

Klamath Basin Fishes: Argument is No Substitute for Evidence

Cooperman and Markle (2003, this issue) have unfavorably reviewed an Interim Report prepared by the National Research Council's Committee on Endangered and Threatened Fishes in the Klamath River Basin (NRC 2002). Their review relates to the committee's treatment of a Biological Assessment prepared by the U.S. Bureau of Reclamation (USBOR) in 2001 and a Biological Opinion prepared by the U.S. Fish and Wildlife Service (USFWS) in 2001 for the shortnose (*Chasmistes brevirostris*) and Lost River suckers (*Deltistes luxatus*) of the Klamath basin. Both the Biological Assessment and the Biological Opinion focus on potential effects of the USBOR's Klamath Project on the endangered suckers.

The NRC committee currently is working on its Final Report, which is scheduled for release in 2003. The committee's Final Report will extend beyond the operation of the Klamath Project to consider all factors that might be relevant to the future welfare of the endangered suckers. Because the Final

Report is not finished, the present response to the article by Cooperman and Markle deals only with the Interim Report. Members of the NRC committee are William M. Lewis, Jr., chair, University of Colorado; Richard M. Adams, Oregon State University; Ellis B. Cowling, North Carolina State University; Eugene S. Helfman, University of Georgia; Charles D. D. Howard, consulting engineer; Robert J. Huggett, Michigan State University; Nancy E. Langston, University of Wisconsin; Jeffrey F. Mount, University of California—Davis; Peter B. Moyle, University of California—Davis; Tammy J. Newcomb, University of Michigan; Michael L. Pace, Institute for Ecosystem Studies; and J. B. Ruhl, Florida State University.

Competence of the Committee

Cooperman and Markle argue that the members of the NRC committee could not have reached a meaningful understanding of the scientific issues surrounding the endangered suckers over the few months during which they studied written documentation and heard oral presentations by researchers and others. Although required to pro-

duce an Interim Report on a schedule dictated by its statement of task, the NRC committee had the option of equivocating on key issues in the event that it could not reach any strong conclusions during the first few months of its work. Instead, the committee voluntarily and unanimously reached several strong conclusions because it was confident that the evidence presented to it supported these conclusions.

The NRC committee gave its conclusions in the Interim Report with two important qualifications. First, the committee noted that it would take into account any new evidence that might become available prior to release of its Final Report. The committee also emphasized that its evaluation was of the quality of scientific information available to support certain conclusions in the Biological Assessment (USBOR 2001) and Biological Opinion (USFWS 2001). Thus, the committee's finding of weak scientific support for any particular hypothesis or proposition in these documents does not constitute a denial on the part of the committee that such a theory or proposition ultimately could be supported scientifically by further study.

Cooperman and Markle suggest that scientists who work the longest on a problem should have the last word in evaluating information related to the problem. If so, the entire peer review system for science in the United States and elsewhere is flawed in that those who report results usually have more immediate knowledge of and longer experience with their own project or site than do those who review their work. The point of peer review is to introduce forms of criticism or independent evaluation that are not always achievable by those who are working closest to a project; this was the purpose of the NRC committee. The committee rejects the notion that the main issues of importance in the Klamath basin are so complex that they can be evaluated only by insiders.

External peer review has been minimal for work relevant to the endangered suckers of the Klamath basin. Very little of the scientific work underlying the Biological Opinion on endangered suckers of the Klamath basin has passed through a review of the type that accompanies publication in the primary literature; most of this information resides in reports or data files. Given the importance of the issues at hand in the Klamath basin, external review seems likely to be beneficial.

Cooperman and Markle illustrate their doubt about the competence of the committee to evaluate data on listed fishes by referencing a verbal error made by the NRC committee's chair. The chair

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does not recall referencing the longnose sucker in place of the Lost River sucker in an oral presentation, but admit to a certain fallibility of this type. The chair even admits to having sometimes mixed up the names of his two retrievers at the end of a long day, but also note that he is aware of the distinct identities of these creatures.

The NRC Interim Report

Criticisms offered by Cooperman and Markle of the NRC committee's Interim Report fall into several categories. Many are trivial in the sense that their resolution one way or the other would not in any way affect the final conclusions of the NRC committee. Because these sorts of trivial complaints are about as significant as the errors that Cooperman and Markle made in reporting the name of the NRC committee or in failing to understand distinctions between singular and plural uses of the noun "alga," they are not dealt with here. More important is the serious and pervasive misrepresentation of the committee's task and methods of work. This topic deserves some attention here. Finally, there are some substantive issues, when removed from the misleading context in which Cooperman and Markle have portrayed them, that deserve discussion from the scientific perspective.

The Nature of the Committee's Work

Cooperman and Markle repeatedly state or imply that the NRC committee presented theories or models of its own in contradiction to those of the federal agencies. The committee did no such work in preparing the Interim Report. The committee's charge, which appears verbatim in the report (NRC 2002), was to examine the strength of scientific evidence underlying various components of the Biological Assessment and Biological Opinion relevant to the endangered suckers. Thus, the committee went about its work by asking exactly what the underlying strength of scientific support might be for each significant element of these documents. The report is a presentation of the committee's analyses and interpretation of the data.

In carrying out its task, which not only guided but also constrained its work, the NRC committee had different objectives than did the USFWS in writing its Biological Opinion. The Biological Opinion prepared by the USFWS in 2001 in fact is an exemplary, exhaustive treatment of information of relevance to the requirements of the endangered suckers, and contains proposals framed in terms of risk reduction for revised operations of the Klamath Project. One of these proposals was for maintenance of higher water levels in Upper Klamath Lake. The USFWS honestly and bluntly stated in

its Biological Opinion, however, that the record of study provides no evidence for connections between water level in Upper Klamath Lake, which could be adjusted through modification of Klamath Project operations, and water quality or fish mortality. The NRC committee and the USFWS reached a similar conclusion in this regard, but the committee and the USFWS made different uses of the conclusion because of differences in their missions.

In discharging its functions as protector of endangered species, the USFWS elected to give considerable weight to the possibility that harm could come to the endangered suckers as a result of water levels within the lower range of observed water levels over the last decade or more. This conclusion was based on professional judgment involving risks that were not quantified or that involve harmful effects not yet mechanistically connected to water level. The NRC committee, in contrast, was asked to make an evaluation of the scientific basis for proposals by the USFWS. Professional judgment is useful but not scientifically rigorous, as it is drawn from generalities rather than information specific to a particular site. Thus, opinions based mostly or entirely on professional judgment were viewed by the committee as weakly supported or, when contradicted by site-specific data, as unsupported.

The use of professional judgment could be viewed by some observers as inadmissible for agencies administering the Endangered Species Act. The NRC committee might appear to endorse this viewpoint by finding professional judgment as applied by the USFWS to water levels of Upper Klamath Lake to be scientifically unsupported. The committee was merely following its task, however; it was not constructing an indictment against use of professional judgment. Indeed, professional judgment is the constant companion of applied science. It is commonplace in medicine, even when the stakes are very high indeed. Thus there is no reason to expect it to be absent from applied science of the environment.

The extent to which professional judgment can be used in avoidance of risk to endangered species is a question of policy. Because the USFWS or any other agency charged with administering the Endangered Species Act will be faulted greatly for errors of omission in protecting species, it is obvious that professional judgment will be used extensively by these agencies to minimize risk of error leading to decline of species. Where the economic stakes are high, however, it is useful for all parties to recognize which components of Biological Opinions are indeed scientifically solid and which are to varying degrees based on informed speculation. Thus, in concluding that there is no scientifically-sound support for the maintenance of specific water levels in Upper Klamath Lake proposed by the

USFWS, the NRC committee was not stating that the USFWS was derelict in its duties under the Endangered Species Act. A comparison of the final opinions of the USFWS and the NRC committee in this case exposes an unavoidable conundrum that is well known to those who are familiar with implementation of the Endangered Species Act: policies that are intended to reduce risk may be scientifically weak or even in contradiction to available evidence. No policy or law has yet been developed for resolution of this practical difficulty that agencies face in implementing the Endangered Species Act.

Cooperman and Markle comment specifically on the committee's apparent unawareness of the USFWS's duty to minimize risk. On the contrary, as explained above, the committee was well aware of these duties, but an assessment of risk was not part of the committee's charge. Thus, a hypothesis favoring recovery of a fish species at a given site could be weakly supported or even unsupported scientifically at a particular site, and yet be recommended by the USFWS as prudent based on general knowledge of the behavior, physiology, or other characteristics of fish. A greater difficulty comes with judgments based on the idea of prudence that are in contradiction with information from the field at a particular site, as is the interesting case for the welfare of endangered suckers in relation to water level in Upper Klamath Lake.

One additional misleading aspect of the article by Cooperman and Markle is that it fails to acknowledge the committee's finding that most of the specific recommendations made by the USFWS in its Biological Opinion of 2001 were scientifically sound based on observations and research. While the recommendation for specific water levels in Upper Klamath Lake has received much attention because of its economic and sociopolitical implications, it is not necessarily the most important

component of the reasonable and prudent alternatives proposed by the USFWS.

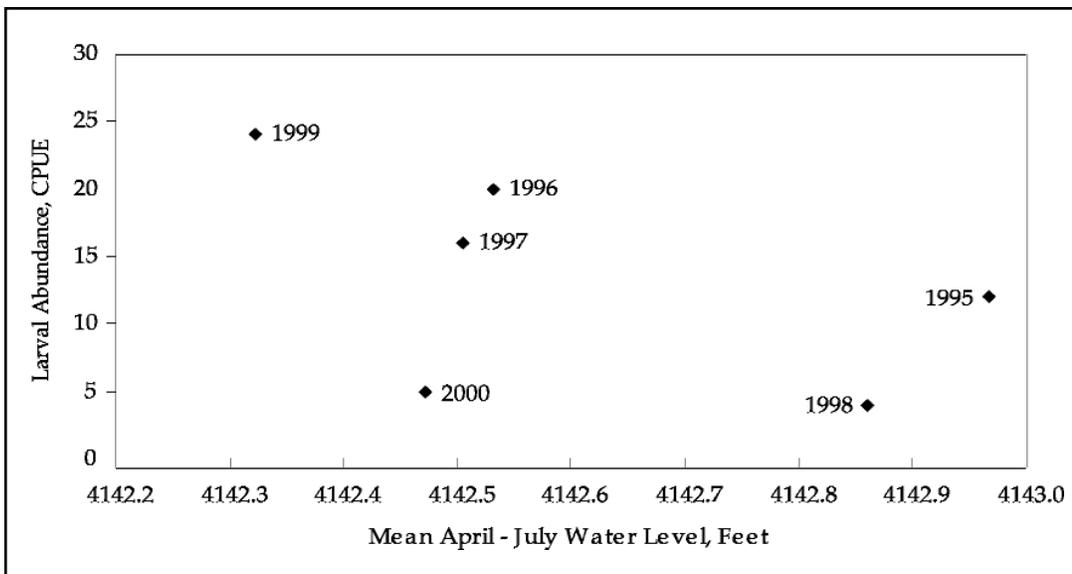
Specific Scientific Issues

Cooperman and Markle comment on the abundance of the two populations of endangered suckers in Upper Klamath Lake. They suggest, quite absurdly, that the NRC committee held the covert opinion that the populations are recovering. The section of the committee's Interim Report on population size is merely a presentation of background material distilled from the USFWS Biological Opinion (2001) and documents cited therein. Only a few facts about population sizes for Upper Klamath Lake are evident from the data, and these seem to be uncontroversial on all sides: (1) the populations once were very large and now are much smaller, (2) exact or even approximate sizes of the populations now and in the recent past are unknown, (3) the number of large fish in the population episodically has been reduced significantly by mass mortality, and (4) recruitment to the larger sizes is known to have occurred since the late 1980s, but the balance between this recruitment and loss of large fish to mass mortality is unknown. None of this is new and, contrary to the indication of Cooperman and Markle, it was not used in any sort of model or theory by the NRC committee. Most importantly, the committee did not use any novel assumptions about population sizes or changes in population sizes of the suckers in reaching its conclusions. The committee took as given the general basis for federal listing of the suckers, i.e., they are of such low abundance relative to earlier times and show such evidence of stress and failure to thrive, particularly in Upper Klamath Lake, that measures must be taken to create better conditions for them. Thus, the point of departure for the committee in reaching its conclusions was

an evaluation of various proposals to create better conditions for the suckers leading to an increase in the size and vigor of their populations.

The NRC committee used a portion of a histogram showing the age distribution of fish in fish kills (NRC 2002, Figure 5). Cooperman and Markle suggest that the committee had some motive for truncating this distribution so as to feature years after 1987, when the fishery was

Figure 1. Relative abundance of larvae (from Simon and Markle 2001) as determined by standardized sampling, in relation to mean water level of Upper Klamath Lake during the main interval of larval development (April–July). Confidence limits for individual points are substantial (95% C.I. \approx 50–100% of means).



closed. The caption of the figure indicates that the histogram was truncated; it is clear from the associated text that the focus was on the 1990s because the committee was interested in comparing age-classes of fish with coincident environmental data, which were not available for earlier years. Contrary to what Cooperman and Markle indicate, the committee was merely setting the stage for comparison of year-class strength with water quality conditions and water levels over the period of environmental data collection in Upper Klamath Lake.

Cooperman and Markle take issue with the committee's empirical tests of the hypotheses of underlying relationships between water level and the relevant population data on suckers (year-class strength, relative abundance of larvae and juveniles) and water-quality variables that are considered directly or indirectly threatening to the welfare of suckers (extremes of pH, dissolved oxygen, chlorophyll *a*). Cooperman and Markle characterize the committee's examination of these relationships as a search for linear correlations. The committee did not do any correlation analyses. Indeed, an examination of all plots of this type showed no hint of any relationship, be it linear, logarithmic, stepwise, or otherwise. The committee did not rule out the possibility that relationships exist, but could say with certainty that the data, which are considerable in some instances, simply do not support the existence of relationships between water level and indicators of the abundance or welfare of fish. These conclusions were not unique to the NRC committee. As acknowledged by Cooperman and Markle, the USFWS was straightforward in declaring the absence of any such relationships, as were the limnologists who made a detailed examination of water quality data (Welch and Burke 2001). Clearly both of these parties would have had an easier task in defending proposed adjustment of water levels for the welfare of the fish had they neglected to comment on the absence of relationships; it is a credit to their professional integrity that they did so. In continuing to advocate higher water levels in Upper Klamath Lake in the face of this information, however, the USFWS scientists were making recommendations unsupported by and even contradictory to scientific information, i.e., based on speculation in a doubtless well-meaning attempt to reduce risk to the fish.

Cooperman and Markle have alluded to the fact that complex factors might underlie relationships between water level and other variables involving the welfare of fish. For example, particular combinations of water level and weather conditions might be especially bad for fish. In fact, variations of weather conditions from year to year do seem to underlie variations in mass mortality of adult suckers from year to year, but there is no hint of any connection with water level. One could go even further in invoking complexity by suggesting that

the importance of water level is not evident because it is governed by a large suite of other variables. Thus, the relationships could be understood only by a very large data set. While this could be true, it begins to look like an attempt to salvage a hypothesis rather than to test it, as required by standard scientific practice. Furthermore, when converted into a management recommendation, a complex relationship such as the hypothetical one referred to by Cooperman and Markle would appear to be of little use. For example, one might tell the water manager to hold the water level high but not to expect any beneficial result because the effects of holding the water level high are only hypothetical and in any event are conditional upon a complex of other factors that cannot be controlled or predicted. More likely the key to mortality and hardships of suckers lies elsewhere.

Contrary to claims by Cooperman and Markle, the committee was well aware that fry are associated with shallow water and with macrophytic vegetation, and that both of these habitat features are influenced in extent by variations in water level in Upper Klamath Lake. It does not necessarily follow, however, that variations in the amount of this habitat are sufficient to influence the welfare of fry. In fact, extensive sampling of fry between 1995 and 2000 by Markle and colleagues has shown no indication of any relationship between water level and abundance of fry (Figure 1). Thus, while shallow water and its vegetation constitute habitat, variations in this habitat in response to water level do not appear to be a key factor in controlling the abundance of fry. Cooperman and Markle seem to be suggesting that the extent of marginal lake habitat for the fry must be maximized even if such an action does not result in greater abundance of fry. This stance certainly is possible under the breadth of policies available to the USFWS through the ESA, but it has little scientific credibility in terms of promoting the welfare of the species.

Cooperman and Markle also object to conclusions about the welfare of larvae in relation to water levels of Upper Klamath Lake in October, at the time of the annual minimum. The NRC committee did not base its conclusions solely on water levels in October. The committee considered relationships between abundance of larvae and water level in various months and combinations of months. For example, Figure 1 shows the relative abundance of larvae in relation to water level during the months when larvae are most abundant for the years over which larvae have been collected by standardized methods. The committee considered plots such as the one shown in Figure 1 relevant to the assertion that higher water levels would produce greater abundances of suckers in Upper Klamath Lake. Cooperman and Markle do not display plots of this type, although they extensively discuss the use of such plots by the committee. Evidently, plots of a

presumed dependent variable against a presumed independent variable carry no significant amount of information from the viewpoint of Cooperman and Markle. One wonders why the information should be collected if only one interpretation of it is allowed.

Cooperman and Markle complain about time spans of analysis used by the committee. Time spans for examination of empirical information vary because the time spans of data collection vary. Fish kills, for example, give information on older fish but no information on younger fish. Systematic larval sampling has been in progress since 1995 but not earlier; rigorous collection of water quality data began in 1990. Cooperman and Markle indicate that the committee either was confused or was manipulating time spans in order to reach preferred conclusions. Neither is correct; the committee was dealing with a variety of uncoordinated data sets.

Cooperman and Markle suggest that the NRC committee disregarded data on juveniles because the data were not consistent with some preconceived notions that the committee had about water levels. Figure 2 shows information on the abundance of juveniles in relation to water levels in June. As evident from Figure 2, and contrary to the implication of Cooperman and Markle (who cite specific years rather than graphing data), there is no hint of a relationship between the abundance of juveniles and water level in June (or other months). Contrary to the claim by Cooperman and Markle, the committee did not “dismiss” data on juveniles; it merely indicated a concern about uniformity and success of capture for the increasingly mobile juveniles, as has the USFWS (2002:30).

Cooperman and Markle characterize the NRC committee’s conclusions with regard to lake management as confusing in referencing both the mean and the minimum water levels in Upper Klamath Lake for various hydrologic categories of years. The agencies,

however, seem to have understood the committee’s conclusions (USBOR 2002; USFWS 2002). The committee mentioned both minimum and mean water levels because it did not want to be misconstrued as finding support for the use of operating plans that would preserve a given minimum while going to more extreme means or preserve given means while going to more extreme minima. Most important, and clear from conclusions given in the Interim Report, is that the committee was not recommending water levels but rather concluding that proposals to change water levels in either direction with respect to recent historical operating practices would not be supportable by way of scientific evidence. The committee did not prescribe water levels; it evaluated changes in water levels proposed by the agencies.

In their concluding remarks, Cooperman and Markle note that the NRC committee should have produced “alternative interpretations” rather than making an evaluation of the scientific validity of the proposals for management of the Klamath Project. As Cooperman and Markle surely must know, the requirement to judge the scientific underpinning of the proposals is given in the committee’s task. Furthermore, science could not progress without the constant evaluation of validity for hypotheses; this source of scientific rigor cannot be displaced by assertions to the effect that “alternative explanations” are possible for hypotheses that fail to pass empirical tests.

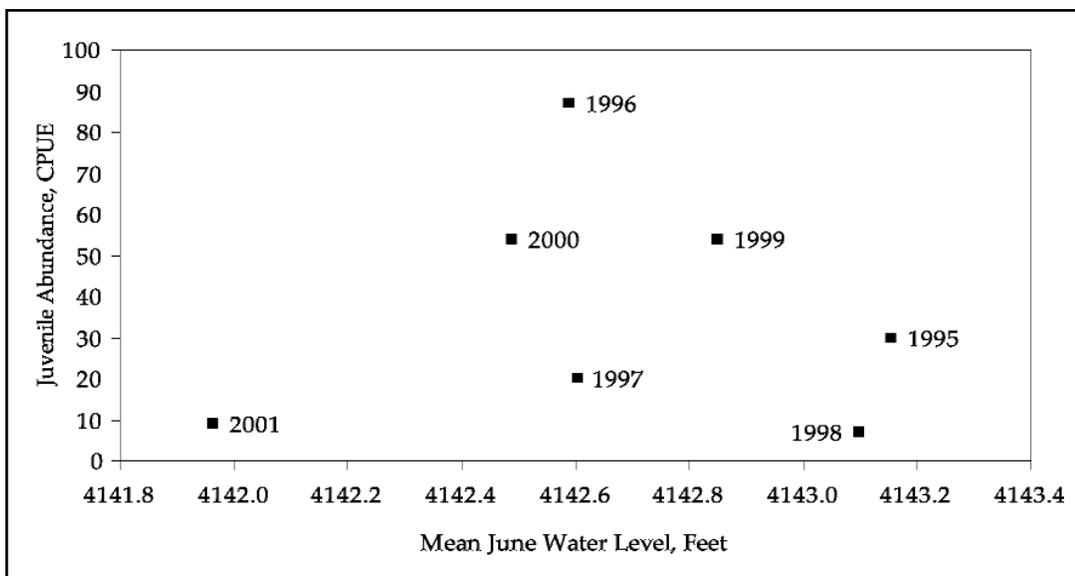
Cooperman and Markle are critical of a conclusion that the NRC committee made concerning Clear Lake, which contains endangered suckers. Cooperman and Markle fail to take into account the great morphometric and hydraulic differences between Clear Lake and Upper Klamath Lake. Upper Klamath Lake has a characteristic hydraulic residence time of approximately six months, whereas Clear Lake has a characteristic hydraulic residence time of well over a year. Thus, an interannual evaporation buffer is needed for Clear Lake but not for

Upper Klamath Lake. This distinction should have been evident from the USFWS Biological Opinion of 2001.

Conclusion

Cooperman and Markle, in grasping at every item in the NRC committee’s report that could be perceived or portrayed as an error, and in casting doubt on the committee’s competence and even its honesty, have shown that their main purpose is to discredit the committee

Figure 2. Relative abundance of juveniles (from Simon 2002) as determined by standardized sampling, in relation to water level of Upper Klamath Lake in June, when juveniles are likely to reach peak abundance. 95% confidence limits are typically 50-100% of means.



rather than to deal in a useful way with some of the important issues that the committee's report has highlighted. A strictly scientific approach to the evaluation of information can be disturbing when it contradicts conventional wisdom or long-held assumptions. Thus, from the viewpoint of public relations, the application of scientific methods to problem solving can be disruptive of the peace over the short term. Over the long term, however, a scientific approach to problems such as those that appear in the Klamath basin ultimately is the only reliable way of focusing remedial actions where they will be most effective rather than where they are most popular or most convenient. In this way the application of science to environmental problem solving works toward maintaining the credibility of environmental restoration or remediation, as necessary in the long run for public support of activities such as those carried out under the Endangered Species Act. 

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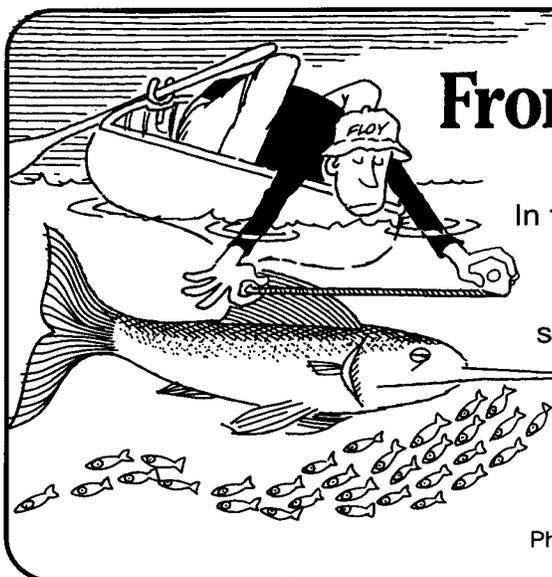
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Fisheries recognizes the controversial nature of the issue discussed here but, at the same time, encourages frank and considered exchange of views. The AFS does not take a position on this matter.



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