State Water Resources Control Board
Informational Proceeding to Develop Flow Criteria for the Delta Ecosystem Necessary to Protect Public Trust Resources

Clarifying Questions on Written Testimony and Exhibits
March 9, 2010

The Coalition for a Sustainable Delta here submits clarifying questions in response to written summaries submitted by a number of parties to the State Board. These clarifying questions focus on statements made by stakeholders regarding or based on scientific information. The written summaries provided by the stakeholders raise a multitude of questions, but below we provide several key scientific questions.

QUESTIONS 1 AND 2

Parties: The Bay Institute and Natural Resources Defense Council

Excerpt from Written Summary: Recommending to the Board "the use of 'umbrella' or keystone species" when "determining minimum public trust flows in this proceeding."

Questions and Explanation:

Can you explain why the use of surrogate species is an appropriate management tool in the Delta?

Can you please provide the most complete explanation you are able -- grounded in findings from empirical research to the extent possible -- for your recommendation that certain species serve as surrogates for the broader ecological community in the Delta?

It is commonplace for biologists to suggest to resource managers that the measurement of the distribution, abundance, or demography of one species provide measures that can be used as surrogates for the distribution, abundance, or demography of other, less readily measured species or of status and trend of other environmental attributes. In some situations, the selection of surrogate species has been informed by analyses that show high levels of spatial and temporal correspondence in occurrences; but, unfortunately, the choice of surrogates in practice is often *ad hoc*, and assumptions underlying selection of a given surrogate for a given environmental attribute are usually implicit, not explicit (Andelman & Fagan 2000). Surrogates rarely are selected using rigorous statistical methods. And researchers and practitioners generally have not subjected past applications of surrogate species to inform resource management decisions to empirical, post-implementation testing (Favreau et al. 2006). For these reasons, little evidence exists regarding the effectiveness of past resource management decisions that have been based on the use of surrogate species. In fact empirical research oftentimes provides *post hoc* evidence that assertions that the presence of one species correlates with presence of others is untrue (Favreau et al. 2006). In light of these facts, it is unsurprising that one survey of the use of surrogates found "little evidence to support the claim that umbrella, flagship, or biodiversity

indicator schemes have special biological utility as conservation surrogates for protecting regional biota" (Andelman & Fagan 2000).

Umbrella species typically are defined as species, the conservation of which serves to protect co-occurring species (Fleishman et al. 2001; Rowland et al. 2006). Keystone species are essential to maintaining the organization and diversity of their associated ecological communities and are exceptionally important vis-à-vis the rest of their communities (Mills et al. 1993). The two concepts are dissimilar and should not be used interchangeably. The explicit use of an organism as surrogate presumes that the measurement or management of it can facilitate broader inferences or can guide management of an ecosystem. Surrogate species often are defined as one or a small set of species with presence or absence patterns that are correlated functionally with species richness of a larger group of organisms over a defined geographic area.

The basic premise that informs selection of one or more surrogate species is that "management practices adopted for a species group or surrogate species will adequately pertain to all species in the group or represented by the surrogate, and that the larger set of species will respond in a uniform way to management actions" (Wiens et al. 2008). One notable problem with the potential use of surrogate species for management planning purposes in the Sacramento-San Joaquin Delta stems from the well-documented distinctiveness of the native species of conservation concern, their abiotic and biotic resource requirements, their life histories, and their responses to environmental cues (Jassby 1995; Kimmerer 2009). Those differences make it nearly impossible to predict consistently species co-occurrences in space and time. This problem is not unique to the Delta (Rowland et al. 2006).

To the extent that the State Board believes it is appropriate to give due consideration to the use of surrogate species to inform the establishment of flow criteria, the Board should be analytical in its selection of those species, and plan for rigorous validation of any surrogates that may be selected. Reliance on expert opinion alone as a basis for selection of surrogate species is inappropriate (MacNally et al. 2008). Guidance on implementation and validation of a surrogate based approach to conservation planning and resource management is available in the existing literature (Wiens et al. 2008; Caro & O'Doherty 1998).

QUESTIONS 3 AND 4

Parties: The Bay Institute and Natural Resources Defense Council; Environmental Defense Fund

Excerpt from Written Summary: "There is no compelling evidence that anything other than restoration of adequate flows can fuel restoration of public trust resources."

Questions and Explanation:

Is there an empirical basis for the assertion of the Bay Institute, Natural Resources Defense Council, and Environmental Defense Fund that no management actions other than restoration of adequate flows can fuel restoration of public trust resources?

How can you reconcile this assertion with the statement by the California Department of Water Resources that "[o]ne of the most significant developments in recent years is the deterioration of the flow-abundance relationships" (California Department of Water Resources 2010)?

It is beyond dispute that the Sacramento-San Joaquin Delta has undergone substantial changes over the past 150 years (Healey 2008; Lund et al. 2007; Moyle et al. 2010a). These changes include destruction of 95 percent of the tidal wetlands in the Delta; deepening and hardening of water channels; introduction of contaminants as a result of human activities including natural resource extraction, urbanization, and farming operations; proliferation of non-native invasive species following intentional or unintentional introduction to the system; predation of native fishes by non-native fishes; reduction of sediment transport due to construction of water storage facilities; and diversions from the Delta watershed both upstream of and in the Delta (Nichols undated; Healey 2008; Lund et al. 2007; Lindley & Mohr 2001). These changes have led to species extinctions (including thicktail chub and Sacramento perch) and rendered many at-risk species conservation reliant (for example, delta smelt) (Moyle et al. 2010b; Fleishman 2010). "Species decline and, ultimately, species extinction is a consequence of a multiplicity of interlinked and interacting factors in the Delta" (Healey 2008). While this may seem to be a truism, a number of stakeholders repeatedly attribute decline of certain species in the Delta -- and the ecosystem, more generally -- to one or a very small number of factors and discount other factors. In this context, the narrow focus on flows, rather than a broad examination of the various components of the ecosystem, is antithetical to the clear message from the science of ecosystem management, and alone certainly will not serve to stabilize or reverse the decline of at-risk, native species (Healey 2008; Fleishman 2010). As the authors of a Public Policy Institute of California report concluded, "more freshwater inflows or reduced exports alone are unlikely to save [at-risk, native] species because the highly altered nature of the aquatic ecosystem is part of the problem" (Lund et al. 2007).

QUESTION 5

Party: U.S. Department of the Interior

Excerpt from Written Summary: "[I]t is generally logical to presume that flow conditions more similar to natural flows will provide beneficial flow conditions and improved habitat for native species; while the further flow conditions are from what naturally occurs, the less adequate habitat conditions are for our native species."

Questions and Explanation:

Is there any empirical basis for the Department of the Interior's presumption that replicating historic flow conditions will benefit native species and their habitats?

As explained above, the Sacramento-San Joaquin Delta has undergone substantial changes over the past 150 years (Healey 2008; Lund et al. 2007; Moyle et al. 2010a). Given the number, diversity, and extent of such changes, it is unclear why the Department presumes that reversing the change to any one component of the ecosystem (for example, the flow regime) without altering any of the multitude of other changes to various ecosystem components would provide

demonstrable benefit native species and their habitats. Declines in multiple Delta fishes during more than a decade and a half of directed water export curtailments and adjustments in the Delta belie that presumption. We are aware of one study that provided some evidence in support of the hypothesis that the abundances of several species in the Delta increase as outflows from the Delta increase (Kimmerer 2002); but, since that study was published other studies have demonstrated the need to further test the hypothesis, and to explore alternative hypotheses (Dege & Brown 2004; Thompson et al. in press). One recent multivariate study provides evidence that water clarity is one of several likely predictors of abundances of multiple pelagic fishes in the Delta (Thompson et al. in press). But that finding notwithstanding, the authors of the study concluded that the covariates of abundance they had identified, including water clarity, winter exports, and spring X2, could not could not fully explain post-2000 declines in pelagic fish abundances.

Importantly, it is necessary underscore that habitat is a species-specific concept. Each individual fish species in the Delta has a distinct set of abiotic and biotic resources that it relies on; as Dr. Fleishman explains in her expert testimony to your board, "[h]abitat is the physical space within which an animal or plant lives and the abiotic and biotic resources in that space (Morrison and Hall 2005)" (Fleishman 2010). A presumption that adjustment of one component of the ecosystem -- here, adjustment of flows to mimic the "natural" hydrograph -- will improve habitat for *all* native species is based on the false premise that the abiotic and biotic components of habitat that contribute to survival and reproduction of those species are the same. Evidence that all fish species in the Delta do not respond in the same manner to flows is provided in a recent article on the subject (Kimmerer et al. 2009).

QUESTIONS 6 AND 7

Parties: The Bay Institute and Natural Resources Defense Council

Excerpt from Written Summary: "Based on the need to reclaim core habitat for delta smelt and other species, increase fall outflow to ensure that X2 is positioned between 83 km (in the driest years) and 71 km (in the wettest years)."

Questions and Explanation:

What is your response to the criticism of the key studies and analyses that provide the basis for the numeric criterion proposed by the Bay Institute and Natural Resources Defense Council?

Is there any published, empirical research that demonstrates that maintaining the position of X2 at less than 80 km (i.e., 71, 74, and 77 km, respectively, as recommended by the Bay Institute and Natural Resources Defense Council) will increase subsequent abundance of native, at-risk species? If so, which species?

This numeric criterion proposed by the Bay Institute and Natural Resources Defense Council is based on scientifically flawed studies (Feyrer et al. 2007; Feyrer et al. 2008). These studies also formed the basis for Reasonable and Prudent Alternative component 3 in the U.S. Fish and Wildlife's Biological Opinion for the Proposed Coordinate Operations of the Central Valley

Project and State Water Project (U.S. Fish and Wildlife Service 2008). The legality of Biological Opinion, and more specifically Reasonable and Prudent Alternative component 3, is being challenged in federal district court. There are numerous flaws associated with the Reasonable and Prudent Alternative component 3, which are comprehensively documented by the plaintiffs in the challenge to the Biological Opinion. A subset of those flaws demonstrates that the numeric criterion proposed by the Bay Institute and Natural Resources Defense Council is contrary to the best available scientific information.

One critical flaw in the more recent of the two studies used to support the X2 prescription is that the correlation found between the location of X2 in the autumn and subsequent delta smelt abundance during the period 1987-2007 is driven by a single data point (Carr 2010). If that single data point is removed, the relationship between fall X2 and subsequent abundance is not statistically significant (Carr 2010). Furthermore, the authors of the more recent study acknowledge that they were unable to detect a statistically significant relationship between the location of X2 in the autumn and subsequent delta smelt abundance when they looked at the period 1968-1986, or the more inclusive period of 1968-2007 (Feyrer 2008). Another critical flaw in the more recent of the two studies stemmed from the fact that the residuals were not normally distributed. This flaw was identified both by the Fish and Wildlife Service in its Biological Opinion and by the peer review team assembled by the Fish and Wildlife Service to review a partial draft of its Biological Opinion (U.S. Fish and Wildlife Service 2008; PBS&J 2008).

More generally, the numerous flaws associated with the two studies and their subsequent interpretation by the Fish and Wildlife Service call into question the value (if any at all) of a management regime that controls the location of X2 in the autumn in the Delta. As the authors of the peer review of Reasonable and Prudent Alternative component 3 noted, "[t]he degree to which moving X2 seaward will affect delta smelt habitat is not well supported by the analyses presented [by the Service in its Biological Opinion], and the additional arguments presented for this action also seem weak" (PBS&J 2008).

Finally, the numeric criterion is subject to criticism because it equates the habitat of "delta smelt and other [unnamed] species" with a single abiotic component of habitat, namely salinity as measured by X2. As indicated above, "[h]abitat is the physical space within which an animal or plant lives and the abiotic and biotic resources in that space…" (Fleishman 2010). Again, the notion that the position of X2, a single abiotic variable, can serve as an effective functional surrogate for the distinct habitats required by multiple fishes in the Delta is simply not credible (Hanson 2009). Importantly, it is well documented that delta smelt are found outside the low salinity zone demarcated by X2 and a substantial portion of the low salinity zone is not occupied by delta smelt (Hanson 2009). In other words, there is not a tight fit between X2 and actual distribution of delta smelt.

The Coalition prepared an analysis of Reasonable and Prudent Alternative component 3 and submitted that analysis to the National Research Council Committee on Sustainable Water and Environmental Management in the California Bay-Delta (Hamilton 2010). That analysis demonstrates that Reasonable and Prudent Alternative component 3 may actually contribute to reducing subsequent abundance of delta smelt -- adding outflows to the naturally low flow

autumn hydrograph is likely to negatively impact delta smelt, which is adapted to slack water in the fall. Given the weak evidence for the numeric criterion, it is impossible to justify adoption of the criterion -- even for informational purposes -- at this time.

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