PATH -- UW TECHNICAL SUPPORT 9700200

SHORT DESCRIPTION:
We will provide modeling and data collection support to the PATH process. In particular, we will a) continue to improve existing downstream migration models by addition of more realistic hydro operations, b) add capability to model adult migration, c) work to partition salmon mortality into pre- and post-migration components, and d) participate in PATH workshops and analysis.

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SUB-CONTRACTORS:
none

GOALS

GENERAL:
Supports a healthy Columbia basin, Increases run sizes or populations, Adaptive management (research or M&E), Program coordination or planning

ANADROMOUS FISH:
Hydro ops, mainstem passage, construction

NPPC PROGRAM MEASURE:
3.2F.2

TARGET STOCK	LIFE STAGE	MGMT CODE (see below)
Wild Snake River Chinook	All	P, L, W

AFFECTED STOCK	BENEFIT OR DETRIMENT
Mid- and lower Columbia salmon stocks	Beneficial

BACKGROUND

Hydro project mitigated:
entire FCRPS

Project is an office site only

HISTORY:
While the PATH process has been ongoing since 1995, separate funding of CRiSP staff participation only began in October 1996. Since that time, we have participated in a group workshop, written critiques of several aspects of the PATH program, and produced several relevant publications (listed below). We have also provided considerable modeling and database support to the PATH process, thus far in retrospective analyses.

PROJECT REPORTS AND PAPERS:
Ebbesmeyer, C.C., R.H. Hinrichsen and W.James Ingraham, Jr. Spring and fall wind transitions along the West coast of North America, 1900-1994. Presented at PICES, October 18, 1996.
Hinrichsen, R.A., J.J. Anderson, G.M. Matthews, and C.C. Ebbesmeyer. Assessment of the Effects of the Ocean and River Environment on the Survival of Snake River Stream-Type Chinook Salmon. BPA Technical Report.
Anderson, James J. and Richard A. Hinrichsen. Climate Indicators to Salmon Survival. Presented at PICES Meeting, October 18, 1996.
Hinrichsen, R.A., J.J. Anderson, R. Zabel and J. Hayes. Review of PATH: Plan for Analyzing and Testing Hypotheses, Final Report on Retrospective Analysis (26 September,1996) and Conclusions of FY96 Retrospective Analysis (October 18-25, 1996). Report to PATH.
Hyun, Saang-Yoon. Ocean distributions of the Columbia River Hanford Reach and Snake River fall chinook salmon

(Oncorhynchus tshawytscha) stocks and the effect of interannual ocean conditions on their survival. M.S. thesis, December 1996.

ADAPTIVE MANAGEMENT IMPLICATIONS:

The Plan for Analyzing and Testing Hypotheses (PATH) process is framed in an adaptive management milieu. Earlier work by the Analytical Coordination group (ANCOOR) provided a basis for developing analysis in an adaptive fashion. PATH divided hypotheses into two broad categories: retrospective and prospective. By early 1997, much of the work on retrospective hypotheses was completed, and planning is now underway for prospective analyses. Retrospective analyses explicitly utilized results from past studies in an attempt to explain all of the relevant observations in one coherent framework. While disagreements remain, this has been a fruitful approach for identifying areas of major uncertainty. Prospective analyses will build on the groundwork of retrospective analyses, and will point the way to the studies necessary to illuminate the areas of greatest uncertainty and greatest impact.

PURPOSE AND METHODS

SPECIFIC MEASUREABLE OBJECTIVES:

Specific tasks for calendar 1997 include the following:
1) Calibration issues: New data and more sophisticated modeled mechanisms will require new calibration efforts. These include new dissolved gas modeling, improved dam passage modeling, and rigorous analysis of transportation survival data.
2) Adult migration: Upstream migration of adult salmon clearly has a significant impact of recruitment, but modeling efforts have not included this process in any detail to date. We will develop a mechanistic model to describe adult migration, including calibration of relevant processes and validation against available data.
3) Mortality outside hydrosystem: The objective is to identify and quantify how ecological and hydrosystem changes have altered fish survival outside the hydrosystem. We will focus our attention on several approaches: differential ocean distributions, models of ocean current patterns (OSCURS), other oceanographic factors (upwelling, outfall changes), and estuary effects.
4) Participation in PATH activities: This will include providing relevant data sets and model outputs, critiquing results from other team members, finalizing retrospective analyses, initiating prospective analyses, and attending group meetings and workshops.
5) Database Support: Our ongoing commitment to provide all relevant data in accessible World Wide Web pages will continue, and new databases will be added as they become available.

CRITICAL UNCERTAINTIES:

The major uncertainty involved in the PATH process as a whole is the risk that political pressures will outweigh scientific inquiry. If PATH only provides rubber-stamp approval of uninformed bureaucratic dictates, it will fail.

BIOLOGICAL NEED:

The PATH process addresses survival of salmon at all life stages, although much of the focus to date has been on smolt migration within the hydrosystem. In addition to continuing that focus, on a stage by stage basis, we will address the following: Early Ocean Survival: We will analyze the impact of estuary arrival timing on smolt survival, relating this where possible to transportation operations. Ocean Survival: We will examine several relevant processes that affect salmon survival on the high seas, including ocean current patterns, stock distribution patterns, changeover from winter to summer regime, and decadal-scale cycling in ocean conditions. Adult Migration: We will produce a model of adult survival during migration from ocean to spawning grounds, including relevant processes like dam passage, fallback, straying, and competition for suitable spawning habitat. It is clear that declines in salmon survival in the last several decades are due to a multitude of causes, some of which are related to the hydrosystem, and some of which are not. We will attempt to characterize the importance of changes in various stage-specific survivals for affected stocks.

HYPOTHESIS TO BE TESTED:

The PATH process will consider a very large collection of hypotheses. Our particular participation in this funding cycle will take up a number of these, including: - Survival during downstream passage can be assessed accurately using models that incorporate sufficiently complete descriptions of the processes affecting fish during their migration. - Differences in survival between up and downstream stocks are related to entry timing into the estuary. Entry timing for upriver stocks is currently strongly affected by transportation programs. - Differences in survival among stocks are at least in part due to differential ocean distributions, or to changing ocean conditions over time - Stocks that experience different adult migration patterns will have significantly different

survivals from ocean to spawning, and may have different spawning success and egg-to-smolt survival.

ALTERNATIVE APPROACHES:

The use of models to assess the impact of salmon management programs has a long and contentious history. In the past, competing models were formulated and championed by various sponsors with no attempt to compare the results of the different models, or to coordinate a process aimed at finding areas of agreement and other areas of disagreement. Three years ago, the Analytical Coordination (ANCOOR) team began an attempt to compare different models on an equal footing. The PATH process continues toward this objective. If this cooperative endeavor disintegrates and models stand alone, uncompared, there will be no agreement on appropriate measures and strategies for salmon management.

JUSTIFICATION FOR PLANNING:

Some aspects of salmon biology are well understood and well agreed-upon. Other areas are filled with uncertainty. This process aims to identify areas of uncertainty, and to rank the importance of these areas so that the limited resources available for on-the-ground research can be applied in the most useful and effective fashion. In the absence of a broad conceptual framework, fieldwork is useless. PATH will provide the guidance that produces useful research.

METHODS:

The PATH process itself is an ongoing project involving participants from state and federal agencies, tribal representatives, university researchers, and interested private parties. Our participation has been, and will continue to be, in several distinct areas: 1) Providing data sets, database support, and model output to the group for further analysis in existing retrospective or prospective analyses. 2) Improving our models to address more aspects of salmon life histories, and to address all aspects in more accurate and sophisticated ways. This includes improvements to the existing passage model (CRiSP1) as well as development of new models (Adult Migration model). 3) Developing new approaches to analyze hypotheses of interest to the PATH community; in particular, investigating the impact of estuarine and ocean factors on salmon survival. Results of our work will be assessed by the PATH group as a whole, using a variety of statistical techniques, and will be submitted for peer review.

PLANNED ACTIVITIES

SCHEDULE:

Implementation Phase **Start** in progress **End** 1999 **Subcontractor**

Task 2) Adult migration: Upstream migration of adult salmon clearly has a significant impact of recruitment, but modeling efforts have not included this process in any detail to date. We will develop a mechanistic model to describe adult migration, including calibration of relevant processes and validation against available data. 3) Mortality outside hydrosystem: The objective is to identify and quantify how ecological and hydrosystem changes have altered fish survival outside the hydrosystem. We will focus our attention on several approaches: differential ocean distributions, models of ocean current patterns (OSCURS), other oceanographic factors (upwelling, outfall changes), and estuary effects. Planning and Implementation task: 4) Participation in PATH activities: This will include providing relevant data sets and model outputs, critiquing results from other team members, finalizing retrospective analyses, initiating prospective analyses, and attending group meetings and workshops.

Implementation Phase **Start** in progress **End** 1999 **Subcontractor** no

Task Tasks to be addressed in 1998 include work in several areas.1) Calibration issues: New data and more sophisticated modeled mechanisms will require new calibration efforts. These include new dissolved gas modeling, improved dam passage modeling, and rigorous analysis of transportation survival data.

O&M Phase **Start** in progress **End** ongoing **Subcontractor**

Task Database Support: Our ongoing commitment to provide all relevant data in accessible World Wide Web pages will continue, and new databases will be added as they become available.

PROJECT COMPLETION DATE:

1999

CONSTRAINTS OR FACTORS THAT MAY CAUSE SCHEDULE OR BUDGET CHANGES:
The PATH process requires the cooperation of a large number of groups which have been in conflict in the past. Should this cooperation fail, the process will be delayed, or may fail. Model improvements and new model development also are predicated on the availability of data for model calibration and validation. If these data are not available, this will cause the project to be delayed.

OUTCOMES, MONITORING AND EVALUATION

SUMMARY OF EXPECTED OUTCOMES

Expected performance of target population or quality change in land area affected:
Informed and effective decision making for hydrosystem operations, implementation of mitigation alternatives, and research needed for improved fish survival.

Present utilization and convservation potential of target population or area:
N/A

Assumed historic status of utilization and conservation potential:
N/A

Long term expected utilization and conservation potential for target population or habitat:
N/A

Contribution toward long-term goal:
Model output and analysis from a mechanistic and ecological standpoint. Database support via world wide web. Broad analysis of salmon life history impacts.

Indirect biological or environmental changes:
The PATH process will not directly produce recommendations for management actions, but results of our analysis should suggest mitigation measures that will be most effective in restoring salmon populations.

Physical products:
N/A

Environmental attributes affected by the project:
N/A

Changes assumed or expected for affected environmental attributes:
N/A

Measure of attribute changes:
N/A

Assessment of effects on project outcomes of critical uncertainty:
The major uncertainty is the continued cooperation and goodwill among the participants in the PATH process. If that fails, the entire project fails. Should data be unavailable for model calibration, we will have to assume the models are less robust than desired.

Information products:
We will produce calibrated and validated models of downstream passage and upstream migration. We will produce data and analy

sis of impacts of ocean and estuarine processes on salmon survival, and will link all the pieces of salmon life histories together in that analysis. We will provide efficient and easy access to a wide variety of historical and ongoing databases.

Coordination outcomes:
Our contribution to PATH will lead to consensus on a variety of hypotheses concerning salmon survival, recruitment, production, and restoration, in cooperation with a number of agencies and parties. We will provide new analytical tools of use to the entire region, and will also provide worldwide access to a variety of historical databases.

MONITORING APPROACH

Provisions to monitor population status or habitat quality:
There are no specific monitoring aspects to this project; a related project (Monitoring and Evaluation Modeling Support, contract BPA #DE-BI79-89BP02347) focuses on monitoring of relevant salmonid stocks.

Data analysis and evaluation:
We will apply a variety of statistical techniques to assess the validity of our models and analysis, including regression and likelihood approaches, for our improvements in the downstream passage model, the new upstream migration model, and analysis of ocean and estuarine processes.

Information feed back to management decisions:
The PATH process is embarking on prospective analyses that will provide information of use to managers who must make decisions on mitigation measures aimed at restoring salmon stocks. Products from the CRiSP project have been, and will continue to be, used by a variety of managers (BPA, COE, NWPPC) and other parties, and analyses will continue to be made available via the world wide web.

Critical uncertainties affecting project's outcomes:
A broad regional consensus that cooperation among formerly competing agencies must be established. The greatest possible public exposure of all phases of PATH and related analysis must be provided. Areas of uncertainty should be addressed as swiftly as possible, and studies carried out to provide the necessary information.

EVALUATION
Our goal is to provide mechanistic explanations for all phases of salmon life history. Mechanistic explanations allow us to make predictions; those predictions can and should be tested against new data and observations to verify that the models capture most of the relevant processes. This would include comparing against independent estimates of migration timing and survival (e.g. PIT tag analyses), ocean survival based on returning adult counts and coded wire tag information, upstream passage survival based on adult counts, and observed physical parameters (e.g. total dissolved gas) compared to model predictions.

Incorporating new information regarding uncertainties:
The CRiSP project has always been eager to incorporate new information into our modeling and analysis structure. New information provides additional challenges to existing models, and can either provide validation, or demonstrate the need for modifications. The decision process can itself direct the collection of data: where areas of uncertainty exist, opportunities for useful research also exist.

Increasing public awareness of F&W activities:
Our participation in the PATH process will produce numerous applications that will be demonstrated, or will be made available for use, on the world wide web. Use of existing information on our web pages has increased steadily in the last two years, and we expect public awareness and public confidence in our work to increase as well. The PATH process will also produce written and peer-reviewed documents in order to disseminate information to the public.

RELATIONSHIPS

RELATED BPA PROJECT	RELATIONSHIP
NMFS smolt survival analysis supported by National Marine Fisheries Service (Smolt Mortality Data Analysis NA57FE0570).	This project is directed at developing mechanistic models for the environmental and biological conditions required for fish to initiate smolt migration.
Technical Management Team Web page maintained by Pacific Northwest Laboratory (PNL) contract	The information the PNL maintains for its TMT Web page is principally obtained from our Web page.
Dr. John Skalski's Endangered Species Act contract	Information from this project is used to calibrate and validate the CRiSP models.
Monitoring and Evaluation Modeling Support	Provides improvements to modeling platforms as well as increasing the scope of coverage of current modeling efforts.

RELATED NON-BPA PROJECT	RELATIONSHIP
NMFS Harvest model NMFS	The NMFS project develops a multi-stock multi-species ocean harvest model that will include spatial and temporal harvest details. This could be of use in the prospective analysis phase of PATH.
DEGAS Army Corps of Engineers	The Army Corps DEGAS project is evaluating the impacts on fish from dissolved gas produced by spill. The project is developing ways to mitigate the impacts of spill. The CRiSP project is working closely with this Army Corps project. We are using their results to improve CRiSP algorithms and calibration.

OPPORTUNITIES FOR COOPERATION:

There are many opportunities to meld research in this area into a coherent whole. Some possibilities include: 1) Use of current data on physical parameters (e.g. dissolved gas) and fish survival (PIT-tag studies) in developing short-term operation goals, using modern technology (WWW pages) to disseminate information. 2) Incorporation of new life-cycle and harvest models into prospective analyses. 3) Incorporation of new models and information on early life history stages and post-migration mortality in prospective analyses.

COSTS AND FTE

1997 Planned: $0

FUTURE FUNDING NEEDS:

FY	$ NEED	% PLAN	% IMPLEMENT	% O AND M
1998	$400,000			
1999	$400,000			
2001	$0			
2002	$0			

PAST OBLIGATIONS (incl. 1997 if done):

FY	OBLIGATED
1997	$300,000
TOTAL:	$300,000

Note: Data are past obligations, or amounts committed by year, not amounts billed. Does not include data for related projects.

OTHER NON-FINANCIAL SUPPORTERS:

US Army Corps of Engineers; National Marine Fisheries Service

1997 OVERHEAD PERCENT: 35%

HOW DOES PERCENTAGE APPLY TO DIRECT COSTS:

total direct costs excluding equipment

SUBCONTRACTOR FTE:

Are the project's objectives and outcomes clearly defined, and is the project design likely to meet the objectives?