

ALASKA LEGISLATURE SPECIAL COMMITTEE / SUBJECT FILE 8672
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**REIMBURSABLE SERVICES AGREEMENT CONTRACT
SPECIFICATION AND REQUEST FOR PROPOSAL
SALMON FISHERY COST MODEL**

Background

In the early 1970s, the state of Alaska initiated a salmon enhancement and rehabilitation program through the Alaska Department of Fish and Game (ADF&G), Fisheries Research and Enhancement (FRED) Division. The program consists of production from hatcheries, lake fertilization, fish passes, spawning channel and stream habitat improvements. The hatchery, or ocean ranching, portion of the program provided for two categories of hatcheries: one funded and operated by the state, and the other comprised of private, non-profit (PNP) hatcheries. The PNP hatcheries were to share their harvestable surplus with the traditional fishing fleets and sell a portion of returning fish to sustain the operation of the hatchery.

What began as an experiment, however, has resulted in a large, very successful pink salmon hatchery program, as well as chum and coho production, in Prince William Sound (PWS); chinook, coho and chum salmon production in southeast Alaska; sockeye and pink salmon production in Kodiak; and sockeye and king production in Cook Inlet. In general, the enhancement program has been successful in increasing salmon production and harvests in Alaska.

In the last 20 years, the FRED Division program has constructed over 20 hatcheries, 19 of which are currently in operation. Since 1972, the state of Alaska has invested approximately \$81 million in capital construction of hatchery facilities, and another \$170 million in the operation of these facilities. In addition to the state-owned facilities, 30 PNP-hatchery permits have been issued since the inception of the program, including 3 for the operation of state-owned facilities under special contract with the FRED Division. Currently, 21 of the permitted hatcheries are in operation and had returns of adult salmon in 1990. For PNPs, the state of Alaska has invested approximately \$51 million in loans, an additional \$20 million in operating costs, and \$31 million in grants. For state operated hatcheries and the enhancement program, the legislature has appropriated \$208 million for operational costs, \$41 million in capital costs, and authorized \$77 million in bonds sales.

As a result of these hatcheries and enhancement projects, the estimated total return of adult pink salmon to hatcheries in PWS has grown from 0.1 million fish in 1977 to 25.2 million fish in 1990. The hatchery-produced pink salmon have contributed up to 98 percent of the total pink harvest in PWS in recent years. In southeast Alaska, the initial plan was to produce 100,000 chinook salmon for the troll fishery. In 1990, however, the troll fishery harvested 55,000 fish because of difficulties targeting hatchery fish. Current statewide salmon harvests from the hatchery program range from 15 to 23 million fish and are expected to grow to approximately 30 million fish by 1995 given current levels of hatchery production capacity. The enhancement program could soon account for 20 to 35 percent of the statewide salmon harvest.

Purpose of the Proposed Research

In May 1991, the Senate Special Committee on International and Domestic Fisheries initiated an extensive review of the Alaska salmon hatchery and enhancement program. As a result of considerable interest in the project, participation in the Hatchery Research Project includes representatives from both the Senate and the House of Representatives. The purpose of the study is to 1) review the history and legislative intent of the enhancement program, 2) analyze the current status of the program, and 3) consider future options for the program--ranging from fine tuning to possible redirection.

As part of the Hatchery Research Project, an **Economics and Marketing** study group was developed to provide information to the legislature on the economic impacts of salmon hatchery production. The group was formed to help determine

- if the current levels of Alaska salmon harvests are over-or under-supplied from a world-market perspective and
- if increased hatchery production of salmon will raise or lower prices, fishing and processing revenues, and the total net value of Alaska's salmon fisheries.

To address these public policy questions requires a benefit-cost analysis. This type of analysis measures the level and cost of hatchery salmon production, the cost of harvesting and processing salmon, and the impact or "price responsiveness" of world salmon markets to various levels of Alaska salmon production. The costs are then subtracted from the benefits to estimate the net benefits of the salmon enhancement program and the incremental net benefits of different levels of salmon hatchery production. To provide this information the economics group has proposed a series of contracts, one of which is a fishing cost model designed to be part of a bioeconomic model of the fishery.

Description of Parties Involved

The Reimbursable Service Agreement (RSA) is between the Alaska State Legislature and the principal investigator or contractor. The primary legislative contacts are Ginny Fay, Economics and Marketing Group and staff to the Senate Special Committee on International and Domestic Fisheries, and Molly McCammon, Hatchery Project Coordinator. The Alaska Department of Fish and Game will provide technical advise and data required for the completion of the projects. The ADF&G contact(s) is Jeff Hartman, FRED Division, Juneau.

Fishing Cost Model for the Alaska Salmon Fishery

The objective of this study is to formulate and test empirical models that will project short- and long-run fishing costs for specific Alaska salmon fisheries. AS part of the contract, the contractor will also be expected to develop computer software from reduced form equations to use in benefit-cost analysis computer simulations of fishery enhancement projects.

To conduct a benefit-cost analysis, fishing costs must be determined in the short and long run. In the short run, an enhancement project or a management action may encourage salmon fishermen to direct more fishing effort--which is a function of gear, boat size, horse power, and crew size, for example--into a specific statistical area and away from another statistical area (or alternative fishing opportunity). With the existing management constraints on salmon fishing in place, such as limited entry and fisheries openings and closures, the short-run increases in marginal costs may be smaller or larger than the potential short-run revenues from a given project. However, in the long run, fishermen can be expected to increase fishing effort in statistical areas where the marginal revenues are greater than marginal costs of fishing. Fishing effort would be increased even if new vessels are not allowed to enter the fishery. As a result of insufficient research, economists currently can only provide informed guesses of the magnitude of these short- and long-run fishing costs in Alaska's salmon fisheries.

Economic theory suggests that fishermen's behavior will be driven by their desire to earn economic profits. This means that fishermen will participate in fisheries that they perceive to be the best alternative available to them. The cost of remaining in a particular fishery or area depends upon fishing costs and revenues, and what alternative fishing opportunities are available in other areas. These costs can be inferred from entry/exit decisions (such as switching from one fishery to another) or from the travel costs from moving between fishing areas or fisheries. Fishing entry and exit decisions and fishing movements will also be affected by the abundance of fish in a fishery which affects the cost of fishing. An enhancement program or management action may alter fishing costs and revenues. Therefore, the marginal fishing costs of enhancement projects can be explained through fishery entry and exit and travel behavior. A fishing revenue model can be combined with a fishing cost model derived from entry and exit information to determine the net benefits of enhancement activities.

As a result of Alaska's limited entry permit and management programs that rely on area licensing, and records obtained by fish ticket and vessel surveys, it is possible to track the movements of individual fishermen within and between fisheries. It is also possible to relate these movements to the changes in fishing opportunities from enhancement and management actions. These relationships can be analyzed and modeled by examining the vessel-level data that are contained in fish ticket and vessel license files.

The purpose of this modeling exercise is to use data from the fish ticket and vessel license files to determine (1) the short-run marginal fishing costs from additional salmon harvests as a result of salmon enhancement projects, and (2) the long-run marginal fishing costs as fishermen increase capital investment in boats and gear.

Products of the Contract and Research Instructions

Cost-Model Requirements

The contractor will produce an empirically developed fishing cost model for each region of the state, capable of estimating marginal

fishing costs for changes in the abundance of salmon for each species and district (or aggregation of districts).

The contractor will produce the models through the application of inferential techniques that are consistent with economic theory.

In the event that inferential methods do not produce statistically reliable models, the contractor will be expected to provide ad hoc cost models for each fishery based upon best professional judgement.

All software for running simulations of the models must be produced in SAS, microcomputer version _____.

All computer software must be accompanied by complete usage instructions. In addition, the model must be sufficiently documented such that a user familiar with the SAS microcomputer software can operate the models.

A report using a standard research report format must be produced that includes sections describing the background, methodology, results, and conclusions of the modeling effort. For an example of an acceptable format, see (Boyce 1990).

Several simulations of policy questions must be included in the fishing cost analyses and report. These simulations will be dependent on hatchery and enhancement production scenarios resulting from a survey of enhancement projects. The simulations will be developed and specified to the contractor by mid-November.

The model, all explanatory variables, relevant input data files, and output data sets from simulations will be programmed in SAS and delivered to Ginny Fay with the Alaska State Legislature.

A thorough documentation of model assumptions and structure as well as instructions for model operation will be produced.

Any data collected to conduct the analysis will be the property of the Alaska State Legislature.

Information to be Supplied to the Contractor

The contractor will receive the following information from the Legislature and ADF&G:

During a fishing season, there are approximately 650,000 fish tickets generated to track landings in the state's commercial fisheries. For each fish ticket, one observation is created for each species harvested and delivered to a fish processor. Fish ticket data are collected into a single SAS dataset that encompasses all landings in a given year in regulated fisheries. A large portion of the fish ticket file consists of salmon landings.

However, only a portion of the landings are relevant to fisheries affected by the fishery enhancement program. These include salmon fisheries in Kodiak, the Alaska Peninsula, Prince William Sound, Cook Inlet, and Southeast Alaska. The fish ticket computer file is available back to 1975. In addition, a computerized vessel license file goes back to 1978. This file provides information on the fisheries in which a particular fisherman participates. This file also includes detailed information on fishing vessel characteristics. It is updated each week through out the fishing season.

The contractor will receive a listing of SAS library and file names from CFEC for the fish ticket file, and the vessel license file that corresponds to the relevant salmon fisheries.

- The contractor will receive a password for a hard drive accessible through the CFEC computer (available off the state mainframe) that will house the computer files. These data bases are confidential and modeling exercises as well as published simulations must be designed around these constraints.
- Information on the operation of the fisheries is to be made available to the contractor by providing recent management reports. Some ADF&G management biologists will be available to confer on the operation of the fisheries.
- FRED Division will supply information on the location of state and PNP enhancement projects, production from the hatcheries and historical harvests, by region and species from FRED Division annual reports.
- A list and map of state and PNP salmon hatcheries in Alaska - available by late-September from the FRED Division
- A computer file that matches the 1990 Annual Report production numbers to catches by an aggregation of fishing districts in each region - available by October 1 from the FRED Division for state hatcheries only.
- List of the primary fisheries harvesting state and PNP hatchery-produced fish - available from the FRED Division
- Survey results from enhancement project operators providing a time series of production of juveniles by hatchery and by species - available by early November from the FRED Division
- Estimates of average historical harvests for ten-, fifteen-, and twenty-year periods by species and subareas

Survey results from enhancement project operators providing a time series of the returns and harvests of adult fish by region, district, and species - available by early November from the FRED Division

Information to be Provided in the Research Proposal

The contractor will be expected to explain the following in the research proposal:

- Which fish ticket file data fields will be used in each of the cost models for a region of the state.
- Which vessel license file data fields will be used in the cost models.
- Specify the model equations to be tested.
- Show how the dependent variable (marginal fishing cost) will be computed for any year, species and district in the relevant fisheries for each modeling approach that will be applied.
- Identify each variable that will be used from the fish ticket file and vessel license file explicitly in the equations.
- List additional information or data that will be required from ADF&G.
- List any additional variables, not accessible in the fish ticket, and vessel license files required for the models. Explain how additional data will be obtained.
- Explain what statistical tests will be performed, what econometric statistics will be generated in the estimation, and how analysis of prediction errors will occur.

Cost Estimate

As part of the proposal, the contractor will itemize expected costs for: data collection, subcontracting, programming, and model documentation of statistical results and software operating instructions.

Schedule of Research Activities

Proposals should be submitted by September 27, 1991 and should include a schedule of completion milestones from data collection through programming and model testing. The due date for the final model software and documentation is December 1, 1991. The decision on contract awards will be made by October 4, 1991.

DRAFT

Research Funding Provided

\$20,000

**REIMBURSABLE SERVICES AGREEMENT CONTRACT
SPECIFICATION AND REQUEST FOR PROPOSAL
SALMON HATCHERY POPULATION AND EXPLOITATION MODELING**

Background

In the early 1970s, the state of Alaska initiated a salmon enhancement and rehabilitation program through the Alaska Department of Fish and Game (ADF&G), Fisheries Research and Enhancement (FRED) Division. The program consists of production from hatcheries, lake fertilization, fish passes, spawning channel and stream habitat improvements. The hatchery, or ocean ranching, portion of the program provided for two categories of hatcheries: one funded and operated by the state, and the other comprised of private, non-profit (PNP) hatcheries. The PNP hatcheries were to share their harvestable surplus with the traditional fishing fleets and sell a portion of returning fish to sustain the operation of the hatchery.

What began as an experiment, however, has resulted in a large, very successful pink salmon hatchery program, as well as chum and coho production, in Prince William Sound (PWS); chinook, coho and chum salmon production in southeast Alaska; sockeye and pink salmon production in Kodiak; and sockeye and king production in Cook Inlet. In general, the enhancement program has been successful in increasing salmon production and harvests in Alaska.

In the last 20 years, the FRED Division program has constructed over 20 hatcheries, 19 of which are currently in operation. Since 1972, the state of Alaska has invested approximately \$81 million in capital construction of hatchery facilities, and another \$170 million in the operation of these facilities. In addition to the state-owned facilities, 30 PNP-hatchery permits have been issued since the inception of the program, including 3 for the operation of state-owned facilities under special contract with the FRED Division. Currently, 21 of the permitted hatcheries are in operation and had returns of adult salmon in 1990. For PNPs, the state of Alaska has invested approximately \$51 million in loans, an additional \$20 million in operating costs, and \$31 million in grants. For state operated hatcheries and the enhancement program, the legislature has appropriated \$208 million for operational costs, \$41 million in capital costs, and authorized \$77 million in bonds sales.

As a result of these hatcheries and enhancement projects, the estimated total return of adult pink salmon to hatcheries in PWS has grown from 0.1 million fish in 1977 to 25.2 million fish in 1990. The hatchery-produced pink salmon have contributed up to 98 percent of the total pink harvest in PWS in recent years. In southeast Alaska, the initial plan was to produce 100,000 chinook salmon for the troll fishery. In 1990, however, the troll fishery harvested 55,000 fish because of difficulties targeting hatchery fish. Current statewide salmon harvests from the hatchery program range from 15 to 23 million fish and are expected to grow to approximately 30 million fish by 1995 given current levels of hatchery production capacity. The enhancement program could soon account for 20 to 35 percent of the statewide salmon harvest.

Purpose of the Proposed Research

In May 1991, the Senate Special Committee on International and Domestic Fisheries initiated an extensive review of the Alaska salmon hatchery and enhancement program. As a result of considerable interest in the project, participation in the Hatchery Research Project includes representatives from both the Senate and the House of Representatives. The purpose of the study is to 1) review the history and legislative intent of the enhancement program, 2) analyze the current status of the program, and 3) consider future options for the program--ranging from fine tuning to possible redirection.

As part of the Hatchery Research Project, an Economics and Marketing study group was developed to provide information to the legislature on the economic impacts of salmon hatchery production. The group was formed to help determine

- if the current levels of Alaska salmon harvests are over-or under-supplied from a world-market perspective and
- if increased hatchery production of salmon will raise or lower prices, fishing and processing revenues, and the total net value of Alaska's salmon fisheries.

To address these public policy questions requires a benefit-cost analysis. This type of analysis measures the level and cost of hatchery salmon production, the cost of harvesting and processing salmon, and the impact or "price responsiveness" of world salmon markets to various levels of Alaska salmon production. The costs are then subtracted from the benefits to estimate the net benefits of the salmon enhancement program and the incremental net benefits of different levels of salmon hatchery production. To provide this information the economics group has proposed a series of contracts, one of which is a population and exploitation model designed to fit into a bioeconomic model of the fishery.

Population and Exploitation Model

In contrast to farmed salmon, salmon produced by hatcheries and other enhancement projects are exposed to similar biological and environmental conditions and fisheries as wild stocks. As a result, population and exploitation research will estimate the interdependence of wild and hatchery stocks and the impacts of salmon harvesting pressure on population sizes. The objective of the modeling exercise is to produce both a model and simulations from the model that project the number of fish returning as adults from enhancement projects, the harvest of these enhanced salmon in the commercial fishery, and harvests of wild salmon in the commercial fishery. The population and exploitation modeling will be conducted by formulating and testing empirical models that will project short- and long-run harvests of enhanced salmon and harvests of wild salmon stocks for each year from 1992 to 2022 under various enhanced salmon juvenile production levels. The outputs from the bioeconomic population and exploitation modeling will be combined with salmon demand models and fishing cost models to estimate the net benefits of the statewide salmon enhancement program on the commercial fishery.

Description of Parties Involved

The Reimbursable Service Agreement (RSA) is between the Alaska State Legislature and the principal investigator or contractor. The primary legislative contacts are Ginny Fay, Economics and Marketing Group and staff to the Senate Special Committee on International and Domestic Fisheries, and Molly McCammon, Hatchery Project Coordinator. The Alaska Department of Fish and Game will provide technical advice and data required for the completion of the projects. The ADF&G contact(s) _____.

Products of the Contract and Research Instructions

As a result of data limitations, the contractor is expected to "bound" the possible outcomes of wild and enhanced stocks interaction and population responses to fishing pressure. One modeling approach will assume that the wild and enhanced salmon stocks are biologically independent--the enhanced stock production will be considered to be linear and independent of the wild salmon population size. Under this scenario, ten-, fifteen-, and twenty-year harvest averages will be used to develop the probable harvests of wild and enhanced salmon stocks by species and region. Information on adult returns, historical fishing pressure and harvest rates will be provided by the survey of hatchery operators. This modeling exercise will be the simplest and probably the most optimistic in terms of enhanced salmon production scenarios. The estimates of average historical harvests to be used in this modeling approach will be developed by the Legislative Research Agency. This information will be provided to the contractor by October 15, 1991.

A second and more complex approach includes the assumption of density dependence between the wild and enhanced stock. However, because of data limitations, future harvests of enhanced and wild stocks can not be projected with much precision. Some of the barriers to the estimation of harvests are identified below:

- There is a lack of precise data on harvest and escapement of wild stocks. In many cases, survey data for wild stock escapements are primarily estimates. Harvest data by region and district may be fairly accurate, but harvests in specific statistical areas are difficult to determine because landings can not be related to specific natal streams.
- There is a lack of data on biological and habitat influences in the near-shore marine and open-ocean environment, and how these biological and environmental influences interact to limit or control the growth of wild and enhanced salmon populations. The major influences might consist of food and feeding competition, predator-prey relationships, and genetic and fishery interactions.
- As a result of insufficient tagging data, in most fisheries there is an inability to 1) separate enhanced and wild stocks in mixed fisheries, and 2) model fishery management actions and decisions in dynamic fisheries, and the resulting fishing behavior in regulated fisheries. This undermines the ability to model fishing pressure that would be exerted on enhanced and wild salmon stocks.

Because of these data and modeling constraints, the contractor will be expected to roughly "bound" the possible population estimates of wild and enhanced salmon stocks and the responses of these populations to fishing pressure. Many of the assumptions of the density-dependent population model will need to be developed with data and staff assistance from the ADF&G, Division of Commercial Fisheries. This will necessitate direct interactions with Division of Commercial Fisheries area management biologists.

The contractor will be expected to produce the following:

The model, all explanatory variables, relevant input data files, and output data sets from simulations will be programmed in SAS and delivered to Ginny Fay with the Alaska State Legislature.

Thorough documentation of model assumptions and structure as well as instructions for model operation.

Any data that is not litigation sensitive, will be the property of the Alaska State Legislature.

Simulation of several population modeling outcomes representing a range of pessimistic, most likely, and optimistic production scenarios. The contractor will be expected to identify which of the simulation outcomes fit into an optimistic, most likely, and pessimistic harvest range.

Information to be Supplied to the Contractor

The contractor will receive the following information from ADF&G:

- Copies of the FRED Division Annual Reports which list the major salmon enhancement projects in Alaska, and current enhancement numbers by species, and historical harvests by species - available by October 1
- A list and map of state and PNP salmon hatcheries in Alaska - available by October 1 from the FRED Division
- An address file for state and PNP hatcheries in Alaska - available by October 1 from the FRED Division
- An computer file which matches the 1990 Annual Report production numbers to harvests by an aggregation of fishing districts in each region - available by October 1 from the FRED Division for state hatcheries only
- List of the primary fisheries harvesting state and PNP hatchery-produced fish - available by October 1 from the FRED Division
- Survey results from enhancement project operators providing a time series of production of juveniles by hatchery and by species - available by early November from the FRED Division

Estimates of average historical harvests for ten-, fifteen-, and twenty-year periods by species and subareas - available by mid-October from the Legislative Research Agency; the data for these estimates will be provided to the Legislative Research Agency by ADF&G by mid-September

Survey results from enhancement project operators providing a time series of the returns and harvests of adult fish by region, district or aggregate of districts, and species - available by early November from the FRED Division

Annual escapement and harvesting data by species and district from annual Area Management Reports and other databases - available by mid-October from the Division of Commercial Fisheries

Comments on fishery manageability of the surveyed enhancement projects - available by mid-November from the Division of Commercial Fisheries

Access to coded wire tag data used to determine survival rates and differentiate wild and enhanced salmon stocks relevant to annual escapement and harvest by species and district - available by October 1 from the FRED Division

Information to be Provided in the Research Proposal

The contractor will be expected to explain the following in the research proposal:

- 1) Explain the model specifications, dependent variables, and function(s) intended to be used to describe the future population size of enhanced and wild salmon stocks.
- 2) Explain how biological and environmental sources of potential interaction will be modeled.
- 3) Explain how data necessary for the development of the model will be obtained.
- 4) Explain how the effects of fisheries management will be included in the model.
- 5) Explain how the effects of learning by fisheries managers will be included in the model.
- 6) If there is insufficient time and/or data to empirically model wild and enhanced stocks interactions for the entire statewide enhancement program, the contractor should identify ad hoc approaches to modeling harvests and populations. Based on data limitations, the modeling exercise in each region could be conducted at the "super-district" level--a combination of

two or more districts. For example, the contractor could concentrate on an empirical modeling approach for pink salmon in PWS and conduct a more ad hoc analysis for other areas and fisheries in the state. This approach needs to be explained in the contractor's research proposal.

Cost Estimate

As part of the proposal, the contractor will itemize expected costs for: data collection, subcontracting, programming, and model documentation of statistical results and software operating instructions.

Schedule of Research Activities

Proposals should be submitted by September 20, 1991 and should include a schedule of completion milestones from data collection through programming and model testing. The due date for the final model software and documentation is December 1, 1991. The decision on contract awards will be made by September 25, 1991.

Research Funding Provided

\$10,000

**REIMBURSABLE SERVICES AGREEMENT CONTRACT
SPECIFICATION AND REQUEST FOR PROPOSALS
SALMON DEMAND MODELING**

Background

In the early 1970s, the state of Alaska initiated a salmon enhancement and rehabilitation program through the Alaska Department of Fish and Game (ADF&G), Fisheries Research and Enhancement (FRED) Division. The program consists of production from hatcheries, lake fertilization, fish passes, spawning channel and stream habitat improvements. The hatchery, or ocean ranching, portion of the program provided for two categories of hatcheries: one funded and operated by the state, and the other comprised of private, non-profit (PNP) hatcheries. The PNP hatcheries were to share their harvestable surplus with the traditional fishing fleets and sell a portion of returning fish to sustain the operation of the hatchery.

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To address these public policy questions requires a benefit-cost analysis. This type of analysis measures the level and cost of hatchery salmon production, the cost of harvesting and processing salmon, and the impact or "price responsiveness" of world salmon markets to various levels of Alaska salmon production. The costs are then subtracted from the benefits to estimate the net benefits of the salmon enhancement program and the incremental net benefits of different levels of salmon hatchery production to the commercial fishery. To provide this information the economics group has proposed a series of contracts, one of which is additional research on the demand for Alaska salmon.

Description of Parties Involved

The Reimbursable Service Agreement (RSA) is between the Alaska State Legislature and the principal investigator. The primary legislative contacts are Ginny Fay, Economics and Marketing Group and staff to the Senate Special Committee on International and Domestic Fisheries, and Molly McCammon, Hatchery Project Coordinator. The Alaska Department of Fish and Game will provide technical advice and data required for the completion of the projects. The ADF&G contact is _____.

Background on Alaska Salmon Demand Modeling

In 1990, Dr. John Boyce, University of Alaska Fairbanks completed work for the ADF&G, FRED Division comparing single-equation and system of equations demand models for Alaska salmon (Boyce 1990). The study compared two, single-equation models developed by Ben Muse of the Alaska Commercial Fisheries Entry Commission (CFEC) in 1984 and Nick Ronan, University of Alaska Anchorage, Institute for

Social and Economic Research (ISER) in 1989, and an alternative model proposed by Hongru Zhang, University of Alaska Fairbanks graduate student, using a Two-Stage-Least-Squares (2SLS) approach. Boyce found that the 2SLS approach appears to have superior predictive capability within the sample.

Boyce (1990) estimates ex-vessel and wholesale prices for five species of Pacific salmon, which is required for evaluating enhancement project tradeoffs between different salmon species and markets that are relevant to the state of Alaska. However, Boyce's study did not (1) develop a satisfactory profit function at the wholesale level for all salmon species, (2) conduct a full testing of wild, enhanced, and farmed salmon substitutes, including the extent to which farmed-salmon production is a substitute for Alaska salmon harvests, (3) link ex-vessel markets or wholesale markets to retail consumer markets, and (4) produce demand models for pink and sockeye salmon with low estimation errors.

In addition to this recently completed research by Dr. Boyce, recent econometric analyses completed by Lin and Herrmann (1988) and Mittelhammer, Herrmann, and Lin (1989) provide considerable information on the import and export markets for salmon, and the relationship of farmed-salmon markets to capture-fishery markets.

The models of Mittelhammer, Herrmann, and Lin develop demand functions using import and export data closer to the final markets. They include more substitutes, and incorporate a supply and demand model for farmed salmon. However, the models are not sufficiently stratified by species at the ex-vessel level for evaluating tradeoffs in Alaska's statewide enhancement program.

Neither of the two modeling efforts (Boyce or Mittelhammer, Herrmann, and Lin) were designed to compute regional distribution of gross earnings within the major Alaska salmon fisheries, or the amount of price response imposed on a given region by another region's salmon production. The ability to discern regional impacts is a lower priority than other objectives of the RSA, but is still of interest in evaluating the benefits and costs of the salmon enhancement program.

Products of the Contract and Research Instructions

Demand Model Requirements:

Computer simulation models must be developed that will project market prices for the five species of Pacific salmon such that the change in total revenue can be estimated for various enhancement production scenarios in Alaska. The time horizon of the projections will be 30 years.

The models must have the ability to estimate own price-response for each of the five species of Pacific salmon and cross-price response with respect to other relevant species of salmon harvested in capture fisheries--the model must be able to detect changes in prices of one species from the output of another species.

The models must have the ability to estimate price impacts of changes in farmed-salmon production on each relevant species of Alaska salmon.

If possible, the models should have the ability to discern market linkages and price-setting mechanisms between ex-vessel, wholesale, and export markets.

The contractor will be expected to produce the following:

All variables used to estimate the dependent variables of ex-vessel prices, must be provided by the contractor and projected 30 years into the future.

The models will be judged on their conformance to economic theory, econometric statistics generated in the estimation, and analysis of prediction errors (see the appendix).

The performance of the demand models for sockeye, chum, pink, coho, and chinook salmon will be judged by their ability to estimate annual CFEC ex-vessel prices, and possibly monthly or quarterly prices at the ex-vessel and other market levels. Specific econometric tests for the estimation of errors are defined in the appendix, but the ability to minimize errors (as well as the sign and significance of the coefficients on the independent variables) will be highly weighted in judging model performance.

After model performance is established, the contractor will run model simulations aimed at predicting annual CFEC statewide prices for all five species of salmon. Appropriate sensitivity testing will be applied to determine how variability in the input variables will affect the variability of the dependent variable, ex-vessel price. See Lin and Herrmann, 1988, An Econometric Analysis of Atlantic Salmon Markets in the United States and France for an example of how the sensitivity analysis could be conducted.

A description of how the contractor will handle uncertainty in estimating the dependent variable and any exogenous variables in the model must be included.

The contractor will also choose an interval of the time series for out-of-sample testing and compare the predicted and observed dependent variables using the statistical tests described above and in the appendix.

The contractor will test the ability of the data to econometrically estimate regional prices in Prince William Sound, Cook Inlet, Kodiak/Alaska Peninsula, Southeast, and Interior/Alaska Yukon-Kuskokwim Delta. Regional price estimates must be able to detect the amount of price response distributed in each region as a result

of changes in salmon prices and/or production in another region(s). In the absence of an econometric solution to the estimation of regional prices, the contractor will construct a best-professional estimation methodology.

All software for running simulations of the models must be produced in SAS, microcomputer version _____.

All computer software must be accompanied by complete usage instructions. In addition, the model must be sufficiently documented such that a user familiar with the SAS microcomputer software can operate the models.

A report using a standard research report format must be produced that includes sections describing the background, methodology, results, and conclusions of the modeling effort. For an example of an acceptable format, see (Boyce 1990).

Several simulations of policy questions must be included in the demand analyses and report. These simulations will be dependent on hatchery and enhancement production scenarios resulting from a survey of enhancement projects. The simulations will be developed and specified to the contractor by mid-November.

Information to be Supplied to the Contractor

Alaska Commercial Fisheries Entry Commission (CFEC) aggregated annual gross earnings and harvest data by salmon species (king, coho, sockeye, chum, and pink) by region and by fishery (purse seine, gill net, and troll) from 1974 through 1990.

CFEC annual ex-vessel prices by species, region, and fishery from 1975 through 1990.

CFEC annual aggregate of salmon processors gross earnings by species and region from 1984 through 1990.

Completed work of Dr. Boyce, A Comparison of Demand Models for Alaska Salmon, University of Alaska Fairbanks, 1990.

Survey results from enhancement project operators providing a time series of projected adult salmon harvests by hatchery, species, and fishing district (or combination of districts) - available by early November from the FRED Division.

Estimates of average historical harvests for ten-, fifteen-, and twenty-year periods by species and subareas - available by early October from the Legislative Research Agency; the data for these estimates will be provided to the Legislative Research Agency by ADF&G by mid-September.

Information to be Provided in the Research Proposal

The contractor will be expected to explain the following in the research proposal:

- The variables to be tested in each of the demand models developed, and the source of the data for each of the model variables.
- The structural equations and functional forms to be tested in the development of statewide and regional demand models.
- Explain how the dependent variable (marginal revenue) will be computed for any year, species, and fishery for each modeling approach applied.
- Identify each variable that will be used from the list in 1) explicitly in the equations.
- List additional information or data on fisheries that will be required from ADF&G.
- Explain what statistical tests will be performed, what econometric statistics will be generated in the estimation, and how analysis of prediction errors will occur.
- A cost estimate for various portions of the work and a schedule of activities (see below).

Cost Estimate

As part of the proposal, the contractor will itemize expected costs for: data collection, subcontracting, programming, and model documentation of statistical results and software operating instructions.

Schedule of Research Activities

Proposals should be submitted by September 27, 1991 and should include a schedule of completion milestones from data collection through programming and model testing. The due date for the final model software and documentation is December 1, 1991. The decision on contract awards will be made by October 4, 1991.

Research Funding Provided

\$18,000

Appendix. Suggested Statistical Tests for Analyzing Model Prediction Errors

For each of the specified price models, the Principal Investigator will compare model price forecasts with actual prices, and calculate and graph the prediction errors, and calculate the following statistics:

- mean percent error
- mean absolute error
- mean squared percent error
- Theil's bias, variance, and covariance and Theil's bias, squared percent error (as described in Maddala, 19__, pages 344 and 345),
- Theil's U1 statistic, as described in Maddala, 19__, pages 346 and 347,
- root mean squared error

Where appropriate, the contractor will compare the errors produced by the different models and will test to see if there are statistically significant differences between the mean absolute percent errors and the mean squared percent errors produced by those models. Parametric and non-parametric tests will be used to evaluate statistical significance.

The contractor will summarize these statistics in a convenient form. This form should permit easy comparisons of the statistics for comparable models. The contractor will (1) provide a description of the error statistics that is useful to persons unfamiliar with these statistics, and (2) discuss the implications of the model error statistics for the use of the models, and for future research directions. Among other research possibilities, the contractor will evaluate the potential of combining the structural models evaluated in this RSA with time series models of their error terms.

Rough preliminary
DRAFT

**REIMBURSABLE SERVICES AGREEMENT CONTRACT
SPECIFICATION AND REQUEST FOR PROPOSALS
SOFTWARE DEVELOPMENT AND POLICY ANALYSIS
OF A BENEFIT-COST ANALYSIS
OF THE STATEWIDE ENHANCEMENT PROGRAM**

Background

In the early 1970s, the state of Alaska initiated a salmon enhancement and rehabilitation program through the Alaska Department of Fish and Game (ADF&G), Fisheries Research and Enhancement (FRED) Division. The program consists of production from hatcheries, lake fertilization, fish passes, spawning channel and stream habitat improvements. The hatchery, or ocean ranching, portion of the program provided for two categories of hatcheries: one funded and operated by the state, and the other comprised of private, non-profit (PNP) hatcheries. The PNP hatcheries were to share their harvestable surplus with the traditional fishing fleets and sell a portion of returning fish to sustain the operation of the hatchery.

What began as an experiment, however, has resulted in a large, very successful pink salmon hatchery program, as well as chum and coho production, in Prince William Sound (PWS); chinook, coho and chum salmon production in southeast Alaska; sockeye and pink salmon production in Kodiak; and sockeye and king production in Cook Inlet. In general, the enhancement program has been successful in increasing salmon production and harvests in Alaska.

In the last 20 years, the FRED Division program has constructed over 20 hatcheries, 19 of which are currently in operation. Since 1972, the state of Alaska has invested approximately \$81 million in capital construction of hatchery facilities, and another \$170 million in the operation of these facilities. In addition to the state-owned facilities, 30 PNP-hatchery permits have been issued since the inception of the program, including 3 for the operation of state-owned facilities under special agreement with the FRED Division. Currently, 21 of the permitted hatcheries are in operation and had returns of adult salmon. For PNPs, the state of Alaska has invested approximately \$51 million in an additional \$20 million in operating costs, and \$31 million in grants to state operated hatcheries. In the enhancement program, the legislature appropriated \$208 million for operational costs, \$41 million in capital costs, and authorized \$77 million in bonds sales.

As a result of these hatcheries and enhancement projects, the estimated total return of adult pink salmon to hatcheries in PWS has grown from 0.1 million fish in 1977 to 25.2 million fish in 1990. The hatchery-produced pink salmon have contributed up to 98 percent of the total pink harvest in PWS in recent years. In southeast Alaska, the initial plan was to produce 100,000 chinook salmon for the troll fishery. In 1990, however, the troll fishery harvested 55,000 fish because of difficulties targeting hatchery fish. Current statewide salmon harvests from the hatchery program range from 15 to 23 million fish and are expected to grow to approximately 30 million fish by 1995 given current levels of hatchery production capacity. The enhancement program could soon account for 20 to 35 percent of the statewide salmon harvest.

Purpose of the Proposed Research

In May 1991, the Senate Special Committee on International and Domestic Fisheries initiated an extensive review of the Alaska salmon hatchery and enhancement program. As a result of considerable interest in the project, participation in the Hatchery Research Project includes representatives from both the Senate and the House of Representatives. The purpose of the study is to 1) review the history and legislative intent of the enhancement program, 2) analyze the current status of the program, and 3) consider future options for the program--ranging from fine tuning to possible redirection.

As part of the Hatchery Research Project, an Economics and Marketing study group was developed to provide information to the legislature on the economic impacts of salmon hatchery production. The group was formed to help determine

- if the current levels of Alaska salmon harvests are over-or under-supplied from a world-market perspective and
- if increased hatchery production of salmon will raise or lower prices, fishing and processing revenues, and the total net value of Alaska's salmon fisheries.

To address these public policy questions requires a benefit-cost analysis. This type of analysis measures the level and cost of hatchery salmon production, the cost of harvesting and processing salmon, and the impact or "price responsiveness" of world salmon markets to various levels of Alaska salmon production. The costs are then subtracted from the benefits to estimate the net benefits of the salmon enhancement program and the incremental net benefits of different levels of salmon hatchery production to the commercial fishery. To provide this information the economics group has proposed a series of contracts, one of which is the development of computer software that combines each of the software packages into a simultaneously estimated system that computes producer surpluses and several other economic outputs, as well as reports on the results of several economic simulations.

Benefit-Cost Analysis Research Components

The five research components of the complete benefit-cost modeling effort are:

- 1) a hatchery production and cost model, produced by a survey administered by the Alaska State Legislature,
- 2) a fish population and exploitation model linked to fishing effort and harvests,
- 3) a demand model for Alaska salmon in world markets,
- 4) a fishing cost model, and

- 5) a computer software system to combine the four models, simulation of specific policy questions, and a report summarizing the results of the simulations.

The latter four research components will be conducted through RSAs between the Alaska State Legislature and University of Alaska.

Description of Parties Involved

The Reimbursable Service Agreement (RSA) is between the Alaska State Legislature and the principal investigator. The primary legislative contacts are Ginny Fay, Economics and Marketing Group and staff to the Senate Special Committee on International and Domestic Fisheries, and Molly McCammon, Hatchery Project Coordinator. The Alaska Department of Fish and Game will provide technical advise and data required for the completion of the projects. The ADF&G contact is _____.

Combining of Models for Public Policy Analysis

The purpose of this RSA is to:

- 1) combine the enhancement production, population-exploitation, demand, and fishing cost models into a single, benefit-cost model programmed in SAS,
- 2) complete specific public policy simulations to evaluate the salmon enhancement program,
- 3) analyze the distribution of probable simulation outcomes and model prediction reliability,
- 4) conduct sensitivity analyses to test the impact of changes in model exogenous input variables (such as changes in world farmed-salmon production and exchange rates on salmon prices), and
- 5) report the results of the simulations in a written report to the Alaska State Legislature, Senate Special Committee on International and Domestic Fisheries.

The purpose of the model computer simulations is to estimate the net present value and the distribution of the net benefits of various salmon enhancement program alternatives. The results of these simulations and a discussion of their public policy implications are to be reported to the legislature.

The final computer software product will be an interactive model, housed and operated by the Alaska Department of Fish and Game. While the primary intent of the contract is to analyze the ADF&G salmon enhancement program, the computer model should also be capable of forecasting Alaska salmon prices.

Specific Policy Questions for Computer Simulations

For each of the following specified cases, the contractor will be required to report the absolute mean price for each salmon species; own-price elasticity of demand for each salmon species; the cross-price elasticity of demand for other species of Alaska salmon and farmed salmon, where applicable; the change in total revenue by species; distribution of gross earnings by fishing region and gear group, if possible; distribution of fishing costs by district or combination of districts; distribution of enhancement program net benefits by fishing region and by gear group within fishing regions, if possible; distribution of production costs by government and regional associations; and the net present value of the fisheries over a 30-year period.

- Case 1. Base Case--the salmon enhancement program continues at currently permitted capacity levels.
- Case 2. The salmon enhancement program is eliminated.
- Case 3. The budget for enhancement projects is increased by an increment of 10 to 20 percent.
- Case 4. The budget for enhancement projects is decreased by an increment of 10 to 20 percent.
- Case 5. The pink salmon program is eliminated and all else remains at the currently permitted program capacity level.
- Case 6. The sockeye salmon program is eliminated and all else remains at the currently permitted capacity level.
- Case 7. The budget for pink salmon projects is increased by an increment of 10 to 20 percent and all else remains at the currently permitted capacity level.
- Case 8. The budget for sockeye salmon projects is increased by an increment of 10 to 20 percent and all else remains at the currently permitted capacity level.

Modeling Data

The population and exploitation, demand, and cost models will each result in data inputs, outputs, and stochastic methods for sensitivity analyses to test the impacts of uncertainty. Each of these models will result in computer software containing model variables and sensitivity tests.

While it is impossible to identify all significant variables that will result from these studies, the probable input and output variables are listed below.

Data from Survey of State and Private Non-Profit Operators

The following variables will be projected for each enhancement, rehabilitation, or limnology project by species, commercial harvest, year, and district or aggregation of districts. The variables will be projected for each of the eight simulation cases identified above.

- Eggs taken
- Juvenile salmon releases
- Number of returning adult salmon
- Exploitation
- Adults produced
- Adults harvested
- Mean weight per fish
- Accounting costs of enhanced production
- Accounting costs of additional administration costs
- Accounting costs of additional evaluation and management costs

Salmon Population and Exploitation Model

Inputs:

- All survey information from state of Alaska and PNP enhancement and rehabilitation projects described above.
- Historical juvenile releases from all projects by species and year.
- Coded wire tag estimates of harvests by statistical area, species, and gear group.
- Estimates of enhancement releases (from the coded wire tag database) by species, size, and location.
- Juvenile survivals by age class and aggregated across age classes.

Outputs:

- Harvests for wild and enhanced fish by year species and district or combination of districts.
- Harvest weight of wild and enhanced fish by year, species, and district or combination of districts.

Demand Model**Inputs:**

- 10-, 15-, and 20-year historical commercial harvests of Alaska salmon.
- Aggregated statewide CFEC annual gross earnings and production summaries.
- CFEC annual gross earnings and production summaries aggregated by fishing region.
- CFEC wholesale price series.
- Import and export prices and quantities by country (monthly or quarterly).
- Prime Interest Rate in importing countries
- Exchange rates with respect to U.S. dollar in importing countries.
- Population
- Income of consumers
- Historical farmed-salmon imports and exports by pounds and gross earnings
- Inventories for fresh frozen, canned salmon products
- Salmon substitutes prices and production

Outputs:

- Projection of ex-vessel prices for each species by region.
- Supply and demand equations for Alaska and farmed salmon.

Cost Model**Inputs:**

- Fish ticket file data for relevant fisheries (e.g. harvest and gross earnings by social security number of fisherman, statistical area, species, and date).
- Vessel license file data for relevant fisheries (e.g. boat length, net tonnage, fisherman social security number).

- Historical fishery management area openings and closings
- Basic information on how the fisheries are managed.

Outputs:

- Projection of marginal costs of fishing and incremental costs of fishing by: district or combination of districts, species, and gear group, and year.

Combined Software Benefit-Cost Analysis

Inputs:

- Costs of producing salmon enhancement increments.
- Distribution of funding for enhancement productions costs from state government and/or regional aquaculture associations.
- Costs of evaluating and managing enhanced and wild stocks.
- Distribution of funding for management costs from state government and/or regional associations.
- Cost of FRED administration of enhancement projects.
- Demand model, SAS software, and operating instructions.
- All exogenous variables required to estimate market prices for computer simulations.
- Cost model, SAS software, and operating instructions.
- Distribution of the gross earnings by permit holder/fisherman's residence.

Outputs:

All model results should be conducted in the context of a low-, mid-, and high-salmon price sensitivity analyses based on the variation in model exogenous variables such as world farmed-salmon production levels and monetary exchange rates. Specific data to be provided include:

- Present value of the salmon enhancement benefits, by year, and state, and national accounting stance.
- Distribution of gross earnings by fishing region, e.g. Prince William Sound, Southeast Alaska, Cook Inlet, Kodiak and Alaska Peninsula, and Interior, and Alaska Yukon Kuskokwim Delta, and nonresidents.

- Distribution of fishing costs by fishing region and nonresidents.
- Present value of the costs, by year and state and national accounting stance.
- Distribution of the enhancement program net benefits between fishing regions and gear groups.
- Estimates of Net Present Value (NPV) of the salmon enhancement program under each of the eight simulations and a 90 percent confidence interval for all NPV estimates.
- Elasticity of demand at given harvest level and mean values of exogenous variables.

Products of the Contract and Research Instructions

The contractor will be expected to produce the following:

- The contractor must formally comment on the other research proposals to identify any variables not specified in this proposal that will be required to complete the combined software development and policy analysis.
- The contractor must transfer the population and exploitation model from Fortran to SAS.
- The contractor must develop the final SAS programming for an integrated benefit-cost model.
- The contractor must estimate an interest rate for discounting and a variance for the interest rate appropriate to sensitivity testing.
- The contractor must interact with other the research component contractors to understand individual models. The contractor for the combined model simulations will be responsible for synthesis of the research components/models into one software package.
- The contractor must report on the results of the simulations.
- The contractor must describe a methodology for addressing uncertainty in estimating the dependent variable and any exogenous variables not estimated in the other research component modeling contracts.
- All software for running simulations of the models must be produced in SAS, microcomputer version _____.

- All computer software must be accompanied by complete usage instructions. In addition, the model must be sufficiently documented such that a user familiar with the SAS microcomputer software can operate the models.

- A report using a standard research report format must be produced that includes sections describing the background, methodology, results, and conclusions of the modeling effort. For an example of an acceptable format, see (Boyce 1990).

Information to be Supplied to the Contractor

- Completed work of Dr. Boyce, A Comparison of Demand Models for Alaska Salmon, University of Alaska Fairbanks, 1990.

- Survey results from enhancement project operators providing a time series of projected adult salmon harvests by hatchery, species, and fishing district (or combination of districts) - available by early November from the FRED Division.

- Estimates of average historical harvests for 10-, 15-, and 20-year periods by species and subareas.

- Hatchery production survey results.

- Population and exploitation models, and all related software by December 15, 1991.

- Demand models, all related software by December 15, 1991.

- Fishing cost models and all related software by December 15, 1991.

Information to be Provided in the Research Proposal

The contractor will be expected to explain the following in the research proposal:

- Explain how the contractor will interact with the other research contractors to ensure an understanding of the other models and the ability to combine the models.

- Explain how the dependent variable, net present value, will be computed for any year, species, and fishery for each modeling approach.

- Identify each variable that will be used from the inputs and output list explicitly in the model equations.

- List any additional information or data on fisheries that will be required from ADF&G.
- Provided a cost estimate for the various portions of the work and a schedule of activities.
- Identify any additional policy analyses you believe should be analyzed.
- Identify any problems anticipated in coordinating other parts of the benefit-cost analysis.
- Suggest a methodology for using the salmon enhancement cost and production projections from surveys to interpolate marginal costs and production for alternate enhancement scenarios to incorporate into the population and exploitation model.

Cost Estimate

As part of the proposal, the contractor will itemize expected costs for: data collection, subcontracting, programming, and model documentation of statistical results and software operating instructions.

Schedule of Research Activities

Proposals should be submitted by September 27, 1991 and should include a schedule of completion milestones from data collection through programming and model testing. The due date for the final model software and documentation is February 1, 1991. The decision on contract awards will be made by October 4, 1991.

Research Funding Provided

\$10,000

LEGISLATIVE

HISTORY

+

INTENTS

AK DEPT.

FISH + GAME

MANAGEMENT

PAPER

The Management of the Alaskan Salmon
Hatchery Commercial Harvest¹

(June, 1991)

by

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Geiger, H.J., S. McGee, D.M. Gaudet, L. Peltz, and J.A. Brady. 1991. The Management of the Alaskan Salmon Hatchery Commercial Harvest. Can. Spec. Publ. Fish. Aquat. Sci.

ABSTRACT: Since 1971, the State of Alaska has allowed the production of Pacific salmon using an ocean ranching system. Traditional users compete to capture the returning fish in a number of different fisheries, while private hatcheries are allowed a special harvest of returning hatchery fish to fund hatchery operations. Fishery managers are asked to maintain the biological health of the wild stocks, economic health of the hatchery system, and conduct orderly fisheries, all while meeting allocation guidelines established by a separate body: the Alaska Board of Fisheries. Alaskan commercial salmon management is learning to exist in an era of increased hatchery production. Examples of management problems from the large-scale hatcheries in Prince William Sound, the mixed-stock chinook troll fishery in Southeast Alaska, and a newer pink salmon hatchery in Southeast Alaska are presented. We found (1) a lack of guiding principles, even after experience with pioneering hatchery programs, and (2) that production-based objectives for the hatcheries are often in conflict with more important fishery goals. We suggest that formal policy be used as a fishery management tool to shape goals and establish guiding principles for hatchery development.

Introduction

Beginning in the early 1970's the State of Alaska began an experiment in the production of Pacific salmon using ocean ranching. This system allowed two classes of hatcheries: one funded and operated by the state, the other a class of private hatcheries which were to share their harvestable surplus with the traditional fishing fleets and sell some of the returning fish to sustain the operation of the hatchery. Below we will describe fisheries management of the large, successful pink salmon hatchery program in Prince William Sound and the smaller chinook salmon hatchery program in Southeast Alaska. To examine how the management system performs in a novel situation, we will also consider a newer pink salmon hatchery in Southeast Alaska. The Alaskan hatchery system has unquestionably produced benefits. Yet we are not writing about those benefits. We wish, foremost, describe our hatchery system and management issues and secondly consider some of the problems hatchery production has caused fishery managers: a group required to solve problems rather than benefit from hatcheries.

Often, explicit *fisheries-based goals and objectives* for the harvest of hatchery fish have not accompanied large-scale enhancement projects. We define goals to be a statement of the ideal of what we want to achieve in the long run. Objectives are measurable intermediate tasks that must be accomplished to reach

the goals. Many hatchery projects have stated goals that are unfocused, like providing "benefits to all citizens." The projects also have stated objectives based on production which may conflict with important unstated fishery goals, such as control of fishing effort on a particular stock.

The management apparatus has not used *policy* until recently as a tool to solve recurrent fishery management problems when hatchery production objectives clash with fishery goals: *policy* being used here to mean a statement of a consistent, sustained, course of action in support of a stated goal. As a result, fisheries managers and hatchery planners are still asking surprisingly basic questions. How will the production from hatcheries be allocated to traditional users? What levels of production will be considered overproduction from hatcheries? How will biological, or even economic, considerations come into the process of determining what overproduction is? How can management information be generated to manage hatchery production in increasingly complex mixed stock fisheries? How will we catch hatchery salmon in traditional fisheries? We now see that management of our hatchery fish will require a better job of coordinating policy and developing common goals among different interests involved in the production, management, and utilization of the hatchery produced salmon.

The hatchery salmon producers

Roppel (1982) traces the beginnings of Alaska hatchery production to 1891 at Karluk on Kodiak Island. The modern hatchery era in Alaska began in 1971, when the Legislature and the Governor created the Fisheries Rehabilitation, Enhancement and Development (FRED) Division within the Alaska Department of Fish and Game. The harvest of salmon was at an all-time low, and the development of an enhancement program was supported through the passage of voter-approved bond issues in the amount of \$63.3 million for the construction of hatchery facilities. FRED was given broad statutory authority by the Legislature to "... through rehabilitation, enhancement, and development, do all things necessary to insure perpetual and increasing production and use of the food resources of Alaska waters and continental shelf area ..." (Alaskan Statute 16.05.092). In the last 20 years, the FRED program has constructed over 20 hatcheries, 19 of which are currently in operation. Since 1972, the State of Alaska has invested \$81 million in capital construction of hatchery facilities, and another \$170 million for operation and support of these facilities.

In 1974, the Alaska Legislature created a second hatchery program for the State of Alaska. It authorized the Alaska Department of Fish and Game to issue permits to private nonprofit corporations for the construction and operation of hatcheries for ocean ranching

of salmon. The intent of the private nonprofit hatchery program was to allow the private ownership of salmon hatcheries that would contribute to the state's existing fisheries but at the same time be self-supporting. The cost of construction and operation of these facilities was to be derived from the sale of a portion of the returning fish by the hatchery operator. The private nonprofit hatchery program was intended to operate "... without adversely affecting natural stocks of fish in the state and under a policy of management which allows reasonable segregation of returning hatchery-reared salmon from naturally occurring stocks," (Section 1, Ch.111, Session Laws of Alaska 1974). Fish released from private nonprofit hatcheries were to be "... available to the people for common use and are subject to regulation under applicable law in the same way as fish occurring in their natural state until they return to the specific location designated by the department for harvest by the hatchery operator," (Alaskan Statute 16.10.440).

Two types of private entities were recognized in the enabling legislation: regional aquaculture associations, formed of commercial fishermen and other salmon users in a designated region of the state; and local, nonprofit, non-association corporations. All commercial fishing permit holders in a region automatically become members of the regional aquaculture association. Thirty private nonprofit hatchery permits have been issued since the inception of the program, including three for the operation of

state-owned facilities under special contract with the FRED Division. Three permits have been given up or rescinded. Twenty-one of the permitted hatcheries are in operation and all of them had returns of adult salmon in 1990.

Funding for the private hatcheries is obtained through two mechanisms: both types of private hatcheries may sell a portion of the returning fish; and members of the regional association may vote to assess themselves a one, two or three percent tax on the ex-vessel value of the salmon harvested in their region. Since 1976, over \$42 million has been generated through assessments and returned to aquaculture associations via contract with the state.

In 1976 and 1977, the Alaska State Legislature modified and expanded the private nonprofit program to include comprehensive salmon planning and a revolving aquaculture loan fund. The planning involved fishery managers, FRED Division, and the regional associations. Early in the development of the hatchery program, comprehensive salmon plans were developed to anticipate and solve problems resulting from salmon hatcheries. An early mistake was a decision not to include allocation of the hatchery produced fish to traditional users or include fisheries management issues directly in the planning process.

Recent reductions in state budgets have resulted in a move to transfer operational responsibility for state-owned hatcheries to

private operators in cases where the hatcheries primarily benefit the commercial harvesters. The only mechanism for funding state operated hatcheries is annual requests for public money from the state legislature. The state-operated hatcheries must compete through the budget process for funding with schools, social services, and other public needs, while the private hatchery operators can fund the operation of the hatcheries through sale of a portion of the returning fish. The operations at three state hatcheries have been fully contracted to the respective regional aquaculture association for the region in which they are located. Partial operation or funding for part or all operations of three other facilities have also been supplied by regional aquaculture associations.

Currently there are eight regional associations and seven non-regional associations. These private corporations currently operate 23 hatcheries around Alaska, and reported releasing 925 million juvenile salmon in 1990. In 1990 the FRED Division operated 15 hatcheries and reported releasing 231 million juvenile salmon. Figure 1 shows the location of these hatcheries.

The fisheries management

The commercial fisheries management apparatus consists of the Alaska Board of Fisheries, and the Alaska Department of Fish and Game, Commercial Fisheries Division. Enforcement of fishing

regulations is provided by a separate police force within the Alaska Department of Public Safety.

The Board of Fisheries is a group of seven interested citizens, usually fishermen, appointed by the governor of Alaska for a three year term. This board makes allocation decisions and establishes specific fishing regulations. In the spring, citizens and interested organizations can propose virtually any regulation for those fisheries that the Board will be considering the following fall. At the present time the Board of Fisheries considers each specific salmon fishery once every three years. The Board process is expensive, slow, tedious, yet thorough. Days of public testimony, testimony by local advisory groups, lengthy Department of Fish and Game staff reports, and public debate among the Board members lead up to a decision on a proposal relating to the management of the fishery. Because the members currently appointed for three years they may consider the issues and make decisions on each fishery only once during their term.

The Alaska Department of Fish and Game is responsible for taking actions that ensure conservation, and for following the directions handed down by the Alaskan Board of Fisheries. Since 1985, managers in Southeast Alaska, and on the Yukon River, have also been required to meet objectives set down by the Pacific Salmon Commission, under the authority of the US-Canada Salmon Treaty. Actual in-season management is decentralized, with the day-to-day

management decisions delegated to an on-site manager in one of 20 local area offices around the state. These managers are familiar with the local situations and are given broad discretion to close and open fisheries to achieve fixed escapement goals and the allocative balance specified by the Board of Fisheries. Fisheries are opened or closed by issuing Emergency Orders (Alaskan Statute 16.05.060). To get the information for opening and closing decisions the managers operate an extensive data gathering apparatus during the summer and fall: monitoring escapement, fishery performance, stock identification information, and harvest and processing progress. Little surplus is unharvested, yet escapement goals are usually met because managers respond quickly to changing fishery situations. The essence and advantage of this kind of in-season management is the ability to process large amounts of information quickly, and local, unincumbered control over fishing effort.

The fishing fleets

There are four types of gear used principally in the commercial harvest of Alaskan salmon: purse seine, drift gillnet, set gillnet, and troll. Fishtraps were outlawed following statehood in 1959, with the single exception of the Metlakatla Indian Reserve in Southeast Alaska. Fish wheels are used on the Yukon River, and beach sein are also allowed in some areas. Salmon are also harvested for personal use by sport and subsistence users. The

commercial salmon fisheries are divided into distinct geographic management areas, with one or more of the legal gear types operating in the same area. These areas may in turn be divided into subareas in which the legal gear types may be separated or allowed to fish together.

All commercial harvests of salmon in Alaska operate under a limited entry system. The state was divided into 26 species-gear-area fisheries for limited entry implementation. Limited entry of the first 19 fisheries began in 1973, and the last commercial salmon fisheries were limited in 1979. The number of permits allowed in a fishery was determined at the time the Alaskan salmon fishery was limited and was based on the historic use of that fishery. Of the 12,909 permits issued 11,343 are transferable, and can be sold. Permit prices have generally risen over the years with the median price of a permit climbing to over \$150,000 in many fisheries by 1988; the median price was over \$200,000 in some fisheries by that time (Denneford and Cohen 1989).

The Two Case Studies

Pink salmon hatchery production in Prince William Sound

The FRED Division and two private aquaculture corporations, the Prince William Sound Aquaculture Corporation, or PWSAC, and the

Valdez Fisheries Development Association, or VFDA, own salmon hatcheries in Prince William Sound. PWSAC is the Regional Association for commercial fishermen in the Prince William Sound area. VFDA is a private nonprofit non-association corporation. Currently the FRED Division has contracted its pink salmon hatchery in Prince William Sound to PWSAC.

The production of juvenile pink salmon from private nonprofit and state hatcheries in Prince William Sound for 1977 to 1990 is presented in Figure 2, based on the estimates of Eggers et al. (1991). During this time, releases of fry have increased from approximately 1 million (broodyear 1976) to 518.1 million (broodyear 1989). The estimated commercial harvest of pink salmon in Prince William Sound over time is presented in Figure 3. The estimated total return to hatcheries has increased from 0.1 million fish in 1977 to 33.1 million fish in 1990. The estimated harvests in traditional fisheries has increased from nearly 0 in 1977 to 25.2 million in 1990. Hatchery-produced pink salmon have contributed up to 98% of the total pink harvest in Prince William Sound in recent years, when wild stock returns have been low.

Prince William Sound commercial salmon harvest areas (see Figure 4) were established in 1964, and correspond to the geographical distribution of natural stocks. Within Prince William Sound, purse seine, drift gillnet, and set gillnet gear operators compete for the returning salmon. Fish heading throughout Prince William Sound

generally pass through purse seine districts first: the Eastern, Northern, Northwestern, Southwestern, Montague, and Southeastern districts. Drift gillnet gear is allowed in Copper River and Bering River districts, which are actually outside of Prince William Sound, and Unakwik, Coghill, and Eshamy districts. Set gillnets and drift gillnets fish together in Eshamy District, and drift gillnets and purse seines fish together in Coghill and Unakwik districts.

Wild pink salmon production is spread throughout the Prince William Sound, with salmon spawning in over 1,100 documented streams. Escapement performance is monitored throughout the season by weekly aerial surveys of approximately 200 key, index streams. Based on escapement observations, wild stock strength determines the fishing time that may be permitted in the general fishing districts of the sound.

Hatchery stocks utilize the same entrance areas and migratory passages as wild fish. Originally "early" and "late" broodstocks were selected for the Prince William Sound hatcheries to minimize overlap with wild stocks. Even so, considerable overlap in timing exists. Hatchery run strength is assessed in-season by daily tracking of harvest performance near the hatcheries and by monitoring sex ratios. Strong hatchery returns migrating through these areas may incorrectly give managers the impression of strength in the wild stock components. Overexploitation of wild

stocks in the entrance areas (i.e. Southwest District where stocks are highly mixed) can result in escapement shortfalls which cannot be corrected by full season closures. This happened in the Northwest areas of Prince William Sound in 1990 (Brady et al. 1991).

When there is a large wild stock harvestable surplus, fishing is conducted in all waters of Prince William Sound, and a large portion of the hatchery harvest is taken distant from the hatcheries. If the wild stock component is large and the hatchery run is weak, exploitation of hatchery stocks in the mixing areas (when all Prince William Sound districts are open) may exceed the level that hatchery stocks can withstand. Hence, broodstock and cost recovery goals (economic escapement) will not be realized. This situation occurred in Prince William Sound in 1984 and 1985 when the hatchery stock was still developing. In 1984, PWSAC harvested approximately 300,000 sales fish, falling well short of the revenue goal of 1.3 million fish.

Following this revenue shortfall, PWSAC petitioned the Alaska Board of Fisheries to establish the subdistrict outside of the existing Armond F. Koerning Hatchery subdistrict to be used to protect hatchery returns. PWSAC successfully convinced fishing groups that although closure of this area would displace fishermen from traditional fishing sites in a highly lucrative area, all fish not harvested could be taken later in other areas because there was no

escapement inside the proposed subdistrict.

The Board of Fisheries adopted management plans for corporate escapement goals after receiving public testimony by fishermen supporting the plan. The management plan (1) established a subdistrict to be used to protect returning hatchery fish for both broodstock and revenue, and (2) directed the Department of Fish and Game to manage to assist hatchery operators at the Armond F. Koerning Hatchery in achieving corporate (economic) escapement goals. Similar regulatory management plans now have been established for the Esther and Solomon Gulch Hatcheries. Management for corporate escapement (published revenue goals) for all salmon hatcheries in Prince William Sound is now assigned importance equal to that assigned biological escapement of natural stocks.

In response to the great potential and actual management error separating hatchery and wild run strengths, half-length coded wire tag studies were chosen to assess the hatchery stock component in the general fishing districts to track management performance in these mixing areas. This method has been shown to be a workable means of assessing the hatchery component of the harvest from the mixing areas, post-season in Prince William Sound (Peltz and Miller 1990; Peltz and Geiger 1990; Geiger and Sharr 1990). Yet, in spite the potential for loss to both the wild stocks and the hatcheries from management's ignorance about the mixing rates, the

responsibility for funding the coded wire tag studies has never been established. PWSAC provided funding and support for pilot coded wire tag studies which began in 1986. In 1988 the Department of Fish and Game requested that PWSAC continue to fund these studies entirely, as no new public resources were available to fund the management of new hatchery fish, without redirecting funds away from wild stock management. PWSAC maintained that the management was the State's responsibility and resisted funding tag recoveries. Within the Department of Fish and Game some elements sided with PWSAC. PWSAC has not been able to budget for these studies as it was not clear that these studies were a necessary use of their resources. This issue strained relations between PWSAC and the Alaska Department of Fish and Game in 1988 and 1989. The issue has still not been resolved, merely postponed by the Exxon Valdez oil spill; studies of the damage from the oil spill created another source of funding for the coded wire tag program in the short term.

The success of the hatcheries has created another important issue: that of who will benefit. Limited entry, and the high value of the harvest has led to strong gear groups, or coalitions of fishermen using the same fishing gear, throughout Alaska, and in Prince William Sound in particular. The majority of hatchery fish production up to recent times has been pink salmon easily caught in the seine fishery. In the last few years programs designed to produce salmon for the gillnet fleet have begun to produce sockeye and chum salmon in significant returns. However, the structure of

existing fisheries has resulted in interception by the seine fleet of some of the fish which were produced for the gillnet fleet.

In 1988 when the allocation issues were finally presented to the Alaska Board of Fisheries; the proposals were piecemeal short-term solutions, presented without any context. The Board of Fisheries recognized a lack of precedent, and a lack of understanding of the years of planning and undocumented history of agreements between the user groups and hatchery operators. The Board of Fisheries then directed the hatchery operator, PWSAC, to come up with a solution to the problem by the next Board meeting in 1991. PWSAC formed an allocation task force composed of salmon users to develop the policy. The task force decided that the guiding principle should be that the historic ex-vessel value split should be maintained through hatchery production. The historic records showed the ex-vessel value of salmon was approximately equal between the gillnet and seine fleets. One important principle was then established: to maintain an equal share in benefits between the two commercial user groups in Prince William Sound (Prince William Sound Aquaculture Corporation 1990). Eventually PWSAC convinced all gear groups to endorse a modified plan which was adopted unanimously by the Board of Fisheries at their 1991 meeting.

PWSAC is currently working on a production plan, with allocation explicitly recognized as a part of the planning. The plan also

gives some hint of future management challenges. PWSAC is currently planning new production facilities to provide an additional 22.0 million adult pink salmon (from a document titled Production Plan from the Prince William Sound Aquaculture Corporation, Cordova, Alaska, dated January 27, 1991).

The Prince William Sound experience began with increased hatchery production superimposed on wild production through the 1980's until hatchery production surpassed wild stock production. As the hatchery production grew, the dominate fisheries issues were how protect the economic health of the corporation, and how the surplus was to be allocated to traditional users. These latter two issues have consumed most of the off-season management efforts, and have largely been dealt with. In-season fisheries management continued much as it had prior to the hatcheries without any new tools except the ability to move the fishing fleets into terminal areas to protect weak stocks. Yet the hatcheries have led to a highly capitalized fleet. Capitalization has contributed to a dramatic increase in fleet efficiency. Changes in both the stock composition and the increases in fleet efficiency are now complicating management. Coded wire tags were introduced for the 1987 season, but information from this technique has only been available post-season, and no ongoing marking program has been established. Looking ahead, the upcoming issues will be how to (1) reduce congestion and improve product quality -- which will require dispersing the seine fleet throughout mixing areas; (2) how to cope

with increased pink salmon production -- which could require congesting the fleet into terminal areas, and may require relaxing genetic standards, to disperse hatchery releases in order to disperse the fleet; and (3) how to improve in-season management. Quality concerns and the general dislike for congested fisheries will lead to an even greater push on the part of the fleet and industry to conduct a majority of the harvest in mixed stock areas.

Chinook hatchery salmon production in Southeast Alaska

Catches of chinook salmon in Southeast Alaska peaked in the 1930's at approximately 600,000 per year (Figure 5). Total catch declined to about 280,000 in the 1960's, rose slightly higher in the 1970's and declined to its lowest level during the 1980's. The low total catch during the 1980's has been primarily due to ceilings placed upon the harvest by the North Pacific Fishery Management Council through 1985 and the Alaska Board of Fisheries and the Pacific Salmon Commission since that time. The abundance of wild chinook salmon declined drastically since the first half of the century because of overfishing and the loss of freshwater spawning and rearing habitat, particularly in the Pacific Northwest where construction of dams drastically reduced salmon production.

Native chinook and coho salmon stocks in Southeast Alaska were also depressed during the 1970's, and hatcheries seemed to be a logical way to restore harvests to prior levels. Beginning in the early to

mid 1970's, the State of Alaska embarked upon a program to produce chinook and coho salmon in Southeast through construction of both state and regional aquaculture facilities. The abundance of chinook salmon continued to decline and by the early 1980's managers used closures of the troll fishery during the spring to protect native Southeast Alaskan chinook salmon. During the 1980's, chinook salmon became the focus of discussion in pre-U.S./Canada Treaty negotiations (Fraidenburg and Lincoln 1985). Research indicated that the majority of the chinook salmon caught in the Southeast Alaska troll fishery were from systems in British Columbia, Washington and Oregon (Van Alen 1988). The Southeast Alaska chinook salmon catch was placed under a ceiling in order to return more chinook salmon to these systems. To offset the loss of chinook salmon resulting from the ceiling, losses primarily to the troll fishery, an initial plan was adopted to produce 100,000 harvestable chinook salmon adults for the troll fishery. This plan was not well documented but traces of the thinking of the time can be found in various unpublished documents (e.g., 1990 Annex: Chinook Salmon Plan for Southeast Alaska, July 1990; available from the Alaska Department of Fish and Game, Juneau, Alaska).

As a part of the treaty, chinook salmon produced in Alaskan hatcheries were allowed to be harvested without a quota provided the State could estimate the number in-season. This add-on, as it was called, was calculated through an intensive catch sampling program for coded wire tags. The recovered coded wire tags are

numerically expanded to account for the percentage of the catch sampled and the tagging ratio. Corrections are also made for missing tags, lost heads and other factors (Clark and Bernard 1987).

The summer fishery results in the bulk of the chinook salmon harvest, but the summer fishery has taken the lowest proportion of Alaskan hatchery produced chinook salmon. This proportion has been between 3-5% through the 1980's, but in 1990 it was at the historical high of approximately 7%. Throughout the late 1980's the Alaskan produced hatchery fish were not being harvested in the troll fishery, primarily because no fishery was taking place in the spring when mature adults were returning. To remedy this, new fisheries were established in June: the Experimental Fisheries, as they were called. These fisheries were located in areas along the suspected migratory path of hatchery chinook salmon and in areas adjacent to the facilities themselves.

The Experimental Fisheries were not effective; the total number of fish caught was very small. Recently another type of fishery, the Hatchery Access Fishery, was established. To comply with the US-Canada treaty and to increase the proportion of hatchery chinook salmon, the fishery operated only within the inside waters of Southeast Alaska. In 1989 and 1990, the fishery operated three days in early June and three days in late June. It harvested 24,000 and 31,000 chinook salmon with an Alaskan hatchery

proportion of 14% and 17% in 1989 and 1990, respectively.

The hatchery add-on has resulted in more expensive management. However, because the add-on calls for more expensive and timely improvements of many existing management tasks that will be performed anyway, it is hard estimate the additional expense due to hatchery production. To allow the maximum number of chinook salmon to be harvested in Alaska, salmon heads suspected of containing coded wire tags are shipped by priority air freight and read, processed, and analyzed at the peak-load time for laboratory and analytical resources.

In 1980 to 1989 the average estimated Alaska catch of hatchery produced chinook salmon was only 13,400 fish for all fishing gear types. In 1990, this catch rose to approximately 55,000. The hatchery production is increasing and we expect large returns in the next few years. However, the troll fleet, which was expected to harvest 100,000 Alaskan hatchery chinook salmon, is currently harvesting only about half of the total hatchery chinook salmon harvest. At present we don't know if it is possible for trollers to improve their ability to target on hatchery chinook salmon, but it seems improvements will come from greater congestion. Can the production based objective of harvesting 100,000 chinook salmon by the troll fleet be met? Perhaps a much, much larger hatchery production, a considerably more expensive management, and congesting the troll fleet into small terminal areas might be

required to reach the production (harvest?) objective of 100,000 chinook salmon, if it is reachable at all.

A novel situation

As new pink salmon hatcheries in Alaska begin to reach production capacity, hatchery operators and some fishery managers have assumed that the large-scale pink salmon program in Prince William Sound established the guiding principles and precedents for pink salmon hatcheries in the state. Fisheries managers and hatchery operators in Prince William were forced to face the issues of allocation of hatchery production to traditional users; they successfully persuaded the Board of Fisheries to adopt regulations charging the fisheries managers to attempt to achieve broodstock as well economic escapement needs; and they successfully resisted attempts by the Alaska Department of Fish and Game to require the funding of management information studies. The assumption that the Prince William Sound experience has led the way for management of hatchery produced pink salmon was recently put to the test in Southeast Alaska.

In 1989, poor returns to a private nonprofit hatchery in Gastineau Channel in Juneau resulted in charges that management allowed the overharvest of the hatchery stocks in a mixed stock fishery. This hatchery is operated by Douglas Island Pink and Chum Inc., or DIPAC as it is commonly known, an operation that is not a regional

association. Because no mechanism was in place to identify the hatchery stocks, a debate between the Alaska Department of Fish and Game managers and the hatchery operators has been inconclusive. The hatchery operators publicly and loudly charged that management had been negligent. The credibility of management, rightly or wrongly, was damaged in the public mind, and the response to the charges absorbed considerable management resources. But most importantly, without a marking program in place, no definitive conclusions about the management actions were attainable, and no corrective action was possible.

DIPAC has voluntarily agreed to tag pink salmon from time to time, but funds for tag recovery, processing, and analysis have never been secured. As in Prince William Sound, it has never been established who is responsible for providing this funding. At present no formal agreement exists between the Alaska Department of Fish and Game and DIPAC on fish marking studies, and the Alaska Department of Fish and Game has not yet taken a policy stand as to what it requires of DIPAC in the way of these kinds of studies.

In 1990, DIPAC petitioned the Board of Fisheries to "... permit the department in consultation with the hatchery operator to manage net fisheries in [disputed mixing areas] to achieve the corporate escapement goals for the Gastineau and Sheep Creek hatchery facilities." DIPAC used wording identical to wording that the Board of Fisheries adopted in Prince William Sound, except for

corporate names and specific locations. The Board of Fisheries rejected this proposal after hearing considerable negative public testimony. Fishermen were fearful that their fisheries could be closed by a private corporation without any apparent safeguards. Indeed there was no reason to believe hatchery fish could be differentially managed in the area under consideration, without information on stock mixing rates.

DIPAC helped show that the situation with regard to the Department of Fish and Game's responsibilities to manage for economic escapement is more confusing than we first realized. In 1990, after eighteen years of hatchery development, in the opinion of Alaska's attorney general, the Department of Fish and Game did have the authority to manage the hatcheries for broodstock, but *did not necessarily have the authority to manage for economic escapement to the private hatcheries* (memorandum from Assistant Attorney General Stephen M. White to the Commissioner of the Alaska Department of Fish and Game dated August, 1990). The DIPAC experience has shown how unprepared the fisheries management is to deal with a novel situation because policies and guiding principles seem to have failed.

Discussion

In reviewing the management of the Alaska commercial salmon harvests from hatcheries we found ourselves wondering why some of

these recurrent fisheries problems, like harvest allocation or agreement on funding hatchery tagging studies, resist permanent, statewide solutions in spite of considerable effort by otherwise effective managers. The immediate cause is that the hatchery operations are new. The system has not yet had time for guiding principles to establish themselves in an evolutionary fashion. But, guiding principles could have been established by deliberate planned policy statements from the management apparatus. Currently we are rethinking the goals for the hatcheries in more specific terms, and proposing policy to coordinate behavior to reach these goals.

Recently Barber and Taylor (1990) considered concepts of goals, objectives, and values from the business management literature and speculated on their utility in fisheries management. Barber and Taylor point out that rarely in fisheries management are specific goals stated. They go on to point out that goals that are stated are often unspecific, without measurable objectives that help to define the goals. In their words, this lack of specificity allows goals that are "good for public relations and political gamesmanship, but are difficult to use in effective rational management."

The comprehensive planning process that began early in the development of Alaska's hatchery program was put in place to develop specific goals and objectives. Oddly enough the plans --

by design -- were not to address the issue of allocation of hatchery fish or the issues of salmon management. The plans do contain unspecific goals, such as "Provide as many fish as possible to each user group," and "Benefit all Alaskans through opportunities for commercial, sport, and subsistence fishing." The plans also contain very specific objectives, such as "...increase the average harvest and gross income of [Prince William Sound] purse seine permit holders from the base level of \$21.2 million to \$32.9 million by the year 2002," or "increase the average annual chinook harvest [in Southeast Alaska] to 537,000 by the year 2000," (from the Prince William Sound - Copper River, and Southeast Alaska comprehensive salmon plans respectively).

The plans say nothing about mechanics of the fishery management. Statements about management never get much more specific than "...managing agencies and the fishermen should work together to find the best solutions currently available and to allow the use of limited data to reverse declines," (from the Southeast Alaska comprehensive salmon plan). Perhaps this lack of specifics was an attempt by the managers to maintain flexibility; but today many of the production-based objectives are increasingly in conflict with fishery goals including the preservation of the genetic integrity of wild stocks, the reduction of fishing effort on specific wild stocks, and the maintenance of uncongested fisheries.

We agree with Royce (1989), that Alaska's system of wild stock salmon management has worked well by comparison. The Board of Fisheries acts *pragmatically and decisively* on specific regulatory proposals that are *proposed by someone else* after considering an enormous amount of public input. Local managers use *judgement and individual initiative* to react to dynamic situations in the fishery. Since statehood, this flexibility has resulted in increasingly effective management, which has resulted in larger yields (Eggers *in press*). While a single explicit statement of the goal of salmon management may not exist, most if not all involved in the salmon industry have a similar idea of what this goal is: to support a sustainable salmon fishing industry, providing for orderly harvests, without loss of yield from overharvest of any stock.

Paradoxically the management system's strengths are at the heart of why the management apparatus has so much trouble with statewide fisheries policy relating to hatcheries. Processors, fishery managers, hatchery operators, harvesters, environmental organizations, and others have unstated goals for the hatcheries which range from "make fish!" to subverting the success of the hatcheries in any way possible. Unfortunately, the pragmatic, dispersed management decision making machinery has not been able to behave consistently without a shared common goal.

We think of policy as statements of a sustained future course of

action. They are effective if they correctly state the course of action. They are useful if they shape and control the behavior of various entities toward a common goal, particularly if the entities would otherwise behave in an uncoordinated fashion. Since the mid 1970's many government officials, including the various commissioners, the ultimate spokesmen for the Alaska Department of Fish and Game, have issued notes, letters, memoranda, and reports which claimed to be policy. Yet, we could find no single collection of these policy statements. Many have not survived in any physical form. Some of the policy statements that have been put forward have been designed to be, foremost, unoffensive. These have accomplished little. Other policy statements have been so specific that they solved or attempted to solve only a single very narrow problem, such as requiring a specific number of tags to be applied in a particular hatchery tagging study. In other cases the steps needed to establish a policy and the necessary regulations were ignored or not coordinated among all interests and parties. Glaring examples include the lack of an established management policy about economic escapement for the private nonprofit hatcheries, and the lack of a mechanism for allocation issues to be settled in an orderly fashion. Policy has generally failed in the past because it was written to sound good, not to direct behavior toward the realization of specific compatible goals.

Under our current system in Alaska, commercial salmon production can only come through new or existing fisheries. Goals for a

hatchery project need to be stated in terms of what is hoped to be achieved in the fishery. The fisheries issues of increasing or reducing fishing effort, allocation of harvest, dispersing fishing effort, protection of weak stocks and so forth are correctly the raw materials of goals for hatcheries. Fishery managers and hatchery planners are currently working on articulating policies on overproduction, the responsibility for the cost of management of hatchery production in existing fisheries, and harvest and escapement strategies for wild and hatchery stocks as a way to shape common goals, and establish consistent expectations of management. In the 1970's and 1980's hatchery production and fisheries management were incorrectly managed separately in Alaska. In the 1990's the challenge for fishery managers and hatchery planners is to use the tools of goals, objectives, and policies to define how Alaskan hatchery production will be used as a management tool in existing salmon fisheries.

Literature Cited

- Barber, W.E. and J.N. Taylor. 1990. The importance of goals, objectives and values in the fisheries management process and organization: a review. *North American Journal of Fisheries Management*. 10:365-373.
- Brady, J.A., S. Morstad, and E. Simpson. 1991. Review of the 1990 Prince William Sound commercial salmon fisheries. Regional Information Report 2C91-02. Alaska Department of Fish and Game, Division of Commercial Fisheries. Juneau Alaska.
- Clark, J.E., and D.R. Bernard. 1987. A compound multivariate binomial-hypergeometric distribution describing coded microwire tag recovery from commercial salmon catches in Southeast Alaska. Informational Leaflet No. 261. Alaska Department of Fish and Game, Division of Commercial Fisheries. Juneau Alaska.
- Dinneford, E. and K. Cohen. 1989. Changes in the distribution of Alaska's commercial fisheries entry permits: 1975-1988. CFEC Report 89-3. Alaska Commercial Fisheries Entry Commission. Juneau, Alaska.

Eggers, D.M., L.R. Peltz, B.G. Bue, and T.M. Willette. 1991. Trends in abundance of hatchery and wild stocks of pink salmon in Kodiak Island, Cook Inlet, and Prince William Sound, Alaska. Can Spec. Publ. Fish. Aquat. Sci.

Eggers, D.M. *in press*. The benefits and costs of the natural sockeye salmon stocks management program in Bristol Bay, Alaska. Fisheries Research.

Fraidenburg, M.E. and R.H. Lincoln. 1985. Wild chinook salmon management: an international challenge. North American Journal of Fisheries Management 5:311-329.

Geiger, H.J. and S. Sharr. 1990. The 1988 tag study of pink salmon from the Solomon Gulch hatchery in Prince William Sound, Alaska. In Pilot studies in tagging Prince William Hatchery Pink Salmon with coded-wire tags. H.J. Geiger [ed.]. Fisheries Research Bulletin 90-02. Alaska Department of Fish and Game. Juneau, Alaska.

Peltz, L. and H.J. Geiger. 1990. A tagging study of the effects of hatcheries on the 1987 pink salmon fishery in Prince William Sound, Alaska. In Pilot studies in tagging Prince William Hatchery Pink Salmon with coded-wire tags. H.J. Geiger [ed.]. Fisheries Research Bulletin 90-02. Alaska Department of Fish and Game. Juneau AK.

Peltz, L. and J. Miller. 1990. Performance of Half-Length coded wire tags in a pink salmon hatchery marking program, pp 244-252. In Fish marking techniques: American Fisheries Society Symposium 7. N. Parker, A.E. Giorgi, R.C. Heidinger, D.B. Jester, Jr., E.D. Prince, and G.A. Winans [ed.]. American Fisheries Society. Bethesda, Maryland.

Prince William Sound Aquaculture Corporation. 1990. Enhanced salmon allocation task force Report Number Six. Prince William Sound Aquaculture Corporation. Cordova Alaska. 187 p.

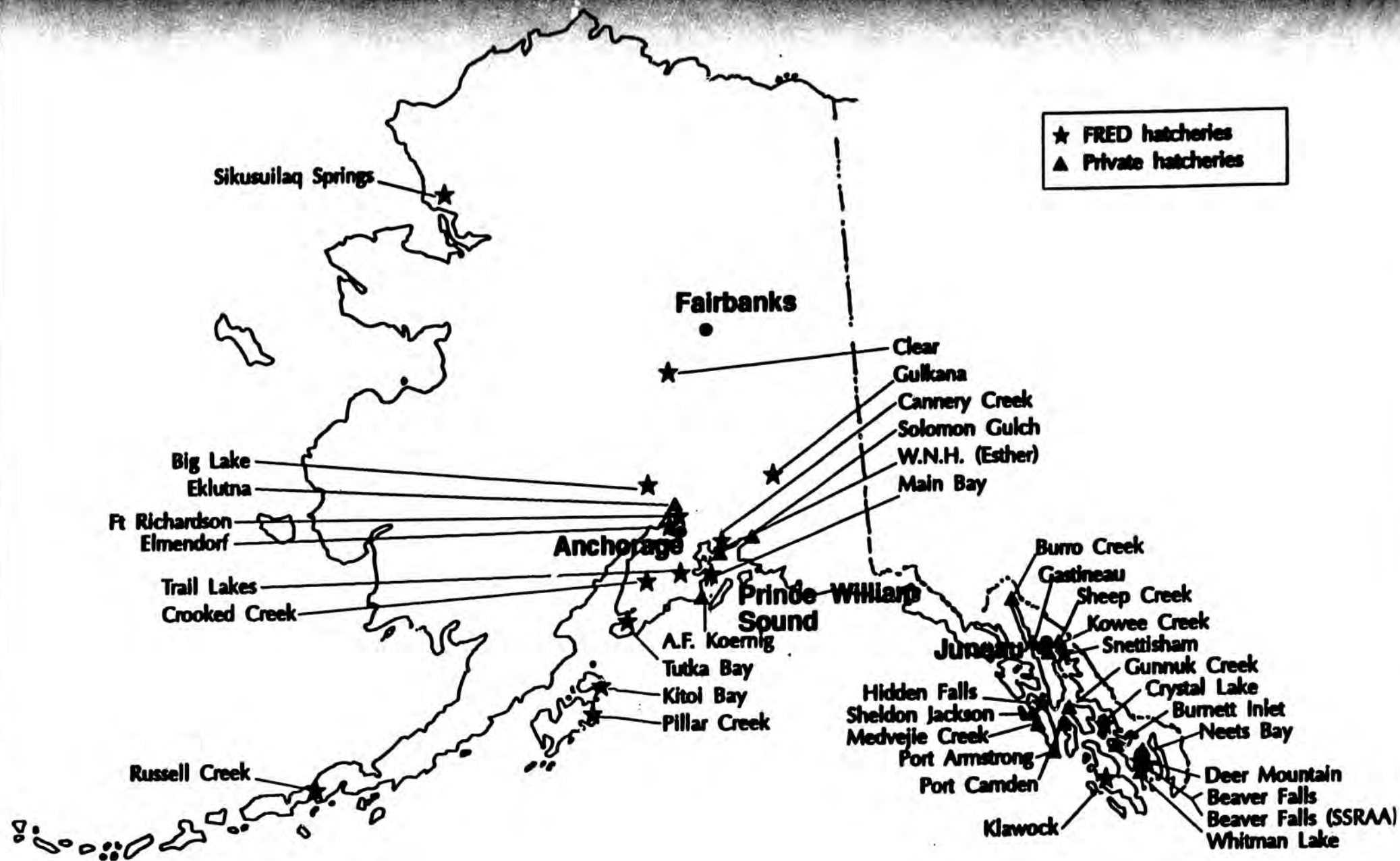
Roppel, Patricia. 1982. Alaska's salmon hatcheries: 1891-1959. Alaska Historical Commission Studies in History No. 20: 299 p.

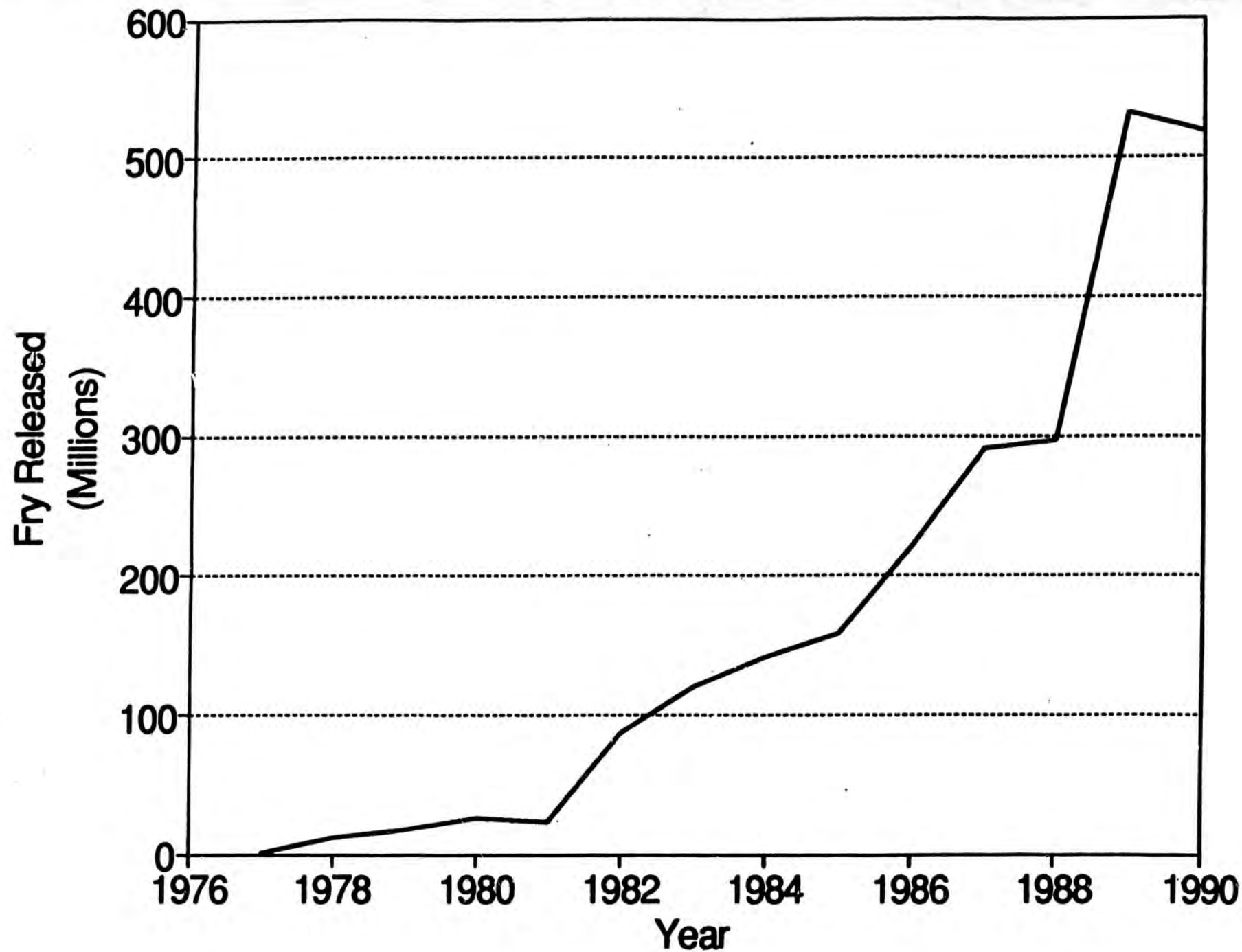
Royce, W.F. 1989. Managing Alaska's salmon fisheries for a prosperous future. Fisheries, Vol. 14, No. 2. pp 8-13.

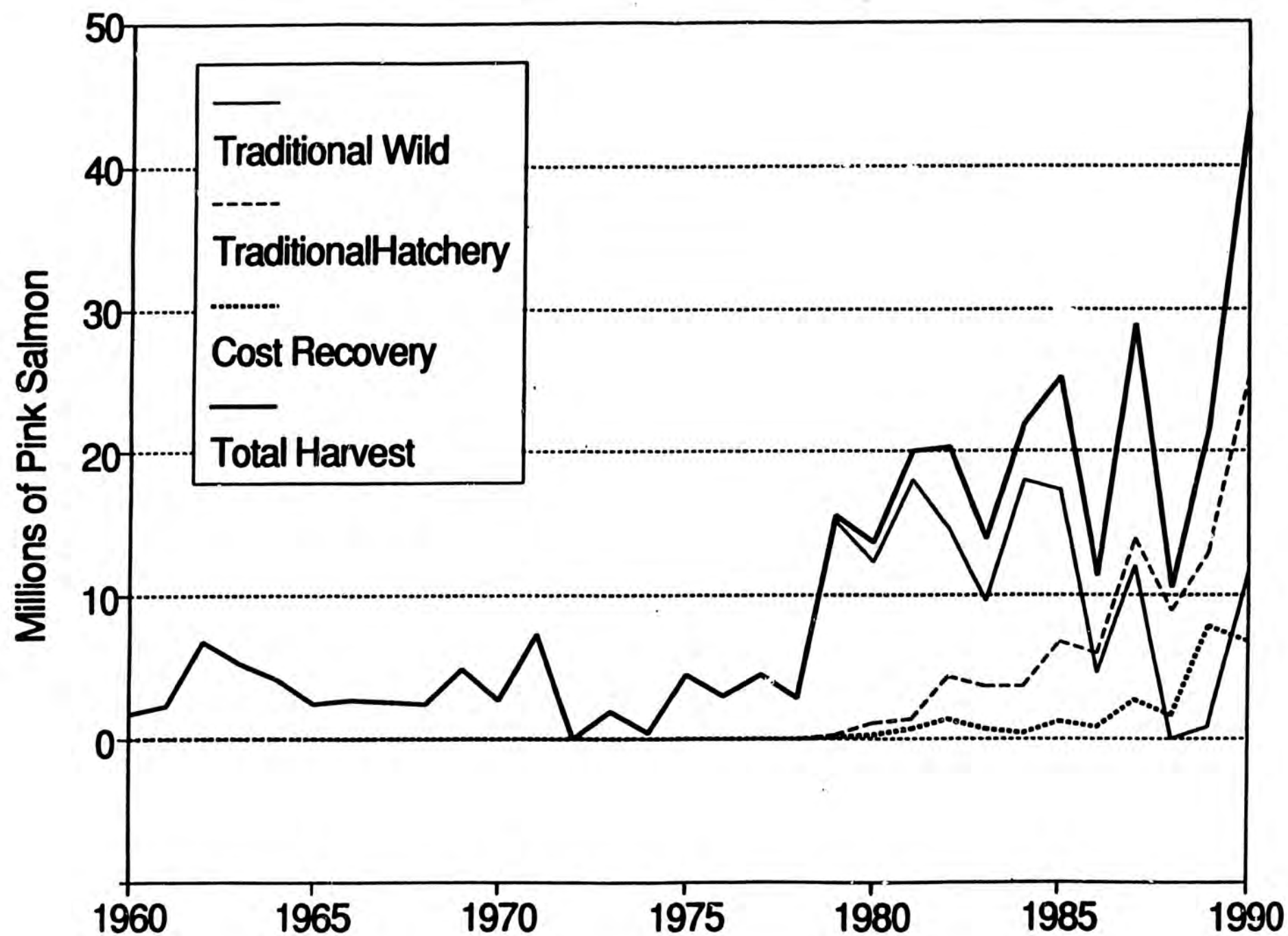
Van Alen, B.W. 1988. Feasibility of using scale and tag data to estimate origins of chinook salmon harvested in Southeast Alaska fisheries in 1982. Fishery Research Bulletin 88-04. Alaska Department of Fish and Game, Division of Commercial Fisheries. Juneau, Alaska. 102pp.

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2. The production of juvenile pink salmon from Prince William Sound hatcheries from 1977 to 1990.
3. Commercial harvest for pink salmon in Prince William Sound from 1960 to 1990. The thick line shows total commercial harvest. The thin line, and the dashed line show wild and hatchery harvest in the traditional limited entry commercial fisheries. The dotted line shows the cost recovery harvests conducted by the hatchery operators.
4. Map of Prince William Sound showing fishing districts and hatchery locations.
5. Catches of Southeast Chinook Salmon with the estimated hatchery component.







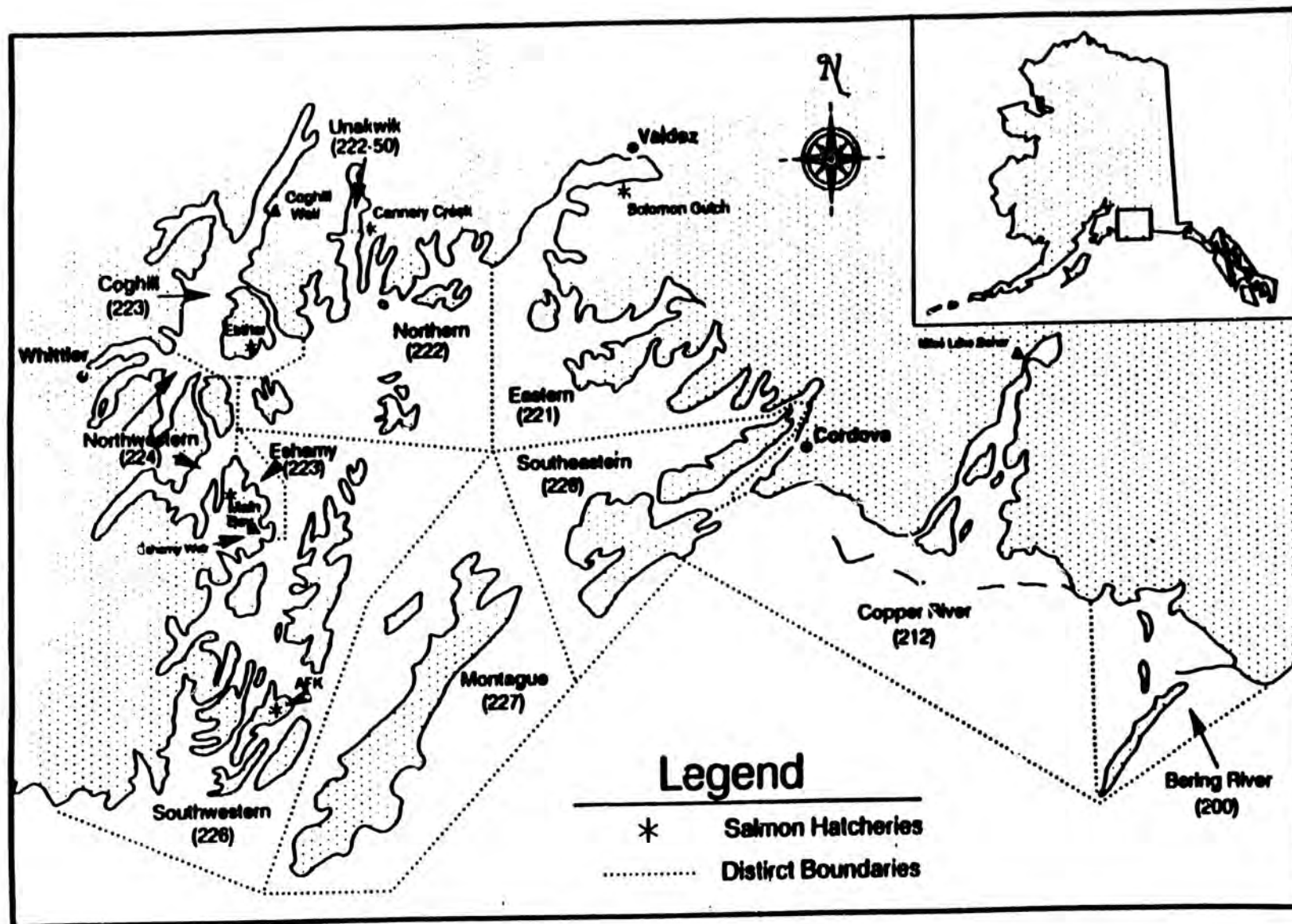
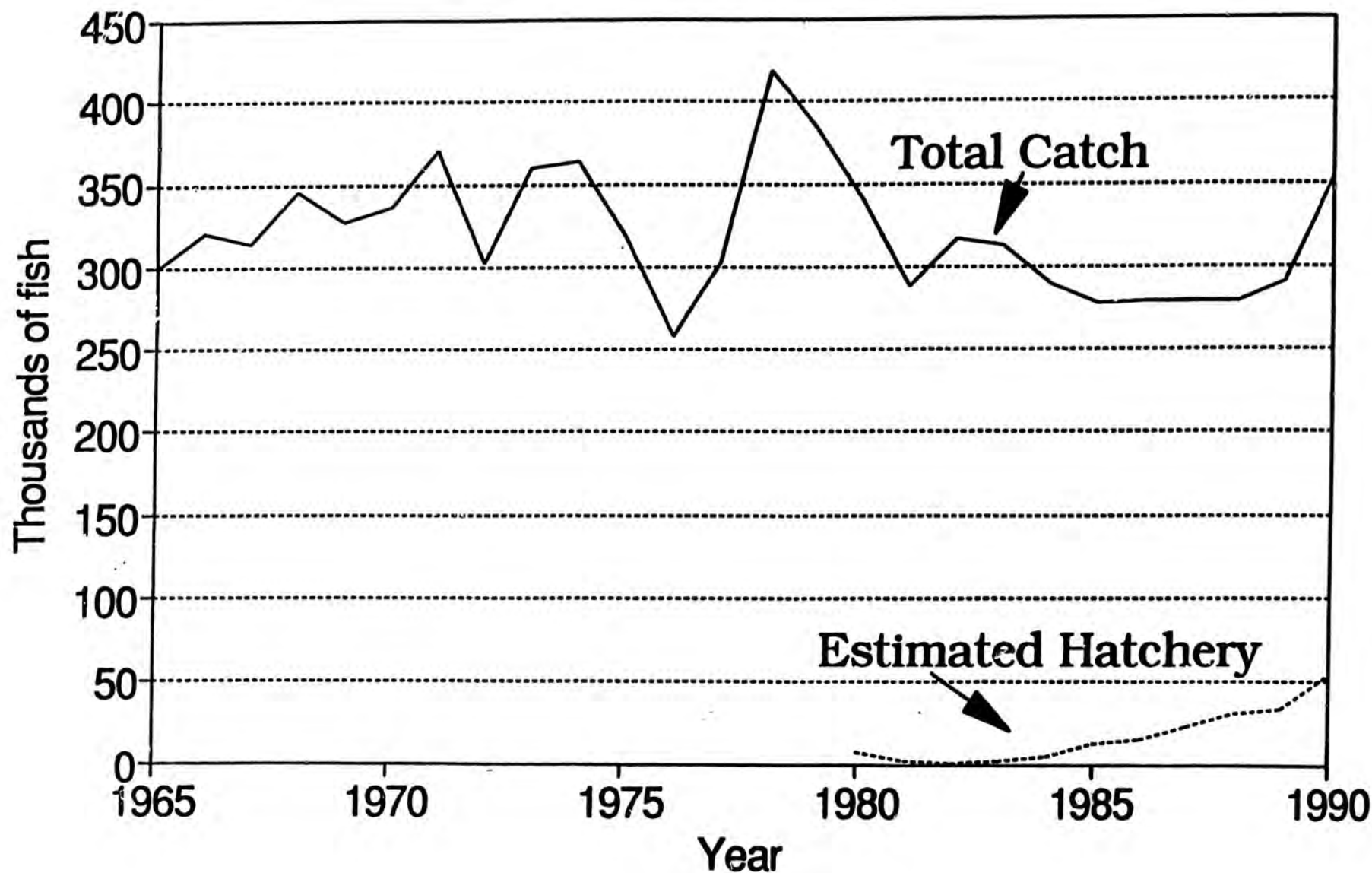


Figure 1. Map of Prince William Sound showing commercial fishing districts and hatchery locations.

S.E. Alaska Chinook Harvest

(all gears combined)



GENETICS / BIOLOGY

GOVERNOR'S
SALMON
STRATEGY
TASK
FORCE

Agenda
Salmon Strategy Task Force
Frontier Building, Governor's Conference Room
Anchorage Alaska, Aug 29 1991

- 9:00 AM Introduction of members
- 9:15 AM Commissioner Olds (charge to the group)
- 9:20 AM Commissioner Rosier - Overview of the Problems and Issues
Occasioning the Appointment of the Task Force
- 9:30 AM Commissioner Olds
Objectives of meeting
Define purpose and scope for task force
Review written input to date
Establish critical issues and priorities
Identify resources
Assign committees and staff to do research
Establish schedule and decide on next meeting
Purpose, Problem Statement
Discussion - Appendix A
- 10:15 AM Break
- 10:30 AM **Identify Critical Issues & Scope** - Appendix B
Production
Harvesting
Processing
Marketing
Finance
Other
- NOON Lunch Break
- 1:30 PM **Resources**
Economic research/future trends - requires economic
analysis, U of A? Use interim hatchery committee for
some?
Marketing strategy development and analysis - advisory
group?
Costs of production - industry advisory group, CFEC?
Policy analysis - advisory group?
Quality - ASMI?
Development policy and infrastructure - advisory group?
Legal analysis - ongoing in AG's office, drop?
- 3:00 PM Break
- 3:15 PM **Assignments and Calendar**
- 4:30 PM Adjourn

PWS working group - Rosier -

Legal Resources - statutes

- Comments on fed + state anti-trust laws prevent fishermen as producers to act as monopoly.
- summary on natl fish + marketing act!
-

~~marketing~~ -

Bob Van Brocklin - mayrag Ordov

Sept 5, 6, 7 - Kodiak meeting

Information Base *

- marketing studies

- production report ** of AK fish.

•

~~review~~ then MAP

cost of harvesting

* distributional benefits

- last year's salmon conf
BNA

salmon marketing
summary of mtg.
check with Ed Beine.

1)

Rosier - production
Payton - harvesting + processing
Waldrop - mktng.
Crane - finance
Moley - legal

Addl. Resources
product diversification
marketplace analysis.

2) prioritize - top 2 issues within each category

4 meetings: Aug 29
Oct 7

Nov 1 or 6

Nov 26

**INVENTORY OF SUGGESTIONS REGARDING SALMON STRATEGY FOR
ALASKA
THE GOVERNOR'S TASK FORCE**

1. PURPOSE AND FOCUS

Of the approximately 67 surveys returned, all agreed with your statement that the purpose of the task force should be to recommend a production, harvesting, processing and marketing strategy for the Alaska salmon industry, which will maximize the economic return to the State, its' fishermen, and processors. We also need to start marketing salmon domestically.

2. SCOPE AND STUDY

One of the recommendations that a number of the surveys suggested was that one of the goals of the task force should be to review Alaska harbor and port facilities improvement and development needs. A comprehensive marketing plan should be developed (ie; what role should ASMI play in this new challenge). In this marketing plan we need to diversify and develop new markets. The diminishing role of Alaska's salmon production in relation to the world production of salmon needs a careful exploration together with an analysis of the factors governing prices in the world market.

3. CRITICAL ISSUES:

1. The main issue seems to be establishing a marketing strategy to promote Alaskan salmon and also establishing alternative markets. Representative Bert Sharp suggested that the focus of ASMI's marketing change from general "Alaskan Seafood" to marketing particular products, such as an ad campaign in the San Francisco area selling Alaskan Halibut steaks, or canned salmon in the mid-west. Another suggestion was to establish regional marketing associations in Alaska.
2. Resolve the problem of lack of freezer and cold storage facilities.
3. Identifying a market strategy for promoting recreational salmon markets.
4. Change our processing techniques to produce what the consumer wants.
5. Identify what Alaska's hatchery and natural run production levels should be for each salmon species to match the world markets. Is there a consistent range of production that is achievable?
6. What can be done to provide some stability in the ex-vessel price of salmon? Is price averaging a realistic option?
7. What are the possible new product forms for Alaskan salmon? What must be done to secure a market niche for these products?

8. In some areas of low volume, a permit buyback system may be necessary. In large volume areas, hatcheries may not be necessary. If mass production is necessary, fish farming may be needed to replace hatcheries.
9. Reducing the cost of canned pink salmon to make the product more marketable. A suggestion was made that the size of the can be reduced, thereby lowering the price. Is it a possibility to package the canned salmon without the skin and bones?
10. The problem of the fantastic growth of state and federal regulatory requirements has added significant costs to both harvesting and processing sectors.
11. The institution of the limited entry permit has created a new entry cost for the fishermen in the form of a permit.
12. A reduction or termination of state and local fish taxes would be helpful but overall I see few areas in the harvesting and processing sectors where significant cost reductions can be reasonably expected in the absence of some form of governmental subsidy.
13. There are many areas in the world where there could be increased consumption of Alaska frozen salmon but the price must be right to compete against farm salmon and other forms of protein.
14. Should the Alaska Hatchery programs continue to produce high volume, low value salmon, or concentrate on low volume, high value salmon?
15. Representative Moyer suggested that it would be useful for the task force to look at interior region fisheries and evaluate their potential contribution to the industry and the disparity of enhancement initiatives compared to other areas of the state.
16. Establish small to medium scale buying stations.
17. Establishment of certain types of infrastructure development including facilitating the development of strategically located public cold storages.
18. More high-seas fisheries for salmon - they prefer their salmon "fat and oily" and are willing to pay for it.
19. Comprehensive information system on seafood market activity.
20. Increase opportunities for sport fishermen.
21. Japanese eating habits are changing - they are eating more red meat.
22. Send fishermen to Japan to see how their fish is stored, distributed, processed, sold, cooked, and eaten.

3. AGENDA AND TIME FRAME

No one had any objections to the time frame suggested. There were a few who felt that the time frame was too short in order to solve all of the pending problems.

I have broken down the total number of responses into the following categories:

GROUP	NUMBER OF RESPONSES
Legislators	11
Government Agency	9
Academia	3
Consultant	8
Processors	12
Fisherman Associations	7
Independent Fishermen	8
Importers/Exporters	9
TOTAL	<u>67</u>

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Critical Issues Within Scope

can be addressed substantively within time frame

Fish Production

- ♦ What should salmon production levels be? (Inventory available information, but further study probably required):
 - What are likely future world salmon production and pricing levels over the next five years? Ten years?
 - What should Alaska's hatchery and natural run production levels be to match the world market?
 - Should Alaska attempt to compete in lower price mass production with other producers or focus on higher priced specialty markets?
- ♦ How can the quality of Alaska salmon be improved?
 - Catch fish further from terminal harvest areas to improve quality.

Harvesting and processing

- ♦ If prices are expected to remain low, what are the options for reducing the costs of harvesting and processing Alaskan salmon?
 - Growth in state and federal regulatory requirements have added significantly to cost.
 - Limited entry has added significantly to cost.
 - A permit buyback system may be needed in some areas.
- ♦ How can the quality of Alaska salmon be improved?
 - Continue to upgrade handling on vessels and in plants.
- ♦ What are the potential alternative markets for Alaskan salmon?
 - What are the potential product forms?
- ♦ Where does the money spent at retail go, and how can more of that money reach the primary producers?
 - Delineate costs in fishing and processing.
 - Compare costs of canned tuna and salmon.

- Adequacy of management plans
- Access to processing
- Should state take over environmental regulation

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Marketing

- ♦ What is happening to the Japanese market?
 - Japanese eating habits are changing. Take this into account.
 - Delineate growth in supply in world, US, and Japanese markets
 - *Do we understand the Japanese mind?*
- ♦ What are the potential alternative markets for Alaskan salmon?
 - How can niches be developed for products Alaska can produce?
 - *What is capacity of present industry to develop those markets?*
 - *State incentive support for product development*
- ♦ Where does the money spent at retail go, and how can more of that money reach the primary producers?
 - Delineate costs in distribution and retailing.
 - Compare costs of canned tuna and canned salmon.
 - Review available information on how ex-vessel fish prices relate to wholesale and retail price trends.
- ♦ ASMI issues
 - Change ASMI's focus from generic to specific products in specific markets.
 - Establish regional marketing associations.
 - Establish parallel salmon marketing structure funded by assessment on fishermen and controlled by fishermen.
 - *State rules clearinghouse for small associations market their fish.*

Financing and other

- ♦ What practical steps can be taken to Alaskanize the industry?
 - What are the infrastructure developments necessary to improve transportation and warehousing/cold storage capability?
 - Establish small to medium scale buying/processing stations.
 - Establish certain types of needed infrastructure such as transportation and public cold storage.
- ♦ What are the likely effects to vessel and permit values and loan portfolios if the current price trend continues for one, five, or ten years?

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Other issues unlikely to produce results within given time frame

- Identify what Alaska's hatchery and natural run production levels should be for each salmon species to match the world markets. Is there a consistent range of production that is achievable?
- Acknowledge importance of sport fishing and build it into strategy, increase opportunities for sportfishermen.
- Fish farming may be necessary.
- Look at interior fisheries, evaluate their potential contribution to industry, and the disparity of enhancement initiatives compared to other areas of the state.
- Send fishermen to Japan to see how their fish is stored, processed, distributed, sold, cooked, eaten.
- Develop a comprehensive database on salmon production, marketing, exchange rates, etc.
- Is illegal price setting taking place to keep prices artificially low?
- Don't see many places to reduce costs other than fish taxes or outright subsidies.

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