A Joint Independent Scientific Review Panel and Independent Economic Analysis Board Review for the Northwest Power and Conservation Council

Review of the Select Area Fishery Evaluation Project 1993-2003 Final Project Completion Report

(J. North et al. June 2004)
Project #1990-060-00

(SAFE Review)

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Background

On September 11, 2002 the Council provided funding recommendations to Bonneville for the Estuary Province. The Council requested that prior to approval of the staff recommendation for project 1993-060-00, *Select Area Fishery Evaluation Project (SAFE)* included as part of the Lower Columbia and Estuary provincial review, that the sponsors (Wash. Dept. of Fish & Wildlife, Oregon Dept. of Fish & Wildlife, and Clatsop County Economic Development Council) provide additional information on the economic benefits accruing to the commercial fishing economy through the implementation of this project. On October 4, 2002 the Council received, from the sponsors, a document in response to the Council's request. The sponsors followed by presenting additional testimony presented to the Fish and Wildlife Committee on October 15, 2002. Based on this presentation and testimony the Council found that the project sponsors addressed the condition placed on this project as part of the Estuary provincial review. The Council further recommended that Bonneville fund the project at the levels, and with the conditions, provided in the staff recommendation for the Lower Columbia and Estuary:

> Funding associated with Fiscal Year 2003 will address the tenth and final year of the feasibility study. The Council needs to receive a final report regarding this project summarizing and evaluating the findings and conclusions of this investigation regarding the feasibility of terminal fisheries in the lower Columbia. This report needs to be comprehensive and must address the current dynamics in the commercial fisheries such as the market, the economic value of the fisheries made possible through this project, and the value to the industry of this project in the context of all other fishing opportunities and activities in the lower Columbia and Estuary that the industry now has available. At the conclusion of the tenth season the information and data collected to date will need to be summarized and analyzed with the report submitted in Fiscal Year 2004. Activities associated with this final report and project review needs to occur within the budget proposed in the staff recommendation. If there is a budget shortfall, sponsors will need to prioritize tasks from within budget to ensure completion of these final report activities. Staff recommends that the project sponsors' final report be reviewed by both the ISRP and the IEAB during Fiscal Year 2004, and that future funding for this proposal (i.e. Fiscal Year 2005) is conditioned on a favorable review by these advisory boards and the Council.

On June 21, 2004 the project sponsors (Wash. Dept. of Fish & Wildlife, Oregon Dept. of Fish & Wildlife, and Clatsop County Economic Development Council) submitted the "Select Area Fishery Evaluation Project, 1993-2003 Final Project Completion Report" (Completion Report). The submittal is intended to address the conditions placed on the project as part of the provincial review decision that requested that the ISRP and IEAB review the project's final report. Based on the ISRP and IEAB review the Council will provide a recommendation regarding the future funding of the project.

Executive Summary

The Completion Report contains comprehensive biological content describing many parts of the project's ten-year history. The attitude conveyed by the Completion Report is that protection of listed stocks is the highest priority. The appendix lays out a reasonable monitoring program, originally minimal but augmented after 2003. The report documents an increase in availability of salmon to the fisheries as a result of project actions.

In terms of its economic content, the Completion Report is partially responsive to the request to provide information on the ex-vessel market for salmon, the economic value of the fisheries and the value of this project to the industry, in the context of fishing alternatives.

This combined review identifies a number of biological and economic issues that need consideration and improvement.

- The report does not adequately describe or reference either the biological or economic methodology used in the project. This is a major concern. Without methods of sampling and analysis described and documented, it is not possible to verify reported results and ensure that repeatable procedures can be applied in the future

- Production goals are unclear. What is meant by "full implementation" is not specified. The question of the cost-effectiveness of further expansion is not addressed.

- The reported 80-90% harvest rates of SAFE stocks are extremely high. The report should verify these rates and demonstrate that they are achievable without unwarranted impacts on local fishes.

- Fishery impacts on listed as well as non-listed stocks should be better evaluated and described.

- The rationale for importation of a non-local stock is not explained, but should be.

- Efforts to regularly apply CWT for assessment are laudable, but there is concern that given the survival levels quoted, the numbers of tags applied appear to be marginal. Is there a statistical basis for the numbers and what questions are they designed to address?

- Treatment of the test fishery is technically inadequate in determining if a stock of concern was present and at what frequency. If the sole basis for this determination is CWT recovery, then the test fishery may not adequately sample for these rare recovery events.

- The report does not provide information on costs of achieving project goals. This is a major omission in terms of evaluating either the likely cost-effectiveness of continuing investments or the appropriate level of such investments.

- Because cost considerations are absent, the report presents only a partial picture of project benefits (gross, rather than net incremental benefits). Maximizing the value of

harvest, as well as the project overall, requires a consideration of both costs and benefits and how they change under different conditions.

- The report does not thoroughly explain how decisions about project modifications are made, and how costs and benefits inform those decisions.

- Expectations about how long BPA mitigation funding of this fishery should continue are not discussed, nor are possibilities for cost sharing between the region and local interests according to the distribution of project benefits and responsibilities for power system mitigation.

- Economic components (costs and benefits) are not part of ongoing monitoring and evaluation, but should be.

1. Biological Content Review

Introduction

In 1993, Bonneville initiated the Columbia River Terminal Fisheries Project (now named the Select Area Fishery Evaluation (SAFE) project), a 10-year comprehensive program to investigate the feasibility of terminal fisheries in Youngs Bay and other sites in Oregon and Washington. This cooperative project between the Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), and Clatsop County Economic Development Council's (CEDC) Fisheries Project explored the means to increase harvest of hatchery fish while providing greater protection to weak wild salmon stocks. The project was intended to use existing hatchery facilities and selected net-pen rearing (acclimation) and release sites. It developed in three distinct stages: an initial two-year research phase to investigate potential sites, salmon stocks, and methodologies; a second three-year phase of expansion in Youngs Bay and introduction into areas of greatest potential as shown from the initial work; and a final five-year phase of establishing terminal fisheries at full capacity at all acceptable sites. The project is now in the third phase, which expands the number of net pens, the amount of releases, and the scale of fisheries. Several sites are now deemed suitable for this expansion.

General Conclusion

Overall, the Completion Report contains thorough and informative biological content that is responsive to ISRP concerns. It consists of a detailed narrative of the project's 10 years of activity, supported by relevant and comprehensive tables and figures. The project has general goals, which, although stated a bit differently in different sections of the report, are consistent overall. Specific production goals, however, are not defined. The attitude conveyed by the Completion Report is that protection of listed stocks is the first priority, even if it means shutting down the SAFE fishery. The data presented indicates a very limited impact on listed stocks. However, the absence of detailed information on methods used to estimate impacts makes it impossible to assess the validity of this conclusion.

The appendix lays out a reasonable monitoring program, originally minimal but augmented after 2003 as requirements of NPDES permits were implemented. Useful summary data are provided showing some localized impacts from organic loading.

The Completion Report documents an increase in availability of salmon to the fisheries as a result of project actions. It justifies expenditures in terms of the ability to extend fishing seasons beyond those in the mainstem, and to increase fishery participation and catch. In addition to these local effects, the project has also contributed to catch in the ocean and mainstem fisheries. Costs-per-fish caught appear to be in the same realm as other hatchery reared fish, although these data are not presented. A number of future directions for the research and demonstration aspects of the project are well presented.

However, a major concern with the report is the absence of an adequate description of methods. Without methods of sampling and analysis described and documented, it is not possible to conduct a technical review or verify reported results. For example, a major error that is frequently made in the use of CWT data is to assume that the composition of the CWT recoveries is equivalent to the stock composition of the fishery from which the sample was drawn. In most cases this assumption does not hold, unless marking rates are proportional to the abundance of the stocks within the fishery. It appears that this assumption was made in the Completion Report, but it is not possible to determine from the information provided.

Further questions remain about what is meant by "full implementation" (that is not yet attained) and about how long the BPA hydropower mitigation funds should support the work. The report asserts that the select area commercial fisheries provide stable and predictable fishing opportunities. The fisheries produce a consistent fishing income that is then available for reinvestment in gear necessary for other less stable mainstem fisheries. If this is so, then at what point will the BPA subsidy be removed and the operation become supported by the commercial and recreational interests? Is the hydropower mitigation aspect expected to continue forever? On what basis? These issues need to be discussed, perhaps in the economic analysis.

Specific Biological Review Comments

In the following sections we provide comments on eight areas related to the biological content of the report: production goals; suitability of various stocks; straying; fishery management; fishing effort and catch; ecological impact of SAFE Fisheries; water quality; and monitoring and evaluation.

Production Goals

The Completion Report states that the project is not yet fully implemented in 2004. Limitations on fish availability and funds prevent full implementation, based on presumed potential. However, it is not clear what "full implementation" means. How many hatchery fish can be added to the system, even at these controlled locations, without affecting wild stocks? As the ISRP noted in its earlier reviews of this project, there seems to be no real definition of an end point.

At some point, expanded releases will lead to an overload, especially in the juvenile stages, and density dependence will limit returns (note the Ruggerone and Goetz study of pink salmon effects on Chinook production[1]). There is no mention of possible competition of SAFE fish in the ocean with wild endangered stocks, but a telemetry study has been started to assess estuary passage rates in view of possible competition there (fish seem to move quickly through). The project appears to be based on the implicit assumption that ocean carrying capacity is unlimited. The only ESA concern expressed in the report is for the catch of upriver stocks.

Suitability of Various Stocks

The project tested several stocks for suitability: coho, spring Chinook, fall Chinook (Upriver bright, [URB] and a stock long acclimated to hatchery propagation [SAB]). This is a good approach. Salmonid species currently being reared and released from select area sites include spring Chinook, select area bright (SAB) fall Chinook, and early stock coho. These are summarized in Table 1.1. What is unclear is why the importation of non-local Chinook (i.e., Rogue River) into the lower Columbia River is allowed. There are serious questions as to whether the use of that stock should be continued.

All releases are documented with tables and narrative. Coded Wire Tag (CWT) marking of reared and released fish is a good policy, except that only a representative component is tagged and information on how mark rates are determined is not provided. Given the survivals quoted, the number of tags applied is certainly marginal … is there any design developed and/or hypotheses being tested? For example, if a goal is to test two treatments, then the study could be limited to just comparing two CWT groups with the number of tags set by the desired power of the test. If the goal is long-term monitoring of survival rates, then the number of tags released would differ and be more dependent on the precision desired for evaluations over time.

The release of the Deep River smolts (p.6) is delayed until the local natural chum smolts (a listed stock) have left the river. However, these smolts will then remain in the estuary for 2-3 months of rearing. This release strategy would seem to be exactly the opposite of a strategy to avoid overlap of net-pen large smolts and small chum smolts. What was the basis for the delayed release strategy?

Low survivals (adult return rates) and reports of diseases from several locations have caused changes in release sites, but it is not clear what contributes to the low survivals. How are the losses of smolts in the net-pens accounted for? With the level of losses noted they would significantly bias any estimates of smolt-to-adult survivals. The report asserts that overall survival rates of SAFE releases are comparable to hatchery releases, but we question that this is an adequate comparative basis. Since these releases are fed-smolts in the estuary, why would we not expect a better return rate than for hatchery fish released in tributaries?

To avoid predation and other unfavorable effects in the backwaters and sloughs where rearing is undertaken, the project is considering towing the net pens to the mainstem Columbia River for

[1] Ruggerone, Gregory T. and Frederick A. Goetz. 2004. Survival of Puget Sound Chinook salmon (Oncorhynchus tshawytscha) in response to climate-induced competition with pink salmon (Oncorhynchus gorbuscha). Can. J. Fish. Aquat. Sci. 61: 1756–1770

release of the fish. A primary question is what effect this might have on the tendency of the fish to continue up into the select area, or on the rate of straying?

Straying

The project is addressing the straying issue through the modification of release strategies. Releases from locations that showed high rates of straying have been discontinued. One striking example is moving production from a hatchery that had unacceptably high straying rates to another hatchery where the straying rate was considerably lower. Generally, the remaining release locations show rates of straying that would be considered to be within a normal range, i.e. less than 10%. However, the effect of these straying rates on stocks at locations to which they stray deserves analysis.

It is extremely difficult for any analyst that has worked with Pacific salmon to believe that the SAFE fishers can apply 80-90% harvest rates. The report should verify and demonstrate these rates. Can examples of weir counts of total numbers of fish escaping fisheries be provided so that these high rates can be corroborated? If not then our concern for unaccounted fish increases concerns about straying and about the project's assessment and spawning escapement monitoring programs.

Fishery Management

Fishery Regulation is conducted through the Columbia River Compact. Fishing seasons are timed to maximize catch of the SAFE fish while missing passage of the listed stocks. Harvest times are scheduled in the terminal areas to match the expected return dates of adults. Harvest numbers increased through the study period, reflecting combinations of larger releases, better release locations, adaptation by the fisheries (recreational and commercial), favorable market demand and prices, and generally stronger returns as a result of ocean productivity changes.

Strong in-season management of timing and harvest is based on real-time monitoring. The text indicates that in-season adjustments are based on updates in run size estimates and harvest, "following each fishing period." (p.30) This is reassuring, but the decision point remains unclear because of the stated objective to maximize the harvest of returning fish.

Adaptive changes in fishing periods, gear, and areas are made to minimize impacts to listed stocks. This seems appropriate given the project's overall goal. The report documents many of these adaptations in detail as they relate to fish, temperatures, diseases, etc. (shifting fish around, moving sites, etc.).

Both of the latter paragraphs should also be put in the context of the test fisheries. Our review comments on Chapter 4 Test Fisheries are included below (p.10), but our concerns for the limited presentation on those fisheries bear directly on how the above in-season assessments are made and how accurately judgments about run-size and the presence of listed-stocks can be.

Fishing Effort and Catch

Over the time period of the project recreational and commercial fisheries have increased significantly in the SAFE areas. Commercial catches in the SAFE areas have been dominated by the SAFE released fish, as desired. But many non-SAFE fish have also been caught (roughly 10-20%), and there has been significant sturgeon by-catch.

Methods of estimating commercial catch are described. Project sponsors follow what might be considered to be standard practice for expanding CWT fish in samples to total commercial fishery catch in order to develop estimates of the portions of the catch that consist of the stock of interest. (Landings are reported in pounds. Numbers of fish are estimated based on weights of fish in a sample taken each week during the season.) Landed catch is extensively sampled (scales, CWTs) to determine catch rate, size, weight and stock composition. A target sampling rate of 20% is set, but higher rates are sometimes achieved (30-60%). An estimate of total catch is developed from telephone surveys and volunteer in-season returns of fish tickets, submission of which becomes mandatory at the end of the year. Total catch includes estimates of SAFE fishery contributions to ocean fisheries. Each of these steps is subject to potentially large error, a factor that is not discussed.

Recreational fishing effort is measured by counting "trailers, boats, and anglers." However, as described this method does not adequately measure recreational effort because it does not capture either the fishing efficiency of boat anglers and bank anglers or the time spent fishing. Recreational catch is estimated through a creel survey. No information is provided on the sampling rate or schedule of this survey. There is potential for large variance in the estimate of sport catch, based upon the brief description of methods in the text.

Overall, the fishery appears to operate with high rates of fishing mortality. A large percentage of the returning SAFE fish is reported to be caught (>92%), but some reviewers had serious concerns that such high rates are accurately determined. Verification of these values would have strengthened the report.

Ecological Impact of SAFE Fisheries

Expansion of commercial and recreational fisheries is claimed by project sponsors to be a major benefit of the project. Future plans include enlarging the program by increasing the numbers of fish released at locations where feasibility has been demonstrated. Although there seems to be adequate coordination with regulatory bodies (NMFS BiOps and BPA EA with FONSI), discussions of potential fishery expansion should include some numerical analysis of the effect of fishery expansion on protected stocks.

For the existing fishery, impacts to listed stocks are calculated for each species involved in the project, as well as for sockeye as a potential candidate for incidental take. All are documented to be low at less than 1%, except for the Sandy River spring Chinook at 4% in 2002. Fall Chinook are less than 0.1%, chum are less than 0.2%. Steelhead are not permitted to be taken. It seems possible that some steelhead may be taken as incidental catch or mortality in the commercial fishery and not reported. No mention of this is made.

It is important to consider the impact of other fisheries on the listed stocks and the extent to which the total impact might be at an unacceptable level. Presumably this is the responsibility of NOAA Fisheries in issuing permits for incidental take in the fisheries. The report alludes to that responsibility.

In addition to impacts on protected stocks, estimated impacts on non-listed stocks and species should also be evaluated. For example, a large number of sturgeon are caught incidentally; is this incidental catch having an effect on the sturgeon population in the Lower Columbia? The issue of effects on non-listed stocks should be explicitly recognized and addressed.

Water Quality

Many sub-studies (research) and water quality monitoring were conducted during juvenile rearing. Some water quality changes appeared, but most were temporary. Some sites were moved in response to problems.

Sediment benthic sampling is detailed in the appendix with a good narrative and data tables and figures. For reference, mixing-zone perimeter, and impact stations (under nets) the total organic carbon, total organism numbers, and species composition are provided. A general picture of organic enrichment under the nets and diminishing enrichment at the mixing zone perimeters are compared to reference sampling sites. Differences from this pattern are described. The appropriate work seems to be getting done, especially since the NPDES permits and monitoring requirements have been in place (2002) in Oregon. Some inconsistencies with the NPDES permit requirements were found that will require watching. Less detailed monitoring is being conducted in Washington sites. General water quality parameters monitored at the net pens show no problems.

Monitoring and Evaluation

Field and Laboratory Data Collection Procedures: Words such as sample size, variance, standard error, confidence interval and precision do not occur in the report. Statistics are presented as fixed deterministic values when in fact, values reported are subject to sampling variance in space (area surrounding the sites) and time, and to measurement error. The authors should be required to follow standard scientific requirements for reporting of uncertainty (precision and bias) due to sample size, measurement error, variation due to location of data in space and time, etc. For example, if the estimated SAR for a given batch of fish is 1.1%, is the 90% confidence interval on the parameter from 0.9% to 1.3%, or is the confidence interval from 0% to 9%?

Data, e.g. from the CWT programs, are reported with no indication of precision of estimates.

Methodological detail is missing from the report. No information is given concerning location of reference sites, methods for location of core samples are not described, there is no information on laboratory methods for analysis of benthic samples, etc. This report is probably not the place for such detail, but adequate references to published methods must be given.

Coded Wire Tag Data Collection and Analysis: The authors are to be complimented for their efforts to regularly apply CWT for assessment; they have maintained excellent coverage of releases. There is a concern though about the numbers of CWT released and the analyses. Given the survivals quoted, the numbers of tags applied appear to be marginal.

The authors should be more careful in how they use percentage values. Most notable is the percent of certain compositions in a catch versus the percent impact on a listed stock. These differences are not clearly noted or described. Further, the methods of estimating these values based on CWT data must be better described, including values in Table 3.7.

In the SAFE area many spring Chinook were marked at high rates (say 3 unmark to 1 mark), but the up-river spring Chinook are likely marked at much lower rates **AND** the marked groups are not likely to account for the natural production of real concern. Therefore, *the composition of CWT within the catch strata may not equal the stock composition in the strata.* Estimates of impacts on stocks-of-concern would then be biased on the low side, and possibly seriously so. If this was accounted for, the methods of doing so should be described.

Test fishery: The treatment of the test fishery is technically inadequate. The reason for test fishing is to assess the abundance and stock composition of the available fish. There should be an effort to demonstrate how well the test fishery performance predicts the fishery outcome. Further, the issue regarding stock composition would be to determine if a stock-of-concern was present and at what frequency. If the sole basis for this determination is CWT recovery, then *the test fishery may not adequately sample for these rare recovery events*. The sponsors should consider using a technique that can assess every fish caught, such as DNA analysis.

Run Reconstruction: It is *not possible to review these values since the method of analysis is absent and not referenced.* For example, in the SAFE release groups, there is extensive sampling and a suggestion that catch accounts for 80-90% of the terminal return. These catches are then sampled very intensively for tag recoveries and most returning tags should be accounted for. This is not the case for up-river stocks. The stocks of concern are deliberately harvested at very low rates. Most of these stocks will return to spawning grounds that are poorly enumerated (at least quantitatively) and have very limited sampling for tag recoveries. It is not clear that these differences in sampling rates have been correctly accounted for in the statistical inferences toward the natural populations.

Statistical Methods: Again, this report is probably not the place for presentation of detailed statistical procedures for estimation of complex statistics (e.g., smolt to adult return rates and harvest estimates). However, methods must be adequately referenced so that repeatable procedures can be applied in the future. On the basis of the information provided, it is not possible to assess or verify the low impacts reported on the up-river or listed stocks.

Storage and retrieval of data: The word “database” does not occur in Appendix A and occurs only in reference to the Regional Mark Information System (RMIS) managed by the PSMFC (www.psmfc.org) for storage and retrieval of CWT data. Original data from this project should be made available in one of the region’s databases such as Streamnet, or perhaps in databases

maintained by the states of Oregon and Washington. Adequate reference to the location of original data collected by this project should be given.

The monitoring and evaluation for the SAFE project is probably adequate except for the above points. However, field and laboratory data collection methods could not be replicated based on only the material in this report. Field and laboratory data collection procedures must be given in the report, or references must be given to published sources for each method, each site and over time.

2. Economic Content Review[2]

General Conclusion

The Completion Report is partially responsive to the request to provide information on the ex-vessel market for salmon, the economic value of the fisheries and the value of this project to the industry, in the context of fishing alternatives. However, the economic evaluation of the SAFE project is incomplete primarily because it does not consider costs and does not consider the incremental benefits of the project relative to the alternative of "no SAFE project." The Report focuses on fishery benefits and excludes cost information that would allow an evaluation of net incremental fishery value. Overall, the report emphasizes the technical and biological feasibility, rather than the economic feasibility, of the SAFE project.

In failing to assess the cost of achieving project goals, the report does not provide the Council with the information it needs to evaluate either the likely cost-effectiveness of continuing investments or the appropriate level of such investments. The perspective of the project is a local one, whereas the perspective of the Council is regional, in terms of the impacts of the project and the opportunity cost of investing in it. The Report does not address the regional impact of the project or its cost-effectiveness. It evaluates the project in absence of cost considerations and so presents only a partial picture of project benefits (gross, rather than net incremental benefits).

Assessment of project performance would be aided by a clearer definition of goals and objectives from an economic standpoint (as well as biological). This could be accomplished through the specification of one general goal and several supporting (measurable) objectives. Many of the goal statements expressed in the report are concerned with maximizing the value of the harvest. However, maximizing the value of harvest, as well as the project overall, requires a consideration of both costs and benefits. It also requires an assessment of how benefits and costs vary under changing biological and economic conditions. This assessment has not been done. The evaluation also needs to specify how costs and benefits will inform decisions about project modifications, and how economic data will be incorporated into routine project monitoring and evaluation.

[2] Dr. Hans Radtke, IEAB member, was an author of the economic study on which many of the Completion Report's economic discussions were based. Accordingly, Dr. Radtke did not participate in the Completion Report review, but did provide information and insight to the IEAB when requested.

Going forward, a reasonable question may be whether there are possibilities for cost sharing between the region and local interests according to the distribution of project benefits (including protection of listed stocks) and responsibilities for power system mitigation.

Specific Economic Review Comments

In the following sections we provide comments on six areas related to the economic content of the report: project goals; rationale for project modifications; project monitoring and evaluation; benefits calculation; absence of cost information; and use of the IEAB hatchery study. In addition, specific comments by chapters are provided.

Project Goals

Project goals are expressed in various ways that are consistent in concept if not in wording. The goal of the project is to maximize harvest while minimizing impacts on listed stocks. The following goal statements appear throughout the document:

- Page xiv: One of the primary goals of this project was to maximize harvest of returning adults while minimizing catch of non-SAFE stocks.
- Page xv: Another major goal of the SAFE project was to develop fisheries that provided greater protection for depressed and listed stocks.
- Page 1: The goal of the project is to determine the feasibility of creating and expanding known stock sport and commercial fisheries in the Columbia River Basin to allow harvest of strong anadromous salmonid stocks while providing greater protection to depressed stocks.
- Page 29: Select area fisheries have been developed to minimize impacts to listed and depressed stocks while providing expanded harvest opportunities for commercial and recreational fisheries. The goal of complete harvest of returning adults maximizes project benefits and reduces concerns of straying.
- Page 70: This low escapement rate is desirable since a primary goal of the SAFE project is to maximize harvest of local stocks in order to achieve the greatest economic value of the project while minimizing impacts of the program.
- Page 130: The goals of this project are to participate in the recovery of listed or depressed stocks through alternative harvest opportunities and to increase the value of regional fisheries.
- Page 137: The ultimate goal of fish produced by the SAFE project is for harvest; therefore, maximizing the value of the harvest is a logical objective of this project.

A clearer definition of the project goal would help both project sponsors and reviewers maintain the focus on desired outcomes. Clarification could be accomplished through the specification of one general goal and several supporting (measurable) objectives designed to support the achievement of that overall goal. A more detailed discussion is also needed about how the SAFE Project objectives relate to regional management practices and recovery objectives.

Rationale for Project Modifications

The SAFE project has been conducted in phases representing differences in project approach and scale. Project reconfigurations have included discontinued releases as well as movement of release and collection sites. It is not clear how decisions to modify project operations relate to incremental costs and incremental biological effects. Were these reconfiguration decisions informed by analysis of the economic costs and biological effectiveness of each stage, or by an estimate of their incremental change in the next stage? If so, what did the analysis reveal? If not, why not, and how were decisions actually made?

It appears that information to support this type of analysis has not been collected, but without such information, it is unclear how the decision to expand the fishery was balanced against the objective of minimizing impacts on protected stocks, or how the resulting project might meet cost-effectiveness criteria. From the quotes on page xii and 29, it appears that the relative priorities of expansion and minimizing impacts have not been defined. The "future plans" section of the report includes a statement that establishment of new sites will be evaluated in part based on their impact on the project's cost/benefit ratio (p.137), but at this point we do not have any overall sense of the cost/benefit ratio (or the cost-effectiveness of prior decisions).

Project Monitoring and Evaluation

The sponsors have conducted extensive monitoring and evaluation of a range of project components relative to the technical and biological feasibility. However, economic components (costs and benefits) are not part of the ongoing monitoring and evaluation. Rather, the project appears to be based on an underlying assumption that if changes to project management generate more fish, incremental net benefits are generated.

Benefits Calculation

The report states that achieving the goal of complete harvest of returning adults maximizes project benefits. Assuming that "project benefits" in this context refers only to economic effects (which is reasonable given that the goal is "harvest"), maximizing harvest does not necessarily maximize project benefits because the cost of capturing the last fish may exceed its value. Additionally, as the authors acknowledge, ex vessel prices for salmon can be volatile, and in some cases where prices are unacceptably low, fishermen may forego harvest. What happens to unharvested fish in times of low market value? Has the project considered estimating an "optimal" level of catch, where the marginal cost of catching fish equals the marginal benefit or value of the fish caught?

Project benefits are reported as ex-vessel gross revenues (commercial fishery) and non-market values (recreational fishery) both within SAFE fisheries and for SAFE fish caught in other (e.g., ocean troll) fisheries, as well as some economic impacts (i.e., personal income). Aside from these factors, benefits of actions are not estimated but are inferred to follow increased production. This assumption may not hold. Given that prices are volatile and are outside the control of fishermen, it is not necessarily true that expanded production will always lead to increased revenues. Larger catches may occur in times of depressed price, leading to no increase, or even a decrease, in ex-vessel value of the catch relative to smaller catches in different market

conditions. The goal of expanding production and developing "stable predictable fisheries" (p. 136) does not take into account the likelihood of continued price variability in the salmon market.

It is unclear how ex-vessel revenues and non-market user values were calculated. What assumptions were used? How was economic impact calculated? How does the increase in revenues, values, and impacts compare with the costs incurred to date for this project?

Absence of Cost Information

Cost data have not been collected or analyzed for the SAFE project. Although the project sponsors provide some information on project benefits, a complete economic assessment requires that benefits be compared to costs; without cost information it is impossible to assess the soundness of the project investment.

The absence of cost data leads project sponsors to focus on gross, rather than net, benefits of the fishery. For example, the report states: "Increasing the value of the fisheries can be accomplished in two ways: 1) increasing production or 2) increasing the value of the fish harvested." However, there is a third way, which is to reduce the cost of production, since we are, or should be, interested in net value.

The lack of cost data prevents calculation of the net benefits of project actions and has precluded the conduct of a cost-benefit analysis, as the project sponsors acknowledge: "A more robust benefit/cost analysis has not been completed since this will require determination of the costs associated with harvest of salmonids produced by the SAFE project." The report implies that such an analysis should be conducted for a full-scale operation only. Are there any conclusions that can be reached from the biological perspective – for example, better SARs for some species than others – that would affect costs? How would the costs of fry provided by state hatcheries be imputed? The report notes that it is cost-effective to use existing hatcheries with excess rearing capacity rather than building new hatcheries for SAFE, but what is this difference? How would the value of volunteer contributions be estimated? Also, economic analysis requires that incremental costs and benefits be considered, not just the costs and benefits of a "full-scale project."

The report's assertion that "harvest costs of SAFE commercial fisheries are fairly low so total ex-vessel revenue provides a reasonable assessment of net economic value for this fishery" is not supported by any documentation. Also undocumented is the report's claim that the project's net benefits would be increased by fishery expansion because most costs are fixed.

For every stock and brood year described there must be extensive costs associated with moving the smolts to sites, and in the extensive disease treatment that they acknowledge. The economic assessment should account for the full costs of drugs and treatment.

Although the major chapters in the report do not discuss benefit/cost ratios, almost every section in the concluding section (9) discusses how proposed changes to the project will affect the benefit/cost ratio. A benefit/cost ratio criterion is inappropriate since it may result in decisions

that do not maximize net project benefits, defined broadly. Cost-effectiveness is a more appropriate approach. The report states: "In conclusion, key considerations regarding the economic value of the SAFE project are:

- Full-scale production at all SAFE sites has not been an objective during the research phase, thereby increasing the cost-per-returning adult.
- Producing additional smolts above current production would be cost effective since the program's infrastructure has been developed. The costs per-smolt-released and per-returning-adult would decrease with expanded production since limited additional equipment and staff would be needed to maximize releases.
- The true economic potential of the fishery would increase rapidly with advancement to full capacity for all species at each select area site.
- The regional economic contributions of full-scale SAFE releases would be multiplied many-fold due to high survival, exceptional harvest rates, and significant contributions to other high-value fisheries.
- The SAFE project has been designed to investigate the feasibility of net-pen production and fishery development, not to maximize economic benefits. Even so, this project can quantify significant benefits to the regional economy in addition to meeting research objectives."

This section also indicates future plans to evaluate actions based on their benefit/cost ratio. It is good that attention will be paid to the impact of changes in production technology on costs. However, without cost data it is impossible to estimate a benefit-cost ratio for the project in its present configuration, much less estimate whether the proposed changes would result in a positive change in this ratio.

It would have been informative to the question of costs to have had a budget provided accounting for expenditures over the 10-year period. It would be useful to know how the funding was allocated over different categories of expenditures and from different funding sources. This type of information is critical to an assessment of the cost-effectiveness of the project given existing survival rates and harvest.

Use of the IEAB Hatchery Study

The IEAB included the earlier Clatsop Economic Development Council (CEDC) project in its evaluation of hatchery economics. The evaluation of the CEDC net pens was part of a BPA-funded business plan to expand the CEDC Terminal Fisheries Project (TFP). The study provided information about some production costs and economic impacts but did not analyze the cost effectiveness of the project.

Cost per harvested adult fish was calculated for each of the species released by the SAFE project. One finding was that the cost per adult varies dramatically with changing survival rates; the better the survival rates the more cost effective a hatchery appears. We conclude that survival rates should be examined over a fairly long period to average out the good and bad ocean years.

The IEAB hatchery study does not include a full accounting of costs. For example, while acclimation costs for most of the fish released by the project are included, the costs of raising

smolts are not. In addition, the costs and benefits of the SAFE project should be compared with the costs and benefits of not implementing the SAFE project. For example, would the smolts be reared and released somewhere else without the SAFE project? Harvest costs are also not included. Other less tangible costs that may exist but are not accounted for include harmful interactions with native fish (although these appear to have been minimized by the project) or environmental impacts of the net pens.

Specific Comments by Chapter

Executive Summary

- On what basis is an increase in releases at Youngs Bay deemed to be a benchmark for evaluation of new sites, either biologically or economically?
- On what basis were the results of fish propagation studies incorporated into production strategies? What are the economic and biological consequences of the resulting changes to the production strategies?

Chapter 1

- Do we know that "full capacity" is the most cost-effective level?
- "Due to the increased value of sport-caught fish ($50-$199/fish) and a higher price per pound value of salmon caught in ocean troll fisheries, the economic value of SAFE project is significantly increased." A distinction should be made between ocean and river caught fish. For example, income per pound should be calculated to accommodate the smaller size and hooking mortality of ocean caught fish.

Chapter 3

- "Fishing effort is estimated by counting trailers, boats, and/or anglers at each site." This assumes that all fishers are equal in terms of their willingness to pay for the opportunity to go fishing. Is this a reasonable assumption?

Chapter 5

- Table 5.1 demonstrates a wide variation in SARs, both over time and across sites. Has there been any thought given to shifting production to those sites with higher SARs and discontinuing (or reducing) production at sites with lower SARs? (See also Figure 5.7.)

Chapter 8

- "The value of SAFE fall Chinook component of the fishery during 1996-2003 ranged from approximately $22,000-$111,000 with 21-77 percent of the value resulting from harvest of SAB fall Chinook." How was this value calculated?
- "Producing additional smolts above current production would be cost effective since the program's infrastructure has been developed." This conclusion is not supported by any analysis or data.
- Are the unit values in Tables 8.1 and 8.2 used to calculate economic value reasonable?

Chapter 9

- "Another production program that could yield significant economic value if reinstated is releases of spring Chinook from the Tongue Point SAFE site." How do we know this?

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