Northwest Power and Conservation Council

September 24, 2009

DECISION MEMORANDUM

TO: Council Members

FROM: Terry Morlan
Director, Power Planning (IEAB Coordinator)

SUBJECT: Request for Council approval of IEAB Task 153

PROPOSED ACTION
The IEAB, after consultation with the Fish and Wildlife Division, proposes a task to evaluate historical data on both Fish and Wildlife Program costs and accomplishments. Using available data on program actions and other conditions, the IEAB will test whether changes in anadromous fish trends can be related to various conditions and programmatic activities.

SIGNIFICANCE
The region has been implementing Fish and Wildlife Programs and other efforts to restore anadromous fish for nearly 30 years. It is time to pull together data that is available and see if it can inform the region what has been accomplished through these efforts and how various actions and costs have affected fish populations. The work will build on previous analysis and data collection. At a minimum the task will highlight the available data and its usefulness for assessing the effects and costs of the Fish and Wildlife Program.

BUDGETARY/ECONOMIC IMPACTS
The task is estimated to cost $18,500, and funds will come from the IEAB budget.

BACKGROUND
See the proposed Task 153: Retrospective on Relationships between Fish and Wildlife Program Costs and Accomplishments.

ANALYSIS
This task is mostly exploratory. The IEAB gathered a significant amount of existing data in a preliminary task. The intent is to examine this body of data and see if patterns emerge among various measures of FWP activity and costs and trends in salmon populations. In addition, the IEAB will look at previous analyses of specific issues related to how natural conditions and programmatic activities affect fish populations.

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ALTERNATIVES
The obvious alternative is not to approve this task. Staff recommends approval. It is possible that nothing will be learned from examining this data with a new eye, however it may also happened that significant new insights are gained into the cost-effectiveness of FWP actions. At a minimum, the IEAB will have put together a good list of available data relating to the FWP and other information on conditions likely to affect salmon populations, and identified significant gaps and weaknesses in the available data.

ATTACHMENTS
Proposed Task 153

Independent Economic Analysis Board

Task Number 153

Retrospective on Relationships between Fish and Wildlife Program Salmonid Costs and Accomplishments

September 2009

BACKGROUND

A main purpose of the Fish and Wildlife Program (FWP) is to increase populations of salmon and steelhead trout (salmonids). The costs of pursuing this objective are large, but there is no comprehensive analysis of FWP costs and salmonid returns in relation to FWP actions over the life of the FWP. Such an analysis could yield insights into factors that affect FWP costs and salmonids. At a minimum, analysis of program elements, program costs, and salmonid returns would provide a baseline against which future actions, costs and populations can be compared. It would also result in the documentation and qualification of important FWP data sources.

Real costs of FWP actions have increased over time and some costs are affected by measurable factors. For example, spill costs are affected by hydrologic and electricity price conditions as well as discrete events such as biological opinions (BiOps) and fish passage improvements. Hatchery costs are affected by the numbers of hatcheries and the type and amount of production.

The factors affecting annual variability in fish returns are generally well understood. A number of studies are cited in Attachment 1 below. Some studies have shown a strong relationship between spill and juvenile survival, and smolt-to-adult ratios (SARs) are related to ocean conditions such as upwelling and the Pacific Decadel Oscillation. Other factors such as hatchery production, dam passage, and habitat improvements are believed to affect salmonid returns, but these have not been supported by statistical methods.

The IEAB has completed a scoping task which has documented some of the related literature. This literature is cited and summarized in Attachment 1. There is an extensive literature analyzing salmonid populations in the Columbia Basin over time. Clearly, there is already a sophisticated information base about time series analysis of Columbia Basin salmonid populations. However, there are outstanding issues related to how spill, hatchery production and habitat affect these populations. The following questions summarize these issues:

- How might time series analyses of the relationship between spill, passage improvements, transportation and juvenile survival be applied to macroscopic population measures such as total escapement and harvest?

- How might the existing scope of time series analyses be expanded and improved to include more FWP actions?
- How has hatchery production affected survival, harvest and escapement of wild and hatchery fish?
- How, if at all, can the effects of habitat investments on production be measured?

This study will clarify these issues and provide new data and analyses that could help to understand and measure them.

As part of the scoping task, the IEAB has also established Excel® databases containing readily accessible data on FWP costs, salmonid production and escapement, and factors that may affect survival and escapement. A listing is provided as Attachment 2. A variety of data issues will need to be resolved. In particular, the amount of potential time series data on flows and water quality is almost unlimited. Additional data gathering will be governed by theories and precedent that suggest exact measures to be obtained.

STATEMENT OF WORK

This task will

- Acquire and display time series data on FWP actions, costs, and fish survival, harvest and returns;

- Attempt to explain data on FWP activities and costs based on activity levels, electricity prices, discrete events such as agreements and biological opinions (BiOps), and other factors that have changed over time;

- Examine the correlation between annual data on FWP activities and hydrologic, ocean, survival, and population data.

- Analyze and display the extent to which adult counts and escapement data are correlated across species and discuss why;

- Compile existing time series analyses that assess Columbia Basin production, survival, harvest and escapement data using data on ocean and weather conditions, levels of FWP activities, and other factors;

- Contact study authors and other biologists to determine what issues and improvements may be possible;

- Determine how data used in these time series analyses were modified for use in the studies and why;

- Consider the potential for different specifications for time series studies including the use of alternative dependent variables and inclusion of additional explanatory variables;

- Identify data gaps and develop and document new time series analyses, if justified, to expand on or improve the existing set of studies;

This task will not provide detailed statistical analysis of survival for population samples; for example, code-wire tagged groups, or analysis of survival by reach, or any re-analysis of data already completed by bio-statisticians. Rather, we will use simple and multivariate regression analysis using the readily available macroscopic annual data to see if significant correlations exist. These analyses may suggest areas for new statistical analysis, but any new detailed analysis that requires use of sample data will not be undertaken.

The IEAB will

1. Continue to make inquiries about similar analysis that already might be completed and attempt to build on these efforts;
2. Provide an expanded literature review;
3. Continue to compile data sources on FWP activities, production, populations and returns;
4. Obtain, display and analyze the data;
5. Continue discussions with expert scientists to understand, characterize and qualify these data;
6. Display the time series data in a way that demonstrates the issues and results of the analysis;
7. Provide a summary report that displays time series data, discusses the state of science regarding time series analysis of salmonid populations, provides analysis where practical, and summarizes outstanding issues.

DELIVERABLES

A draft report will be provided by November 2009. A final report will be provided by December 2009.

LEVEL OF EFFORT

Estimated Level of Effort and Cost:

200 hours of IEAB time @ $90/hour	$18,000
Travel costs	$ 500
Total Task 153 Cost	$ 18,500

COUNCIL APPROVAL OF TASK

By: _____ Date: _____
Terry H. Morlan, Staff Coordinator

Attachment 1. Initial Literature Review

Literature we have obtained includes:

Fisher. Tim. 2005. Preliminary Abundance-Based Trend Results for Columbia Basin Salmon and Steelhead ESUs. For: Bonneville Power Administration Division of Environment, Fish, and Wildlife Policy and Planning Branch, Portland. This paper explores a variety of abundance indices and finds positive abundance trends for most ESUs in the Basin.

Fujiwara, Masami, 2008.Identifying Interactions among Salmon Populations from Observed Dynamics. Ecology, vol. 89, no. 1, pp. 4-11. This paper explores autocorrelation between Columbia and Klamath Rivers and California Central Valley fall Chinook population counts using maximum factor autocorrelation analysis.

Ho, Kevin. 2005. Salmon-omics: the Effect of Pacific Decadel Oscillation on Alaskan Chinook Salmon Harvest and Market Price. Columbia University. The relationship between PDO in Alaskan waters and the catch and weight of Alaskan Chinook salmon is documented.

Holmes, Elizabeth E. and William F. Fagan. 2002. Validating Population Viability Analysis for Corrupted Data Sets. Ecology 83:2379-2386. This paper explores diffusion approximation methods applied to time series data where there is important measurement error. The authors find that this method is robust and results in unbiased probability estimates.

Also: Holmes, Elizabeth E. Undated. Beyond Theory to Application and Evaluation: Diffusion Approximations for Population Viability Analysis. National Marine Fisheries Service. Northwest Fisheries Science Center

Keefer, Matthew L., Christopher A. Peery, and Christopher C. Caudill. 2008 Migration Timing of Columbia River Spring Chinook Salmon: Effects of Temperature, River Discharge, and Ocean Environment. Transactions of the American Fisheries Society 2008; 137: 1120-1133. This paper examines relationships among regional ocean climate indices, in-river environmental conditions and run timing in an effort to improve run timing forecasts for Columbia River spring Chinook salmon. Best predictors included in-river and ocean factors.

Levin, Phillip S. 2003. Regional Differences in Responses of Chinook Salmon Populations to Large-Scale Climatic Patterns. Journal of Biogeography. Volume 30. Issue 5, Pages 711 – 717. Regression analysis was used to describe trends in data on recruits per spawning adult for thirteen populations of Chinook salmon in the Columbia Basin. Information from residuals suggested that productivity declined following a climate shift in 1977.

McCann, Jerry. 2008. Importance of Spill in Juvenile Hydro-system Survivals and SARs. Preliminary Analysis. February. This presentation shows that in-river and ocean environmental variables can explain some of the variation in variation in smolt-to-adult survival rates for Snake River salmon and steelhead.

A variety of other time series research is available.

Gedalof, Ze'ev, David L. Peterson and Nathan J. Mantua. 2004. Columbia River Flow and Drought Since 1750. Paper No. 03073 of the Journal of the American Water Resources Association. Tree ring data is used to construct flow data for the Columbia River and structural changes over time are explored.

Korman, Josh and Paul S. Higgins. 1997. Utility of Escapement Time Series Data for Monitoring the Response of Salmon Populations to Habitat Alteration. Can. J. Fish. Aquat. Sci. 54: 2058–2067. Simulation experiments were used to explore the potential effects of habitat changes on time series data.

Attachment 2. Data collected to date.

We have collected the following data and compiled it into Excel worksheets for ease of use:

- Anadromous salmonid cost estimates the Columbia Basin, 1978 to 2006 data provided by Council staff includes ten categories of State and federal costs including BPA spending, power purchases, and foregone power revenues.

From the fish passage center:

- Adult counts at Bonneville, 1938 to 2006, 17 categories 1965 to 2006, fewer before 1965

- Hatchery releases, 1979 to 2008, Lower Columbia, Mid-Columbia, Snake River, 6 categories in each region

- Escapement estimates at the mouth of the Columbia, 1980 to 2008, 35 categories, not all mutually exclusive, most series beginning in 1985

- Smolt to Adult ratios, 1997 to 2005, spring chinook, for smolts transported, detected or not detected at Snake River dams, and confidence intervals

From other sources:

- Oregon and Washington, recreational and commercial, chinook and coho, effort and harvest estimates, beginning years vary by port, up to 2008, from the PFMC

- Offshore upwelling indices, 1978 through 2008, 45 N. latitude, 125 W. longitude, from NOAA

- Pacific Decadal Oscillation (PDO) Index, defined as the leading principal component of North Pacific monthly sea surface temperature variability, 1975 to 2008, from the Joint Institute for the study of the Atmosphere and Ocean

- Modified streamflow data, 1928 to 1998, including unregulated streamflows adjusted to year 2000 development condition, at each major project on the Snake and Columbia rivers, from John Fazio

- Historic streamflow data are available from the USGS; some data at Bonneville has been collected for test purposes, we will seek monthly or annual data to facilitate compilation