30 Index	Reclamation letters		
				Date	Action	Compliance
1996	3,136	4,308	W	5/17/1996	Exceed 56 °F 4/26	Bend Bridge
				7/12/1996	Exceed 56 °F 5/27	
				7/18/1996	Conserve cold water	Jellys Ferry
				8/28/1996	Conserve cold water	Balls Ferry
				9/23/1996	Transition to stable min flow for fall-run salmon by Oct 15	Clear Creek
1997*	3,089	3,937	W	7/30/1997	Exceed 56 °F at Bend 4 days	
				8/8/1997	Conserve cold water	Jellys Ferry
1998	2,308	4,061	W	6/25/1998	Exceed 56 °F at Bend 4 days	
				9/18/1998	Temp exceed 56 since Sep 12	Jellys Ferry
1999	3,441	4,256	W	8/19/1999	Exceed 56 °F at Bend 4 days	
2000	3,327	4,153	AN	6/2/2000	Exceed 56 °F at Bend 3 days	
				7/14/2000	Conserve cold water	Jellys Ferry
				8/29/2000	Conserve cold water	Balls Ferry
				10/16/2000	Exceed 56 °F at Balls 3 days	
2001	2,985	4,020	D	7/17/2001	Exceed 56.5 °F at Jellys 2 days	
				1/10/2002	Exceed 56 °F at Jellys 8/28/2001 to 9/1/2001 and 9/152001 to 9/30/2001	
2002	2,200	4,297	D	6/5/2002	Exceed 56 °F at Jellys 5/18/2003	
2003	2,558	4,537	AN	6/18/2003	Exceed 56 °F at Bend 5/14/2003	
				8/28/2003	Conserve cold water	Balls Ferry

Note:

* 1997 was the first year that the temperature control device (TCD) was used.

They were limited in ability to control temperature because the temp control device leaks. Wet years the device leaks and warms up the temperatures below the dam. Side flow in RBDD warms things up too. Quite a few data problems. Also, the Spring Creek diversion dam controls flows from Iron Mountain Mine and is toxic with heavy metals so in order to reduce that need to increase releases from upper levels of the reservoir. By releasing water from the upper levels, however, there is a warming effect. The effect of heavy metals on winter-run has been reduced based on EPA actions to minimize mine runoff.

(Jim Lichatowich): What is the maximum number of redds below the compliance point?

(Bruce Answer): We do not know. Typically we have 1 to 2 redds below RBDD. Usually less than 5 redds are exposed to high temperatures. Population is 9,000 to 10,000, so pretty insignificant.

(John Williams): Would target be a better term than compliance?

(Bruce Answer): It was a reasonable and prudent alternative initially, so it was a hard compliance point initially. Before 2004 BO, every time Bureau missed the compliance point, they had to write NOAA Fisheries a letter, specify how many days they were in non-compliance, and what actions were taken, NOAA Fisheries would say OK and keep doing what they were doing, write letter back, etc. Forced us to look at the data.

Mortality Model Results (see slide):

Mortality Model Results

Winter Run

40-30-30	D1641 w3406 b(2) (1997)	Today b(2) (2003)	Today EWA (2003)	Future b(2) w/ SDIP (2030)	Future EWA (2030)
Average	6.9	8.3	8.4	9.2	9.3
W	1.0	1.2	1.2	1.2	1.2
AN	1.7	1.9	2.0	2.0	2.1
BN	2.3	2.5	2.5	3.1	3.2
D	3.5	4.3	4.3	4.5	4.6
C	34.1	40.7	41.5	45.8	46.1

Results from CALSIM -- summary of winter-run. In Butte Creek there is no temp model. First column in the above slide is the 1997 baseline, 2003 is today, with EWA 2003, etc. Differences are not that great: 1-2 degree difference except in critical years when it is three percent difference. Do not know what the range or variance is on the numbers. There is a lot of uncertainty, but not quantified.

Table 9-6 (slide below): same results in previous slide, just differences presented in new form. Critical dry years are most different. This critical dry year scenario is the impact we are looking at most carefully.

Table 9–6. Long-term Average Annual and End of September Storage Differences for Shasta Storage, Spring Creek Tunnel Flow, and Keswick Release

Differences (taf)	Study 2 - Study 1	Study 3 - Study 1	Study 5a - Study 1	Study 4a - Study 2	Study 5a - Study 3
Annual Spring Creek Import	-81	-78	-220	-139	-142
Shasta EOS	-43	-46	-159	-113	-113
Annual Keswick Release	-79	-77	-218	-137	-141

Shows impact on Trinity River, in critical dry years.
In Shasta at end of September, this is just a storage level, but a relationship exists between storage water and cold water available. Good for the Bureau. Currently losing 4-6,000 acre-feet to the Trinity River, under current conditions. Study 4 & 5 included Trinity River at the maximum at 8,500, which is where you lose the storage at Shasta. Shasta end of year storagewould be higher if more water could come from the Trinity River, but because they cannot extract more from the Trinity it must be taken from Shasta.

Keswick flow is reduced a lot in future conditions because less water in storage

Reservoirs will be much lower than normal when at future flow conditions.

In critical dry years everyone gets hurt, fish and operators. Less water for temp control. About 15% of 72 years were critical dry years.

(John Williams): Why does it look like we're losing more fish in average than dry years?

(Bruce Answer): It is the average of all scenarios (not a dry year).

(Jim Anderson): Is this a percent of the natural baseline mortality or is this a percent above the natural baseline mortality, which is 40% in a critical dry year. We're focusing on the 1-2% above this mortality baseline and this is just in the egg to fry life stage. In a wet year, there may be 1% mortality in the gravel lost in the spawning processes (not from the temperature effect). The temperature effect is the difference.

(Bruce Answer): Not too many spring run pass the RBDD and less than ten percent of the population spawns above the dam.

(Jim Lichatowich): Is this selective incremental difference in survival rates based on the timing and the mortality differences for each run?

(Bruce Answer): Yes, good question. Temperature control actions are taken through the summer in August and September. Managers can then relax control in September to 60 degrees. The fish that come in early are more affected by the temperature control device than fish that would come in later in September, October, and November.

Steelhead timing and mortality similar to fall-run run. If spawning in mainstem will get 2% mortality in eggs to fry (for each fall-run and steelhead).

Estimating Loss for Unscreened Diversions:

- Based on timing of CVP contract water.
- Used 0.06 % hatchery fish diverted from Hansen (2001) Wilkins Slough x percent Sacramento flow diverted (note: varies with location, DFG uses 3.5 percent in tributaries).
- Take is small (0.37%) of winter-run population (assume spring-run is similar, steelhead use different habitat).
- Assume most major diversions will be screened in next 10 years.

Hansen 2001 determined rate of diversion from continuing operation from the Sacramento river depends a lot on location in the Delta or upstream. Some reports use 3.5% for wild fish and different estimates for hatchery fish. There is lots of variability. One study is the Hansen study that determined a mortality loss from unscreened diversions of less than 1%. Based this on the winter-run timing. Juveniles going downstream versus pumping times in the summer were different.

Also assumed that most large water diversions will be screened in the next 10 years. This may not happen. Many big ones in BO already screened, in process of being screened. Many small ones likely will not.

(John Williams): For winter-run this may not apply since fish smaller in size are more likely to be diverted into these areas with diversions.

(Bruce Answer): All this is in the BA.

Jim Anderson: What percentage of the water is diverted?

(Bruce Answer): Good question for the Bureau (he wasn't sure off the top of his head).

The percent of long-term contracts diverted for Sacramento River is a lot. If these calculations are moving fish out of the water directly proportioinal to all diverted water, then 60% of the fish could be diverted. Once diverted, these fish die. If 50% of the fish in the water column are diverted, there could be a large difference in number of large and small fish that are impacted, with small fish being more susceptible to this mortality source. We're basing this idea on the hatchery fish studies. If an order of 10-30% of water is converted into diverted fish, it is probable that this diversion mortality rate is higher for wild fish because wild fish are typically smaller than hatchery fish. It is hard to find good studies on the fish that are diverted.

Most diversions are upstream of the Delta where the juveniles are smaller and more apt to come in contact with the diversion. Most of the large screened diversions are on the Sacramento River.

American River Impacts:

- Effects on steelhead only
- Flow fluctuations (stranding, dewatering)
- Temperature control >68F in summer
- 300 TAF increased demands in future
- Reduced flows, higher temperatures in future conditions significant
- Hatchery population not part of ESU

Usually looking at flow fluctuations when the CVP ramps up or down -- ramp down usually causes problems for steelhead.

Using Folsom Reservoir storage to meet standards in Delta can result in water releases for temperature control, with direct trade-offs and negative impacts to the critical stage when redds emerging. These trade-offs can result in de-watering, stranding, and other unintended side effects.

Relatively low and insignificant effect of flow fluctuations on American River.

Temperature target used to be 63 degrees, but new BO calls for 68 degrees. Limited to what we can do based on the water available in Fulsom. This occurs in the CVP project arear before water gets to the Delta. Some connection to SDIP and the reduced flows, higher temps, hatchery effects analysis are all part of the SDIP.

(John Williams): What analysis did you do on the effect of the hatchery fish?

(Bruce Answer): We looked at the size of the populations and the resulting likely effect that the fish in river are descendants of hatchery fish. Based on our information, it appears that over half of the "wild" fish are probably introgressive descendants.

(John Williams): It seems to me a disconnect. Cannot make any sense of the policy for American River steelhead.

(Bruce Answer): Assume that American River wild pop is genetically mixed with hatchery fish, but still taking actions.

(John Williams): Then why are they listed? Why not take out of ESU?

(Bruce Answer): There remains the chance that within the AR steelhead population there are still genes that are from the wild fish. We do consider the hatchery as a threat to the wild population, but this will be detailed and addressed in the hatchery BO.

In BO it says that hatchery fish are part of the baseline operations instituted to mitigate the effects of the dam, and now we think that the hatcheries may impact the wild pops. This takes additional information. It will take an additional BO and more work, but scope is not here.

(John Williams): Hatchery population is continuing to regress into the wild pop, but the BO does not have to analyze that?

(Bruce Answer): No, the two are interrelated but we are not analyzing the hatchery details ant a specific level. There is nothing quantitative, only qualitative. We did look at threats and benefits, but at a larger scale. We addressed issues at a top level of competition, genetics, etc., but not day-to-day, just as general population impacts. Still looked at it, but not as in much detail as maybe wanted to because data not available. Look at overall picture, some part of operations baseline, etc.

(John Williams): If more info on hatchery impacts on wild fish, should we say that?

(Penny Ruvelas and Bruce Answer): Yes, we would like to know. Very interrelated. If we didn't do a good job, or underestimated the significance of hatcheries please say that.

(Kenny Rose): The American River effects are the list of things is things you considered (yes) and this is a mix of qualitative and quantitative metrics.

(Bruce Answer): Most are quantitative.

(Kenny Rose): What about flow fluctuations?

(Bruce Answer): That is professional judgment. Relied heavily on DFG analysis of flow fluctuations. Could quantify. How many times did the Bureau ramp down due to flows? Found winter-run and spring-run that were non-natal rearing in the upstream system that were also affected. Used that report, but many of them just qualitative descriptions although the quantitative analysis could be done. Most fluctuations occur in fall when ramping down to get flows down. Each month, flows drop, most impacts on fall-run Chinook. This is a good example of how b2 flows are used to stabilize fall flows going into winter for steelhead or fall-run. Usually water quality problems kick in and we have to release water, which can be problematic for steelhead redds. Less than 10% of steelhead redds have been stranded.

(Kenny Rose): There should be a very systematic way to quantify this and put it into an egg model so that it is numerical; when he came to flow fluctuations and spawning habitat in the BO, the analysis was uneven. This current approach is not a clean systematic approach because we do not have a systematic way of quantifying flow fluctuations. Therefore, it seems that the BO authors used the data available, but this is problematic. For example, in the Feather River there have been several changes to estimating flows in the past 10 years. It should, however, be easy (and important) to develop this type of flow flux model consistently across all streams, rivers, etc.

(Bruce Answer): Flow fluctuations are probably not a major impact now.

(John Williams): But with climate/global changes, the impacts of flow fluctuations will get worse and worse.

(Bruce Answer): True, it will get worse and worse. In American River almost wrote off entire river.

(Kenny Rose): Same approach for spawning habitat. You did not do a quantitative evaluation consistent across all streams for reduced spawning habitat?

(Bruce Answer): For fall-run we did do the quantitative, but not for steelhead

(Kenny Rose): Temperature is linear and straightforward. But what is the logic used here? The assumptions and logic are not blatantly obvious in the BO.

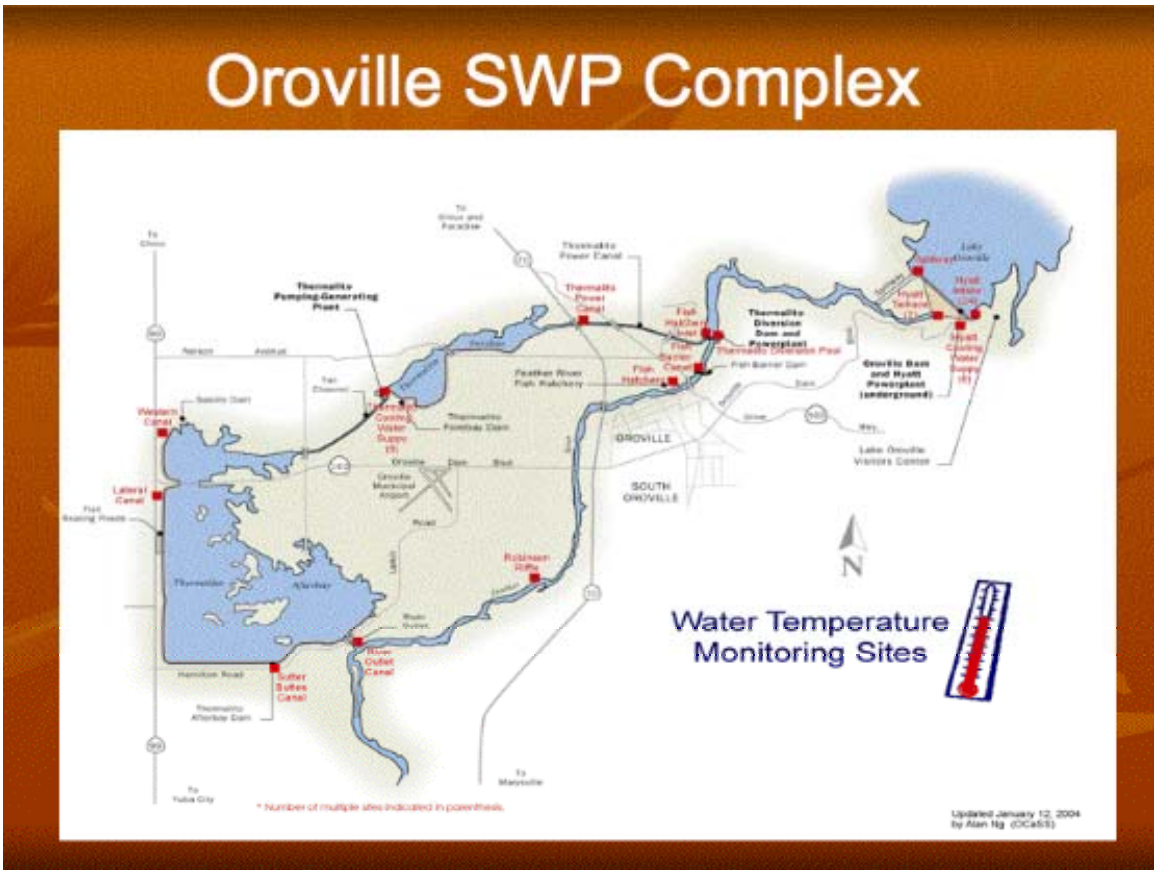
(Bruce Answer): Case by case basis. Temperature effects appear greatest in the American, less prevalent in the Feather, could be substantial to Sacramento River but probably not too much

Returning to his prepared presentation, Bruce discussed the Feather River impacts:

- Spring-run and steelhead impacts from limited space available in Low Flow Channel (< 5 miles of river below the fish barrier dam)
- Flows and temperatures adequate to support remnant populations (unknown spring-run component, < 200 steelhead)
- Hatchery impacts far greater than operational effects

- Fish studies are now being analyzed for obtaining a new FERC license for the Oroville complex, including the Feather River Hatchery.

Oroville SWP complex map (see slide):



Low-flow channel between hatchery and Afterbay. Most flows go through Thermalito Afterbay which was constructed to heat up the water for rice production. Low-flow water (constant 600 cfs) remains in the main channel. 65 deg required for over-summering spring run and steelhead,

Agreements between DWR and DFG for spring-run, fall-run Chinook can keep temps lower, within certain temperatures ranges the fall to protect fall-run Chinook. Most steelhead have are spawning below the Feather River Hatchery (in the "Hatchery ditch") which receives a small outflow from the hatchery and provides a site for limited spawning. There appears to be approximately 200 steelhead natural spawners in the Feather River ; first count 153; very limited remnant population; few riffles; have put in gravel. Most spring-run spawn just below the fish barrier dam and are thus crowded into1-2 miles below hatchery. This crowding can lead to hybridization and later spawning fall run can spawn on top of spring-run redds. Amazing that there are any steelhead left. Altered biology of fish with this hatchery.

NOAA Fisheries decided to let the DWR FERC process reach its conclusion before dealing with the Feather River Hatchery impacts. The FERC process is likely to lead to much different operations of the FRH than has been the practice for the past 3 plus decades.

The agencies have started a process on the Feather River (because deemed significant); ongoing studies should give us insight and information about the impacts from hatcheries in the Feather River. Instead of deciding early on, we would rather deal with it next year with these other processes and settlement through the FERC process. Did not have enough info at time of writing the BO to be able to address the impacts of the hatchery and operations. There was a flow study and used those results and proposed higher flows in low-flow channel and DWR came back and said that they could not do temp compliance below red dot in middle of low-flow (see map). That turned out to be good, because they can drop that compliance to 56 rather than 65 and then expand some of the thermally desireable habitat.. In hindsight, probably a good decisions. . We lumped loss of spring-run in Feather with loss of spring-run Sacrament on mainstem together and got significant impacts. When separated out, the Sacramento River is less impacted. This was the process that we went through.

(Jim Lichatowich): Bruce, in several cases you have addressed/acknowledge lots of uncertainty. Is there some threshold of cumulative effects that says cannot get a BO.

(Penny Ruvelas): We do not have that option. Legally have to do BO, even if it is with a mountain of uncertainty. Want to avoid type II and no option to not come to conclusions.

(Bruce Answer): If not enough information for conclusion, can delay consultation process and wait for information available or delay it and put it into a later process. Usually do not delay because there will always be data gaps and information unknowns.

(Jim Lichatowich): For each uncertainty should you talk, concentrate, quantify, discuss and frame the uncertainty.

(Bruce Answer): Yes, all this is under assumptions, CALSIM review by Science Panel : great deal of uncertainty that needs to be quantified, do not know what it is. CALSIM is the best available model, so we went with it. Still need to calibrate CALSIM (currently change in San Joaquin River part of CALSIM) and there is considerable uncertainty, but this is acknowledged and we are working on it.

Flow fluctuation on the Feather River were somewhat quantified. Fluctuations are related to safety of dams, inspection of gates, shutting down operations and run all water through low-flow channel and then small channel goes from 600 to 5,000 and can wipe out all spawning. DWR likes to quantify effects of flow fluxes, for example, the quantification of how many fish left stranded, isolated, etc. Lots of ponding goes on in this area. It can

lead to isolating fish. Problem with quantifying effects is that we cannot tell difference between spring-run and fall-run on the Feather River. This is always a major issue.

On Stanislaus River we have:

- Flows and temperatures that are adequate to maintain steelhead
- 25 miles of suitable habitat below Goodwin Dam
- 2 years of operating a fish weir with only one adult steelhead counted
- CALSIM modeling shows little effects in the future case.
- b2 water used to support flows

There is a temp compliance point at 65 degrees at Point Lasu Road. The last two or three BOs provide guidelines. The Stanislaus River is one place where lots of b2 water is used to control flows and keep for the stream suitable for spawning and -over summering steelhead.

Three years ago implemented the Stanislaus the fish weir to estimate the fall run Chinook and the steelhead populations. We have only seen one adult steelhead during this period.

Interim agreement with FWS DFG results in fish flows releases in certain year types and Bureau allocates water via CVPIA, Limited by flow and quality standards in San Joaquin River. To help meet D1641 water quality requirements, the Bureau uses only Stanislaus River water. Also other flow requirement met with Stanislaus River. These requirements really improve conditions for adults going upstream or juveniles going down.

Clear Creek (out of Whiskeytown Reservoir) we have:

- Flows and temperatures supported with b2 releases from Whiskeytown Dam
- Fish populations increasing due to removal of Saeltzer Dam and restoration efforts provided by CVPIA & CALFED
- Flows expected to be stable in future
- Some straying of winter-run into Clear Creek have been documented
- In the future, warmer water in Clear Cr due to less Trinity R water moving through Whiskeytown Reservoir

Most flow increases supported with b2 releases. Fish pops increasing from the removal of Saeltzer dam which resulted in additional habitat. Immediately after the dam was removed, spring-run number increased (63 spawners in Clear Creek). Expect flows to be stable in future. Some documentation of winter-run that entered into Clear Creek from straying : these would be impacted and probably die in lower part of creek. Relatively insignificant (i.e. 1-2 redd in the 9,000 total). Less water from Trinityto Clear Creek means the stream may be warmer, although releases have been higher than anticipated. Included a recommendation for a temperature Control Device in Whiskeytown Reservoir. No temp model and little data were available before, but BO asks for a new temp model for Clear Creek. Being adaptively managed right now and the impact on spring-run and steelhead appears pretty minimal.

Lots of gravel put at the base of Whiskeytown and it moves downstream, provides habitat for steelhead.

Summary of Impacts (see slide below):

Summary of Impacts

Upstream Effects	Winter-run	Spring-run (mainstem Sac. R only)	Steelhead
EOS carryover storage reduction in Shasta, juvenile mortality below Balls Ferry *	2.4% in some years	U/N	U/N
Average increase in mortality (3 v 5) *	1-2%	4%	0.1%
Critical Year increase in mortality (3 v 5)	3%	6%	0.3%
Flow fluctuations, based on redds dewatered *	minor	minor	1% juveniles

We used a combination of quantitative information, best professional judgment to come up with the effects. In critical year mortality for winter-run, spring-run, and other species of concern, this goes up a bit. Steelhead impact is low.

Percentage of population that would be affected by reduction of carry over storage does account for fish that spawn below temperature compliance point and the reduction in viable eggs due to the increased temperatures. Numbers correspond to 3=baseline, 5=future with EWA in table of scenarios.

Cumulative and indirect effects (including hatcheries): some effects are unknown (e.g. water quality effects, like agriculture drain water that goes back into the river after farmer use with lots of salts, pesticides, and contaminants. The BO deferred that to the Bureau and asked for more information.

We compared future conditions to the baseline, taking into account current protection measures (e.g., ocean harvest, water quality standards, and salmon decision tree used to

evaluate the need for EWA fish actions in the Delta) to determine how large of an effect future conditions might have.

(Panel Member Unknown): You could expand this into other elements to look at ocean harvest: Consumer Report table for all management actions of the species.

(Bruce Answer): Could but did not. It is linked, but not controllable through the operations.

(Kenny Rose): Population level comes together when you pull together the upstream and Delta impacts. Are these impacts based on a particular level of water use?

(Bruce Answer): Yes, based on the 72-year historical record of patterns, equal distributions of wet and dry years, with 3 drought periods. The drought periods are the real kickers for us to draw down the population and they are part of the baseline condition. Hard for the Bureau to manage against this and hedge against impacts.

(Jim Anderson): This is all based on monthly averages, which do not give us anything in between.

(Bruce Answer): Based on historical record, but does not take into account climate change, droughts, etc.

(John Williams): Perhaps our comments could say that this should and could be done with probabilities.

(Bruce Answer): Info not yet told about: the NOAA Fisheries 20 questions. Requested a set of runs from Bureau about the flood control frequency to get at eh question of flood control factors and releases that are very detrimental. Usually occur in winter, scour redds, etc. Did not include this 20-quesiton analysis in the BO. Bruce thinks that it is in the package → this is part of the BA and assessment, but it came out very slowly and wasn't until the BA was completed did NOAA Fisheries get a letter from the Bureau saying that they answered questions. Answers not all in one place, but scattered throughout BA. (Note from editor – the panel was provided with 20 questions posed to the Bureau and their responses.)

(Kenny Rose): Regarding the historical record, did CALSIM model the sequences as they actually occurred.

(Bruce Answer): yes

(Kenny Rose): When average over year types, there has got to be considerable variation. Did analysis reflect coherence among years, i.e. did not occur one year at a time. There is not population level impacts (i.e., output goes from one year into the next year, not

carrying over into the third year -- or whichever -- impacted by the fish). Is there no memory in the egg mortality model. There is no spawning recruit model to plug the hydrologic info into. 20 salmon models exist in the CV, but none of them fit: either incomplete, or not peer reviewed.

(Jim Anderson): Do you have a list of the available salmon models:

(Bruce Answer): Wim is doing one, most are bits and pieces (not whole life cycle) or based on old data with very small numbers. Cramer model not peer reviewed at this time. CPOP, Kenny's model, many models…

(John Williams): Hatcheries are a continuing effect.

(Bruce Answer): It is a continuing effect, hence the process that the Bureau will initiate consultation with the Trinity and the Coleman National Fish Hatchery and the (Feather and Merced hatcheries are state, so no jurisdiction over them). So, you are saying that it is in our discretion to do something about it? In the original BO, we did try to separate the run in the Feather River and that has been added to one of the alternatives and we're looking at that.

(John Williams): In regards to the hatchery component of Feather River, we know the effect.

(Bruce Answer): We know the effect, but we didn't analyze it or take the opportunity through the OCAP opinion to analyze this hatchery challenge. Can only analyze impacts that the Bureau has discretion over. To the degree that the Bureau funds a federal fish hatchery, NOAA Fisheries could require them to change things. NOAA Fisheries cannot, however, make the State of California take action. Through the FERC collaborative effort on the Feather River, however, NOAA Fisheries can try to exert some influence through this process. NOAA Fisheries can look at the hatchery effects and then try to mitigate these effects, but it cannot force the State into regulation.

Pumping is a direct action and hatcheries are indirect. It is harder to address the indirect challenges.

(Penny Ruvelas): NOAA is required to analyze the direct and indirect effects, but the take actions and conditions can only focus on those that fall within an organization's authority and discretion. Still can analyze, but doesn't go to the fuller recommendation based on the available information, but cannot take it further in depth. Maybe this was just a feasibility decision, because NOAA Fisheries knows that it cannot change some actions.

(Al Giorgi): Big issue in Columbia system is effects of water operations on predatory fish and the resulting impacts on the native prey fish.

(Bruce Answer): Local studies at diversion pts (e.g. CCFB, RBDD, Tracy), but no system wide study on predation. Predation is ongoing in the Delta, and increasing, but do not

know the populations of these predators (increasing for the last 20 years) e.g. striped bass, large-mouth bass, and small-mouth bass all increasing and preying on salmon. BO only analyzes it on indirect effects going through the Delta. Hard to get at. There is a range. Reference those studies and workshops, etc, trying to get at that. E.g. Randy Brown's CCFB workshop. These increases are not studied at a population level except may be striped bass which is used as an indicator species and widely studied. Know less about large-mouth bass, and even less about small-mouth bass, which is taking off in the Delta now in every area where there is riprap.

(Al Giorgi): In base case operations, if operations have fostered predator growth in populations, then this has also likely increased the mortality for species of concern.

(Bruce Answer): Did not do that, just looked at cumulative effects, same as aquatic weed problems, loss of habitat.

(Al Giorgi): And Bureau is not concerned either.

(Bruce Answer): Bureau is not as concerned as DWR, who is more concerned about weed control in CCFB. These are not topics that we looked at. These probabilities are probably going to continue and to increase as changes in Delta further decrease water flow and habitat area. Changes will likely exacerbate predation and risk probabilities for native fish. The BO had a section on aquatic weeds, pesticides, etc, but it was hard to quantify and we knew very little so we took it out. It was just plain hard to use this information that raised more questions than it answred. This is an example of the project that may have some effect that is indirect and included in the BO effects analysis, should the data become available.

If operations make habitat worse for native pop and losses can exceed the 1-2% take level and thus puts us over that jeopardy level, then it is important.

1400 – Additional questions from the panel for NOAA
1500 – Adjourn – Panel meets in executive session

October 13

0900 – Overview of State Water Project operations in the Delta with comments on joint operations with the Central Valley Project – *Tracy Hinojosa, DWR*

Tracy provided an overview of SWP operations with comments on Joint Operations with the CVP. Her talk outline included an overview of the State and Federal storage and conveyance facilities, the role of the Delta in California’s water delivery system, and characteristics and features of the Delta. It touched on flow and water quality objectives, required by D-1641, and the tools that DWR has for meeting those objectives, as well as some factors which affect Delta conditions. She planned to discuss the Coordinated Operations and joint points of diversion, and then have a question and answer period.

Tracy mentioned that she is relatively new to this position, so if she cannot answer the panel questions immediately, she will find out the answers and get back to the reviewers.

We have a geographic mismatch of supply and demand in California. Two-thirds of the State's water supply comes from precipitation in the northern part of the state, while two-thirds of the State's demand is in the southern part.

The State and Federal projects have a number of storage and conveyance facilities to take water from where it's more plentiful to where it's needed

The SWP's (State) facilities include Lake Oroville (~3.5 MAF), and pumping plants, aqueducts, and pipelines designed to take water to the North Bay, south Bay, Central Coast, and southern California communities, as well as agricultural customers in the Central Valley. The SWP and CVP share a storage facility—San Luis Reservoir and a reach of the California Aqueduct in the Central Valley. CVP has more storage in the North (Shasta): Theema Colusa Canal, delta Mendota canal, Madeira and Frank Kern canal (operated independently from northern faculties).

The CVP (Federal) stores water in Shasta and Folsom Reservoirs. Conveyance facilities include the Tehama-Colusa Canal, the Folsom South Canal, and the Delta-Mendota Canal. Other facilities operated independently of the Northern California facilities include the Madera and Friant-Kern canals. Delta becomes the hub of our water delivery system. Yuba, Feather, and Sac River are the main ones in the north of the delta,; southern side San Joaquin, Tuolumne, Calvarias, Stanislaus.

The principle tributaries to the Sacramento River are the Yuba, the Feather, and the American rivers; the San Joaquin River tributaries include the Merced, the Tuolumne, the Stanislaus, and the Calaveras rivers.
Nearly half of the State's runoff comes from the Sacramento & San Joaquin Rivers and flows through the Delta.
From the Delta, the Projects export water west and south.

Dark slide: average of 27.8 maf flows into delta or flows out through the delta:
75% flows out to bay on average.
SWP and CVP each pump about 9%
CCC and North Bay : 1% and
Delta consumptive water use (primarily agriculture)

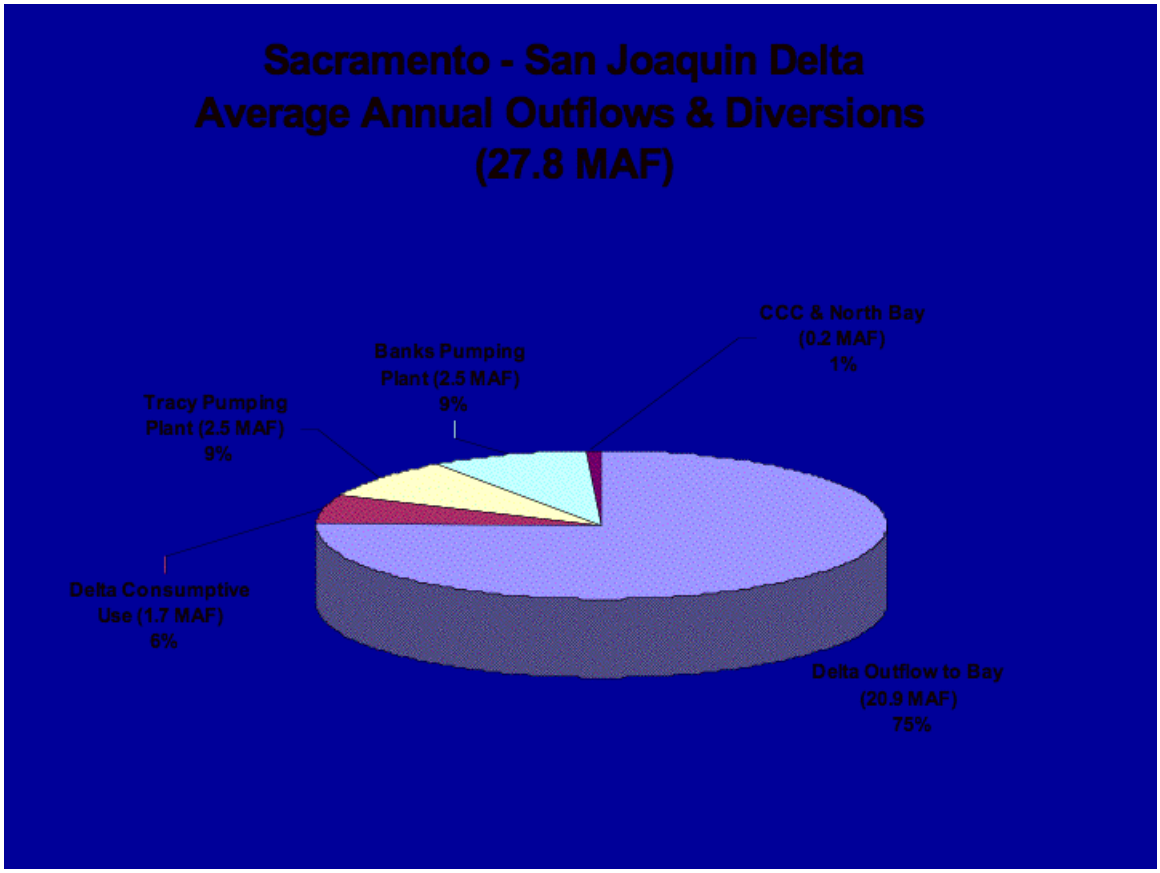
The Delta is the hub of California's integrated water resources system where a portion of the water is exported south to meet demands.

North Bay Aqueduct intake (is the red top diamond); CCFB is the state; green is federal: Contra costar canal and Tracey pumping moves water south.

Over 2,000 agricultural diversions in the delta. Note – you got it right, she used old data.

The Delta Cross Channel is highlighted by the blue arrows. Operated and opened to get more water into the Sacramento River. Orange markers agricultural barriers & temp barriers to improve water levels, one is a fish barrier. All four are installed seasonally.

An average of 27.8 MAF passes through the Delta each year. 75% flows out of the Delta into the San Francisco Bay, while the remaining 25% is diverted for use. The State and Federal projects each export about 9% of the average volume, while about 1% supplies M&I uses nearer the Delta, and about 6% is used (primarily for agriculture) within the Delta.



Water is diverted from the Delta at:
the North Bay Aqueduct intake at Barker Slough and at Clifton Court Forebay (SWP facilities); and at Contra Costa Canal and Tracy Pumping Plant (CVP facilities).

Also of note are the Delta Cross Channel gates, which when opened (or "operated") allow more Sacramento River water to flow through the central Delta; and the temporary barriers, which are installed seasonally in the south Delta. These three barriers are primarily designed to improve south Delta water levels.

Salinity is a major concern in the Delta. Function of a lot of factors. Flood tides → higher salinity. Increased river flow into the Delta will also decrease salinity levels. Delta Cross Channel operations affects flow and salinity as a function of these. Agricultural returns and diversions also affect.

- Salt and freshwater mix in the Western Delta.
- Salinity in the Delta is a function of tides, river flows, the DCC operation, drainage, and diversions.
- Weather can often affect tides and salinity conditions (low pressure system increases tide heights and wind pushes salinity in further into the delta).

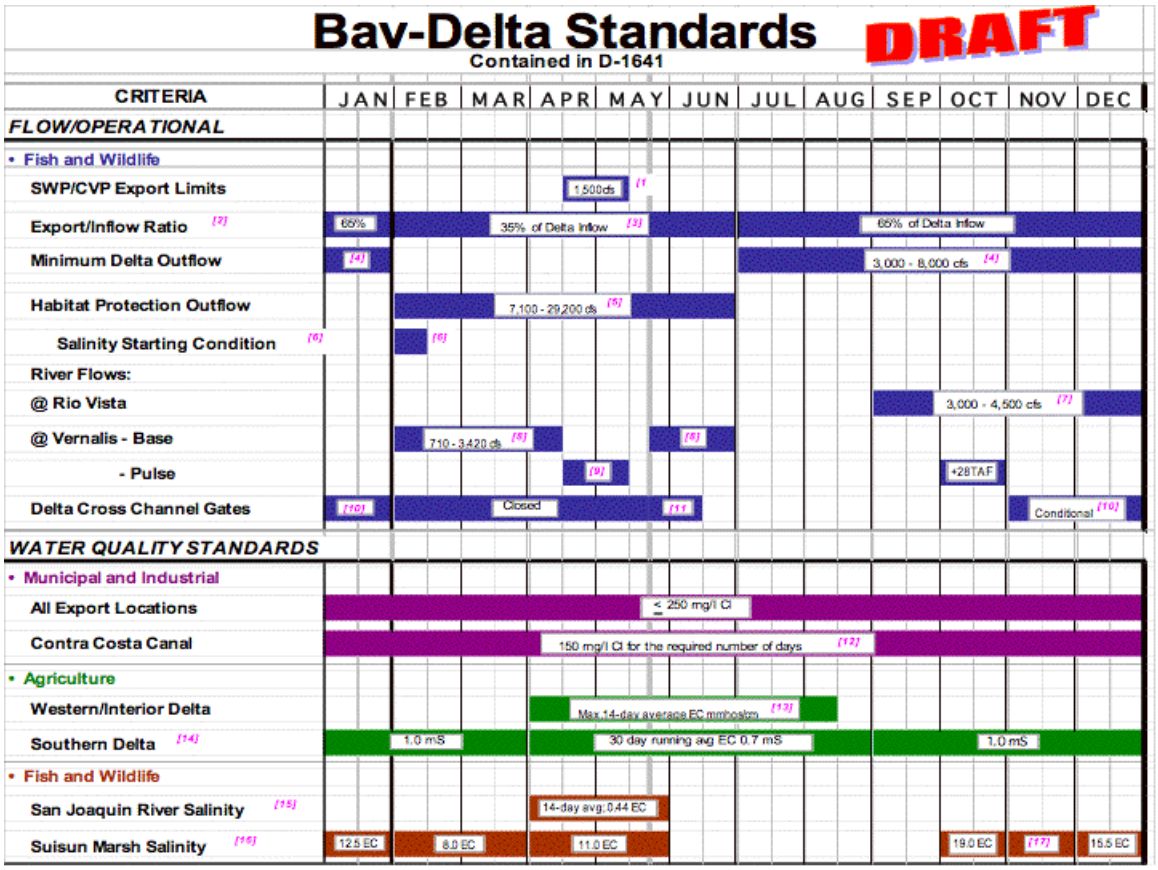
High or "flood" tide, higher salinities; low or "ebb" tide, lower salinities;
Higher river flows, lower salinities.

Tracy presented a map of DWR and USBR telemetry monitoring stations to measure salinity, water temp, flows, and other parameters are measured at different locations throughout the Delta. Continuously recorded. The data are continuously recorded at each station, and at some stations, transmitted by microwave or satellite to allow monitoring on a near real-time basis.

In December 1999, the SWRCB adopted Water Rights Decision 1641, which requires DWR and USBR to meet certain water quality and flow objectives as a condition of our Water Rights permits.

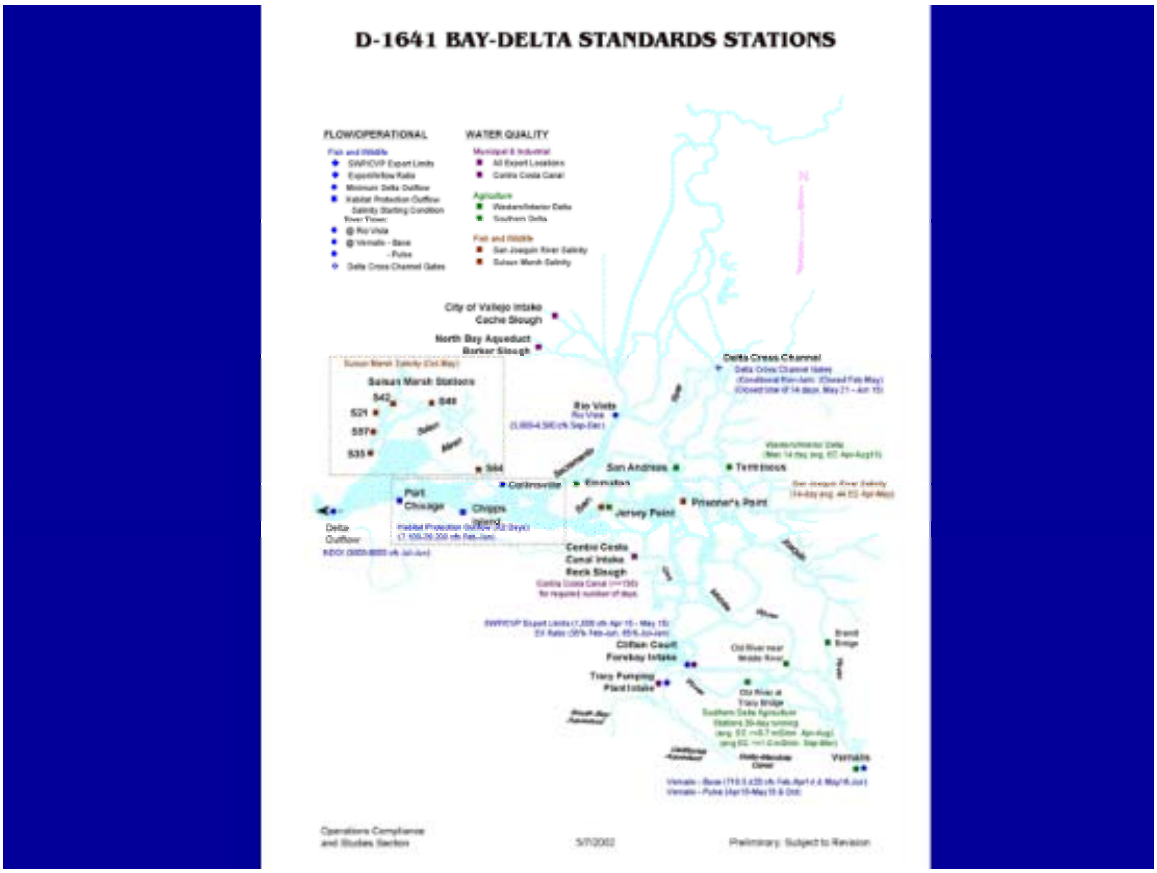
There are objectives to protect municipal and industrial uses, fish and wildlife uses, and agricultural beneficial uses.

This chart shows, at a glance, which objectives apply for each month of the year. adopted a D1641, which required DWR and USBR to protect municipal and industrial water and fish rights. Meet the standards. There are many different requirements in the delta.



This picture shows the complexity of the different water quality standards. Industrial and municipal are in purple; agricultural standards are also shown. Lots of marsh stations and some outflow stations also marked.

Tracy then showed a map with locations at which these standards apply.



The hydrology of the Delta is complex.

For the most part, the Projects can control the inflows from the Sacramento River (excepting after heavy winter rains). The CVP can only influence a portion of the San Joaquin Flow (New Melones on the Stanislaus).

Tides dominate the hydrology within the Delta. The flows are more tidally driven in summer, but even in winter tidal sloshing is huge.

Tributary flows upstream of Sacramento River and San JoaquinR that aren't controlled impact the hydrology of the delta. Consumptive use (agriculture, municipal, industrial) and exports also change hydro. Although the effects of the Projects is most pronounced nearer to the export facilities, CCFB is operated to lessen impacts to water levels (driven by tidal action) in the South Delta channels.

Operational tools for meeting D-1641 objectives are limited and include:

- Modify Upstream Reservoir Releases on the Sacramento or San JoaquinR
- Modify Export Operations (can decrease)

- Operate the Delta Cross Channel (can open gates and let more water into Central Valley)

To meet D-1641 objectives, operators can use any combination of those three tools:

…at Shasta, Oroville, or Folsom
…at TPP or CCFB
.
The Coordinated Operations Agreement (COA) is a very complex subject. The COA, signed in 1986, specifies the parameters for the operations of both projects towards common objectives (set by the SWRCB).

Basically, it lays down who is responsible for what and outlines a means of accounting for water contributions to the basin. Generally speaking, delta can be in excess (currently here) or in balanced conditions:

"Balanced conditions" are defined as:
Releases and unregulated flow are equal to in-basin uses plus exports.
"Excess conditions" are defined as:
Releases and unregulated flow exceed in-basin uses plus exports.

When in balanced conditions, the CVP and the SWP share responsibility for meeting Delta requirements. The COA specifies State and Federal responsible for water operations and provides an outline of accounting for water operations.

When unstored water is available for export, the Projects share as follows:
CVP 55% SWP 45%

When stored water is necessary to meet in-basin uses, the Projects share as follows:
CVP 75% SWP 25%

These shared responsibilities that change depending on hydrological conditions result from the fact that the Federal side is storage rich and the State is conveyance rich.

The Joint Point of Diversion enables the Federal and State projects to better share each other resources. For example, suppose that the State is not pumping and the Feds need to move water, then they can use each other's available resources to augment each other's strengths.

The Joint Point of Diversion agreement is used to avoid or mitigate impacts to exports from:

- Curtailments to protect fish.
- Scheduled or forced outages.

It used to augment exports when unused conveyance capacity is available

(Jim Anderson): Are the compliance points flow or salinity requirements?

(Tracy Answer): A lot of the compliance points involve salinity, but some do involve outflow. For example, down south and by Vernalis and export locations, those are salinity and chloride standards. Large majority are salinity, but Rio Vista and some have to do with X2 and out flows.

09:45 – Juvenile salmonid movement in the Delta – ***Dave Vogel, private consultant***

Note that this presentation was based on a series of animated slides showing the movement of juvenile salmon that had radio transmitter attached or implanted. It is not possible to accurately describe the presentation without viewing the slides at the same time. The following is limited to the basic study design and assumptions, the overall conclusions from the various studies and the questions and responses among the panel members and the presenter.

Dave focused on studies in recent years in Delta to better understand Chinook salmon smolt movement: did not talk about CWT studies:

The studies use miniature radio transmitters, dorsal side of smolt, from Mokelumne River Hatchery (fall) and Coleman hatchery (late-fall)
Recently switched to internal transmitters, (concern was that external transmitters were affecting movement through the Delta and perhaps increasing predation risks).

The fish undergo the procedure with no apparent side effects and the process works well – has been used on Columbia River for many years.
More recently have used acoustic transmitters that much smaller that before and with no external antenna: works with fish as small as 94 mm.

Hatchery fish (not wild) are used in the studies
Fish probably approximated spring-run size, but slightly larger than others

No evidence for increased predation or effect on swimming due to transmitters
These studies are more qualitative of fish behavior (Not statistics) but radio tag studies on Columbia suggest that studies work well for parameters like survival.

Radio telemetry was used to supplement CWT studies in Delta. Large numbers of tagged fish released up in Delta, then recaptured at several locations like fish salvage facilities and trawling stations at Jersey Point and Chipps Island, plus recovery from sport and commercial, ocean fisheries 2-3 years later or fish returning to hatchery and spawning grounds. If all goes well, get lots of data from CWT. However, we cannot know where the point sources of mortality occur or how which migratory pathways the fish used. Can release 10s of thousands (e.g. VAMP 2004) and end up getting very fish returned and thus low statistical power

Radio telemetry techniques: 2 jet boats. Large yankee antenna ; elements vertically oriented because of better reception and ability to triangulate locations of fish. Mark

coordinates with GPS sometimes used acoustic Doppler profilers to get low velocities and direction of water where fish moved

Test fish were all moved to Delta, to acclimate overnight, and released in AM: Control fish were kept in live pens in the Delta to make sure that there are not adverse effects of handling & surgery

Conclusions:

- Fish did not move as a school.
- Fish movement showed strong correspondence with flood and ebb tides.
- Fish movement against the flow was rare.
- Net fish movement was more rapid in some Delta regions compared to others.
- Some regions had higher predation rates.
- Fish generally migrated near mid channel.
- Localized hydrodynamic conditions at flow splits affect migration route.
- Delta regions with large tidal prisms greatly affected smolt movements.
- Fish usually moved slower than ambient water velocities.
- Smolt movements on the mainstem Sacramento River are "simple" whereas smolt movements on the San Joaquin River are "complex."
- Smolts moving into channels south of the San Joaquin River do not readily move back into the San Joaquin River.
- Greater exposure of fish to flow splits increases the chances of movements off the mainstem.

These conclusions have come after ten years of lots of effort. These conclusions may sound simple, but coming to them and understanding fish movement in the Delta is not simple.

Discussion

(Al Giorgi): How many time cycles before fish get out of system, typically?

(Dave Answer): Huge variation: couple of days to a week and a half from code wire tagging. The fish do not move as a school, they attenuate. Probably 3-4 days after release show up at Chips Island, Bell shape curve with long tail, but skewed with most leaving at the beginning and a long tail.

(Giorgi) Is the tail the result of fish from getting in the interior areas and hung up in more complex channels

Do predation indices span the whole period?

(Dave answer) Yes. Predation seems to happen in interim channels, complex circulation zones, point bars off of these islands, certain times of day (fishermen know this) and with different tidal regimes.

The level of effort is not equal, spent a lot more time looking for fish in some areas than others, some fish did go south even though not on map and shown. Surprising that some radio tagged fish; swimming in an aquarium 2 weeks later. These batteries typically only last 10 days, and this particular fish was caught when it was up north, somehow it had migrated south a lot. Only sample a small fraction of recapture.

Complexity of fish behavior and hydrodynamics: dilemma of interpreting results. At this time USGS did not have dopplers. They are out now. So, went to DWR and ran the DSM2 simulation model to get model outputs on channel flows. The nodes can give predictions about the magnitude and direction of average channel velocity and hydrodynamic conditions in certain areas after releasing fish from a certain region.

(Al Giorgi): What is the range of values?

(Dave Answer): 80-90 cfs, down to 20-30cfs; channel velocities are 3 ft/sec.

(Mike Deas): What is the zone of influence of the South delta exports. How far does it reach up there and pull fish south. That Zone of Influence was in close extension to the pumping facilities. Probably also extends farther north, but do the export facilities have effect farther north and have an influence and move them into entrainment area. Perhaps barriers can help: do not know this yet. Fish once enter farther south, then fish are home free.

(Dave Answer): Showed on map a significant area.- basically the southern portion of the Delta. The Zone of Influence under medium conditions is unquestionably in south, but the central delta remains unknown. It could change from east to west with the through delta facility being proposed and Franks Tract alterations for water quality, we do not understand what happening to fish in interior portion of the Delta, but this is an important, question.

(Jim Anderson): Is there further analysis of these data to look at flow and fish movements and correlation. Are these fish moving as particles?

(Dave Answer): Yes. There is a CALFED Fellow to research this. People looking into RMA model. I provided all the raw data and are studying that. Fish do not act as particles, need an algorithm or function to plug into hydrodynamic models. Yes, but it is not a coordinated/focused effort; people are just doing a little here and there.

(Jim Anderson): Are there discussion about fish diversion systems at Georgiana Slough to keep fish out?

(Dave Answer): There were some acoustical attempts to keep fish out, deter them. We got mixed results.

Tried closing it off.

Not feasible because locals had a big concern about water quality.

(Dave Answer): Surface reflector wall posed before, but not really liked.

(John Williams): Back in 1900 Schoefield studies migration: nothing new about salmon migrating down through the South Delta.

(Dave Answer): Radio tag signals during the day really week (fish deeper in water column) and at night is much stronger (higher up): maybe one option is to do moveable barriers to take advantage of diurnal cycle

(Bruce Oppenheim): to get a perspective as this relates to the BO, - we're just looking at the listed species. The fish coming out of the San Joaquin River and going into the South Delta are fall-run Chinook (not listed); only ones listed down there are the steelhead of which there are very few. North, there are some in the Sacramento River of the ESA Chinook runs.

Late-fall Chinook appear to be good surrogates for winter-run and spring-run because migrate through delta and smolt over a long, protracted period. Good test fish. All foihs used in these studies were late-fall Chinook (not fall) except Mokelumne studies early on.

10:30 Break

11:00 - Water movement in the Delta - ***Jon Burau, USGS***
CANCELLED TALK AND SCHEDULE CHANGED (TIMES NOT VALID)

12:45 – Assessing Delta impacts to salmonids in the Biological Opinion - ***Bruce Oppenheim, NOAA Fisheries***

Bruce began with assumptions in the BO used to assess Delta impacts to salmonid species of concern:

- Salvage & loss are related to pumping rates
- DCC – closing the gates in December reduces losses in the Delta, winter-run enter the DCC in proportion to flow
- Delta survival – as exports increase direct & indirect survival decreases
- Exports – short-term export reductions have no population level effect
- Delta habitat is not favorable for rearing
- Surrogates – hatchery ;ate fall fish behave like yearling spring-run Chinook
- 8,500 pumping implemented after NEPA completed

These assumptions, for example, that salvage is positively correlated to pumping, works well for some species but not all. It is not apparent for winter-run and deltas smelt, but true for all others.

Delta Cross Channel close gates early; Usually Delta Cross Channel is closed in February and remain closed till near the end of May as per D-1461 criteria.

Some flexibility in DCC gate operation exists in the November through January period with the adaptive management process that involves the salmon decision tree and several CALFED workshops.

Delta hHabitat is not as good as used to be. Bruce McFarland has studied that and shown that the salmon are not rearing as in a typical estuary situation. They move through relatively quickly. Only may be useful as a rearing environment for salmon that come in as fry.

(Mike Deas): Does use of surrogates capture the movement of juvenile Chinook salmon through the Delta to Chipps Island and beyond.? How does increased pumping enter into the equation?

(Bruce Answer): Our "adaptive management" process does use surrogates. Assume that hatchery late-fall-run is similar to spring-run. A yearling life cycle and a fish that comes out as a younger fish (6 months, not a year) defines spring-run. Assume 8,500 will be implemented after NEPA has been done on it (i.e., it will be in the future and not right away).

(John Williams): Is the assumption in analysis that the size criteria work? (e.g., assume that can you differentiate the race of the fish based on their size at the delta pumps salvage).

(Bruce Answer): Yes, but we recognize that it doesn't always work. That is why we adjusted the incidental take limits in winter-run because of uncertainty in size criteria led to modifying the take limitations in 1993-1994.

(John Williams): A timing issue, winter-run come through when ready to migrate and if we reduce the exports for a few days, still get a tremendous amount of loss. That is, the fish will still come though and no matter what we do with the pumping rate, the fish will still show up. Slightly different relationship with other fish. However, for CALSIM models we have assumed that all fish species will behave similarly.

Returning to his prepared presentation, Bruce presented some general modeling results:

- Salvage and loss based on CALSIM results assumed that change in loss would be directly proportional to change in pumping when salmonids are present.
- Overall average increase in loss (taken from BA) 7%, 3%, and 6% for winter-run (12,201 fish total), spring-run (47,387 total), and steelhead (7,837 total), respectively (early consultation)

So, they started with CALSIM (Delta pumping rates) and converted those into the salvage rates of fish based on historical salvage rates, then expand salvage rate to a loss.. How they did this: calculations of salvage based on 10 years of data 1993-2003 where they looked at each month of the year under each water year scenario and under each of the 5 model runs. BO has 26 pages dedicated to explaining this and generating summary outputs. A lot of work to run these calculations. One person 3 months to do this.

Quantified it based on pumping rates and fish started to be present.

That is an increase over the baseline, from the additional pumping that occurs. Loss equates to mortality (not just entrainment)

(Jim Anderson): So you have 50,000 spring-run is that 50,000 total spring run loss. Numbers confuse me: what does it mean?

(Bruce Answer): That is an average umber of fish lost for the period. Percentages are above current baseline mortality.

Base case loss has got to be a lot more, so, yes.

That 10 years of historical salvage loss, represents 5 wet years, 3 normal, 2 dry, and one critical water year. Lacking a critical water year, which is a huge factor for winter-run so this may be a problem.

(Al Giorgi): For clarification, conceptually, this is an increase in loss of 7% so that is approx 12,000 additional juvenile fish removed because of project. When evaluate jeopardy, do they look at the 12,000 or the 12,000 plus the 100,000 on baseline.

(Bruce Answer): We only evaluate the 12,000 because we've already determined that the 100,000 is a non-jeopardy.

What percent is the 12,000 or 100,000 for all the fish? In the Delta? This is approximately 40,000 fish. This incremental difference is below the take levels, so we are not getting to numbers that would put us over the current take guidelines; not even at the half way mark. For steelhead, it could be, but do not know. Many assumptions about steelhead. We just do not know yet.

(Al Giorgi): At what point of the system do you index the population to develop this 2% estimate?

(Bruce Answer): As the fish enter the Delta, so it looks at the mortality between RBDD and Delta is approximately 60%. So the number of fish actually entering the Delta is the number from the JPE. The 60% river mortality is based on tagging studies, paired releases, CWT and try to update this info every 2 years or so. We did not get into the details of the JPE estimate in the BO. Talk about it in our assumptions, but that is it.

Modeling results continued...

- Particle Tracking Model (PTM) – using flows alone indicates no salmon escape alive!
- Simple Model used for indirect survival
- Assumed steelhead loss same as Chinook loss
- Assumed no new fish screens

- Fish agencies would adaptively manage south Delta barriers
- Current b2 & EWA water minimize take & provide some benefit upstream, but are not enough to determine a population level response

PTM -- used by DWR -- shows that no particles gets out if you put particles in the south delta they are all diverted through the agricultural diversions or though the project pumping facilities in the South Delta. These are neutral particles, not with salmon behavior, but still tells us where the water is going.

Tried to define the indirect mortality across the Delta integrating many studies of survival from Delta Cross Channel and Georgiana Slough. Simple model is back calculating what survival would be for fish gong through the Central Delta based on historical salvage. If have 1 fish in entrainment, how many fish would it take to get it there : approx 32 fish entering into the Delta Cross Channel, but the indirect mortality can be very large. We had to figure out the indirect mortality changes from the increase in pumping facilities.

There is no population index for this mortality, instead we have lots of different studies (CWT, PTM, radio tagging).

(Al Giorgi): There is no model calibrated to data?

(Bruce Answer): We calibrated our model with 3 conditions: low, medium, high exports, and then compare to the JPE of fish entering the delta. It compared pretty well. Showed the CVP was 32:1 and SWP 107:1 fish: entrained. Millions of fish diverted.

The loss (never calculated before this BO) for steelhead assumed to be the same as Chinook. This is a big leap of faith, because steelhead are much larger. Larger fish probably avoid predation, diff behavior, screened differently, etc. The effective screening rate for steelhead is an approximate 100% screening rate, whereas for Chinook salmon it is estimated at 85%. Large uncertainties exist here. Some studies initiated because of BO, but this opinion assumes that losses are the same. May overestimate steelhead loss.

(John Williams): Positive relationship is linear, correct? pump → entrainment→ loss.

(Bruce Answer): Yes, linear, but in real life it is not like that. Get clumps of fish and then lots of loss. But, on average, it is a linear relationship.

Also assume that no new fish screens will be built. DWR is considering alternatives which include fish screens at CCF gates and trying to bypass the huge Forebay, but still get water to the pumps. All of these alternatives nixed because the agencies could not fund a test facility to figure this out. We do not have fish screens at these faculties. They have louvers (behavioral devices) that move fish into bypass, and then held in tanks, and then trucked to release sites on the Sacramento and San Joaquin rivers.

Assumed that fish agencies would adaptively manage head of Old River barrier (HORB) and 3 agricultural rock barriers that are seasonally installed through summer to keep water levels up so that water can be siphoned for agricultural purposes. HORB is put in

the fall to help with adult migration and again in the spring to facilitate juvenile out migration. Constructed and torn down two times per year - spring and fall.

EWA and b2 fish curtailments have a minimum effect as compared to benefits upstream: trying for dual benefits by releasing water when fish are coming out of tributaries: helps juvenile migration as well as curtailing pumping effort.

Given the number of fish saved by use of EWA water, there is no apparent population level response.

(Jim Anderson): A model can always calculate a response unless below the precision level of a computer. What you saying is that there is a very small benefit, or there is no measurable benefit.

(Bruce Answer): Trying to say that the benefit is in reducing take, not in creating a positive population level response.

(Jim Lichatowich): Why are you worried about PTM results?

(Bruce Answer): The model is telling us what is happening with the water. Anything with the San Joaquin River is going to end up at the pumps. Chance that a steelhead makes it out is very, very poor. Pumping leads into the reverse flow problem in the south Delta. Most time when pumps run, water goes south and not towards the west which would give the fish a chance to get to the delta.

(Jim Lichatowich): This only applies to steelhead in San Joaquin River?

(Bruce Answer): For our list of fish, yes, but also applies to delta smelt. Poorer swimmers and behave more like particles

(John Williams): How big are the cells?

(Bruce Answer): Not sure.

(John Williams): At some point the cells get larger and larger.

(Bruce Answer): Delta Cross Channel requirements are to close February through about May 20. Adaptively manage for November and December months when winter-run running through. Decision to close the gates in November and December are based on AM process and decision tree. Based on real-time monitoring at Knights Landing (rotary screw trap), Sacramento River (MWT), and Chipps Island (MWT). The Data Assessment Team (DAT) looks at these data weekly. There are certain data (e.g., number of fish migrating down the river) that trigger a response. First with Delta Cross Channel closures and then export curtailments. Usually start early in the year with spring-run and then winter-run and steelhead. By March DAT is taking a strong look at export curtailments because of smelt. Alice Low (DFG) came up with a positive correlation with

loss of winter-run at the salvage and gate closures. Because of this we try to get gates closed in Dec. If it's a dry year and no winter-run in system, won't close gates. Fish have to be in system first. Water quality is a concern in the fall. Delta Cross Channel flows improves water quality when a lot of salt in Central Delta, so it is good to open the Delta Cross Channel gates in the fall for water quality reasons.

Delta Cross Channel gate operations:- summary

- D-1641 requires closure Feb- April, and part of May for salmon outmigration.
- Decision Tree based on real-time monitoring.
- Earlier closures benefit winter-run juveniles.
- Water quality a concern in the fall.
- Never more than a 1% increase in proportion of Sacramento River flow diverted through DCC when salmonids are present.

Approximately 20-50% of flow is diverted through the Delta Cross Channel but this varies month to month. Given this flow split, 50% of winter-run would remain in the Sacramento River and 70-80% of spring-run and steelhead would remain in Sacramento River. In February and March, we have the E/I ratio that kicks in and the projects can export 65 percent of the inflow through January but no more than 35% from February 1 though June. Lower exports can occur at same time the gates are closed. The closure creates extra protection for the protected fish and allows them to stay in Sacramento River. That management is in place right now. The proportion of fish that does not stay in the river (20-30%.) - their ultimate fate is the Central Delta where they are exposed to indirect mortality, which can be substantial. Fish can either migrate out the San Joaquin River, other sloughs, or be entrained at fish facilities. We do have a simple model to calculate this mortality at 4-40% to be entrained. Keep in mind that some fish will be killed naturally in the Central Delta. We are trying to determine the incremental difference due to project operations?

Data analyses used for estimating the effects of DCC gate operation on juvenile salmon survival included:

- Newman & Rice (1997)
- Newman (2000)
- Brandes & McLain (2001)
- Vogel (2003)
- Horn & Blake (2004)
- FWS annual reports (2001-2004)

All provide the basis for export reductions to protect juvenile salmonids in the Delta

In the future condition, we see an increase in the loss at the pumps, but we're seeing a loss at the pumps, but not an increase in the water diverted. Would not expect the same proportional increase in indirect vs. direct loss at the pumps. Probably indirect losses could continue to occur even with export curtailments.

Conclusion: relatively short (a few days) export curtailments does not do too much for salmon (short-term at least)

(Jim Anderson): Would like to get more info about Georgiana Slough. Seems to me that more fish go through Georgiana Slough than proportional flow volume (pulled into left bank) when exposed to tides. What is the estimate of fish that go into the inner Delta through that pathway?

(Bruce Answer): We do not know the fish split, and that is something that came out of the Delta Action 8 workshop. Want to quantify the "fish split" or quantify how many fish go into that. We need to know that baseline first.

(Jim Anderson): That is kind of the baseline and what we're talking about that is above that. Therefore, there is no estimate of what the fish will do with new scenario. It could be that it is better to keep the Delta Cross Channel open so that there is less going through Georgiana Slough. Just do not know

(Bruce Answer): Yes, right.

The studies listed and used in the BO show that survival in Central Delta is less than in the mainstem: these studies are what were are basing our export reductions on: keep fish out of Delta and get better survival.

(John Williams): Horn & Blake 2004 (does not know where published, perhaps USGS report?): tidal influence and hydrodynamics, adds a piece of the puzzle, not a survival estimate. Where does the Freeport export project fit in the mix?

(Bruce Answer): Freeport project lumped into Delta effects. Added in to modeling. Both the Freeport project and the State-federal canal Intertie cannot be isolated in the modeling. Both contribute to the level of demand in the future 2020 or 2030 conditions. It is unfortunate that we cannot separate them out to determine what percent of take is due to the Freeport project and what is due to Intertie.

The conclusions of the Freeport Project analysis can be summarized as:

- There will be a 286 cfs screened diversion on the Sac River near Freeport.
- Higher diversions in dry years w/Freeport project.
- Maximum of 0.2% of average critical year flow in Sacramento R. (EBMUD would divert 0.1% out of basin).
- No effect on Sacramento River juveniles due to small amount diverted from migratory corridor and location.
- Mokelumne R. steelhead and salmon may be delayed due to less flow in fall.

The Freeport Project is a shared between East Bay MUD and Sacramento County. Max amount to be diverted is 0.2% of critical year flow would move through the project, and half of that would go to EBMUD. Still a very small percent overall, so the BO concludes that it is not a problem. Do not need weirs around diversion, very little impact, a fish screen will be installed. Construction and screen effects are dealt with in a separate BO (The OCAP BO only deals with operations.) Do not have to get into terrestrial

endangered species. We treat terrestrial species separately from aquatic species of concern.

There is some effect from Freeport Project in that the future condition shows more water from Mokelumne and less for attract adult steelhead and fall-run Chinook. This creates added potential delay for fish migration, but probably not significant.

Export Pumping impacts - summary:

- Losses higher in future, but less than the 2% incidental take level.
- Indirect Delta effects will increase.
- Combined direct & indirect loss may reach population level impacts.
- Take will increase at unscreened Rock Slough.

On average, we found that an increase on the species of concern is about 10-12% over the baseline. Losses for the future are still less than the population-level incidental take limits deemed acceptable. Indirect delta effects will increase and this is potentially significant. When combined with direct effects may have pop level impacts.

(Kenny Rose): If using the 2% incremental take limit as a yardstick: what is that based on? Not historical info hopefully, but on what is acceptable for the population level recovery. What is the biological basis for 2%.

(Bruce Answer): The take limit is considered in context of all other components of Cent Valley projects. Considering all the other losses, the 2% was deemed to be a significant (1% at first, but modified because of problems with the size criteria system of assigning fish to race. Exceeding the limit triggered re-consultation. Back in 1993, they had onlyt a few hundred adults and very low JPE and were trying to get take as low as they could without influencing operations of the faculties. The project side of how they could do things, which was taken into account of what was feasible and what could be afforded. In a sense, it is not based on historical levels, but what is feasible and looks to be a small number. This number is calculated every year and it increases as the species recovers – at least for winter Chinook. Spring-run and steelhead take limits are static and do not grow as pops increase which may be a problem.

Rock Slough was the first screened diversion in Central Valley, screen did not work, FWS required them to screen it, The screen built up with debris, and failed to work. FWS then removed it and the intake has never been re-screened. Owned by Bureau and operated by Contra Costa Water District with a capacity of 300-400 cfs. It is mandated in CVPIA to be screened, but problem in land acquisition and the size of the screen. Because of it is tidally influenced they need large screen to get fish past it. Or do what we do now at the State and Federal pumps (i.e., collect and haul fish). The bottom line is that it never went in. Also there is not a significant portion of population of fish in there. Most Contra Costa Water Distric water is diverted at a screened facility on Old River. The District is trying to minimize Rock Slough diversion and pumping more through the screened diversion. Hopefully, this will continue into the future. Still some take, although deemed insignificant, not even 1% but still has to be added into the total project take for BO analysis because considered part of CVP project.

Population Level Response (uses CALSIM and assumed predation rate): Use JPE for winter-run. Spring-run has two life history patterns (yearling and younger fish), but this really only applies to yearlings so not the best. For steelheads, we used an estimate from FWS where compared clipped with non-clipped fish at Chipps Island. In most cases the pop changes are very small, except for steelhead, which may be overestimated anyhow.

(Kenny Rose): But these % do not include indirect mortality, which could drastically change things.

(Jim Lichatowich): What is JPE? how do you calculate it?

(Bruce Answer): In the JPE calculation we switched from adult count at RBDD to carcass surveys. We estimate from adults the number of juveniles and then calculate a projected loss and allowable level of entrainment. Same index number for previous calculations for fish arrivals at delta. Yes, we're being consistent.

(John Williams): Try to add in the indirect losses: what percent of water is diverted in winter months? 20% of water perhaps is diverted; percent loss of exports over percent of water that is agriculturally driven. Make a guess about where we are: in the middle, may have some way of testing things. Now things fall below the line, so that incremental effects from pumping will not be too bad. The increase in effects is linear and additive. He questions how well that assumption holds.

(Bruce Answer): We haven't gone back and calibrated that. Something we need to do.

CVP Intertie

- Increases CVP pumping from 4,200 cfs to maximum 4,600 cfs.
- Lowers water elevations in South Delta and at Tracy fish facility.

This is a project that cannot be separated out in CALSIM so had to look at it in its entirety. Most pumping is in winter months. Direct losses increase in both formal and early consultation.

Mainly interested in study 3 (baseline) and study 5 (future condition) For winter-run 12,201 fish. This is similar to other numbers shown earlier. These are direct losses with the assumptions in place.

Other Delta effects:

- X2 change is minor.
- E/I ratio some change, response unclear.
- Reverse flows more probable.
- Increased summer-time pumping to make up for EWA cuts in winter and due to increase in water transfers from North of South of Delta.

X2 relationship with survival has been evaluated but not really established. Assuming that X2 changes that are occurring are relatively minor and not much of an effect on salmonids. Any X2 movement westward is assumed to be beneficial to salmon. Probably

represents relationship with river outflow more than it is a relationship with salmon and X2. Increase river outflow to delta and help salmon (as per Wim Kimmerer)

E/I ratio the current 35/65 percent criteria intended to remain in place, 35%in winter time; 65% in summer. There have been recent changes, but all E/I rations are still below currently required levels.

Delta outflow decreases by 2% on average and coming from excess water available during the winter months. Resulting consequences reduce the suitability of habitat in the Delta for salmonids. The BO considers this a relatively small reduction and not enough to reduce the value of that habitat. Some Delta habitat is considered peripheral, so had to see if decreases in outflow changes value.

Net Future Conditions:

- CVP exports less SOD (due to Trinity & 2020 LOD, i.e. American R).
- SWP exports more.
- Article 21 water increases significantly.
- Amount of b2 and EWA water increases in order to compensate for 8500 increase.

Modeling outputs also show that CVP exports less. In other words, after all contracts are filled and CVP exports made, extra water remains in the system.

Conclusion: To compensate for increased pumping under future scenarios, EWA and b2 must also increase.

(John Williams): But yesterday you said that it doesn't do any good, so why increase?

(Bruce Answer): That's not his decision.

Article 21 Bureau should be able to explain: extract more water from the system? Excess capacity in the winter. If there is no longer a demand and excess water in the system DWR can pump more and make this available to contractors south of the delta. Allows for use of excess water. Use of Article 21 water has grown considerably. Reductions in diversions are problematic when have pumping for Article 21 water.

San Joaquin River Impacts

- Stanislaus R used to control water quality.
- Dissolved oxygen (DO) problem in fall.
- High ag. salt & contaminant load in San Joaquin River.
- Head of Old River Barrier operations increase juvenile salmon survival.
- Most of flow goes to pumps.
- Friant Dam not part of OCAP consultation.

DO problem (<5 mg) mainly in the fall; this happens most years unless wet year with enough flow. Also prob. with high agriculture contaminant loading. Salt and contaminants flowing in from the San Joaquin River. Trying to compensate by installing

the Head of Old River Barrier (HORB) to keep fish in the mainstem San Joaquin River and away from the pumps.

Friant Dam not considered part of OCAP consultation. The river below Friant is dry most the time so salmon and steelhead cannot get up to this point. Chinook have gone to Friant dam when conditions are wet and good (this is for fall-run, not considered in this BO, but interesting aside that the fish do and can utilize this habitat). Concern is that the steelhead could utilize the area below Friant dam if they could access it and were allowed fish passage.

Tracy Fish Facility (CVP)

- Direct losses do not account for cleaning operations.
- Assumed pre-screen loss rate, never documented.
- 50 year old facility in need of repairs.
- Design criteria not being met.

Bruce showed a photo of lots of dead fish and described it as a good day for the fish bucket. He explained the Collection, Handle, Truck, and Release (CHTR) efforts. This program and its conditions are not good. When get out the other end of the CHTR pipe, there is lots of predation at the release site. Not quantified, so underestimate loss. Also underestimate Tracy losses from cleaning because they lift the louvers to clean them so 20% of time part of the water is unscreened. Then it is reduced another 9-10% of time when water is unscreened and we are further underestimating fish loss at Tracy. Also pre-screen losses and assumptions at Tracy never tested: based on another facility that does not have the tidal complications (not analogous but best assumption should do). Also Tracy very old. We have never quantified amount of loss of overall louver efficiency: tested in 1995 was 45% but original design efficiency was 85-90%. No longer meeting the criteria set by the State Water Board for bypass ratios, sweeping velocities for screens, etc.

The more pumping we do at the canal, the lower the elevations in the fish facility. Can get so low that cannot operate the fish facility and have to shut it down. Speculated that this is due to the barriers and increased SWP pumping. What fraction of smolt encounters the Tracy fish screens? Less here than at the SWP.

Number of fish/acre feet varies. It is not the same at both facilities. CVP traditionally had a higher salvage rate, but it has now shifted to SWP. Depends on timing, year.

(John Williams): But averaged out over time, it seems pretty equivalent.

(Bruce Answer): Plotted over time likely very different; disagree; SWP is more recent whereas Tracy goes back to 1950s.

Tracy Fish Facility Operations:

- Current bypass ratios do not meet state board criteria.
- Future surface water elevations will be lower due to barriers and pumping.

- Sometimes not enough water to effectively operate the fish salvage.

Skinner Fish Facility (SWP) more modern louvered fish facility. Loss rate varies with season and hydrology. Problems with debris loading and constrained by the water quality standards and outflow requirements and low flows in the San Joaquin R.
Skinner Fish Facility:

- Loss rate is unknown for steelhead.
- Loss varies more with seasonal fish migrations & hydrology than pumping.
- Future increases in pumping depend on capacity.

Clifton Court Forebay (CCFB) is the huge reservoir located at the very end of the Forebay. Tracy is right off Old River and has no Forebay. At times 10-15K ft/sec (equal to entire flow of Sacramento River) enters the Forebay during high tide through the gates. There is s resident predatory fish population open to the delta. 10 studies on predation: it is a compromise to come up with 75% loss : ranged from 63%-99$ between 1976-93. We may be underestimating predation by as much as 10%.
CCFB:

- Steelhead loss rate is unknown.
- Predation rates extremely high
- Too expensive to screen.

For every one fish salvaged, three would be lost indirectly. Yes, there is pre-screened loss, predation, CHTR, screen. This source of mortality is totally different from Tracy facility and it contributes most of the loss for CCFB. Need to account for loss that occurs during cleaning. The terms and conditions of BO suggest including and quantifying cleaning losses.

From the BO, Bruce provided a Summary of Delta effects (see table):

Summary of Delta Effects

Delta Effects (all juveniles)	Winter-run	Spring-run	Steelhead
CVP/SWP Pumps, juvenile loss as a percentage of JPE (future formal and early actions)*	0.76 (dry) 0.58 (wet)	1.06 (dry) 3.13 (wet)	5.14 (dry) 5.34 (wet)
CVP/SWP Pumps, adults (3.5% of salvage)	N/A	N/A	1% adult
Indirect mortality increase due to pumping *	1-16[1]%	1-16%	1-16%
SMSCG (adults delayed 10-40 hrs)	U/N	U/N	U/N
Rock Slough mortality proportion of JPE *	0.01%	0.03%	0.56%
Long-term Contracts, juvenile entrainment *	< 2%	< 2%	~3.5%
Combined juvenile mortality for most years (Upstream + Delta effects) *	**5-22%**	**10-25%**	**12.5-27.5%**

Breakdown of wet vs. dry years very different --
with steelhead we have adults that live to spawn again and out of the salvaged fish 3.5% of salvaged steelhead are adults. That is, approximately 1% of pop taken out every year. That could be critical if it is that part of the population that is going to spawn again.

(Kenny Rose): Percent, percent what is that?

(Bruce Answer): This is the change of the total population.

(Kenny Rose): So the incremental increase of the loss to the population according to baseline, so the baseline could have been any loss?

(Bruce Answer): Yes, and the range is really dependent on the indirect mortality, which is probably the larges factor in there.
All percents use the JPE except the CVP/SWP Pumps, which deals with adults.

(Kenny Rose): To add them up, we need to have them based on the same denominator, so when we go to the upstream effect. What is that number? The percent of upstream does not compare to the pump percents because there is a difference in locality.

Upstream mortality could be way more than downstream. Therefore, pumps could be a much larger percentage if we included upstream. It would at least get things to change.

It may not be as accurate portrayal of the impacts because they are percentages of different things. If we all used JPE in denominator then need to readjust percent to be able to add the others to it.

(Jim Lichatowich): Percents of the population that enters the Delta? Population levels with favorable ocean conditions contributing this. Therefore, with poor ocean conditions. Those percentages will go way up because the population will be smaller. Is that right?

(Bruce Answer): Yes that should be right.

(John Williams): Well, the JPE varies from year to year, so if the JPE goes down what will happen to the percentages?

(Bruce Answer): Only winter-run has JPE, so the other ones hold constant and no relationship to ocean conditions (low pops will lead to higher percents). Assuming that these incremental impacts will be smaller, not larger, for the JPE, assuming that the ratio of dry to wet years remains the same (or, according to BO, maybe doesn't matter because wet or dry year just effects pumping facilities at the fish faciliites).

(John Williams): If indirect mortality increases, how is that related to E/I ratio? Would indirect effects be less?

(Bruce Answer): Expect E/I to be higher in wet years. More flow split in Central Valley, more fish in Central Delta than in dry year.

When you run the calculations, you are applying some proportion of the split as the pop moves down?

Only did that and the indirect mortality to the simple model. Did not apply it to anything else.

(Jim Lichatowich): During its break out sessions and discussion yesterday, some questions by the panel emerged about the charts in the BO. In the absence of available info to quantify impacts, were reasonable scenarios developed? Also, what do you mean by scenarios? Please point us to an example.

(Bruce Answer): Surrogate late fall fish for spring-run; worst-case vs. best case; comparing Columbia River and the responses from different species. Did not look at a scenario of consecutive drought years? Did look at how often they would occur, but did not compare that to another watershed outside of the CV. For example, what happens if have 3 bad years? That would be a scenario that did not explicitly explore. No, we would just "adaptively manage" the system to minimize the impacts.

1400 - Public input

Did the BO miss important, topics, documents or analyses?

Public Speaker 1: Tina Swanson, Senior Scientist, Bay Institute

Tina agreed to limit her comments to the science that went into BO.

Three really big failures in this process began with the BA and the Bureau, but were then perpetuated by collaborative information efforts and the BO by NOAA Fisheries. The three key failures to use best science in this exercise are.

1. Failure to consider known and predicted effects global climate change on future hydrology in the action area.

Bureau's proposed action not only fails to consider the known and predicted effects of climate change on hydrology, their analyses are based on historical hydrology – conditions that we (and they) know will be different than the long-term future planned for the action.

Known and already measurable effects include: increased air (and water) temps, earlier snowmelt (which has already been measured in this system).

Because of this, their analyses is of their proposed operations and the effects of those proposed ops on stream flows and water temps is (knowingly) inaccurate and, based on what we do know about the effects of climate change, almost certainly underestimate the magnitude and frequency of reservoir storage and stream flow conditions they say will adversely affect salmonids, including elevated water temps, extreme flow fluctuations (flood control releases), and reduced carryover storage.

Tina said that she understands that 2004 was the cut off date for info for this document, but there is growing understanding and consensus on climate change impacts on CV system. Impacts will be significant. Given that this is what we're managing and climate change should be considered in this evaluation.

Suggestions and encouragement to incorporate likely and predicted effects of climate change have been made to Bureau and NOAA.

She acknowledged that the BO information gathering and document development been a transparent process that has allowed many stakeholder opportunities to see science used and preliminary results. However, this process is not best available science.

Problem in two respects;
This information needs to be available to Bureau in terms of accurately predicting what to do with what water they will have

Also what will impacts be on the listed species, based on future conditions?

Failure that the data used were old, historical data not looking forward.

Inaccurately estimated and predicted impacts on species and that prediction is bias and that not included in earlier snow melt, more floods, flow fluctuations, reductions in carryover, the Bureau in analysis of BA have underestimated impacts. NOAA by not picking u p on this made same mistake. NOAA based overall analysis on a couple outputs of the CALSIM model: storage, fluxes, and spring releases. These are the same things that will be different in future hydrologic conditions. There are serious errors resulting from not using best science.

BO and BA proposed operations perhaps flawed have higher mortality in-stream and in delta, increased adverse hydrologic conditions, sometimes spring flows. Clearly, though, many documents from all of the BO agencies have identified that there will be negative impacts form future operations on species.

For most part, these impacts are identified individually, but very often the incremental increase is portrayed and described in ways that are very hard to interpret:

(2) Second major absence: No attempt to incorporate this information in this very complex system to credibly to integrate and assimilate these adverse impacts on a yearly basis, or more importantly for recovery and species extinction risk, and run out these incremental changes in mortality over multiple generations. No attempts to use a Multiple life cycle quantitative models and to plug in the few models can calculate. That is a failing.

Even with this flawed analysis, the Bureau's and NOAA Fisheries' analyses identify numerous instances where proposed future operations (as compared to current operations) will have greater negative impacts on salmonids (higher mortality) and adversely modify their habitat. However, neither party has adequately evaluated the individual or cumulative impacts of those changes on long-term population viability or extinction risk (supposedly the criteria for evaluating jeopardy and recovery) using any of the numerous salmonid life cycle models. Absence of a model developed specifically for CV salmonids does not preclude use of surrogate models, many of which exist. Inability to precisely quantify all life-stage dependent mortality rates (other than those now identified in the BO) does not preclude broad analyses (e.g., estimating bookends on long-term population status). By failing to included this well-known, documented scientific tool and analytical approach, neither the Bureaus' not NOAA Fisheries analysis has any basis upon which to draw conclusions regarding the effects of the proposed action.

(***3) Last thing: how NOAA fisheries is using accepted and Evaluation Criteria as the basis for evaluating extinction risk and effects of project operation on salmon populations.*** There is overemphasis on effects on abundance and too little equally important criteria: distributions and diversity. This is particularly true where NOAA has discounted important impacts of project operations. Example for spring-run unlike winter-run tends to have multi populations, three separate populations in tenuous streams. These populations are close to extirpated from a large part of habitat by RBDD. Currently few fish there, so conclusion that spring-run will not be impacted because few fish are

there. This logic is circular in a negative way. It is a flawed analysis of potential impacts of the RBBD on two key criteria: distribution and continuing to support populations in other streams, as well as diversity.

Both USBR and NOAA Fisheries have failed to appropriately incorporate NOAA's viable salmonid population criteria into their analyses. The agencies have both placed too much emphasis on the abundance criteria and discounted clear effects of the proposed action on other equally important criteria, most notably distribution and diversity. This is true for both consideration of the ESUs and for populations within the ESUs. Example: Winter run – known spawning habitat reduced by large fraction with the upstream shift of temperature compliance point that reduces distribution within the population and ESU – and likely genetic diversity. Spring run – more extreme, with proposed (and current) operations effectively extirpating or greatly limiting population on four streams (Sac, Clear, Battle, Begum).

Same is true of winter-run. Currently restricted to 1 river. Future operations further restrict that and viability does not only refer to viability of pops but also diversity within.

Public Speaker 2: John Ruben, CVP Export Interests

(1) Info presented in presentation is limited, it is not complete: discussion of the Delta Cross Channel is s good example. Heard of the gates being open and the trends for fish when the gates are open. Did not hear about the regulation that control the gates and the effects that the gates have on fish movement.

Lack of discussion of operating agreements and constraints for CVP and SWP ; see pages 8-12

For CVP it is the CVPI and b2 water agreements.
Biological information is not the only criteria. Biological criteria are a small part of the picture of the total operations that are being evaluated. Keep in mind the whole picture.

Second point
(2) Seems as though a lot of questions from the panel helped to develop an understanding of the document and its context in which the BO was prepared, but your scope is much more narrow. Reiterate the scope: scope is to evaluate the science and not the BO science. For example, the first presentation yesterday, which addressed legal questions about BO process, and many of these Panel questions are not relevant to the Panel charge to review the science. Stay focused on charge.

15:00 – The next steps – *Randy Brown, CBDA Science Program*

Next Steps

- Panel will convene this afternoon, Bruce can stick around.
- Hand out assignments.
- Panel Report due December 15.

- 2 drafts due: Randy will look at panel review the first time for editorial comments and typos, but will not comment on content and conclusion.

Then NOAA gets to look it over; and determine that the BO was interpreted correctly, but will not comment on recommendations and conclusions. NOAA's comments will be returned directly to the panel with a cc to Randy Brown.

The final report will be posted on the CALFED Science Program website by Dec 15, 2005.

Some time in January, the panel chair will present the panel report to the public and the rationale for the conclusion and recommendations. This will be an open meeting and will be noticed on the CALFED website.

15:10 – Adjourn

15:10 – 1700 – Panel meets in executive session