

The following is a summary of remarks that I will make to the NRC Committee. A copy of the powerpoint slides will also be left with Committee staff.

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Testimony Before the National Research Council Committee on Sustainable Water and Environmental Management in the California Bay-Delta

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Introduction

Good afternoon members of the National Research Council (NRC) Committee on Sustainable Water and Environmental Management in the California Bay-Delta. I have been asked to appear before you today by NRC staff and to offer my perspectives on the task that you have so graciously decided to take on.

At the outset, it is important for the Committee to understand that I speak to you today wearing essentially two hats. The first hat is that of the former Chair of the CALFED Independent Science Board. This board, which will be reconstituted sometime this year, had three responsibilities: providing oversight of science used to inform policy discussions for the Delta, providing insight into resolving critical scientific uncertainties in the Delta, and providing foresight to help anticipate future technical and scientific challenges. Service on this board afforded me the opportunity to evaluate science activities, in their broadest sense, within the Delta.

My second hat is that of a member of the NRC Committee on Endangered and Threatened Fishes in the Klamath River Basin. I served on this committee, along with Bob Huggett, the chair of your committee, and Peter Moyle, whom you will hear from later this week. The parallels between the events that made up the Klamath crisis and those that make up the current Delta crisis are striking.

Despite the multiple hats, it is vitally important that the Committee understand that I am speaking only for myself as an independent academic. I am not representing the university, CALFED Science, or any other organization.

My testimony today will cover three general topics, focused principally on your charge. The first relates concerns that I have, based on my Klamath experience, over the use of the National Research Council as a review body for Biological Opinions. The second examines the overall sustainability of water and environmental resource management in the Delta and its tributaries as a context for specific review of Reasonable and Prudent Alternatives (RPAs) for preventing extinction of key species. Finally, I will offer some observations about how the Committee's extended labors over the next two years can perhaps make a lasting impact on policies and

practices in the Delta. What I will not do today is focus on the RPAs specifically. You will hear plenty about this over the next few days. Rather, my remarks are intended to be context for those discussions.

Concerns Based on the Klamath NRC Review

First and foremost, it is important to acknowledge the obvious: you are here, much as the Klamath committee was, for political reasons. The added layer of politics is not bothersome to me since the NRC is usually called in when there is a complex mix of scientific uncertainties that affect major policy decisions. The NRC takes on tough issues like this all the time and serves a valuable function in that regard.

Additionally, we should always welcome scientific review. I can confidently state that the culture of peer-review within the Bay-Delta system has become exceptionally strong and, thanks to the hard work of many, including some members of your committee. There is little to fear from additional review and in principle it should be, and is, welcomed.

What is troubling is the precedent that the Klamath review set and whether or not NRC committees are the right vehicle for review of controversial BiOps. We can all agree that no agency or court of law is required to accept your recommendations. Your work is advisory only. Yet political and legal realities insure that this review—of the RPAs in particular--will have a powerful effect on project operations and the course of multiple lawsuits that are either currently before the courts or, after release of your results, will almost certainly appear before the courts.

As you well know, you are being asked to review RPAs and propose new ones based on the best available science. But RPAs are not developed in the manner that your committee is being asked to. They involve years of back-and-forth between agencies, stakeholders and the scientific community and as such, are created through a mix of science, professional judgment and attempts to balance the needs of the species against societal needs within an urgent time-frame that does not allow for greatly extended research. Your charge and the nature of NRC reviews do not permit the incorporation of that kind of complexity, particularly within the time constraints that you are operating under. Therefore, the RPAs you may well suggest will not be developed under the same criteria and standards as those of the Endangered Species Act (ESA), yet they have a high probability of being applied as such, providing the agencies have the authority to carry them out. This creates an interesting problem that the experts on your committee can advise you on.

For better or for worse, the second aspect of your charge is undeniably open-ended and will require some refinements on the part of your committee. As one who worries a lot about how science can best inform policy and management, I would encourage you to examine the issue of when it is appropriate to call for NRC review of BiOps in this system and perhaps around the country. If the NRC must review every controversial BiOp in the country, the nation's high level expertise in such matters will quickly become overwhelmed and distracted, and the NRC will require a larger building. This might well be used as a guide for consideration by federal

agencies, Congress and the NRC so that the precedent set by these reviews—the Klamath and yours—is done in a more equitable manner and does not set arbitrary standards of review that exceed those prescribed by current law.

Having expressed my concerns let me again make it clear: the emerging scientific culture of the Delta is one of peer-review and we all benefit from it. As I will note in the latter part of my talk, there is great potential for this review to advance policy in the Delta and to support a number of on-going initiatives. You are welcome here and are not, as has been quoted by me in a newspaper article, a “side show”.

Unpleasant Realities to Consider

The title of your committee—*Sustainable Water and Environmental Management in the Bay-Delta*—has within it the second most widely used, but perhaps poorly articulated concept in the Bay-Delta system: Sustainability (the other is Adaptive Management). Whether it is the Department of Water Resources, Association of California Water Agencies, Metropolitan Water District, American Rivers, or Restore the Delta, the phrase “sustainable water and environmental management” appears often in everyone’s discourse. Indeed, just this last fall the governor signed landmark legislation that codifies in policy and law for the first time that the Delta shall be managed for sustainability with the co-equal objectives of reliable water supply and healthy ecosystems.

Despite its widespread incorporation into Delta vernacular, no two sustainables appear to be alike. In reality, we treat the definition of sustainability like a topic not to be discussed in polite company. We nod our heads in approval when the term is mentioned, but few ask, with any precision, what sustainability means for the Delta and whether actions that we are doing now or plan to do in the future meet anyone’s criteria for sustainability. It is the elephant in the room that no one really wants to acknowledge.

Your committee can have a major impact here. I would encourage the Committee at the outset to clearly articulate their definition of sustainable water and environmental management. I say this for a simple reason. Your definition of sustainability can form a powerful underpinning or context for your recommendations. That is, if you choose alternative RPAs or support those selected by the agencies, it will be implicit, if not explicit, that they meet your criteria for sustainable management. Recommendations that you formulate as part of your second charge will, if carried out, presumably create or lead to sustainable management. Alternatively, if RPAs or management actions don’t meet your criteria for sustainability, then it is of high value for your committee to point this out.

To perhaps help with some of your considerations about sustainability in water and environmental management actions in the Delta, and to introduce the Delta to members of your committee who may be less familiar with it, I want to briefly review some of the status and trends of this system. The basis of this summary is embedded in three recent publications released by the Public Policy Institute of

California. Two of these publications—*Envisioning Futures for the Sacramento-San Joaquin Delta* and *Comparing Futures for the Sacramento-San Joaquin Delta*—are a collaboration between PPIC and UC Davis, just combined as a book published by the University of California Press. The third—*California Water Myths*—includes additional collaborators from Stanford University, Hastings School of Law, and UC Riverside. I have also added some recent analyses conducted by Bill Fleenor, a member of our team at UC Davis. Additionally, I recommend that you review The State of Bay-Delta Science 2008 put out by the CALFED Science Program.

Ultimately, sustainable environmental management will involve creating conditions suitable to meet the life history strategies of native or desirable species. This is probably as close as you get to first principles in ecosystem management and lies at the root of the designation and conservation of critical habitat as the foundation of recovery efforts.

Herein lies a fundamental unpleasantness that cannot be ignored, but often is ignored in deliberations regarding the Delta. The historical conditions of the Delta, in terms of its landscape, hydrology, and ecology, are irreversibly changed. We are, in effect, managing emerging, novel ecosystems that are changing rapidly (something that many will argue the ESA is ill-equipped to handle). This pace of change often exceeds the ability of our scientific and regulatory institutions to keep up, creating considerable uncertainties and complexities.

To illustrate and to frame the question about how sustainable current or proposed management practices are, consider the following changes that have occurred in the Delta:

Landscape Change. Prior to the Gold Rush, the Delta was a 700,000-acre dynamic mosaic of brackish and freshwater tidal marsh fed by large floodplain rivers. Depending upon how estimates are developed, 90-95% of this original habitat has been reclaimed for agricultural production. Today, the Delta's estuarine ecosystem consists principally of a network of narrow, deep, rock-lined channels with remnant, disconnected patches of marsh and floodplain habitat. Due to subsidence of the former marsh plains, the bulk of the Delta is no longer at or near sea level, precluding the possibility of restoring large areas of historic marsh habitat.

Changes in Flow Volumes. The scope and scale of landscape change has been matched by the transformation of the hydrology of the Delta. As you will undoubtedly hear from many individuals in the next few days, it is all about the changes in hydrology of the Delta. That is a gross oversimplification and routinely misses the fact that loss of physical habitat is likely just as important, but it is the component of the ecosystem service that the Delta provides that is most fought over. For an estuarine system, these changes have been profound at all scales.

We often forget when debating changes in project operations that we are really arguing around the margins. Abstractions upstream of the Delta that are used consumptively are on the order of 25% of annual flow on the Sacramento and 50%

on the San Joaquin. The amount of water exported from the Delta has increased roughly fourfold since the 1960s, from an annual average of around 1.4 million acre-feet (MAF) to 5.1 MAF. Over the last 20 years, we have been diverting and consuming approximately half of the unimpaired flow, with direct exports from the Delta accounting for about one fifth of unimpaired flow.

It is important to note that this does not account for all of the water in the system. Like many places in the west, we are currently mining groundwater. In the Tulare Basin in particular, the US Geological Survey has recently reported an overdraft of nearly 70 MAF of water since the 1960s. Today, the exports from the Delta are augmented by roughly 2 to 2.5 MAF of annual groundwater mining: water that is not restored during wet periods.

Changes in Flow Regime. Reverting back to first principles, the Natural Flow Regime Paradigm that LeRoy Poff and others promulgated back in the 1990s argued persuasively that volume of water, while important, was not the only criteria for measuring impairment. Timing, duration, magnitude, direction (in estuaries), salinity gradients (again, in estuaries) are all important since the life history strategies of many aquatic and riparian organisms are tied to flow cues and the habitat that flow regimes create.

Timing of inflow is, by all measures, significantly changed. The San Joaquin has lost what was historically the most reliable element of its hydrology: the spring snowmelt pulse. And inflows from the Sacramento have lost much of its most reliable hydrologic feature, the winter flood pulse.

Variability, a necessary attribute in so many of these systems, has been engineered out. Take for example the location of X2, a salinity standard that you will hear about in great detail in the next few days. Our modeling suggests that under unimpaired flows, X2 shifted location a great deal on a seasonal and interannual basis, moving back and forth between a geographic region just west of Rio Vista and just east of the Carquinez Straits. However, under today's flow regime it has shifted eastward into the Delta and, most importantly, is a more static feature. Salinity variations and complex gradients are a natural phenomenon of estuaries. Today's estuary is both saltier in its western part and doesn't vary much. This is one example, and you will hear many from Peter Moyle, of how we have homogenized this system.

But in the process of homogenizing it, we have created some bizarre features that may well be producing some poorly understood, but very significant selection pressures. We have, through reductions in flows on the San Joaquin and increases in export pumping, created reverse flows. And to accompany those reverse flows, we have created inverted salinity gradients. Much as we tiptoe around this issue, reverse flows and inverted salinity gradients, along with highly effective sinks for adult, juvenile and larval fish (the pumps) are not common features of estuaries, at least the ones I am familiar with.

Invasive Species. Finally, as you will hear plenty more about in the coming days ahead, this is a highly invaded estuary, with a mix of non-native species that are ecosystem engineers and other species that have dramatically altered food webs. All of these invasives, it turns out, are particularly well-adapted to the new, homogenous landscape and hydrology that is made necessary for the abstraction of water upstream and within this estuary.

In sum, from the broadest view, we have engineered three key attributes out of this system in order to manage water resources: complexity, connectivity and variability. All of these are the hallmark of a healthy estuary. Yet some of these features cannot be restored due to landscape changes.

The previous summary, which leaves out an infinite array of details, is meant to highlight the question: what is and is not sustainable in the Delta under the co-equal objectives of ecosystem health and water supply? However, it completely ignores the larger unpleasant reality that your committee has to face as part of its second charge. Within the Delta, all trajectories of change, including island subsidence, sea level rise, seismic risk, changing inflows and new invasives are pointed in a negative direction. Outside of the Delta, increasing population, groundwater mining in the Tulare Basin, increasing soil salinity in the San Joaquin Valley, and anticipated regional warming point to an increase in demand for water from the Delta and its watershed that will coincide with a potential decrease in supply. Even if you find that conditions can be made sustainable for today, will these practices be sustainable tomorrow?

In our first and second PPIC reports, led by Jay Lund of UC Davis and Ellen Hanak of PPIC, we argue that sustainability, depending on how you define it, probably can be achieved in the future. What we didn't do, however, is describe how to get there. You may well want to think about that problem as well.

This somewhat gloomy look at the Delta is intended only to highlight how important it is for the committee to address the major, overarching question of sustainability, based on your own definition, and to use it as a litmus test for the RPAs put forward by the agencies, your own recommended changes to those RPAs, and actions you would suggest going forward into the future. And if things are not sustainable based on our current course, there is great value in hearing about it from an independent body such as yours. No one within this system wants to rigorously ask this question for fear, perhaps, of the answer.

Opportunities

Despite my personal reservations over NRC review of BiOps, I see this as an extraordinary opportunity to have a lasting and powerful impact on water and environmental management in the Delta.

The very good news that many of you already know is that there is a mature science infrastructure within the Bay-Delta system that can assist your efforts. More importantly, the scientific community has the capacity to absorb, analyze, refine and

adopt your recommendations. Delta science is not, as some will allude to in their comments to you, monolithic or, worse yet, a cabal of scientists bent on the destruction of water users. It is a wonderfully diverse mix of scientists from federal and state agencies, world-class research universities, private consultants, non-governmental organizations, and water contractors. Diversity of opinion is the norm with appropriate vetting of hypotheses and ideas at annual conferences (with attendance close to a thousand), innumerable workshops, incessant independent peer-review, and a journal dedicated to getting peer-reviewed information out into the scientific community.

The CALFED Science Program, which I will mention later, sits at the center of this, and carries out the vital role of coordination and program review. This program is widely viewed as the most successful part of the CALFED experiment. As part of the Independent Science Board, I and my fellow board members have been critical at times over how science is managed in the Delta. Improvements are needed in incorporation of new technology, monitoring, coordination, and funding. But over the past decade there has been steady, significant progress in the objective, peer-reviewed science applied to the problems of the Delta. I believe there is no more sophisticated program anywhere in the country tackling a problem of this scope and complexity.

This comes to the somewhat open-ended nature of your second charge that includes, potentially, a comprehensive review of science as it informs policy and supports adaptive management. I anticipate that once the chaos of meeting your short-term deadline regarding the RPAs recedes, you will be able to choose which topics to focus on. Please consider the following.

There are at least four major planning efforts underway in the Bay-Delta system that would benefit from input and guidance from your efforts. They all will certainly be watching to see what you say. The challenge, as I see it, is where to engage and how to incorporate your findings in a way that is timely enough to affect important policy decisions.

Bay-Delta Conservation Program.

As noted in your charge, you are to coordinate your efforts, where practicable, with the on-going Bay-Delta Conservation Program (BDCP). As a reminder, the BDCP is a Natural Communities Conservation Plan/Habitat Conservation Plan that is being developed to meet take permit requirements under state and federal endangered species act laws. This is the most ambitious NCCP/HCP effort ever undertaken, so it is breaking new ground all the time. As you can imagine, it is beset with difficulties, particularly over how to deal with and respond to major uncertainties. Indeed, the battles within this process are all about uncertainties over how fish populations and plant and animal communities will respond to conservation and restoration measures, and what level of assurance can be provided to water contractors and stakeholders. An independent body with extensive expertise in this regard has much to offer to this process and may well be able to settle some differences.

The biggest challenge, as I see it, is influencing this process in an effective manner. An ambitious agenda pushed by the current administration in Sacramento seeks to have a plan ready this year. This is out of phase with your work and does not work well with the manner in which NRC committees conduct fact-finding and develop results. Having said this, deadlines slip, and there may be an opportunity for you to have significant input after all. Regardless, I encourage to you find a way to interact with BDCP.

State Water Resources Control Board Delta Flows Criteria.

As part of the package of legislation that was passed last spring, the requirement was set forth that the State Water Resources Control Board—the arm of state government that has jurisdiction over water rights and water quality requirements—is to develop flow criteria for the Delta in order to restore and sustain native ecosystems. For those of you familiar with the perennial question for the legislature of “how much water do the fish need”, it has now been written into law. The Waterboard must develop these criteria, which are not binding, by mid-Summer, and will be holding public hearings this March. This effort, particularly given the expertise that you have on your committee, would benefit greatly from your input. However, like BDCP, it is on a fast-track and appears out of phase with your efforts. I am less concerned about this since it is highly likely that these criteria will be nothing more than a first cut which will be adjusted in some form later on when water rights for the entire Delta system are reviewed. Your assessment of this effort will help guide those adjustments in the future.

State Plan of Flood Control.

Following Hurricane Katrina and the loss of a key court case that held the state liable for levee failures, California enacted perhaps the nation’s most progressive flood control legislation. One part of that legislation was the requirement that the state develop a comprehensive flood control plan for the Central Valley by 2012. Normally, you would pay little to no attention to this effort (and vice versa I suspect). However, the 6000 miles of levees in the Central Valley, along with the way we operate our network of large, multipurpose dams, plays a primary role in how we manage water supply and habitat restoration. The 1100 miles of levees in the Delta define the Delta landscape. Any changes in these levees will impact physical habitat, water quality, hydrology and more. Although you may not engage directly with this process, it is important that you be aware of it. It is largely ignored by people working on major Delta problems, but it will prove very important to the questions surrounding sustainability.

Delta Stewardship Council

As part of the water resources legislation passed last fall, California is going to conduct a large experiment in the way Delta land use, restoration and water resource management is governed. This is an attempt to deal with the fact that more than 200 separate federal, state and local agencies have some form of

jurisdiction over the Delta, making it difficult to establish a coordinated plan for its management. Three large entities will be established. A Delta Conservancy, which will oversee restoration efforts and economic development, a Delta Protection Commission that will have land use review authority, and a Delta Stewardship Council that will develop a Delta Plan. All state and local agencies are to conduct their business in a manner that is consistent with this Plan. The old CALFED Science Program will morph into the Delta Science Program and be under the umbrella of the Stewardship Council.

Outside of BDCP, the point at which your committee could have the greatest impact on water and environmental resource management in California is through the Stewardship Council. First, the Plan that this council will develop must meet the notions of sustainability and co-equal objectives of water supply and ecosystem health. The initial Plan, due to be completed in 2012, can incorporate many of your suggestions and translate them directly into action. Second, the creation of the new Delta Science Program is to go on while you are here working on the larger Delta problems. It is a perfect opportunity to help shape that new program in a way that meets the needs for adaptive management. And I remind you again, there is a robust science program and community in place, so you are not starting from scratch. In many ways, I see your greatest, long-lasting impact coming from the manner in which you address this effort as part of your second charge.

Conclusion

To repeat *ad nauseum*, welcome. Welcome to what I view as the thorniest water and environmental resource management question in the West: thorniest not just because of its complexities and uncertainties, but because so very much is at stake. Welcome to a healthy, diverse scientific community that is happy to help you in your efforts. Welcome to a complex array of public and private interests keenly interested in what you have to say about all of this. And welcome to a task that will form a great, but satisfying challenge, with the possibility of lasting impact. I thank you in advance for your many efforts and am happy to take your questions or comments.