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UNITED STATES DISTRICT COURT

EASTERN DISTRICT OF CALIFORNIA

THE CONSOLIDATED SALMON CASES: SAN LUIS & DELTA-MENDOTA WATER AUTHORITY, et al. v. LOCKE, et al.	**LEAD CASE NO. 1:09-CV-1053-OWW-DLB** Consolidated Cases: 1:09-CV-1090-OWW-DLB 1:09-CV-1378-OWW-DLB 1:09-CV-1520-OWW-SMS 1:09-CV-1580-OWW-DLB 1:09-CV-1625-OWW-SMS **DECLARATION OF KENNETH CUMMINS IN SUPPORT OF PLAINTIFFS' MOTION FOR SUMMARY JUDGMENT**
STOCKTON EAST WATER DISTRICT v. NOAA, et al.	
STATE WATER CONTRACTORS v. LOCKE, et al.	
KERN COUNTY WATER AGENCY, et al. v. U.S. DEPARTMENT OF COMMERCE, et al.	
OAKDALE IRRIGATION DISTRICT, et al. v. U.S. DEPARTMENT OF COMMERCE, et al.	
THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA V. NATIONAL MARINE FISHERIES SERVICE, et al.	

I, Kenneth Cummins, Ph.D., declare as follows:

I. BACKGROUND AND QUALIFICATIONS

1. I am Senior Advisory Scientist of the California Cooperative Fishery Research Unit of the U.S. Geological Survey located on the Humboldt State University campus and am adjunct professor in the Fisheries Biology Department at Humboldt State University. I also served on the CALFED Independent Science Board from 1999 to 2005. In this role, I advised CALFED on fisheries issues, habitat modification, and loss of riparian functions in the Central Valley. In addition, I was a member of the Central Valley Improvement Act ("CVPIA") independent review panel funded by the U.S. Fish and Wildlife Service and Bureau of Reclamation at the recommendation of the Office of Management and Budget within the Executive Office of the President and was one of the authors to the report *Listen to the River: An Independent Review of the CVPIA Fisheries Program* (AR 00115092), which focused on Central Valley fisheries issues. I served on the Science Advisory Board of the U.S. Environmental Protection Agency from 1998 to 2004.

2. My academic training includes a Ph.D in Zoology/Limnology from the University of Michigan and an M.S. in Fisheries from the University of Michigan. I have been teaching courses in stream ecology for 40 years. I have authored or co-authored over 140 publications, including *Using environmental variables to predict population change: Forecasting spring chinook runs in two Oregon coastal rivers* (2000). I have done extensive research on salmonids on the west coast of the United States focusing principally on the freshwater portion of the lifecycle of a number of species, including steelhead, Coho salmon, and resident salmonids. I also developed a procedure for using freshwater invertebrates as surrogates for other freshwater invertebrates. In addition, my recent research has involved the use of surrogates between taxonomic groups as well as using surrogates to determine ecosystem parameters, e.g., using invertebrates to categorize riparian conditions. My publications in this area include: Merritt, R., W., Cummins, K.W, & Berg, M.B. eds. 2008. *An introduction to the aquatic insects of North America* (4th edition); Cummins, K.W. 1974. Structure and function of stream ecosystems. *BioScience* 24:631-641; and Cummins, K.W. & Klug, M.J. 1979. Feeding ecology of stream invertebrates. *Ann. Rev. Ecol. Syst.* 10:174-172.

II. USE OF SURROGATES

3. The National Marine Fisheries Service (NMFS) uses surrogates, or ecological substitutes, as part of its analysis in the Biological and Conference Opinion on the Long-term Operations of the Central Valley Project and State Water Project (BiOp), dated June 4, 2009. My evaluation of the use of surrogates in the BiOp focused on: (1) the use of information regarding Chinook salmon (*O. tshawytscha*) behavior to determine steelhead (*O. mykiss*) behavior, and (2) the use of information regarding hatchery Chinook salmon behavior to determine wild/natural Chinook salmon behavior. As NMFS acknowledges, the use of surrogates "may not accurately predict or emulate the exact behavior of the species under analysis in its natural environment in order to determine exact fish routing, timing, duration of migration, and export pumping entrainment patterns." BiOp at p.62, AR 00106142. NMFS claims that it has "utilized data and results from the use of surrogates that exhibit strong similarities in physiological needs, in life history stages, and in general behaviors." BiOp at p.62, AR 00106142. As I will discuss in detail below, there is widespread agreement among biologists that it is necessary to validate the use of one species as a surrogate for another species (e.g., Landres 1992, Wenger 2008), and NMFS failed to validate its decisions to use juvenile Chinook salmon as a surrogate for juvenile steelhead and juvenile hatchery Chinook salmon as a surrogate for juvenile wild/natural Chinook salmon. Furthermore, I will explain that juvenile Chinook salmon do not exhibit sufficiently strong similarities to juvenile steelhead in the categories described by NMFS to justify their use as surrogates, nor do juvenile hatchery Chinook exhibit such similarities to justify their use as surrogates for juvenile natural/wild Chinook. NMFS's failure to validate its use of surrogates is a departure from standard scientific practice and a competent scientist in this field would not use surrogates in any type of analysis without first going through a validation process.

A. Fall-Run Chinook Inappropriately Used as Surrogate for Central Valley Steelhead

1. The BiOp's Use of Fall-run Chinook as a Surrogate for Steelhead

4. RPA Action IV.2.1 increases the ratio of San Joaquin river inflows to Central Valley Project and State Water Project exports (that is, the inflow to export ratio) during specified times of the year. BiOp at pp.641-644, AR 00106721-24. According to the BiOp, the purpose of this action is to "provide flows in the lower San Joaquin River, as measured at the Vernalis monitoring gage, of

sufficient duration and magnitude to increase the survival of emigrating Central Valley steelhead originating in the east side tributaries of the San Joaquin River basin through the lower San Joaquin River and into the Delta." BiOp App. 5 at p.1, AR 00107147. This increase in inflow to export ratio is intended to limit the numbers of steelhead drawn into the channels of the South Delta and to reduce the vulnerability of emigrating CV steelhead to entrainment at the water export facilities in the South Delta. BiOp at p.641, AR 00106721.

5. In formulating this RPA action, NMFS "decided to use fall-run Chinook salmon populations in the San Joaquin River basin as a surrogate species." BiOp App. 5 at p.12, AR 00107158. NMFS's justification for using fall-run Chinook as a surrogate for steelhead is that fall-run co-occur in the three basin tributaries alongside steelhead and that both species have similar environmental needs for cool water, river flows, and migratory corridors. BiOp App. 5 at p.12, AR 00107158. "NMFS makes the <u>assumption</u> that conditions that are favorable to fall-run Chinook salmon will provide similar benefits to co-occurring steelhead populations in the same watershed. Therefore, using juvenile fall-run Chinook salmon populations in the basin as an indicator species, conditions that improve the abundance of fall-run should improve the abundance of steelhead." BiOp App. 5 at p.12, AR 00107158 (emphasis added).

6. In assessing the species' response to the proposed projects, specifically the Delta Cross Channel ("DCC"), NMFS relied on studies that are based on examination of the survival of salmon smolts as they migrate through Georgiana Slough and portions of the central Delta. NMFS examined data from investigations conducted using late-fall run Chinook, which NMFS deemed most applicable to emigrating steelhead and spring-run Chinook yearlings "due to their comparable sizes." BiOp at p.405, AR 00106485. Those studies were conducted by releasing one group of marked, hatchery-produced salmon juveniles into Georgiana Slough, while a second group was released into the lower Sacramento River. According to NMFS, these results from the studies showed that "the survival of juvenile salmon released directly into the Sacramento River while the DCC gates are closed are, on average, two to eight times greater than survival of those released into the Delta via Georgiana Slough." BiOp at p.405 AR 00106485. NMFS concluded that the study results "demonstrate that the likelihood of survival of juvenile salmon, <u>and probably steelhead</u>, is reduced by deleterious factors in the central Delta." BiOp at

p.406, AR 00106486 (emphasis added).

7. NMFS's assessment of the risk to individual juvenile steelhead that move through the Delta through the DCC or Georgiana Slough is also based on studies of late-fall run Chinook salmon. The assessment ostensibly uses data generated from acoustic tracking studies of salmon reported by Perry and Skalski (2008) and Burau et al. (2007). BiOp at p.409, AR 100106489. Perry and Skalski (2008) tracked juvenile late fall-run Chinook salmon from the Coleman National Fish Hatchery; Burau et al. (2007) also used acoustic-tagged Chinook from Coleman Hatchery. Drawing inferences from these studies, NMFS estimated that losses of steelhead that would be associated with the operations of the DCC should range from approximately 5 to 17 percent of the steelhead entering the Delta from the Sacramento River Basin. "These estimates used the percentage of fish entering the Delta interior through either the DCC or Georgiana Slough channels (based on acoustic tracking data of Chinook salmon smolts: 28 percent when DCC open, 18 percent when closed), the survival estimates within those channels (35 percent survival base case, 10 percent survival when high losses occur, 75 percent survival when losses are low), the monthly position of the DCC gates, and the percentage of the winter-run population entering the Delta from the Sacramento River each month from table 6-26." BiOp at p.409, AR 00106489.

2. Overview of the Surrogate Use and Validation Process

8. The use of surrogate (or substitute) species in conservation planning has been debated vigorously by scientists (Landres 1992, Andelman & Fagan 2000, Rowland et al. 2006, Wenger 2008) and has been the subject of multiple investigations (e.g., Hitt & Frissell 2004, Rowland et al. 2006, Banks et al. 2010). A substantial scientific literature addresses the question of whether ecological or genetic information on any species can be used to draw conclusions useful in conservation planning for another. Almost 20 years ago, Peter Landres concluded that the use of surrogates is "financially not practical, conceptually inappropriate, and empirically unsupported potentially leading to inaccurate long-term management and assessment decisions." (Landres 1992). Numerous experts have since reaffirmed his conclusion. For example, Sandy Andelman and William Fagan conclude based on a review of three case studies, that there is "little evidence to support the claim that umbrella, flagship, or indicator schemes have special biological utility as conservation surrogates for regional biota."

(Andelman & Fagan 2000). As a result, Tim Caro (who is among the foremost experts on the use of surrogate species) and his colleagues have drawn the following conclusion: "[T]he assumptions required to use substitute species in conservation biology are too onerous when applied to trying to predict population responses to anthropogenic disturbance. Where at all possible, we advocate making every possible effort to examine the target species directly before resorting to substitute species." (Caro et al. 2005). In other words, use of surrogate species should be a tool of last resort.

9. Based on the body of scientific literature regarding surrogates, it is fair to conclude that use of surrogate species is seldom viewed as scientifically justified (Andelman & Fagan 2000), and when justified as a potential approach to informing management, scientists agree that a rigorous validation process is required (Landres 1992, Wenger 2008). Numerous past studies have concluded that the use of surrogate species absent prior validation was improper and resulted in poor resource management decisions (e.g., Rowland et al. 2006, Welsh et al. 2001).

10. Scientists have been particularly concerned when the responses of one species to environmental disturbances have been used to predict the response of another species to a similar disturbance (Landres et al. 1988). In such circumstances, a rigorous process for selecting an appropriate surrogate is critical to ensure that the surrogate and target species have similar responses to the same suites of environmental conditions. A surrogate species will not be adequate as a management-planning substitute if it varies in its response to any environmental stressor that affects the target species in a measurable way (Caro et al. 2005).

11. Caro et al. (2005) concluded that for a surrogate to be appropriate, they should share the same key ecological or behavioral traits that make the target (in this case juvenile steelhead) sensitive to environmental disturbance and the relationship between population vital rates (for example, survival) and level of disturbance should match that of the target. The study concluded that, "these conditions are unlikely to pertain in most circumstances and the use of a substitute [surrogate] species to predict endangered populations responses to disturbance is questionable." (Caro et al. 2005).

12. While the ideal surrogate would be one that responds to the stressor in precisely the same way as the target species, because the response of the target species is unknown, selection of a surrogate must be based on characteristics that are likely to correlate with stressor response (Wenger 2008).

"A surrogate should be not selected a priori without estimating its sensitivity, unless there is excellent evidence that it will respond in the same way as the target (as in the case of use of a different population of the same species as the surrogate)." (Wenger 2008) (emphasis added).

13. Recognizing that superficially similar species may overtly or subtly differ in response to environmental conditions that affect their population sizes and trends, it has been argued that surrogate status be reserved for species that are either extremely closely taxonomically related or members of the same ecological guild, that is, a group of species that share a number of fundamental biological characteristics. But even then, the use of a one species that is a member of a guild to guide planning for another species that is a member of that same guild has been anticipated, and largely rejected. Block et al (1987) concluded that one species of a guild cannot adequately represent the two most essential characteristics of other species in the guild – population status and trends, and habitat use and specificity – knowledge of which, are absolutely essential to conservation planning. Mannan et al. (1984) noted that, whereas a guild of species may show little variation in presence, species richness, or abundance in response to environmental changes, individual species in the guild may respond dramatically differently to those same changes. And Morrison et al. (1986) concluded that while grouping species into guilds may be useful for depicting species that may have similar biological characteristics that may be important in conservation planning, a guild approach to species and resource management is not useful for predicting individual species responses to environmental conditions and change. This is not to say that the use of guilds in conservation planning is improper, particularly for the purpose of preserving overall ecosystem function. Instead the literature establishes that species that are ecologically similar and share the same environments, but exhibit significant genetic differences cannot be used as surrogates at the individual species level absent validation (e.g., Kostow 2004, Araki et al. 2007, Mesick et al. 2008).

14. It is widely recognized in the scientific community that each individual species differs from others, not just because it is reproductively isolated from others, but because individual species are by definition, at some measurable level, biologically distinct (Mesick et al. 2008). Since all species are different to some degree in regards to their life history strategies, ecological relationships with other species, and selection and use of habitat, substituting data from one species to draw inferences about

another for purposes of conservation planning without validating that decision *a priori* is not justified. And since no two co-occurring species are biologically identical, that would seem to rule out management planning for one species that is informed using biological information that is available for another unless use of a surrogate species for the target species is validated. For example, in a survey of the literature on the use of surrogate species to protect other species in conservation plans, Favreau et al. (2006) found that in less than 2 percent of the cases examined did a surrogate represent the target species better than a random selection of potential surrogates. Further, in less than 4 percent of the cases could the surrogate be considered as effective in representing the target species. This makes it clear that without detailed data supporting very similar responses of juvenile Chinook salmon and juvenile steelhead to specific stressors, such as a given set of flow conditions, there is no scientific justification to choose Chinook as a surrogate over any other co-occurring species.

15. There are various approaches to validation that scientists may employ before relying on surrogate data. One approach to validation sets forth three criteria that must be met in order to use a surrogate confidently: (1) establish the relationship between levels of environmental disturbance and demographic vital rates for the surrogate species; (2) identify the key traits that affect demographic viability in both the surrogate and target species with regard to the environmental disturbance; and (3) establish the relationship between the key trait and the disturbance threshold Caro et al. (2005). Under this approach NMFS should have identified the key traits for both Chinook and steelhead that affect their survival as they migrate through the Delta. NMFS failed to do this.

16. Drawing on the existing scientific literature that has addressed surrogate species and also suggested criteria for identifying and validating a defensible surrogate (e.g., Landres et al. 1988, Carignan & Villard 2002), Wenger (2008) describes another approach to validate the use of the stressor response of one or more surrogate species to develop a working hypothesis or model of the stressor response of the target species. The process has four steps:

(a) identify one or more candidate surrogate species,

(b) model the relationship between the stressor and the response variable of interest for the surrogate species,

(c) adapt the stressor–response relationship from the surrogate species to a model for the target species, possibly using Bayesian methods, and

(d) Incorporate additional data as they become available and adjust the response model of the target species appropriately. NMFS failed to follow any portion of the last three steps.

17. After selection of candidate surrogate species, a model of the surrogate's relationship with the stressor should be generated (Wenger 2008). Once the model has been developed, the model should be evaluated and its ability to predict population status under current conditions should be tested.

18. Another alternative approach that has been suggested by Caro et al. (2005) advised that when it is impossible to study the target species, the selection and validation of a surrogate should involve:

(a) identifying the traits most likely to affect the survival of the target species, and finding a substitute species that shares those same traits;

(b) measuring population growth rates for the surrogate and establishing a relationship between disturbance and population growth rate for the surrogate; and

(c) studying surrogates with a sufficient range of values of key traits to establish a relationship between those traits and the environmental disturbance of concern.

19. Any reasonable scientist contemplating the use of surrogate data would have undertaken one of these approaches to validation. Without undergoing a validation process, the use of surrogate data amounts to mere speculation.

3. NMFS's Failure to Validate use of Fall-run Chinook as a Surrogate for Steelhead

20. NMFS did not undertake any validation process and instead simply adopted the use of fall-run Chinook as a surrogate for steelhead, and merely stated that it used data and results "from the use of surrogates that exhibit strong similarities in physiological needs, in life history stages, and in general behaviors" and that in the absence of data, "these studies [are] one of the best available sources of information used to determine the potential effects of CVP/SWP operations." BiOp at p.62, AR 00106142. As discussed below, because NMFS failed to analyze the data that any reasonable ecological scientist would have in order to validate the use of juvenile Chinook as a surrogate for juvenile steelhead, the assumption that the two species behave the same was not justified and, therefore the

speculation of how juvenile steelhead would behave is not valid.

21. The following statements by NMFS illustrate that the use of surrogates was a judgment call and did not follow the standard scientific method of validation:

> NMFS understands that the use of surrogates in the from of hatchery releases (*e.g.*, late fall run to determine spring run behavior), different species (*e.g.*, Chinook salmon to determine steelhead behavior, . . .) and even the same run and species (*e.g.*, hatchery fish and laboratory studies to determine wild/natural fish behavior) <u>may not accurately predict or emulate the exact behavior</u> of the species under analysis in its natural environment in order to determine exact fish routing, timing, duration of migration, and export pumping entrainment patterns. However, when direct evidence or similar evaluations are not available for the species under analysis, NMFS has utilized data and results from the use of surrogates that exhibit strong similarities in physiological needs, in life history stages, and in general behaviors. In the absence of data on salmonids . . . in the wild, NMFS considers these studies one of the best available sources of information used to determine the potential effects of CVP/SWP operations.

BiOp at p.62, AR 00106142 (emphasis added).

> NMFS makes the assumption that conditions that are favorable to fall-run Chinook salmon will provide similar benefits to co-occurring steelhead populations in the same watershed. Therefore, using juvenile fall-run Chinook salmon populations in the basin as an indicator species, conditions that improve the abundance of full-run should improve the abundance of steelhead.

BiOp App. 5 at p.12, AR 00107158.

22. Given all the uncertainties involved in the surrogate to target relationships used by NMFS, any reasonable ecological scientist would have followed acceptable procedures (e.g. Caro et al. 2005, Wenger 2008) to determine the best course of action, in this case largely involving the use of data from outside the Central Valley.

23. NMFS's failure to validate its use of fall-run Chinook as a surrogate for steelhead is contrary to the widely accepted view in the scientific community that validation is a prerequisite for use

of one species as a surrogate for another, distinct species (e.g., Caro et al. 2005, Wenger 2008). NMFS assumed that conditions favorable to fall-run Chinook would provide similar benefits to steelhead because they co-occur in the same basin and have similar environmental needs for cool water, river flows, and migratory corridors. In addition, NMFS considered the species functionally the same for conservation planning because they exhibit similarities in physiological needs, life history stages, and general behaviors. BiOp at p.62, AR 00106142. However NMFS failed to explain how or whether these similarities are significant with regard to species survival rates as they migrate through the Delta. NMFS did not explain whether these similarities are the key traits that affect demographic viability for the Chinook or steelhead with respect to the environmental disturbance being examined (flow being influenced by the project operations).

24. Furthermore, there are examples in the scientific literature of species that are related or that share similar ecological behaviors that live in overlapping, disturbed habitats, but show very different responses to specific alterations of their shared environment (e.g., Wenger 2008; Dickson et al. 2009). In an example from the Delta, the native, predatory Sacramento perch declined for decades and has been extirpated, while the non-native, predatory large-mouth bass rapidly expanded after its introduction and now thrives. Using one of these species for management planning for the other species would certainly be a failed strategy.

25. The Wenger (2008) model on the use of surrogate species is the type of model that NMFS could have employed to determine the validity (probability) of using juvenile Chinook salmon behavior as a surrogate for juvenile steelhead behavior. As an example, in its simplest form, the relationship between flow, as a mean velocity in stream reaches suitable for the occurrence of the surrogate species, (on the x-axis) versus the density or probability of occurrence in each habitat of the surrogate species (Chinook salmon) is plotted (on the y-axis). This relationship would be compared to the same plot for the target species (steelhead) using any direct data available from the habitats suitable for the target species.

26. Population data and information on the effects of environmental stressors exist for both Chinook salmon and steelhead. Absent suitable sets of surrogate data on steelhead from Central Valley streams, good data sets on steelhead from other similar streams outside the Central Valley provide

alternative sources of ecological data from which conservation planners can infer directed management responses (e.g., CDFG 2002, CDFG 2008a, CDFG 2008b). The suitability of one species to serve as a surrogate for another or for itself is not tied to its co-occurrence in the same watershed (Banks et al. 2010). For example, the detailed and extensive data on steelhead populations in the Freshwater Creek watershed in Humboldt County could have provided a population viability model that could be used to represent steelhead populations in the Central Valley. The data that are available include paired antennal arrays on each tributary for logging the movements of a large percentage of pit- tagged adult steelhead (and Chinook) for determining the efficiency of redd, spawner, and carcass count methods of estimating escapement. Reliable data are also available on the dominance of females in the population in any given year and for repeat steelhead spawners that return to the monitoring weir at the mouth of the Freshwater Watershed that can be used to correct the escapement estimates for any given year (e.g., CDFG 2002, CDFG 2008a, CDFG 2008b). Thus, NMFS could have used data on steelhead from other similar tributaries to create a validation model like the one described in Wenger (2008) to determine whether Chinook and steelhead react to flow disturbance similarly enough to justify the use of Chinook as a surrogate.

27. Using the approach in Wenger (2008), NMFS could have plotted the relationship of flow to survival for both Chinook and steelhead (using statistical methods such as the Bayseian method for steelhead if only minimal data are available) and then the statistical similarity between the two plots would be used to judge the validity of using Chinook salmon to represent the steelhead. There is no indication in the BiOp that NMFS followed such a validation procedure in deciding to use Chinook as a surrogate for steelhead. In fact, I have not been able to find any evidence that NMFS followed any validation procedure either in the BiOp or the Administrative Record.

28. Using the approach described in Caro et al. (2005), any competent scientist would have identified the traits in steelhead that are most likely to be indicative of survival of the species given the specific environmental disturbance, here migration through the Delta. Any competent scientist would then have studied various substitutes with a range of those similar traits to establish a relationship between those traits and the environmental disturbance. NMFS did neither of these things. NMFS simply chose Chinook as a surrogate because it shares some similarities with steelhead (though NMFS

does not explain whether those similarities are the key traits that would affect survival with respect to migration through the Delta).

29. Although they occupy the same habitat, steelhead and Chinook different in significant ways. Steelhead are iteroparous, that is, they are capable of spawning more than once before death. BiOp at p.104., AR 00106184. Tagging studies have shown that 10 to 20 percent of steelhead return for two or more spawning events. (McGinnis 2006, CDFG 2002, CDFG 2008a, CDFG 2008b).) Spawning occurs during winter and spring months. BiOp at pp.104-105, AR 00106184-85. "Juvenile steelhead emigrate episodically from natal streams during fall, winter, and spring high flows." BiOp at p.106, AR 00106186. Detailed studies of steelhead life histories in northern California watersheds have shown that spawning areas and rearing areas differ significantly in that species, with steelhead spawning occurring in the main stem of a watershed, and rearing in the small feeder tributaries (e.g. CDFG 2002).

30. The life history of steelhead differs from that of Pacific salmon in two key ways: (1) juvenile steelhead have a longer fresh water rearing requirement (usually from one to three years for steelhead versus 6 months to two years for Chinook salmon), and (2) both adult and juvenile steelhead are much more variable in the amount of time they spend in fresh and salt water. (McEwan and Jackson 1996.) Steelhead parr (juvenile, freshwater life stage) spend on average 2 years in freshwater growing to 15 to 20 cm (6-8 inches) before smolting and migrating to the ocean. (McGinnis 2006.) Comparatively, Chinook spend on average one year in freshwater growing to an average size of 4-8 cm (1.6-3 inches).

31. Thus, although Chinook salmon and steelhead juveniles may occupy the same general habitat, they differ significantly in size early on in their growth, which imparts significant differences in swimming strength, food habits, specific physical habitat requirements, and size of predators to which they are susceptible. The sizes of the juveniles two species when they migrate to the ocean are sufficiently different such that steelhead actually have been observed to prey on juvenile Chinook salmon – hence the target species feeds on its ostensible ecological surrogate. Because of these size differences steelhead are stronger and faster swimmers, can swim against stronger currents, and can navigate differently. Therefore, steelhead will behave differently because they will react differently to flow.

32. NMFS did not provide any information in the BiOp that could address salient differences

between Chinook salmon and steelhead responses to environmental stressors that put the two species at risk. In light of the failure of NMFS to validate its use of Chinook salmon as a surrogate for steelhead, the use of juvenile Chinook salmon as a surrogate for steelhead is not justified because the co-occurrence of two organisms inhabiting streams in the same watershed or basin does not allow conservation planners to automatically confer surrogate status on them, regardless of taxonomic affinity.

B. Hatchery for Wild

1. The BiOp's Use of Hatchery Chinook for Wild Chinook

33. NMFS also used hatchery Chinook as a surrogate for wild Chinook in its analyses. NMFS relied on studies conducted in the Delta that used hatchery releases of late fall-run Chinook to determine spring-run behavior as well as hatchery fish of the same run to determine wild fish behavior. BiOp at p.62, AR 00106142. NMFS relied on studies using fall-run Chinook to analyze the effect of the projects on spring-run Chinook migrating through the Delta. *See e.g.* BiOp at 375-380, 408-409, AR 00106455-60, AR 00106488-89 (e.g. NMFS relying on data generated from the acoustic tracking studies of Perry and Skalski (2008) and Burau et al. (2007) to estimate that "losses to spring-run population associated with operations of the Delta Cross Channel and fish entering the Delta interior range from approximately 5 to 17 percent of the spring-run population entering the Delta.").

2. NMFS Failure to Validate Use of Hatchery Chinook as a Surrogate for Wild Chinook

34. NMFS acknowledged that hatchery salmonids may not provide a sufficient match with wild fish to justify their use as surrogates – "the use of surrogates in the form of hatchery releases . . . may not accurately predict or emulate the exact behavior of the species under analysis in its natural environment in order to determine exact fish routing, timing, duration of migration, and export pumping entrainment patterns." BiOp at p.62, AR 00106142. However, NMFS does not discuss the differences between hatchery and wild fish and the impact that such differences would have on the uncertainty of the analysis. Nor does NMFS validate its use of hatchery fish as surrogates for wild fish, which is critical in any analysis using surrogates, but especially critical when there are well-known significant differences between the surrogate (hatchery) and the target (wild). No conclusive data are presented in the BiOp to justify using hatchery-reared juvenile salmonids for naturally produced juveniles.

35. It has been long-recognized that hatchery-reared salmonids are different from and inferior to their wild counterparts. For example, Wales (1954) reviewed evidence that hatchery fingerlings exhibited lower survival than wild ones and Reisenbichler and McIntyre (1977) demonstrated that hatchery and wild steelhead differed genetically and the hatchery fish had lower survival rates. Roper and Scarnecchia (1996) reported, trapping efficiencies for hatchery versus wild juvenile Chinook salmon differed significantly, particularly at lower flow velocities, showing that that the two exhibit distinctly different behaviors. Other empirical evidence provides a basis to question NMFS's decision to use hatchery salmon as surrogates for wild salmon absent validation of that decision. For example, "hatchery fish differ from their wild counterparts in that their genetic makeup differs . . . and because hatchery-rearing environments are very different than natural streams." (Weber and Fausch 2003), AR 00150890. "Behavioral, morphological, and physiological differences may arise in hatchery-reared fish because of differences in learning, expression of phenotypic traits, and genotypic selection, compared with wild fish reared in natural environments." AR 00150890. Specifically, "[h]atchery-reared salmonids released into streams may be less energetically efficient than wild fish, which can result in lower survival rates for hatchery fish." (AR 00150891-92.) Hatchery fish also exhibit reduced stamina or swimming ability than wild fish, they also do not avoid predators as well as wild fish do, and therefore suffer higher mortality rates, especially when predators congregate near large releases of hatchery fish. AR 00150892. Furthermore, research regarding wild and hatchery Atlantic salmon indicates survival and growth differ substantially for the two groups (Jonsson et al. 2003).

36. More recently, it has been found that there are significant genetic differences between hatchery and wild steelhead and these differences favor the wild fish over the long term (Kostow 2004), AR 00213692-00213704. Given that hatchery fish genetics can contaminate wild fish genetics (Mesick et al. 2008), the two are clearly quite different and hatchery fish make a poor and dangerous surrogate for wild fish (Araki et al. 2007), AR 00212001-04. Jonsson et al. (2003) demonstrated that survival of wild Atlantic Salmon smolts in the ocean was much higher than hatchery smolts, again supporting the position that hatchery salmonids make poor surrogates for wild fish. Hatchery produced smolts are not well matched as a surrogate for wild smolts and, given the lesser fitness of hatchery fish, their use as surrogates would underestimate the survival of wild fish (Hatchery Scientific Review Group 2004).

37. Araki et al. (2007) concluded that hatchery releases to supplement wild salmonid populations can have negative effects on natural reproduction of wild fish after three generations. AR 00212001-04. All of this evidence was available to NMFS and should have led to careful examination and application of a validation process of the procedures detailed by Caro et al. (2005) and Wenger (2008) before the behavior of juvenile hatchery produced Chinook could be used as surrogates for wild juveniles with any validity.

38. Given the well-known differences in behavior and swimming ability in hatchery fish versus wild fish, any competent scientist would have gone through an appropriate validation process, such as the one articulated in Caro et al. (2005) or Wenger (2008) to determine whether using hatchery Chinook as a surrogate for wild was scientifically appropriate.

I declare under penalty of perjury under the laws of the State of California and the United States that the foregoing is true and correct and that this declaration was executed on August 5, 2010 at Cooke City, Montana.

Dr. Kenneth Cummins