PATH (PLAN FOR ANALYZING AND TESTING HYPOTHESES) - PARTICIPATION BY STATE AND TRIBAL AGENCIES 9600800

SHORT DESCRIPTION:
PATH tests hypotheses underlying key salmon management decisions in the Columbia River Basin with scientists/managers from BPA, NPPC, NMFS, IDFG, ODFW, WDFW, and the CRITFC and their member tribes, as well as independent peer reviewers. In addition, the PATH participants are in the process of developing a prospective analysis and decision analysis to evaluate alternative management packages for Columbia basin salmon recovery. PATH will assist in designing research, monitoring and adaptive management experiments. This project is for State agency and tribal participation in PATH .

SPONSOR/CONTRACTOR: ODFW
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SUB-CONTRACTORS:
Idaho department of Fish and Game (IDFG) Washington Department of Fish and Wildlife (WDFW) Columbia Basin Fish and Wildlife Authority (CBFWA) Columbia River Inter-Tribal Fish Commission (CRITFC)

GOALS

GENERAL:
Supports a healthy Columbia basin, Maintains biological diversity, Maintains genetic integrity, Increases run sizes or populations, Adaptive management (research or M&E), Program coordination or planning, Decision analysis for alternative comprehensive management action packages

ANADROMOUS FISH:
Research, M&E

NPPC PROGRAM MEASURE:
3.2.A, 3.2.F , 4.2a, 4.3, 7.1E

RELATION TO MEASURE:
The PATH program was designed to provide coordinated and peer reviewed analytical assessments for Columbia Basin salmon populations. Although not directly identified in the Fish and Wildlife program, the PATH project directly addresses the quantitative needs of the program identified under section 3, 4, and 7.

BIOLOGICAL OPINION ID:
NMFS BO RPA 13; RPA A17

OTHER PLANNING DOCUMENTS:
NMFS Recovery Plan task 0.3.b and 2.11.b

TARGET STOCK	LIFE STAGE	MGMT CODE (see below)
Steelhead	ALL	P
Fall Chinook	ALL	L
Spring-Summer Chinook	All	L

BACKGROUND

Hydro project mitigated:
N.A.

Habitat types:
N.A.

HISTORY:

PATH began in 1995. In 1993 and 1994, funding was provided to facilitate cooperative efforts by the Bonneville Power Administration, the Northwest Power Planning Council, the National Marine Fisheries Service, Idaho Department of Fish and Game, Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, and the Columbia River Inter-Tribal Fish Commission and their member tribes to compare and enhance the simulation models they use to evaluate Columbia River salmon management options. Results from these model comparison activities and associated peer-review efforts showed that each modeling system has different strengths and weaknesses, several common patterns of model behavior, and some significant differences. In 1994, an independent scientific review panel (coordinated by Dr. Larry Barnthouse, then of Oakridge National Laboratory) completed an interim report in which they concluded that there were three major differences between modeling systems: 1) the distribution of survival over the life span; 2) the effect of flow on juvenile salmon survival; and 3) the benefit of transporting juvenile salmon around hydroelectric dams. The panel felt that as long as these differences exist the models were going to give different answers in a fairly predictable fashion. This would result in conflicting advice to decision makers and would make further analysis of details of model behavior relatively unproductive. The panel concluded that it would be more fruitful to focus on describing and attempting to resolve the fundamental issues, through hypothesis formulation and testing (applying Bayesian and other approaches). The 1995 NMFS Biological Opinion on operation of the federal Columbia River Power System (pg. 124, Rec. 17) stated that "The BPA shall participate with NMFS in activities to coordinate the regional passage and life cycle models and to test the hypotheses underlying those models." NMFS noted that the emphasis should shift to analyses that test the different assumptions underlying the models, rather than refining our understanding of how the models are different. NMFS concurred with the recommendation of the Scientific Review Panel (SRP) to conduct an analysis of alternative hypotheses, and worked with BPA to ensure that this work was funded out of the dollars dedicated to actions arising out of the Biological Opinion. This was the genesis of the Plan for Analyzing and Testing Hypotheses (PATH). Critical to the success of PATH are three components: 1) facilitation and funding of the interagency scientific working groups, 2) specialized expertise in Bayesian statistics, multivariate analysis, and Columbia Basin salmon stock assessment and population dynamics; and 3) external, independent peer review.

In the first year and a half of its existence, PATH has already made considerable progress. Specific achievements include:

· clarification of management decisions with senior personnel in the major institutions;
· development of hypothesis frameworks and sets of alternative hypotheses relevant to management decisions;
· considerable data reconnaissance, acquisition and refinement prior to completion of retrospective analyses of specific hypotheses;
· detailed retrospective analyses for hypotheses related to hydrosystem, habitat, hatchery and harvest management decisions;
· three workshops, each involving about 30 research scientists, to plan retrospective and prospective analyses, review the results of preliminary analyses and assess their implications for management decisions;
· a series of technical meetings of task work groups to advance progress on specific retrospective analyses;
· novel development and/or application of analytical tools to assist in decision making
· three-level hypothesis framework
· decision trees for hydrosystem, habitat and hatchery management decisions
· a Bayesian maximum likelihood estimation (MLE) framework to evaluate ability of different models to predict stock-recruitment patterns
· several different statistical analyses (cluster analyses, multiple regression, analysis of variance and covariance) to assess patterns implied by spatial and temporal contrasts in stock-recruitment
· a method for evaluating survival trends in the freshwater spawning and rearing life stage
· prospective analyses for determining the required improvements in the chinook salmon life cycle survival needed for achieving recovery goals
· development of a Bayesian population model to be used to simulate the implications of habitat. harvest, hatchery, and hydro management actions for survival and recovery of listed Snake River spring/summer chinook stocks
· a plan for formal decision analysis to assess through a variety of performance measures the effects of different combinations of actions in each of the four H's (hydrosystem, hatcheries, habitat, harvest]
· numerous reports (see below)
· a 30-page Conclusions Document synthesizing the major findings from the 620-page Final Report on Retrospective Analyses for FY96, including outstanding information needs necessary to resolve major uncertainties
· a set of presentations on progress by PATH participants to the Implementation Team (IT) Committee on PATH and other IT representatives; members of the NPPC and the public; meetings with the Research Review Group of the IT; and meeting with the Independent Scientific Group (now the Independent Scientific Advisory Board) to coordinate our activities.

BIOLOGICAL RESULTS ACHIEVED:

PATH has had indirect, yet significant benefits for anadromous fish: it has developed a rigorous framework of testable hypotheses

, and generated results which shed light on the potential to develop management actions to recover endangered Columbia River salmon populations. This will ultimately benefit fish populations by first attempting to minimizing the risk to the populations and second guide the best use of limited resources for fish population expenditures. The improved understanding generated through PATH's retrospective analyses has helped to sharpen the focus of hydrosystem management decisions, and provided quantitative tests of the hypotheses that hydro, habitat, hatchery and harvest activities have contributed to declines in Snake River spring-summer chinook populations since early 1970s. These analyses are currently being extended to other regions (Mid-Columbia) and stocks/species (fall chinook, steelhead). The independent Scientific Review Panel (SRP) has given two thorough and positive reviews of PATH's work to date. In addition, decision makers at the NPPC and Implementation Team have found the results of our work very helpful to their discussions on future management decisions. They were impressed by the clarity of our Conclusions Document, and the fact that such a diverse group of scientists have been able to achieve consensus on many hypotheses concerning Columbia River salmon population management.

PROJECT REPORTS AND PAPERS:

Beamesderfer, R.C.P., H.A. Schaller, M.P. Zimmerman, C.E. Petrosky, O.P. Langness, and L. LaVoy. in preparation. Spawner-recruit data for spring and summer chinook populations in Idaho, Oregon and Washington. July 1996 Draft Documentation for PATH - Plan for Analyzing and Testing Hypotheses, Retrospective Analysis.

Langness, O. P. and H. A Schaller. 1996. Contrasting Stock-Recruitment, Harvest, and Upstream Passage Survival Patterns of the Columbia River Stream-Type Chinook Populations. Draft Chapter 13 in: Plan for Analyzing and Testing Hypotheses (PATH).

Marmorek, D.P. and I. Parnell (eds.). 1995. Plan for Analyzing and Testing Hypotheses (PATH): Information package for Workshop 1 - Design of retrospective analyses to test key hypotheses of importance to management decisions on endangered and threatened Columbia River salmon stocks. Prepared by ESSA Technologies Ltd., Vancouver, BC with contributions from ANCOOR (Analytical Coordination Working Group) and Dr. R. Deriso, 88 pp. and appendices.

Marmorek, D.R, I, Parnell, L. Barnthouse and D.R. Bouillon. 1995. PATH - Plan for Analyzing and Testing Hypotheses. Results of a Workshop to Design Retrospective Analyses. Prepared by ESSA Technologies Ltd. Vancouver, BC for Bonneville Power Administration, Portland, 71 pp. and appendices.

Marmorek, D.R. (ed.)., J.J. Anderson, L. Bashan, D. Bouillon, T. Cooney, R. Deriso, P. Dygert, L. Garrett, A. Giorgi, O.P. Langness, D. Lee, C. McConnaha, I. Parnell, C.M. Paulsen, C. Peters, C.E. Petrosky, C. Pinney, H.A. Schaller, C. Toole, E. Weber, P. Wilson, and R.W. Zabel. 1996. Plan for Analyzing and Testing Hypotheses (PATH): Final report on retrospective analyses for fiscal year 1996. Compiled and edited by ESSA Technologies Ltd., Vancouver, B.C. 620 pp. Chapters 3, 5, and 9 are about to be submitted to Canadian Journal of Fisheries and Aquatic Sciences.

Petrosky, C.E., H.A. Schaller and R.C.P. Beamesderfer. 1995. Spawner-recruit relationships for spring and summer chinook populations in several Columbia and Snake River subbasins. Draft prepared for PATH Workshop 1

Petrosky, C.E. and H.A. Schaller. 1996. Evaluation of survival trends in the freshwater spawning and rearing life stage for Snake River spring/summer chinook. Chapter 9.0 in: Plan for Analyzing and Testing Hypotheses (PATH). Final Report on Retrospective Analyses for Fiscal Year 1996. Prepared by ESSA Technologies Ltd., Vancouver, B.C. for Bonneville Power Administration, Portland, OR. September, 10, 1996.

Schaller, H.A., C.E. Petrosky and O.P. Langness. 1996. Contrasts in stock recruitment patterns of Snake and Columbia River spring/summer chinook populations. Chapter 3.0 in: Plan for Analyzing and Testing Hypotheses (PATH). Final Report on Retrospective Analyses for Fiscal Year 1996. Prepared by ESSA Technologies Ltd., Vancouver, B.C. for Bonneville Power Administration, Portland, OR. September, 10, 1996.

Toole, C., A. Giorgi, E. Weber, , W. McConnaha, and anonymous. 1996. Hydro Decision Pathway and Review of Existing Information. Chapter 6.0 in: Plan for Analyzing and Testing Hypotheses (PATH). Final Report on Retrospective Analyses for Fiscal Year 1996. Prepared by ESSA Technologies Ltd., Vancouver, B.C. for Bonneville Power Administration, Portland, OR. September, 10, 1996.

Wilson, P. and anonymous authors. 1996. PATH: Hatchery Impacts. Chapter 11.0 in: Plan for Analyzing and Testing Hypotheses (PATH). Final Report on Retrospective Analyses for Fiscal Year 1996. Prepared by ESSA Technologies Ltd., Vancouver, B.C. for Bonneville Power Administration, Portland, OR. September, 10, 1996.

Barnthouse, L. (ed.), J. Collie, B. Dennis, S. Saila, and C. Walters. 1996. Plan for Analyzing and Testing Hypotheses (PATH): First Scientific Review Panel Report. Prepared by ChemRisk Division, McLaren/Hart Environmental Engineering Co., Oak Ridge, TN for Bonneville Power Administration, Portland, OR, 20 pp.

Barnthouse, L. (ed.), J. Collie, B. Dennis, S. Saila, and C. Walters. 1997. Plan for Analyzing and Testing Hypotheses (PATH): Second Scientific Review Panel Report. Prepared by ChemRisk Division, McLaren/Hart Environmental Engineering Co., Oak Ridge, TN for Bonneville Power Administration, Portland, OR, 20 pp.

Peters C. and D. Marmorek. 1996. Detailed notes from PATH Workshop 3, Wenatchee, Washington (October 7-11, 1996). Prepared by ESSA Technologies Ltd., Vancouver, BC for Bonneville Power Administration, Portland, OR, 24 pp.

ADAPTIVE MANAGEMENT IMPLICATIONS:

The hypothesis and decision frameworks we developed and applied in PATH have provided a means of harnessing a wide array of information, analytical tools and unpublished scientific knowledge towards key management decisions. The analyses have clearly confirmed patterns of spatial and temporal change in spring-summer chinook stocks, which not only elucidate the most likely causes of recent declines, but also lay the groundwork for grouping stocks for future adaptive management experiments. By bridging across different types of data sets and studies (e.g. migration corridor survival, transportation benefit, spawner-smolt survival, spawner-recruit survival, climate and ocean indicators, land use and hatchery indicators), PATH has generated a higher level understanding of how to integrate across life history stages and spheres of management action (hydro, hatchery, habitat, harvest). This provides a concrete foundation for designing adaptive management programs and coordinating research initiatives. PATH scientists have recommended several specific research, monitoring and evaluation approaches to resolving critical uncertainties (e.g. assessing the magnitude of delayed mortality of both transported and in-river migrants). In addition, by rigorously assessing the value of additional information from research studies, monitoring, and adaptive management experiments, PATH will provide a scientific basis for assisting in prioritizing expenditures for conserving and restoring these populations given limited financial resources. The design of this adaptive management framework is already in progress: it is being driven by the management questions of interest, the alternative hypotheses relevant to these questions and the data available to test these hypotheses.

PURPOSE AND METHODS

SPECIFIC MEASUREABLE OBJECTIVES:

ll occur for steelhead, but most work on spring-summer and fall chinook will focus on prospective analyses, as outlined below. 2. PROSPECTIVE 1. 1. RETROSPECTIVE ANALYSES: Publish peer-reviewed reports and journal articles demonstrating the overall level of support for key alternative hypotheses with implications for management decisions on endangered or threatened salmon populations of the Columbia River Basin. Provide succinct guidance to management agencies (particularly NPPC and Implementation Team) based on these outputs in written format and through oral presentations. Propose other hypotheses and/or model improvements that are more consistent with the data. Develop improved models that incorporate what has been learned from the retrospective analyses. In FY96 our retrospective analyses focused mainly on spring-summer chinook. There are five goals for FY97 retrospective analyses:

· publishing several of the FY96 spring/summer analyses in a peer-reviewed journal;

· completing a Conclusions Document summarizing FY96 results (now finished and distributed to NPPC and Implementation Team);

· complete follow-up retrospective analyses for spring-summer chinook (for hydrosystem, hatchery, habitat, harvest and climate hypotheses, especially improving the quantification of habitat and hatchery impacts;

· complete data acquisition, run reconstructions and retrospective analyses for fall chinook; and

· complete data acquisition and begin run reconstructions for steelhead.

In FY98 further retrospective analyses will occur for steelhead, but most work on spring-summer and fall chinook will focus on prospective analyses, as outlined below.

2. PROSPECTIVE ANALYSES: Publish peer-reviewed reports and journal articles that use a number of analytical approaches that explicitly account for uncertainty (e.g. Bayesian statistics, formal decision analysis) to project the range of possible future states of salmon populations under different management actions. A related objective is to apply these analytical approaches to assess the ability of adaptive management experiments to distinguish among competing hypotheses from future information. In generating these outputs, we will gradually evolve a quantitative adaptive management framework for development and implementation of a regional salmonid recovery program. Advise various institutions (IDFG, ODFW, NMFS, NPPC, BPA, USFW, WDFW, and Columbia River treaty tribes) on research, monitoring and adaptive management experiments which would maximize the rate of learning and clarify decisions. Integrate the future information from basin wide research, monitoring, and adaptive management experiments in a quantitative framework to provide ongoing, coordinated, and peer reviewed management advice.

CRITICAL UNCERTAINTIES:

Uncertainties:

1. Rates of Learning: There are serious limitations on how quickly we can improve the existing data base, due to both the serious condition of the stocks (which limits the possible range of experimentation and monitoring), and the time needed to accumulate sufficient statistical power to have 'comfortable' levels of confidence in decision paths taken. However, due to the extremely depressed status of many of the salmon populations there may be an extremely high conservation risk if status quo management is maintained. Decisions will need to be made under considerable uncertainty; PATH can help to maximize the learning associated

with chosen decision paths and assist in minimizing the risks to salmon population conservation. The formal decision analysis and Bayesian statistical approach used by PATH is intended to explicitly account for these uncertainties.
2. There were no major court cases in FY96, but the amount of future litigation is highly uncertain.
3. The reopening of the NPPC Fish and Wildlife Program in FY97 could require significant time investment by many agency PATH participants, slowing progress on or refocusing PATH deliverables.

Risks:
As PATH is not a physical project, it does not have any risks to other stocks. Risk assessment of alternative management actions is a key component of PATH.

BIOLOGICAL NEED:

Salmon populations in the Columbia River Basin have been in decline since the early days of western settlement, with dramatic declines occurring in the last three decades. The annual production of the Snake River spring/summer chinook during the late 1800's was probably in excess of 1.5 million fish or 39% to 40% of all Columbia River spring/summer chinook (NMFS Biological Opinion, 1995). Today the population of Snake River spring/summer chinook is approximately 0.5% of its historic abundance, with approximately 1,800 spring/summer chinook returning to the Snake River. The story is similar for the Snake River fall chinook. From 1938, when Bonneville dam was completed, to 1950, the returns of Snake River fall chinook fell from approximately 72,000 to 29,000. Today, after completion of the Snake River dams approximately 350 Snake River fall chinook return. Such declines have led to both races of Snake River chinook being listed under the Endangered Species Act, though both have continued to decline since listing (NMFS, Proposed Recovery Plan for Snake River Salmon, 1995). Past efforts to halt the decline have been ineffective because 1) they didn't adequately reduce hydrosystem mortality; and 2) not all entities shared common objectives. A common adaptive management framework (analytical monitoring, evaluation and management assessment approach) for guiding research and monitoring activities and providing management advice for salmon population conservation and restoration, could have helped clarify these issues. Therefore, there is an urgent need for coherent, defensible biological guidance to decision makers.
PATH has made very significant progress in building constructive working relationships among scientists from agencies with different perspectives (i.e. BPA, NMFS, CORPS, State and Tribal agencies, NPPC). PATH has helped to define many areas of common agreement and is specifying the information or experiments needed to resolve remaining key areas of disagreement. The high quality retrospective analyses cooperatively generated by the PATH group over the past 17 months and the PATH prospective analyses currently underway, is beginning to identify biological performance measures such as improvements in survival over the salmon life-cycle and smolt to adult return rates (SARs) which are need to achieve population recovery goals. This PATH work and the conceptual foundation provided by the ISG in their Return to the River report, will together strengthen the scientific basis for the difficult and urgent decisions that must be made.

HYPOTHESIS TO BE TESTED:

A number of testable hypotheses have been developed and tested as part of the PATH process. For the retrospective analyses, these hypotheses fall into three groups: 1) Level 1 Hypotheses are exploratory analyses to assess patterns of change in stock indicators over space and time to identify differences in trends among species and stocks, without investigating mechanisms to explain those differences; 2) Level 2 Hypotheses attempt to explain trends in stock indicators in terms of changes in either the survival of particular life history stages, or the stresses affecting life stage survivals, thereby providing inferences on where to focus management actions; and 3) Level 3 hypotheses explain mechanisms associated with observed trends in survival of key life stages identified at Level 2, and link directly to management decisions on hydro, harvest, habitat or hatcheries.

ALTERNATIVE APPROACHES:

N.A.

JUSTIFICATION FOR PLANNING:

BC, U. Rhode Island, U. Idaho, Inter-American Tropical Tuna Commis

METHODS:

PATH consists of an iterative series of workshops, analytical activities and reporting steps to test key hypotheses underlying management decisions, coordinated by an interagency PATH Planning Group. (The PATH Planning Group includes the PATH facilitator, David Marmorek (ESSA Technologies); H. Schaller, ODFW (representing the State fishery agencies); J. Geiselman, BPA (representing the power system operating agencies); C. McConnaha, NPPC; E. Weber, CRITFC; and C. Toole, NMFS.) The

workshops and reports force participants to complete tasks, and provide for fruitful exchange, feedback and internal peer review. Both a core set of 25 PATH participants, and an extended set of 15 - 20 occasional participants, provide input to analytical activities. Interaction with the Implementation Team for the Draft Recovery Plan and NPPC helps to prioritize major goals. Iteration within the PATH process occurs as the logical framework of hypotheses is revised over time in response to improvements in both information and analytical methods. This framework is intended to:

1. compile and analyze information to assess the level of support for alternative hypotheses relevant to key management decisions, identifying knowledge and data gaps that could be filled through management experiments, research and monitoring;
2. provide guidance to the development of regional programs that would stabilize, ensure persistence, and eventually restore depressed salmon stocks to self sustaining levels; and
3. provide a structure for an adaptive learning approach to development and implementation of a regional salmonid recovery program.

The overall PATH process has five features to ensure high quality outputs: 1) fisheries scientists from the participating agencies; 2) active participation of three internationally recognized independent fisheries scientists in PATH workshops and technical meetings (Drs. Peterman, Deriso and Botsford); 3) the formation of interagency work groups to address specific topics, which ensures strong internal review of all work products; 4) overall coordination , mediation and integration by the PATH facilitator; and 5) external review by the Scientific Review Panel (Drs. Walters, Collie, Saila and Dennis).

PATH activities in FY96 culminated in the completion of a Conclusions Document, which summarizes the findings of retrospective analyses. This document represents the consensus view of PATH participants on what the data and analyses completed thus far say about probable reasons for the decline in abundance of Snake River spring/summer chinook. This document has been supplemented by a series of presentations to the NPPC, the Implementation Team, and the public. Summary outputs and quarterly presentations are an integral part of the PATH process and are an important means of communication between PATH and interested groups in the region. PATH products are also available on the BPA-maintained www site.

Some of the technical methods used to date in PATH were summarized in Section 2 on historical information. PATH uses a weight-of-evidence approach to hypothesis testing, looking for consistency across all available evidence, and the sensitivity of conclusions to the weights assigned to different data sources and analytical results. The retrospective analyses provide the foundation for prospective analyses. The FY97 goals for the prospective analyses are as follows:

P1.•Estimate the improvement in life cycle survival required to reach various salmon objectives (survival, recovery, rebuilding) and the uncertainty associated with these estimates, using a Bayesian modeling approach that incorporates all uncertainties and compare results with existing stochastic life-cycle models (ELCM and SLCM). These survival improvements can be expressed as Biological Objectives, consistent with the 1994 NPPC Fish and Wildlife Program. To develop goals for rebuilding, decisions will need to be made on which stocks are included. For survival and recovery goals these are clearly related to stocks listed under the Endangered Species Act. (This task nearly complete for Snake River spring-summer chinook as of Jan. 30/97).

P2.•Develop a formal decision analysis framework, which provides a common tool for incorporating alternative management action packages, alternative states of nature (with their respective posterior probabilities based on retrospective analyses), and a variety of performance measures. The decision analysis framework will permit the calculation of the expected value of various performance measures (e.g. probably of survival, probability of recovery, expected rates of learning), given a number of different hypotheses about key processes, and their associated probabilities. In some cases (e.g. hydro) these probabilities may be computed from retrospective analyses, whereas in other cases (habitat, hatcheries) they may need to be more subjectively assigned (although bounded by inferences of empirical stock performance). The development of a suite of performance measures will involve interaction with the Research Review Group and the Independent Scientific Advisory Board (ISAB). Development of a set of action packages for the decision analysis will involve interaction with the Implementation Team as well as other entities. A modular set of interacting software tools is expected to evolve within this task to permit all PATH investigators to flexibly explore the implications of alternative model formulations. This modular framework would include the output from different passage models; tests of this output against both stock-recruitment, SARs, passage survival, and transportation studies (using an MLE framework to estimate Bayesian posterior probabilities); and a decision analysis tool to generate expected values of different performance measures given the model output and associated probabilities.

P3.•Use of the decision analysis approach and other methods to assess the rate of learning associated with alternative sets of management actions, research and monitoring activities, and adaptive management experiments. This analysis of the benefits of different management and research directions would be linked to ongoing research, monitoring and evaluation programs, guide management decisions to minimize risks to extremely depressed populations, to assess how existing activities could be modified to better answer key uncertainties, and also to suggest new activities which could be added to those already planned. A component of this objective is to define performance measures to optimize the likelihood of reaching survival improvement objectives.

The above three tasks will be completed in FY97 for spring-summer chinook. Prospective modeling and decision analyses for chinook and steelhead will be completed in FY98, though more qualitative assessments will certainly occur in FY98. This work would continue through the year 2001 focusing on integrating these analyses and decision tools over many of the salmon populations in the Columbia River basin. This is the period where many critical management decisions and assessments of those

decisions must be made.

PLANNED ACTIVITIES

SCHEDULE:

PROJECT COMPLETION DATE:
2001

CONSTRAINTS OR FACTORS THAT MAY CAUSE SCHEDULE OR BUDGET CHANGES:
As indicated above, lawsuits and NPPC re-examination of Fish and Wildlife Program could divert the time of some key PATH participants.

OUTCOMES, MONITORING AND EVALUATION

SUMMARY OF EXPECTED OUTCOMES

Expected performance of target population or quality change in land area affected:
N.A.

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:
The project will help define the long-term population goals for Columbia River basin salmon. The project will provide the tools to assess if populations are achieving long-term goals.

Indirect biological or environmental changes:
N.A.

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 project is focused on helping to design future adaptive management experiments (through decision tools described above) to resolve or reduce critical uncertainties clouding management choices.

Information products:
Improved rationale for salmon recovery decisions on transportation, drawdown, in-river measures; habitat restoration; hatchery activities and harvest Improved research, monitoring, and adaptive management strategies. Increased consensus among scientists in different agencies on the state of knowledge, range of possible trajectories of endangered stocks, and appropriate management actions. Improved consolidation of decision support and decision analysis tools, and stronger links of these tools to empirical evidence. Publication of results in peer-reviewed journals. Regularly scheduled presentation to decision makers and the public.

Coordination outcomes:
Better integration of decision making among management agencies through a clear framework for decision analysis and adaptive management.

MONITORING APPROACH
N.A.

Provisions to monitor population status or habitat quality:
PATH's research, monitoring and adaptive management recommendations will detail the most appropriate monitoring approach. This must consider the whole life cycle of the stocks of interest, as well as life stage specific measures.

Data analysis and evaluation:
See previous sections

Information feed back to management decisions:
Quarterly meetings with Implementation Team, NPPC, Research Review Group, ISAB, System Configuration Team

Critical uncertainties affecting project's outcomes:
Securing full commitment of PATH participants from senior managers in NPPC, ODFW, IDFG,WDFW, and Tribal fish agencies, BPA, NMFS, CORPS. PATH's work is quite broad in nature and on a strategic level. More tactical issues are best addressed by others.

EVALUATION
Section 101L and 101M above - essentially by the clarity brought to the decision making and recovery planning process.

Incorporating new information regarding uncertainties:
The PATH Planning Group has weekly conference calls during which we adapt to new information, analytical findings, and uncertainties. The planning group works with the PATH members and the Implementation Team to make adjustments to assignments and assessment tasks.

Increasing public awareness of F&W activities:
Through quarterly presentations to the NPPC and public; concise summaries of conclusions; peer-reviewed journal articles; and the BPA-maintained World-Wide Web site on PATH.

RELATIONSHIPS

RELATED BPA PROJECT	RELATIONSHIP
8910800 CRiSP Modelling	funds James Anderson's and colleagues' participation in PATH
9601700 Technical Support for Path - Chapman Consulting, Inc.(now Bioanalysts, Inc.)	funds Al Giorgi's hydrosystem work participation in PATH

9303701 Technical Assistance With the Life Cycle Model	funds Charlie Paulsen's simulation modeling participation in PATH
9203200 Life-cycle Model Development and Application, and Analyis of Fish-habitat Relationships	funds US Forest Service for quantitative habitat assessments (Danny Lee) participation in PATH
9600600	fund ESSA for PATH, Facilitation, Tech Assistance & Peer Review- work with planning group to develop specific PATH workplans and reports to be submitted to PATH peer review process.

OPPORTUNITIES FOR COOPERATION:

PATH currently involves cooperation among scientists from NMFS, BPA, NPPC, ODFW, IDFG, WDFW, CRITFC, USFS, CBFWA, CORPS, as well as from a number of academic and research institutions (U.Washington, Simon Fraser University, UC Davis, UBC, U. Rhode Island, U. Idaho, Inter-American Tropical Tuna Commission) and private firms (ESSA Technologies, Paulsen Environmental Research, Don Chapman Consultants). In addition, the Independent Scientific Group has participated in PATH since its inception (Phil Mundy, Jim Lichatowich, Chip McConnaha, and recently Chuck Coutant). Close cooperation with the ISG is very important to PATH. PATH provides a formal process to efficiently utilize and focus the regional technical expertise. The PATH work will also be coordinated with US vs Oregon Columbia river Management Plan activities and the Mid-Columbia Habitat Conservation processes.

COSTS AND FTE

1997 Planned: $716,200

FUTURE FUNDING NEEDS:

FY	$ NEED	% PLAN	% IMPLEMENT	% O AND M
1998	$637,000	100%		
1999	$669,000	100%		
2000	$720,000	100%		
2001	$737,100	100%		
2002	$774,000	100%		

PAST OBLIGATIONS (incl. 1997 if done):

FY	OBLIGATED
1996	$453,598
1997	$606,381
TOTAL:	$1,059,979

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

LONGER TERM COSTS:

$750,000.00. There will be a continued need for: interagency analytical work groups; re-evaluation of key hypotheses; adaptive management experimental design; research, monitoring and evaluation. PATH is the group best equipped to play this continuing role.

1997 OVERHEAD PERCENT: ODFW applies a 20.5% to our direct project cost. No overhead is charged for subcontractors

HOW DOES PERCENTAGE APPLY TO DIRECT COSTS:

Overhead only applies to direct ODFW costs. The direct costs are 24% of contract cost.

CONTRACTOR FTE: 2.33 FTE

SUBCONTRACTOR FTE: CBFWA 1 CRITFC 1.25 IDFG 1.09 WDFW 1.5