

Keystone Kops evaluate hatcheries

- Key in on tangible
cost / benefits

article - 9 yr. 19 mil \$

both prog.

catchables direct + ex. ind. w.

$$= 1.50 / \frac{1}{2} = \frac{3}{1b}$$

Economic volatility

to Dana Schury -

higher ex
821
contri. horizon + cost

$$- 50 - 8 - 150 -$$

max. value marginal value
ex. fish caught

expense?
with
fish

fish for
how much .. - 100 2

5 3 wild - 2 hatch

5 mil surplus

6 mil for cost

3

50%

$$3 \times 2 = 602$$

2 mil cost

$$3 \times 200,000 \text{ cost } 5 \text{ mil}$$

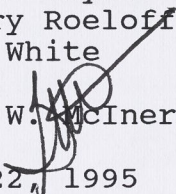
LAW OFFICES OF
BARRETT W. McINERNEY
SUITE 415
5900 NORTH SEPULVEDA BOULEVARD
VAN NUYS, CALIFORNIA 91411-9998

TELEPHONE (818) 787-7766

TELECOPIER (818) 787-1384

MEMORANDUM

TO: Dr. Robert J. Behnke
Dr. Eric Loudenslager
Dr. Peter Moyle
Dr. Terry Roeloff
Dr. Ray White

FROM: Barrett W.  McInerney

DATE: August 22, 1995

RE: **Various Comments on the EIR**

This process is quickly developing into a Fellini - like scenario. Enclosed is my memo re: the August 8, 1995 meeting; the DFG Comments and the CRI response. It just gets curiouser and curiouser.

LAW OFFICES OF
BARRETT W. McINERNEY

SUITE 415
5900 NORTH SEPULVEDA BOULEVARD
VAN NUYS, CALIFORNIA 91411-2511

TELEPHONE (818) 787-7766

TELECOPIER (818) 787-1384

MEMORANDUM

TO: Trout Unlimited

FROM: BARRETT W. McINERNEY

DATE: August 9, 1995

RE: Status of Environmental Assessment of Hatcheries.

On August 8, 1995, I attended my first meeting of the Hatchery Environmental Study Advisory Group. In attendance were Drs. James Vilkitis, Diane Long, Royden Nakamura and Richard Thompson of Cal Poly San Luis Obispo's Coastal Resource Institute ("CRI"), Gene Flemming, California D.F.G. Assistant Chief of Inland Fisheries, Tim Farley, California D.F.G. Director of Inland Fisheries, Bruce Barngrover, a Regional Director of Hatcheries, and Jim Edmondson, Executive Director of California Trout.

The meeting lasted four (4) hours with no breaks. The bottom line is that the draft will be re-written again and submitted for internal review before a public draft is released. This will open still another window for comment.

The common overriding complaint from CRI members was a lack of qualitative information to adequately address biological and economic concerns. Dr. Nakamura pointed out that California DFG has provided little or no information available assessing either the biological carrying capacity of the State's planted waters in order to evaluate viable alternatives to hatchery grown catchable trout or the potential and expense of habitat improvement to improve fish survival and reproduction. The CRI has concluded:

"The team lacked qualitative and quantitative data for specific ecological statements. There is not enough scientific information to extrapolate to specific ecological conditions. As such, only generic statements (can) be made."

As disappointing as that may seem on the biological front, the informational vacuum on the economic side of the ledger is absolutely cavernous. California DFG now claims that even some of the most fundamental "facts" in the Draft were the product of misinformation:

1. Cost of the Hatchery Program

A. CRI Draft

1. "Fifteen state hatcheries are funded with about \$15 million" (Draft at p. 61).

2. "Inland Fisheries' budget is just over \$48 million (and 40% of that budget goes to hatcheries)" [Draft at pp. 59, 61]. Thus a total of \$19.2 million for hatcheries.

B. Discussion at the meeting

The Inland Fisheries' Chief Tim Farley said that the hatchery budget is no more than \$9 million.

2. Habitat Restoration for Trout

A. CRI Draft

"Habitat Restoration is primarily directed at improving habitats for native and non-native game species that are in high demand, mainly trout. . . . Habitat Restoration was 30% of the Inland Fisheries' budget (or \$14.4 million)" [CRI Draft at p. 61].

B. Discussion at the meeting

- Tim Farley admits that virtually all of the Habitat Restoration spending is for salmon and steelhead and not trout.

3. Hatchery Budget as an indicator of Production

A. CRI Draft

"In 1988, DFG hatcheries absorbed a 20% reduction in operating budgets, which has not yet been restored" [CRI Draft at p. 62] and "hatchery budgets have been flat (in recent years)" [CRI Draft at pp. 64-64].

B. Discussion at the meeting

In each of the seven (7) years after the unrestored budget at the hatcheries, "DFG Total Trout Pounds

Produced" has equalled or exceeded pre-1988 production levels despite inflationary cost increases.

4. Economic contributions of hatchery trout fishing

A. CRI Draft

"Trout fishing, in a state as large and with as a diverse an array of waters as California possesses, involves considerable direct expenditures (about \$2.2 billion) on travel, lodging, food consumption, sporting gear, boating and other more indirect activity (see Figure 1). This in turn generates nearly \$5.7 billion in direct and indirect business (value-added) activity, or almost 1% of California's domestic product. In turn, this activity creates over 153,000 jobs that provide nearly \$5 billion personal income, representing around 1% of total state's employment and personal income (McWilliams and Goldman 1995). With approximately 1.5 million licensed anglers providing around 30 million angler-days per year, this economic contribution amounts to around \$190 per angler-day (assuming 16 angling-days per angler, Anderson 1990). Direct expenditures alone account for about \$75 per angler-day. Considering those expenditures that can most directly be attributed to fishing activity -- food, lodging, transportation and fishing equipment, nearly \$1.2 billion is spent or about \$40 per angler-day." (CRI Draft at pp. 56, 79.)

B. Discussion at the meeting

The \$2.2 billion represents all recreational fishing in 1985 including ocean, warm water and fly fishing and includes \$700 million in "boats, camping equipment and other RV's." For example, Florida generated \$3 billion in recreational fishing without any coldwater fisheries or trout hatcheries. In fact, it is universally conceded that the hatchery trout-bait angler generates far less economic contribution per angler-day than their more affluent ocean, bass and fly fishing counterparts. Using the "average expenditure" between a hatchery trout angler and free-spending ocean, bass and fly fishermen is the same as adding the sale prices of a used Yugo and a new Rolls Royce, dividing by two and then using that average as the value of a Yugo because, like the Rolls Royce, it is an "automobile."

In fact, aside from the general sales of licenses, Cal DFG has no data to determine the number of licensed anglers who primarily fish for hatchery trout particularly in the streams and rivers where the adverse biological impacts of hatchery trout are the greatest.

Therefore the "economic value" of the widescale availability of hatchery trout can any be speculative and only supporting evidence will be purely anecdotal. Since all of the CRI's Cost-Benefit Analysis is based on the \$2.2 billion premise, the resultant economic analysis is equally flawed.

5. Cost of a hatchery trout in the creel

A. CRI Draft

"Return-to-creel rates reported in the literature appear to (be) fairly stable, averaging around 60-65%" (CRI Draft at pp. 76-77).

B. Discussion at the meeting

The last known creel censuses in California were in the early 1950's on Crystal Lake in Los Angeles County and the late 1940's on Rush Creek in Mono County by two, now retired DFG biologists. The return rates of hatchery trout planted in streams and rivers versus the return rates of those same fish in large and small lakes has never been quantified. All projections of "in the creel" must assume an unquantified return rate and will amount to more than further conjecture based upon still more folklore.

6. Conclusion

The CRI members, particularly in the economic analysis area, have had standing unanswered requests for information from California DFG for almost a full year. In their own words:

"Our assessment is based on California Department of Fish and Game data per our contract and in some cases data are lacking causing a weak base for assessment."

After over a full year into the project, the most optimistic assessment of the process is that we now know pretty much what we don't know. We also know that California Fish and Game has generally been unwilling or unable to close this informational gap despite insisting that the CRI focus on CDFG data. Even worse, it appears that these deficiencies in the California Fish and Game informational base have irretrievably institutionalized this ignorance. Despite all of the best intentions and superb qualifications of the CRI staff, in my lay opinion, it is unlikely that an effective document can be developed within the budget limitations and time constraints established by the contract with the California Department of Fish and Game. It is unclear whether this unfortunate development is accidental or strategic, but the result is the same in either case.

Coastal Resources Institute

California Polytechnic State University
San Luis Obispo, California 93407

M e m o r a n d u m

To: Mr Gene Fleming
Dept of Fish and Game

Date: 14 August, 1995

From: Dr James R Vilkitis
Coastal Resources Institute

Subject: Preliminary Review of Environmental Document

On behalf of the Cal Poly CRI hatchery study team, we would like to thank you for the opportunity to meet with DFG, Cal Trout and Trout Unlimited in Sacramento to discuss the preliminary draft of the environmental document. Our team met and discussed the concerns identified by Mr Tim Farley. The team believes that two points need to be restated prior to responding to the concerns.

First, the team's primary responsibility as identified in the Memorandum of Understanding (MOU), and in all meetings relating to the environmental document, was to conduct a comprehensive review of the historical and current literature in addressing the issues identified by Trout Unlimited in its lawsuit with DFG. The team was not to produce an EIR or conduct any research or analysis which would lead to developing mitigation measures for the various alternatives identified in the MOU. There appears to be a shift in mode from the original MOU, which identifies a comprehensive review of DFG reports and scientific literature, to one that involves research, analysis and mitigation. The latter was never intended to be part of the environmental document, and we do not consider it as part of our agreement.

Second, during the information gathering, document outlining and alternative formation phases of the MOU, the advisory council had frequent opportunities to address their concerns. The direction of the council and DFG were significant forces in developing the draft document. With the council and DFG guidance the team proceeded to expend resources to meet the intent of the MOU. We have expended available resources, but are willing to complete the document as specified in our original agreement. To request significant changes to the document at this time will require additional compensation for the increased work assignments.

In addition, the team strongly believes that by changing the format of the document to mock that of an EIR would give the reader the impression that the document was indeed an EIR. We are of the opinion that this type of presentation would damage the credibility of the review team and its product.

In clarification of the issues raised by Mr Tim Farley, we are able to deliver the following to you in accordance with the existing MOU:

1. Data Analysis and Reporting

The scientific sections of our draft document will be moved into the appendices. The document will cover the scientific sections in a generalized presentation. The team lacked qualitative and quantitative data necessary to extrapolate specific ecological conditions or statements. Therefore, only generic statements will be made in the body of the text. The text of the report will be written for public consumption. The following will be completed in the next draft:

- Enhance organization for readability.
- Clarify the objectives, direction and content early in the document.
- Include all reviewed citations.
- Provide a bibliography on disk.
- Include a glossary / list of definitions.
- Use taxonomic classification of DFG or American Fisheries Society.
- Incorporate summary information to correct or update errors and significant omissions (the deadline for accepting information is September 15, 1995).

2. Document Review

We are in agreement with an additional internal review of the next draft. Please let us know how to handle copies and mailing. We do not have a budget (mailing or personnel) for extended reviews. We would like to participate in these important functions, but must be prudent with what little resources are left. Perhaps we can send a number of disks to various Kinko's offices to expedite availability and reduce costs?

3. The Environmental Document

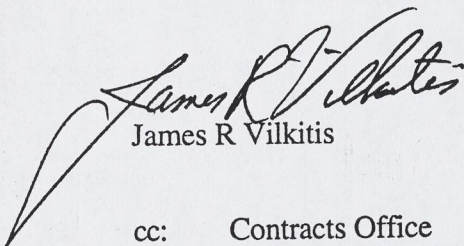
The Environmental Document will be prepared in the format that was presented in the MOU and modified by the advisory council. In general it will include: an expanded executive summary, project description, environmental setting description, environmental effects of trout planting, economic effects of hatcheries and fish planting, discussion of alternatives, literature cited, and appendices with relevant documents including papers related to scoping, program history, and biological and genetic effects. The document is based on a review of scientific literature, reports and summary data we have considered. The document will suggest which alternatives are feasible and which appear not to be feasible.

It is beyond the scope of work to provide a "preferred alternative", since information (summary data) has not been available and no funding or MOU activity had been envisioned for providing the analysis, research and document preparation typically done for an EIR. Thus, we are unable to address mitigations (as would be usual in an EIR). This point was made clear in our MOU and project discussions. As agreed, the report is designed to provide policy direction only and not to provide an environmental impact report which would require extensive analysis of quantitative ecological data, more comprehensive economic data, and site visits.

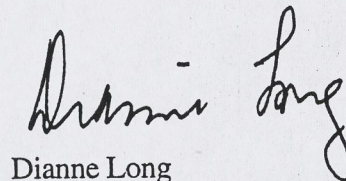
Additional review of data will be dependent on its availability, format, and when it is delivered to the team. The deadline for accepting data is September 15, 1995. A listing of data needs is enclosed. Obviously, a computerized data set is preferable, and all materials will be returned to you if that is your desire.

We are pleased to be working with you.

Sincerely,



James R Vilkitis



Dianne Long

cc: Contracts Office
Env. Cord. Office
Tim Farley
Barrett McInerey
Jim Edmondson
Mike Fish

enc: Listing of data needs

Data Request

In general if you have summary data which had been excluded, particularly that related to the budgets, production, and distribution patterns of the trout and inland salmonids, we would be pleased to include it. Also, we do not have a recent (post-1960's) legislative history related to fisheries nor history of the hatcheries. If these are of interest please forward, so we can explain the evolution of recent practices. Once we see the format and content of a data set(s) and other materials, we can better establish scheduling for completion of the report.

We would like to identify the three major fish diseases that have been a recent challenge, and the major species produced at each hatchery (summary).

The following was specifically requested by team members:

Rich Thompson

- A summary of budget data for 1993-94 specific to Inland Trout and Inland Salmonids programs (trout hatcheries, habitat restoration and improvement, etc.). I already have data on funding sources for WTP and Threatened Trout between 1994 and 1995.
- A summary of catchable, subcatchable and fingerling plantings by type of water (e.g., streams, roadside lakes and reservoirs, high mountain lakes).
- GIS-compatible data for mapping planting locations, wild trout program waters, waters and regions with threatened/sensitive/special concern species.
- Production costs by fish size for all 15 hatcheries for 1993-94 (excluding planting costs).
- Information on costs of redistributing hatchery-raised catchables to high-demand areas (e.g., L.A. basin, Bay Area).
- In response to comments made by L. Ryan Broddrick, could you provide a one or two page narrative describing "the DFG hatchery production and stocking of trout... An overview of how the system functions statewide for each of the different programs, i.e. fingerling, subcatchable, catchable, by species, should be incorporated. These programs function by producing trout and transferring these fish between regions and geographic areas." I have a general "feel" for how this works, but you would be able to describe it more accurately and succinctly than I.

Robert Clover: Summaries and / or references to relevant reports or literature for the following.

- DFG and contractors' reports on ecological interactions between introduced hatchery trout and wild trout.
- DFG and contractors' reports on behavioral interactions, behavioral differences, and/or behavioral anomalies of hatchery-produced trout and wild trout.

- DFG and contractors' reports on genetic characteristics and/or genetic variation in hatchery trout and wild trout.
- DFG and contractors' reports on predation of and by hatchery fish at sites where hatchery fish have been introduced.
- DFG and contractors' reports on angling pressure at sites where hatchery fish have been introduced.

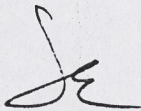
Memorandum

To : Mr. Timothy C. Farley

From : Department of Fish and Game

Subject : Comments on Draft Environmental Document on the Culture and Inland Salmon In California

8/17

Barrett - Haven't
seen DFG's comments,
but suspect these
may not have been
included. 

My staff has reviewed the subject document and would like to submit the following comments. The document is incomplete and has sections that are not well organized. There are statements attributed to other studies or documents that are inaccurate or incorrectly stated.

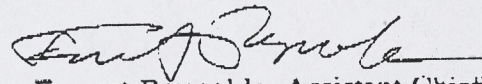
It appears that nearly all material from one major section of the document (Section 4.3. Long Range Environmental Impacts) was taken *verbatim*, with few minor word changes, from another document (Steward and Bjorn 1990). This leads us to question whether the references cited in this section were actually reviewed, and if other sections were similarly taken *verbatim* from other documents. This might explain the disjointed passages and poor organization of the document. Because of this, we have concerns regarding the integrity of this document. We believe a substantial re-write is necessary before the document is submitted for public review.

We reviewed the document from an anadromous fish management perspective, although we realize that the subject of the document did not include anadromous fish hatcheries and possible impacts on the environment. The stocking of resident trout species could have environmental, socio-economic, and programmatic impacts to anadromous fish species, primarily steelhead rainbow trout. Although some of the biological impacts (e.g. genetic and ecological) to steelhead populations are included generally, the analysis of impacts on steelhead populations is lacking. The report should include possible impacts to native resident rainbow trout forms which we believe are important to the persistence of anadromous forms inhabiting naturally unstable environments, such as the coastal streams of southern California.

It appears that the authors were not aware that steelhead throughout California are a candidate species for listing under the Federal Endangered Species Act nor were they aware of the existence of other DFG trout programs, such as the Steelhead Management and Restoration Project.

Mr. Timothy C. Farley
July 24, 1995
Page Two

Attached are our specific comments. Please contact me if you have any questions. Also, we would welcome the opportunity to meet with the authors to discuss status and management of steelhead and the Steelhead Management and Restoration Project. Please let me know if you think this is appropriate and I will make the appropriate members of my staff available.



Forrest Reynolds, Assistant Chief
Inland Fisheries Division

Attachment

bc: Dennis McEwan

MCEWAN:jl

File: IFD File, Chron

Specific Comments

1.1 Purpose and Need

The statement, "[T]his study does not include anadromous fish" should more specifically state that the scope of the study does not include the environmental effects of the anadromous fish hatcheries. As stated in the general comments, we believe that the analysis of affects of resident trout hatchery programs on anadromous fish, primarily steelhead, is deficient and needs to be addressed.

2.6.1 Biological and Environmental Issues

We are not familiar with the term "d-catchables".

2.6.4 Programmatic and Economic Issues

The two paragraphs on the top of page 12 do not seem to pertain to this section.

3.1 Introduction

According to Benke (1992), all California steelhead are included in the coastal rainbow trout subspecies, *Oncorhynchus mykiss irideus*, which includes both anadromous and resident forms. This appears to be widely accepted (see Busby et al 1994). Rainbow trout appear to be taxonomically structured on a geographic basis, rather than on run-timing or tendency for anadromy (Behnke 1972, 1992; Allendorf 1975; Allendorf and Utter 1979; and Wilson et al. 1985). Placement of the two forms in two different subspecies, as the authors have done, is outdated. Benke (1992) ascribes the subspecific name *galrdnert* to the redband rainbow trout (including steelhead forms) of the upper Columbia River system.

3.2 Fish Populations Before 1870

This section is poorly written, contains erroneous information, and is incomplete.

3.2.1 The Sierras and Northern California

The eastern slope of the Sierra Nevada was formed by tectonic processes, not by the presence of Pleistocene Lake Lahontan, as stated.

Tui chub (*Gila bicolor*) should be added to the list of fish species supported by Pleistocene Lake Lahontan.

"Sierras" is an grammatically improper reference to the Sierra Nevada Mountains.

3.2.2 The Owens Valley and Southern California

Owens speckled dace (*Rhinichthys osculus* ssp) should be added to the list of fish species supported by the waters of the Owens Valley. The use of "River" in the common name of the pupfish, chub, and sucker is incorrect.

3.2.4 Early Legislative Response

Cite reference for the statement "...a large number of salmon appear to have been wiped out..." or delete. A more accurate statement would be that serious impacts to salmon populations occurred from these activities.

3.3.4 Proliferation of hatcheries 1910-1960

"Demise" means "death", therefore the "...the obvious demise of the aquatic, riparian, and salmon resources of the west..." is overstating the situation somewhat.

3.4.3 Managing for Genetic Diversity

This section is disjointed, poorly written, and contains material not germane to the subject.

While it is true that the use of artificial spawning channels has been a management strategy to protect "gene banks", it should be stated that, in California, they have largely failed to mitigate for loss of natural spawning habitat and maintenance of genetic diversity, especially for anadromous fish.

3.5 Present Situation

This section is incomplete. Specifics of hatchery planting operations are referred to Appendix B, which was not provided to us for review. Specific information regarding total number of fish stocked (by category), methods of stocking, location, timing, etc. is important to establish the present situation and should be included in this section in detail.

3.5.1 Definitions

The reference for the statement that put-and-take rainbow trout are "ill-adapted for surviving in streams and are likely to die...within a few weeks" should be provided.

The Steelhead Management and Restoration Project should also be acknowledged in this section, in addition to the three "major trout programs" of DFG. As stated in the general comments, we believe that the omission of this program throughout this document is a serious deficiency.

4.1 Long-Term Biological Impacts

It is not clear how the contents of this section relate to long-term biological impacts. Impacts to systematics, taxonomy, ecological relationships, population dynamics, or genetic integrity are not described in this section, although some are covered in subsequent sections. This section contains some good information, however, but it may be more appropriate in an introductory section in the previous chapter.

Information on the effects of hatchery stocking on the ecological integrity of aquatic ecosystems and ecosystem dynamics, particularly those pertaining to native herptofauna, should be included in detail in this chapter. Although mentioned on page 11, analysis of impacts to native herptofauna are lacking in this document.

Impacts to native rainbow trout population dynamics should also be included. As stated previously, we believe that loss or reduction of native resident rainbow trout forms could have serious effects on the persistence of anadromous forms in hydrologically variable stream systems.

4.1.3 Biological Aspects: Population Dynamics and Genetic Integrity

Although impacts to genetics of wild trout is adequately covered in subsequent sections, impacts to population dynamics and structure is lacking (see above comment).

4.3. Long Range Environmental Impacts

Nearly all the material in this section and subsections appears to have been taken *verbatim*, with few minor word changes, from Steward and Bjornn (1990) who synthesized the published literature on anadromous fish supplementation. This leads us to question whether the references cited in this section were actually reviewed. Also, in several passages in this document taken *verbatim* from Steward and Bjornn (1990), the authors simply replaced the term "supplementation" with "fish stocking" or "hatchery planting". Because supplementation (stocking of hatchery reared fish to supplement the wild spawning population) and stocking of fish to enhance angling have different goals and practices, this is not appropriate.

4.3.1 Genetic Diversity

In reference to the statement that "genetic impacts of superimposing hatchery fish on wild populations can be detrimental, benign, or beneficial", the authors provide many references to support the statement that genetic impacts are detrimental, yet there are none in support of the assertion that genetic impacts can be benign or beneficial. The appropriate studies should be cited. We are not aware of any studies that have shown genetic impacts from hatchery stocking to be beneficial to wild populations.

4.3.1.2 Outbreeding Depression

The definition of outbreeding depression is not well presented and not very understandable. This topic can be easily integrated into Section 4.3.1.4 (see below).

4.3.1.4 Gene Flow and Genetic Load

This is a much more understandable definition of outbreeding depression than that contained in Section 4.3.1.2. We suggest that these sections be combined and retitled "Gene Flow, Outbreeding Depression, and Genetic Load". Insert the following sentence into the 2nd paragraph, after the sentence that ends "...their offspring may be less well adapted to the environment than would be the offspring of two wild fish": "The resulting decline in overall fitness of the wild population is termed outbreeding depression".

4.3.1.5 Genetic Drift

Strike "rare" from the statement "...the direction of change is random but may include permanent losses of rare alleles...".

In the last paragraph, after "Kapusinski and Jacobson (1987)" add "and Allendorf and Phelps (1980)".

In the last sentence, it should be noted that the "200 individuals" cited in Allendorf and Ryman (1987) does not refer to the effective population size, but is the total breeding population necessary to achieve an adequate effective population size.

4.3.1.6 Disruption of Coadapted Genetic Structures

The last paragraph is not germane to this discussion and should be deleted.

4.3.2.5. Foraging Behavior

The first paragraph was taken *verbatim* from Steward and Bjornn (1990) except that the 2nd sentence, which states "There is no evidence that the diet or feeding habits of wild fish are unaffected by the introduction of hatchery fish" has been changed from "As far as we know, the diet or feeding habits of wild fish are unaffected by the introduction of hatchery fish". This is an improper and inaccurate reference.

Chapter 5. Programmatic and Economic Impacts

Much of this chapter is too technical and does not appear to be understandable to those that do not have an extensive technical background in economics.

Another socio-economic impact that should be addressed is the effect that hatchery programs have on habitat restoration programs. Hatchery programs promote the perception among the general public that habitat quality has no effect on angling quality, hence no effect

on fish population abundance and health. Hatchery programs palliate the widespread loss and destruction of habitat and tend to conceal from the public the effects of habitat degradation (Meffe 1992).

5.2 Economic Contribution of the Inland Trout Fishery Resource

It is incorrectly stated that trout fishing involves about \$2.2 billion in direct expenditures in California. McWilliams and Goldman (1994), from which this was taken, attribute this dollar amount to recreational fishing, which also includes warm water and saltwater sportfishing.

5.7 DFG Hatchery Stocking and Geographic Distribution

The statement "the Eastern Sierras did not have a native trout population and its habitat tends to be seasonal, making these waters ideal for put-and-take programs" is inaccurate and completely without merit. The eastern Sierra Nevada region is generally defined as the east slope of the Sierra Nevada Mountains in Inyo, Mono, and portions of Alpine counties. Of these counties, only Inyo county lacks a native trout species. In all of these counties, abundant perennial trout habitat exists, and there are many self-sustaining populations. The citation for the statement "Much of the tourist industry in these counties has arisen from the recreational trout supplied by DFG" should be provided or the statement should be deleted.

5.10 Wild and Threatened Trout Programs

The Steelhead Management and Restoration Program should be included in cost efficiency and costs and benefits analysis of this section.

The statement "There has been virtually no work on habitat improvement or restoration, due to concerns over the effectiveness, costs and impact on existing ecosystem" does not make sense.

5.11 Conclusions and Implications

This section is too technical, poorly written, and not understandable.

Literature Cited

- Allendorf, F.W. 1975. Genetic variability in a species possessing extensive gene duplication: genetic interpretation of duplicate loci and examination of genetic variation in populations of rainbow trout. Ph.D. Thesis. Univ. of Washington. 97 pp.
- Allendorf, F.W. and S.R. Phelps. 1980. Loss of genetic variation in a hatchery stock of cutthroat trout. *Trans. Am. Fish. Soc.* 109:537-543.
- Allendorf, F.W. and N. Ryman. 1987. Genetic management of hatchery stocks. in N. Ryman and F. Utter eds., *Population Genetics and Fishery Management*. Univ. Wash. Press. Seattle. pp 141-159.
- Allendorf, F.W. and F.M. Utter. 1979. Population genetics. in W. Hoar, D. Randall, and J. Brett, eds. *Fish Physiology*, Vol VIII. Academic Press, New York. p 407-455.
- Behnke, R.J. 1972. The systematics of salmonid fishes of recently glaciated lakes. *J. Fish. Res. Board of Canada*. 29(6), 639-671.
- Behnke, R.J. 1992. Native trout of western North America. American Fisheries Society Monograph no. 6. 275 p.
- Busby P.J., T.C. Walnwright, and R.S. Waples. 1994. Status Review for Klamath Mountains Province Steelhead. NOAA Tech. Mem. NMFS-NWFSC-19.
- McWilliams B. and G. Goldman 1994. Commercial and recreational fishing in California: their impact on the state economy. College of Nat. Res. Univ. Calif. Berk. Pub CNR001.
- Meffe, G.K. 1992. Techno-arrogance and halfway technologies: salmon hatcheries on the Pacific coast of North America. *Conservation Biol.* 6:350-354.
- Steward, C.R. and T.C. Bjornn. 1990. Supplementation of salmon and steelhead stocks with hatchery fish: a synthesis of published literature. U.S. Dept. of Energy, Bonneville Power Admin. Tech. Rpt. 90-1. Project No. 88-100.
- Wilson, G.M., W.K. Thomas, and A.T. Beckenbach. 1985. Intra- and inter-specific mitochondrial DNA sequence divergence in *Salmo*: rainbow, steelhead, and cutthroat trouts. *Can. J. Zool.* 63: 2088-2094.