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of any state tax or license to any special purpose, to allow for dedication of fisheries tax monies (e.g., A.S. 43.75) to regional associations for construction and operation of fisheries development facilities (Article IX, Section 13 requiring appropriations to withdraw monies from the Treasury may also have to be amended).

(c) Amendments to Article X, Sections 1 and 2, which seek to limit potential duplication of taxing authority by allowing the State to delegate its taxing authority to organized boroughs and cities only, to allow assessments or levies by associations established by law for a public purpose. Again, any amendment to the Constitution could be difficult, particularly if its purpose is limited to a single interest or program.

The first of these amendments would be helpful to resolve potential boundary problems discussed above if the regional association form were to be altered to conform to the service area concept.

The second of these amendments would allow the state to collect a tax on fish harvests and direct those

taxes back to the regional association for use in a manner consistent with the present assessment and without an appropriation by the legislature.

The third of these amendments would allow for significant alteration of the regional association form and increase capability to finance its operations. It contemplates the establishment of "junior" taxing districts in any variety of forms. There are many examples in the lower 48 states which might serve as appropriate models for an altered regional association program. We have suggested that port authorities in Washington and Oregon provide an excellent model for "junior" governmental economic development activities similar to those of AFRDP. Port authorities operate pursuant to statute, elected officials administer them, they have bonding and taxing authority (with ceilings on each), and are subject to considerable voter controls.

Economic development districts have been formed pursuant to federal and state statutes to perform a variety of tasks and are somewhat less visible, more limited in authority and political accountability, and largely have been formed in major centers of commerce. METRO, a local authority in King County, is an example of an organization formed for specific purposes (e.g. transportation, sewage control) to deal with governmental problems shared across jurisdictional lines.

While infrastructure development and other economic

development activities may well be inhibited in Alaska as a result of present constitutional prohibitions, the framers obviously felt strongly that the spectre of junior taxing authorities presented more ominous concerns for Alaska's citizens. This may or may not still hold true, but we wonder if the regional association financing problem and the 200 mile limit fisheries opportunity are sufficient impetus to reverse so strong a policy. This is particularly true if there are alternative legislative remedies to deal with this problem.

To conclude, amendment to the Constitution could affect greater flexibility than presently exists for the legislature to alter the basic form of regional associations and to provide greater organizational and financial stability. However, the process to amend the Constitution is by no means an easy one, and to amend certain of the above provisions for the purposes stated herein may not be realistic. We suggest this is an option which may ultimately have to be considered if further legislative attempts fail to achieve a fisheries development program consistent with the constitutional mandate contained in Article VIII, Section 15, that the powers of the state not be restricted to prevent economic distress in the fishery or promotion of the "efficient development of aquaculture in the state".

Chapter IV - SEARCH FOR GOALS

Introduction

We have discussed in the previous chapters a variety of program reforms which may be necessary to achieve the basic goal articulated in Article VIII, Section 15 of the Alaska Constitution: "... to prevent economic distress among fishermen and those dependent upon them for a livelihood and to promote the efficient development of aquaculture in the State." Article VIII, Section 5 of the Constitution further provides: "The legislature may provide for facilities, improvements, and services... to assure fuller utilization and development of the fisheries..." These provisions indicate the high priority the citizens of Alaska attach to responsible fisheries development. (Note: These provisions do not single out any single species of fish for such development.)

A second series of goals articulated in the Constitution involves the role of local government units in economic development activities. Article X, Section 5 authorizes the borough assembly to establish "service areas to provide special services within an organized borough." Article X, Section 6 authorizes the legislature to do the same in the unorganized borough. The legislature, pursuant to this latter section is to allow "for a maximum of local participation and responsibility." Article X, Section 2 articulates the strong policy of the state against junior taxing districts. The State may "delegate taxing powers to organized boroughs and cities only."

Finally, Article X, Section 13 provides for intergovernmental cooperation or joint administration among local, state and federal governments. These provisions reflect the legitimacy of local involvement in fisheries development activities, but also suggest constraints as to the form such involvement is to take.

We have discussed in detail the financial, economic and institutional implications of these clearly articulated constitutional provisions. It is suggested here that these constitutional goals are sufficient to justify a major expenditure of effort to maximize the effectiveness of all program elements in AFRDP. In fact, our detailed review of studies, program plans and reports, legislation, regulations and policies indicates perhaps too great concentration among fisheries policymakers on the fixing of numerical or other resource development goals, and not enough concentration on the "road map" to achievement of those goals.

Recommendations

With this in mind, we offer little in the way of alteration of State goals affecting AFRDP. We have read the goals articulated in ADF&G's "Alaska Fisheries Plan" for salmon, i.e.,

Short-Term (7 years) - A minimum annual harvest of 40 million salmon.

Long-Term (18 years) - A minimum annual harvest of 100 million salmon.

We have indicated the apparent concentration of regional planning team efforts on the fixing of like goals on a region specific basis and our dissatisfaction with this approach to planning.

The proposed reforms discussed in Chapters I-III suggest that the legislature, the Governor and their constituents should concentrate on a number of improvements to the existing fisheries development program. The basic framework for a solid development program has been developed (with the notable exception of a framework which will assure financial stability to key program elements). Improvement of the program, consistent with the above stated constitutional goals will require in general terms at least the following:

(1) Establishment of a program approach to fisheries development on a multi-species basis (AFRDP);

(2) Improved direction, fixing of program and financial priorities, and coordination among AFRDP program elements;

(3) Establishment of methodologies for the biological, social and economic evaluation of program activities;

(4) Significantly improved and expanded resource data and information;

(5) Expansion of fisheries research in Alaska and improved coordination among federal, state, university and private research activities;

(6) Increased financial stability for state and regional fisheries development programs;

(7) Upgraded planning which addresses region-specific fisheries development needs with input from local user interests and adequate technical support from state agencies;

(8) Establishment of a financial support base and income streams to ensure economic self-sufficiency of development program elements, as appropriate, over a reasonable period of time;

(9) Phasing in of all proposed actions over a ten-year program development cycle, with continued monitoring of progress and reevaluation of priorities and needs; and,

(10) Absolute commitment of the Office of the Governor and the Alaska Legislature to the effective implementation of approved program reforms, recommendations or initiatives.

Each of the above goal statements is directed at improvement of the existing fisheries development program. Each addresses basic needs identified by the study group and the contractors. While there will be disagreement in different circles with some or all of the recommendations addressed in this report, it is our hope that we have articulated a series of program initiatives which will contribute to the accomplishment of the basic goal of the Aquaculture Policy Study Group: to improve on the considerable effort by the State of Alaska to date to provide for the "efficient development of aquaculture in the State," and to "assure fuller utilization and

development of the fisheries." The Constitutional framers and citizens of Alaska have fixed these goals, it is for the Governor and the legislature, with help from their constituents, to effectively implement necessary programs and activities to achieve them.

REPORT

"AN ANALYSIS OF SELECTED ELEMENTS OF THE ALASKAN SALMON RESOURCE DEVELOPMENT PROGRAM"

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An Analysis of Selected Elements of the Alaskan Salmon Resource Development Program

A Report to the Aquaculture Policy Study Group of the Alaska Legislature

By the Firms of:

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MR. WILLIAM R. WILKERSON, ATTORNEY, LAW FIRM OF

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December 1,1979

AN ANALYSIS OF SELECTED ELEMENTS OF THE ALASKAN SALMON RESOURCE DEVELOPMENT PROGRAM

A REPORT TO THE
AQUACULTURE POLICY STUDY GROUP
OF THE ALASKA LEGISLATURE

December 1, 1979

December 1, 1979

TO: Members of the Aquaculture Policy Study Group

FROM: Wallace G. Miller

SUBJECT: Final Report

Attached is the final report, An Analysis of Selected Elements of the Alaskan Salmon Resource Development Program.

The draft report presented earlier has been modified as follows:

-The report has been re-edited to improve its readibility and accuracy.

-An executive summary has been included.

-A brief chapter on goals has been added.

-A comments and response section (Appendix I) has been added to list comments and questions we have received as well as our responses to those comments.

As was discussed during our September meeting the report is a report to the Aquaculture Policy Study Group and as such the recommendations contained in the report should not be construed to be reflective of the views of the members of the Study Group.

While Mr. Wilkerson and I have made every effort to set forth an effective and responsible means for achieving a sound fisheries resource development program in Chapters I through IV, we none-the-less realize that not all of the recommendations will be approved and that others are of a longer range nature and will be subjected to further review and discussion.

We are pleased to have had this opportunity to work with you.

Sincerely,

Wallace G. Miller

Wallace G. Miller
President

WGM/sam

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APPENDICIES

EXECUTIVE SUMMARY

This report sets forth the contractors' findings and recommendations resulting from an analysis of selected elements of the Alaskan Salmon Resource Development Program. This study does not address either the role of the small private or potential role for large for-profit corporations in the state salmon aquaculture program. Care must be exercised to ensure that policy or statutory changes to the state aquaculture program as a result of this report do not have an adverse effect on small non-regional hatchery operations.

Chapter I of the report addresses the need and provides a means for conducting micro and macro economic analyses of the Alaskan salmon fishery. The report recommends that a Return on Investment technique be used by the regional associations to evaluate potential aquaculture projects. The ROI technique is a means for ensuring that sufficient returns will accrue to the project to contribute to the fishery as well as provide the means through a terminal area harvest for the project to eventually become economically self-sufficient.

A second micro economic analysis technique is recommended for government aquaculture projects. This Cost Benefit Analysis technique differs from the ROI method in several important respects. Regional associations, because of their need to repay loans and remain financially solvent, count as "losses", those aquaculture produced salmon caught by domestic non-association members because no revenue accrues to the association from these prior interceptions. Government agencies,

which have a broader constituency, count prior interceptions by domestic fishermen as "benefits" in their calculations of the value of an aquaculture project. In addition, government agencies are not usually dependent upon assessment fees or revenues from terminal area harvests to provide the income necessary to continue in operation.

A second significant difference in the two micro economic evaluation techniques is the value of the catch used in each formula. Ex-vessel prices are used in the ROI analysis because it is the amount association members are paid for their harvest, and it would be the price paid to the association for fish harvested and sold from a terminal area.

Because the intent of a cost benefit analysis is to measure the benefits created by an aquaculture project, the first wholesale price of salmon is recommended for use because it is more reflective of the total value (harvesting and processing) to the domestic economy than ex-vessel prices.

In Chapter I, explicit recognition is given to the need, from an economic point of view, to recognize not only the different stages in the life of a salmon where artificial means can be employed to enhance survival but also the different methods, their attendant costs, as well as differing survival rates which can be employed in salmon propagation. As this analysis indicates, there are a significant number of economic trade-offs which should be considered in the selection of a propagation method.

In addition to the micro economic analysis models, Chapter I recommends the establishment of at least three macro economic evaluation techniques. Whereas the micro economic evaluation models are designed to be applied to specific projects, the purpose of the macro techniques is to provide the state with the economic tools necessary to measure the value of the fishery from a statewide or regional basis. Based upon analyses and information from these models, the state could explicitly formulate an economically sound basis for the fisheries development program.

Chapter II sets forth sources and methods for financing salmon aquaculture programs.

Prior to discussing the financing recommendations it seems appropriate to clarify a misconception about the financial structure of the regional aquaculture corporations. They are non-profit, meaning they cannot sell stock and raise risk capital from speculators. They have three primary sources for financing: fishermen and processors; terminal area harvests in which the association uses part of the harvest to pay operating costs and repay loans; and the state.

Currently all state operated propagation facilities are supported by state appropriations. It is the recommendation of this chapter that ultimately all regional and state production facilities be operated on an economically self-sufficient basis. We do not believe that the regional associations, even if the mandatory assessment were re-enacted, will have adequate revenues available to them to build enough facilities over the next decade to make a significant contribution to the harvestable

number of salmon. We believe an additional state investment in the program, over the next decade, could significantly expand the production capability of the regional associations and allow them to develop to the point where they can assume the managerial and financial responsibility for operating both regional as well as state production facilities. Such an investment will provide two substantial benefits to the state: increased tax revenues and citizen employment from an expanded and more stable fishery and reduced operating costs because the cost of operating state production hatcheries would be shifted from state sources to the primary beneficiaries of the production.

Chapter II discusses the relative advantages and disadvantages of six alternative means for making up the revenue lost as a result of the successful court challenge of the mandatory assessment. As of this writing, option #3, which would provide for a state collection of a regional tax has been reviewed for its constitutional considerations and is being prepared in draft from for further discussion by the Fisheries Council.

Chapter II also contains recommendations regarding the state aquaculture loan program. If a replacement revenue is found for re-establishing the assessment revenue, and if some new revenue stream could be established to provide for the orderly expansion of regional aquaculture programs, then the state aquaculture loan program should be modified as follows:

(a) The $3.0 million loan limitation should be removed;
(b) The loan should be limited to capital construction costs (as defined in Chapter 168, Laws of 1978);
(c) The term of the construction loan should be established at 20 years;
(d) The deferment period should be increased from six years to a maximum of 10 years.

Other recommendations contained in Chapter II include establishing common aquaculture cost categories and a source of funds and applications model. Establishment of common cost categories would aid both the regional associations and the state by providing planning and analysis information. The source and applications of funds model is a standard financial planning technique not only for matching revenue streams to cost categories but is also used as a means for relating long range production expansion to sources for financing the expanded production.

Chapter III contains a discussion of institutional problems and alternative means which could be implemented to overcome these problems. Four general categories of needs are discussed in the chapter. These are: the need to develop means for ensuring that the salmon, shellfish and bottomfish elements of the Alaskan fishery are managed, at least from an overall policy point of view, on an integrated basis; the need to improve coordination among federal, state and regional associations in developing the Alaskan fishery; the shifting of the aquaculture loan program to ADF & G; and, the need to expand and provide for increased coordination of an Alaskan fisheries research program.

The chapter sets forth a variety of alternative means for meeting the identified needs.

In order to improve coordination and provide for a balanced policy management approach over all of the elements of th. Alaskan fisheries, the report recommends the establishment of an Alaskan Fisheries Resource Development Program which encompasses all species. Several options are set forth for achieving this balanced management approach including: an Alaskan fisheries resource development coordinator within the Office of the Governor; establishing lead agency responsibility for the Alaskan Fisheries Resource Development Program; and, establishing a separate office or agency for the program. The assignment of ADF & G as the lead agency over the fishery is the preferred option.

With regard to the need to improve coordination and cooperation among the various elements of the fishery, the report contains a number of optional ways of achieving this need. This includes: enacting a legislative mandate which requires cooperation in certain activities; providing a one stop permitting process for both state and regional fisheries development activities; the use of cooperative agreements between ADF & G, regional associations and federal agencies; the expansion and strengthening of ADF & G regional staffs to improve coordination and support to regional associations; the establishment of a continuing regional association structure to improve coordination among association members; as well as a number of other possible options.

The recommendation regarding shifting the aquaculture loan program from DCED to ADF & G is predicated upon achieving greater consideration in the loan approval process of such biological factors as proposed site location, construction costs, harvest management considerations and other technical factors. The recommendation is also conditioned upon limiting the aquaculture loan to capital construction as discussed in the chapter on financing.

The final need recognized in Chapter III is for an expanded and coordinated fisheries research program in Alaska. The report recommends that efforts be undertaken to expand federal funding of fisheries research in Alaska and further that consideration be given to the establishment of a joint (federal, state and local) fisheries research facility as one means of providing for the necessary research and coordination among the parties involved in the Alaskan fishery.

Chapter IV discusses goals for the Alaskan fishery. The Alaskan Constitution provides an unusually clear goal for the development of Alaskan fisheries. No additional goals are necessary. The remaining need is for effective programs and activities to achieve them.

CONTRACT REPORT

The 1978 session of the Alaska State Legislature established the Aquaculture Policy Study Group as an advisory body to examine a number of policy matters relating to the Alaska Salmon Resource Development Program. Membership in the Study Group includes representatives from the several regional non-profit aquaculture associations, the Alaska Departments of Fish and Game, Commerce and Economic Development and Revenue, the U.S. Forest Service and Department of Agriculture, the University of Alaska Sea Grant program and members of the Alaska legislature.

In March, 1979 the Aquaculture Policy Study Group retained the consulting services of a consortium of three firms. Miller and Associates, Inc., Olympia, Washington; Leonard Lane and Associates, Anchorage, Alaska; and Mr. William Wilkerson, Attorney, law firm of Eisenhower, Carlson, Newlands, Reha, Henriot & Quinn, Tacoma, Washington.

The consulting services to be provided by the team of consultants were defined to include four basic tasks each of which are briefly described as follows:

TASK #1 - Search for Goals

The consulting team was required to research and examine Alaska state constitutional provisions, statutes and other documentation to determine the extent to which goals for an Alaskan Salmon Resource Development Program had been established.

The consulting team was further instructed to examine existing goals and present possible alternative goals to the Study Group for their consideration.

TASK #2 - Institutional and Policy Analysis

The consulting team was required to examine the roles and missions of existing institutions involved in the Salmon Resource Development Program, define existing problems, and recommend alternative institutional arrangements which would be more suitable for obtaining the goals set forth in Task #1.

TASK #3 - Economic Evaluation Techniques

The consulting team was requested to inventory micro and macro economic evaluation techniques, economic factors and methods of analysis and recommend an effective means for making economic evaluations of evaluating Salmon Resource Development Projects.

TASK #4 - Financial Planning

The consulting team was requested to examine the present means of financing salmon development programs, define problems and recommend a model financial planning framework.

The consulting team prepared analytical information for presentation to the Study Group in meetings held in March, May and July.

A fourth meeting was held in late July. At the meeting, discussions and plans were focused upon initiating alternative financing strategies as a result of the State Superior Court ruling in Wayne Alex, etal., v. Southern Southeast Aquaculture Association, etal. As a result of the redirection received during the July meeting, project research priorities were altered. Increased emphasis was to be placed upon developing alternative financing mechanisms to the unconstitutional mandatory assessment.

The consulting team held up preparation of the final report to the Study Group pending the receipt of clarifications to the court decision and to discuss with the Office of the State Attorney General possible alternative organizational as well as financial strategies which might be available to the regional aquaculture associations in light of the court ruling.

This final report incorporates the effect of this late development and attempts in greater detail than originally planned to provide the Study Group with alternatives and recommendations for their further review and analysis which expressly recognize the severe impact on several of the regional aquaculture programs from the ruling. Additional work and analysis of financial and institutional alternatives will be required prior to the 1980 session as a result of present legal uncertainties.

It should be noted that the contractual work almost exclusively focused upon regional aquaculture associations and their interrelationships with government agencies, consequently this report does not specifically cover private, non-association hatcheries sometimes referred to as "mom and pop" hatcheries. As policies or statutes are formulated, full consideration should be given to any effect the proposed changes would have on this group of hatchery operators.

Finally, the consulting team has received comments regarding the report from a number of sources. Because these comments for the most part focus on important issues, they together with responses to the comments have been included in special Appendix I to the report in the hope that this information could aid in clarifying the report and the issues.

The consulting team wishes to express its deep appreciation to members of the Aquaculture Policy Study Group, Mr. John Sund and legislative staff for their interest and valuable assistance in conducting the studies which are contained in this report.

PREFACE

It may be helpful to the reader to understand why the sequence of subject matter is arranged in this report as it is.

Rather than begin this report with a discussion on goals and proceeding on with a discussion of organizational arrangements, economics and financing, it seemed more appropriate to the consulting team to address these subjects in their natural order of occurrence.

In terms of their natural order, the foremost concern about salmon aquaculture is whether it is or can become economically feasible. If aquaculture programs are not or cannot become economically attractive, then there would seem to be little point in carrying the analysis through the remaining subjects, therefore the economic issue is contained in Chapter I.

If salmon aquaculture is or can become economically attractive, it seems the next most appropriate question to raise is who pays for the program and how can this be accomplished, particularly in light of the recent State Superior Court ruling. Financing issues are discussed in Chapter II.

Assuming that salmon aquaculture is economically sound and a method of financing can be developed and implemented, the question of how to organize to carry out salmon aquaculture seemed appropriate for Chapter III.

Appendix I contains some comments and responses concerning various issues discussed in the report.

Appendices II and III contain listings of the state and federal institutions involved in the Alaska Salmon fishery.

If the economic, financing and organizational hurdles can be cleared, only then does it seem appropriate to talk about both existing and potentially new goals as well as other measures which could be adopted to ensure the long term success of the State salmon resources development program, which is covered in Chapter IV.

Finally, in the interest of readibility, we have prepared this report in such a manner so as to eliminate almost all mathematical equations and formulas.

INTRODUCTION

The objectives of this introductory section is to provide a brief recapitulation of the events and circumstances which led to the formation of the Aquaculture Policy Study Group and explain why, at this late date, it is necessary to raise some very fundamental questions about the Alaska Salmon Resource Development Program.

Much has been written elsewhere, and in greater detail about the size of historic salmon runs in Alaska. In recent years, the 1950's to the mid-1970's, and for a variety of reasons, Alaskan salmon runs declined precipitously. This decline in the fishery with its resulting loss of income, employment, subsistence and recreation was a common concern among commercial, sports and subsistence fishermen. The fishing industry (including salmon, shellfish and bottom-fish) was and is the largest private sector employer in Alaska. In addition, fishing had become so ingrained into so much of Alaskan culture and lifestyle that alternative choices were both distasteful and unrealistic for the many small communities and villages in Southeast and other parts of Alaska.

While the propagation of salmonoid species was initiated in western coastal states and British Columbia in the late 1800's, no similar long-term resource development steps were taken in Alaska. In 1971, the Alaska legislature

created the Division of Fisheries Rehabilitation, Enhancement and Development (F.R.E.D.) (Chapter 113 SLA 1971) of the Alaska Department of Fish and Game. The legislature, among other duties, charged F.R.E.D. with the responsibility to "develop and continually maintain a comprehensive, coordinated long-range plan for the orderly present and long-range rehabilitation ... of all aspects of the state's fishery ..." In addition, the legislation authorized the new division to "encourage the investment by private enterprise in the technological development and economic utilization of the fisheries resources."

The creation of F.R.E.D. was the first expressed statutory authorization for the state to enter into programs to rehabilitate, enhance and develop its salmon fishery, notwithstanding that the framers of the Constitution in 1959 (Article VIII, Section 5) authorized the legislature to "provide for facilities, improvements and services ... to assure further utilization and development of the fisheries."

In 1972, the Alaska legislature proposed and the citizens passed a constitutional amendment which provided the state with a constitutional basis for limiting entry into the fishery (resource conservation) and carrying out aquaculture programs in the state. Clearly, restoring the salmon fishery to higher historic harvest levels was and is a high priority in the state.

Through these and other constitutional and statutory provisions two potentially powerful tools had been created which could be used to restore the fishery: (1) limited entry, combined with improved biological data, management, enforcement and stock regulation; and, (2) the rehabilitation, enhancement and development authority of the F.R.E.D. Division. Both were viewed as complementary means for restoring the salmon fishery.

These tools were soon employed in the restoration of the fishery. Stringent restrictions were placed on harvesting to allow natural brood stocks to increase and build run strength. The F.R.E.D. division began the long, arduous process of acquiring technical expertise, enhancement sites and capital funds to design, develop and place into operational status the facilities, rehabilitation projects and similar activities associated with restoring or creating new salmon runs.

Hindsight suggests that regardless of the methods employed, restoration of salmon runs requires a great deal of time, even under the best of circumstances. Two to four years, depending upon the salmon species involved, is the smallest increment of time which can elapse before improvements can be noticeable. Given variations in climatic conditions, the difficulty in regulating escapement needs, and problems attendant to finding suitable sites for construction of propagation facilities and constructing the facilities

under extremely difficult conditions, delays were inevitable and encountered in the anticipated salmon recovery time table.

In 1974 the State legislature enacted what is commonly known as the "Private Non-Profit Hatcheries Act" (Chapter III, SLA 1974), which authorized the private ownership of salmon hatcheries by qualified non-profit corporations for the purpose of contributing by artificial means to the rehabilitation of the state's depleted and depressed salmon fishery. (Emphasis added by underlining.)

It is difficult at this point to accurately gauge all of the factors which motivated the enactment of this legislation. In part the act reflected a declaration of a choice between private for-profit aquaculture and private non-profit aquaculture. Beyond this, a strong motivating factor was the desire to see if less bureaucratic and costly means of restoring the salmon fisheries' stocks could produce the desired result.

While subsequent legislation during the 1976 and 1978 sessions provided a major financing basis for F.R.E.D. division capital facilities, and for further refinements to the Private Non-Profit Hatcheries Act, the stage was being set in 1974 for the addition of private non-profit hatcheries as yet a third potentially powerful tool to the two already established and at work in restoring the salmon fishery.

Results from the improved management of natural stocks became noticeable in 1976 and by 1978 and 1979 statewide harvest levels reached approximately 80 million salmon. F.R.E.D. artificial production facilities in 1978 provided several hundred thousand additional returning salmon. With the exception of the Prince William Sound Regional Association, the new regional non-profit aquaculture corporations were in the beginning stages of production development and did not contribute significantly to the almost record level returns of 1978 and 1979.

The recent near record level salmon harvests, when coupled with the planned increased production capability of the F.R.E.D. division and the limitations imposed by the court decision on the Private Non-Profit Aquaculture Associations, could combine to produce some curious effects on future development of the fishery. A question exists whether, given the current near record levels of harvest, affected fishermen will be willing to re-impose a mandatory assessment or royalty on their harvest income now that the years of deprivation appear to be behind them. On the other hand, are fishermen willing to absorb the cost of resource expansion if regulation of natural stocks is the only tool to be utilized to achieve this goal for Alaska's renewable salmon resource?

One of the present policies of Alaskan state government is for production facilities to become economically

self-sufficient over a reasonable period of time. Thus, a major issue to be addressed by policymakers over the next few years is the level of fisheries development program costs to be borne by primary benefactors or users. For example, if the F.R.E.D. division continues with its planned expansion of operational facilities, who is to pay for the operating cost of the facilities, all of the taxpayers of the state or those who primarily benefit from the development of the resouce?

Another major issue to be resolved is whether a satisfactory working arrangement can be established among the now competing salmon restoration tools: natural production, state artificial production and regional non-profit corporation production.

Finally, is it possible to effect a timely solution to the financial dilemma of the non-profit regional associations which will pass muster by the court, thus avoiding the need for state subsidies or state collected mandatory assessments which will allow these organizations to continue to contribute to the restoration of the fishery?

Clearly there are a number of additional major and unresolved issues affecting the state's Salmon Resource Development Program. While the original scope of the work planned for this report was somewhat limited, we have attempted to broaden its scope to reflect the possible effects current harvest levels and other issues could have in the considera-

tion and selection of alternative courses of action by the Aquaculture Policy Study Group. Moreover, at the direction of the study group, we have addressed organization of fisheries development activities in the context of a holistic program, identifying the reasons why and means for addressing multi-species development which we believe is in the best interest of the citizens of Alaska.

Chapter I - SALMON AQUACULTURE ECONOMIC EVALUATION TECHNIQUES

Micro Economic Evaluation Techniques

The need to have one or more objective means for evaluating in a micro economic sense, the value of a salmon aquaculture project has two primary sources. First, regional non-profit aquaculture associations need a uniformly applicable methodology for assessing whether or not a planned aquaculture project will provide a satisfactory return on the capital investment and expenses of operating the facility.

Regional associations have borrowed millions of dollars, and will borrow more, for capital facility investments and operating expenses. These monies must be repaid. In addition, start-up expenses must be incurred for a minimum of two to four years, depending upon the species, prior to any returning adults being available for fishermen to harvest. Moreover, if required, a terminal area harvest could be implemented with the income from the terminal area harvest used to help defray facility operating costs and to provide a source of funds for repaying the borrowed capital and related interest charges.

A second objective means for evaluating the value of an aquaculture project is required by government agencies. This measure is somewhat different than the valuation measurement needs of regional associations or the private sector.

Whereas the primary concern of regional associations must by necessity be limited to narrow regional financial and economic criteria, government agencies are often charged with performing socially beneficial acts which are seldom, if ever, accorded a value in the traditional financial market places.

In these private markets, a financial/economic evaluation system for salmon propagation facilities would be concerned only with the income produced from the harvest and sale of adults returning to the facility by association members or as necessary to pay the costs associated with the facility.

Because of the more encompassing responsibilities of government agencies, the value of government sponsored salmon propagation facilities must be extended beyond the boundaries established by the traditional financial/economic evaluation system. For example, salmon harvested by sports and subsistence fishermen, which must be considered "losses" in a traditional financial/economic model, should be valued by government agencies whose responsibilities extend beyond pecuniary returns.

Another example is the "value added" to the salmon through processing. This does not directly enure income to fishermen of regional associations; consequently, this societal benefit is not a factor affecting the economic and financial decisions of fishermen or regional associations. The "value added" of processing, however, can and should be

considered by government agencies in valuing the benefits to be derived from a government sponsored propagation facility.

At a more theoretical level at least, the value of the employment provided by the propagation facility as well as indirect employment (the additional clerk at the grocery store who serves fishermen or the attendant who fuels their boats) could also be considered as benefits to values added by aquaculture projects.

The "value added" micro economic model has some practical limitations. If one attempts to be too precise in using the cost benefit analysis micro economic system for valuing government sponsored propagation projects, it obviously becomes difficult and costly to obtain the necessary financial and economic information needed for evaluating each project under consideration. Similar technical measurement problems also plague the traditional financial/economic evaluation system, in its application to salmon propagation facilities. The discounting of future revenue and expense streams, the proper selection of the discount rate, and similar technical considerations, while professionally satisfying, provide for a level of refinement which may be excessive when compared with the value of obtaining information relating to other formula elements such as improving the state of the art in predicting the number of returning adult salmon. In other words, the choice of the parameters or factors and the degree of refinement to be used in both the traditional

financial/economic evaluation model and the government oriented socio-economic evaluation model, should be generally tempered by the cost and availability of financial and economic information as well as the existing capability to estimate the number of adult returns to a propagation facility.

After carefully weighing all of the factors, parameters and methodologies which could be utilized in valuing the benefits to be derived from a salmon resouce development project, and after giving equal consideration to the availability and cost of acquiring data and taking into account the many unknowns which limit the state of the art in predicting run size, the contracting team recommends the following models, factors and parameters be used to meet the evaluation needs of regional associations and government agencies.

I. Financial/Economic Evaluation Model for Regional Aquaculture Associations.

Because of the private sector orientation of aquaculture development in Alaska and the need to attract increased amounts of investment capital to provide for the orderly growth and development of this means of developing Alaska's salmon resources, the most appropriate micro economic model for evaluating salmon propagation projectsis the use of a return on investment model.

The use of a return on investment model by the

regicnal aquaculture associations meets several critically important needs. First, each aquaculture project developed by the non-profit corporations must pay its own way, or in the alternative be financially supported from excess revenues available from other aquaculture projects of the corporation. It is amply clear from recent events that a major concern of lending institutions (including state and federal agencies) is whether or not specific aquaculture projects are sound investments. Moreover, the state legislature needs such information to monitor on a continuing basis the worth of this program. Given the current absence of any mutually acceptable return on investment model, lending institutions and others have no objective basis for considering the relative merits of requested loans and now must use more subjective and arbitrary criteria in approving or disapproving a loan request.

Additionally, fishermen belonging to a regional aquaculture association are critically concerned about the overall soundness of an investment in an aquaculture project and need to know whether or not borrowed funds can be repaid by the project without requiring higher levels of assessment against the fishermen. Fishermen are also concerned about the net benefit to them from the investment in an aquaculture project. They need to know, or have a believable estimate of the number of salmon which can be harvested by them as a result of their investment in an aquaculture project.

Professional managers of the regional associations also need to have an established and accepted means for evaluating alternative investment opportunities, securing the necessary financing for selected opportunities and being reasonably assured that the returns from the investment will be adequate to pay for the cost of the project.

In summary, the use of a return on investment (ROI) model is the most appropriate means for satisfying the financial assessment needs of lending institutions, the legislature and fishermen and to evaluate the financial risks and rewards to managers and members of regional aquaculture associations.

II. Considerations in the Development of a Return on Investment Model for Salmon Aquaculture Projects.

The standard formula for computing return on investment can be stated as follows:

$$\text{Return on Investment} = \text{'s } \frac{\text{Total Revenues Less Costs}}{\text{Total Investment}}$$

While the ROI formula can be stated in quite simple terms, substantial work can be involved in identifying total revenues, total costs, and the total investment.

Total revenues, for example, are a product of the number of returning adult salmon which can be harvested multiplied by the going ex-vessel price paid to fishermen for a particular species in each of the various geographic areas of Alaska.

The single most difficult part of the revenue equation involves the accurate estimate of the number of adult salmon which will return from a particular given brood year. Rates of return, which can be expressed in terms of the percentage of adult survivors to the number of eggs deposited, vary significantly from brood year to brood year for the same species, vary significantly among species and vary greatly among the various means for artificially and naturally propagating salmon. To further compound the problem of accurately estimating returns, run strengths or survival rates for the same species can vary significantly between broad geographic regions as well as between adjoining watersheds.

Notwithstanding the severe difficulty in accurately estimating salmon survival rates, the F.R.E.D. Division of the Alaska Department of Fish and Game has developed some standard assumptions on salmon survival rates. These rates are shown in Table I, in a somewhat different format than set forth in the ADF&G directive.

Table I

AN ANALYSIS OF ARTIFICIAL & NATURAL SALMON PROPAGATION METHODS

		STAGE I			STAGE II				STAGE III			
	FECUNDITY	Survival-Egg Take to Emerge Stage by Propagation Method(2)			Survival Emerge to Migrant Stage by Propagation Method (3)				Marine Survival by Propagation Method (4)			
		Natural	Hatchery	Incu. Box	Natural	Hatchery	Lk. Fert.	Incu. Box	Nautral	Hatchery	Lk. Fert.	Incu. Box
PINK	Ave. 1600	160	1360	720	-	1224	-	-	5	24	-	7
SOCKEYE	Ave. 3000	300	2550	1350	60	179	-	98	5	11	-	10
CHUM	Ave. 2200	220	1870	990	-	1683	-	-	6	34	-	0
COHO	Ave. 2800	280	2380	-	56	1666	-	-	4	100	-	-
CHINOOK	Ave. 6500	650	5525	2925	130	3868	-	293	4	77	-	1

(1) Survival rates for artificial production based on F.R.E.D. Division Directive.
Natural production estimated by contractor.
All percentages rounded to nearest whole percent, where possible.

(2) Survival - Egg Take to Emerge Stage
Percentile Estimates (10% estimate is shown in the Table)

	Natural	Hatchery	Incu. Box
PINK	7-10%	85%	45%
SOCKEYE	7-10%	85%	45%
CHUM	7-10%	85%	45%
COHO	7-10%	85%	-
CHINOOK	7-10%	85%	45%

(3) Survival Emerge to Migrant Stage
Percentile Estimates

	Natural	Hatchery	Lk. Fert.	Incu. Box
PINK	-	90%*	-	-
SOCKEYE	20%	7%**	-	7%
CHUM	-	90%*	-	-
COHO	20%	70%	-	-
CHINOOK	20%	70%	-	10%

*To fingerling size
**Lake released as emergent fry
***Because of their high value chinook would be hatchery reared rather than placed in an incubation box.

(4) Marine Survival Estimates

	Natural	Hatchery	Lk. Fert.	Incu. Box
PINK	3%	2%	-	1%
SOCKEYE	8%	6%	-	1%
CHUM	3%	2%	-	1%
COHO	8%	6%	-	-
CHINOOK	3%	2%	-	3%

Table I suggests that there are at least three distinct stages in the life cycle of a salmon where artificial means can be employed to change the rate of survival of adult returning salmon. In addition, within each stage there are a variety of alternative propagation choices which can enhance survival, each of which have different cost characteristics and yield different rates of return on their associated investment.

As indicated in Table I (Stage I), the basic economic attractiveness of artificially propagating salmon results from the fact that under natural spawning conditions only 7 to 10 percent of the green eggs deposited by spawning salmon produce emergent fry. Under the more controlled conditions of a hatchery, survival rates from the green egg stage to the emergent fry stage of 85% are estimated to be achievable. This 8 to 10 times greater Stage I survival rate provides a major economic justification for artificially propagating salmon. This reasoning is based upon the assumption that the more salmon which are initially produced, the greater the number that will survive to be available for harvest. This should lead to increased fishermen's incomes and provide sufficient economic benefits (e.g. terminal harvests) to pay for the cost of constructing and operating the propagation facility.

There are other alternatives in Stage I to simply choosing between natural production and hatcheries. For

example, incubation boxes, which involve a mere fraction of the cost of hatcheries, under certain circumstances can be considered as an attractive financial and biological alternative to either natural or hatchery propagation methods. Stream rehabilitation (not shown in Table I), a method for improving natural runs, is another example of the type of biological and economic choice which could be made to increase the size of a salmon run or improve survival rates. (Note: In Chapter III we discuss a variety of research activities to be undertaken to improve survival rates at each stage.)

The important point to recognize is that survival rates vary with the type of propagation method, which in turn vary significantly in terms of cost. By combining survival rates and the costs associated with the methods for achieving those survival rates in a return on investment model, a means is available for objectively analyzing and determining which sets of biological and economic considerations will produce the better return for the required investment.

Stage II deals with a second set of economic choices and survival rates from those contained in Stage I. During Stage II for example, emergent fry can be reared to a larger size in a hatchery, which improves their survival rate, but again, certain costs are incurred which have to be carefully weighed against the estimated increase in the number of returning salmon. It is important to recognize

that Stage II economic choices and survival rates may be largely independent of the choices made during Stage I. For example, during Stage I, it may be economically desirable to release unfed pink and chum fry without incurring further costs associated with Stage II types of activities. Alternatively, it may be economically desirable in Stage I, to incur no propagation costs on sockeye salmon by depending upon natural spawning but during Stage II use the newly developing lake fertilization technique as a means of increasing Stage II survival rates.

Another highly interesting Stage II method for improving survival rates is the predation control program established by the Alaska Department of Fish and Game in the Wood River Lake System. Arctic chum are impounded in a holding pen to reduce their predation on outmigrating smolt. According to estimates, up to one million smolts are saved each season by the control project.

Again, the point is made that both Stage I and Stage II propagation methods involve a series of often independent economic choices and differing survival results. The current inability (or limited ability) to clearly distinguish the costs and benefits (increased survival) associated with each stage substantially limits the useability of such data for economic analysis purposes.

Table I, Stage III depicts a very limited series of possible marine survival rates. These rates are largely

predicated upon the current methology in which Stage I and Stage II propagation methods are assumed to be interdependent, which as we discussed earlier, is not always the case. For example, no assumptions or estimates are included which indicate the potential increase in the marine survival of Stage I natural spawning sockeye resulting from lake fertilization during Stage II.

Stage III, Marine Survival also offers an opportunity, quite independently of Stages I and II, to increase the number of returning adults. Methods for reducing predation by beluga whales (or sea lions) in the marine environment, and techniques for reducing shaker (coho, chinook) mortality are but two means which could be used to increase the number of returning adult salmon. The implementation of either or any of these techniques during Stage III, like Stages I and II, depends both upon the expected increase in survival rates as well as the costs to be incurred.

Five critically important observations about salmon survival rates which are apparent from the information contained in Table I need to be made at this point prior to further defining the elements to be included in a return on investment model for salmon aquaculture projects. These are:

(1) There are an increasing variety of opportunities within each of these three stages in the life cycle of salmon to employ artificial methods which will increase salmon survival rates.

(2) The mission of regional aquaculture associations, the F.R.E.D. division and the Salmon Resource Development Program (ASRDP) as a whole, should not be limited to Stage I types of choices (i.e., natural production v. hatcheries v. incubation boxes) but should instead encompass the entire range of biological and economic choices available to them in order to allow the maximum return on investments to be realized.

(3) Too little emphasis has been placed on doing research on improving survival rates and there is a lack of data which corresponds to the alternative economic choices within and across the various life cycle stages. This severely limits the current capability to develop reliable financial estimates of the potential economic benefits to be derived from almost any given salmon propagation endeavor.

(4) Let us assume for a moment, at least, that the F.R.E.D. division were adequately funded to perform the necessary data gathering and research and development of alternative means for increasing salmon survival rates. Let us further assume that such data and means were used in a wide variety of ways by regional associations to increase Stage I, Stage II and Stage III survival rates (in independent as well as an interdependent fashion). As a result of the possible interactions and combinations of propagation techniques, in many instances there may not be a separately identifiable, artifically propagated run which could be

subjected to a terminal area harvest as a means of recovering the capital and operating costs associated with achieving the increased survival rate. A simple example of this dilemma occurs when a regional association incurs costs to rehabilitate a stream bed to improve natural spawning conditions. Because no artificial run was created no terminal area harvest can be employed to recover the investment. Regional associations now regard such projects as non-revenue producing and absorb the attendant costs of the project within available funds. If future aquaculture developments make Stage I - II hatchery type operations economically less attractive than other choices, and at the same time the regional associations are placed in a position of developing and operating new hatcheries simply because they are dependent upon terminal area harvests for a major source of operating revenue it would indeed be unfortunate. Given the growing technological developments in salmon enhancement, it is important that the selected financing mechanisms not lock regional associations into less attractive propagation methods because of harvest considerations.

(5) The bulk of information critical to a return on investment model is biological. Lending institutions must have the capability to evaluate this critical information, or alternatively the lending authority must be placed with those who have the biological expertise to evaluate such proposals (See Chapter III).

III. Elements of a Return on Investment Model for Salmon Aquaculture Projects.

Notwithstanding the present limitations on the availability of reliable information upon which to estimate the number of returning adult salmon, the following propagation factors must be reflected in a return on investment model for salmon aquaculture projects.

A. Salmon Propagation Factors.

1. The Number of Eggs to be Propagated.

If green eggs are used for the initial planning basis it will in turn (together with an estimate of the average number of eggs available per female spawner) provide a basis for estimating the number of salmon required for egg taking purposes as well as the estimated number of adult returns.

2. Stage I Estimated Survival Rates by Species - (Green Egg to Emerge Stage).

(a) Natural production;

(b) Natural production rehabilitation (i.e., stream bed rehabilitation);

(c) Hatchery production;

(d) Incubation box;

(e) Other.

3. Stage II Estimated Survival Rates by Species (Emergent Fry to Migrant Stage).

(a) Natural production;

(b) Natural production rehabilitiation;

(c) Hatchery production

(1) Fed fry;

(2) Fingerling;

(3) Smolt.

(d) Hatchery production (out-station plants)

(1) Fed fry;

(2) Fingerling;

(3) Smolt.

(e) Incubation box;

(f) Lake fertilization (In combination with 2(a), (b), (c) or (d), above);

(g) Other.

4. Stage III Estimated Survival Rates - by Species (Marine Survival).

(a) Natural survival (no human intervention directed at increasing the survival rate of the particular run);

(b) Enhanced survival (human intervention i.e., predator controls applied).

5. Estimated Total Returns - by Species.

Estimate of the number of adult salmon which will return to the area of harvest as a result of propagation methods and any enhanced survival techniques employed.

6. Number of Spawning Stock Required for Run Maintenance - by Species.

Estimate of the number of male and female spawners required to maintain the initial run.

7. Number of Spawning Stocks Required - by Species.

Estimate of the number of additional male and female spawners required to increase initial run size. The decision to increase a run size should reflect the lost opportunity costs (to fishermen) represented by the value of the additional spawners required to build the level of the run.

8. Hatchery or Other Surplus - by Species.

There are often surplus male salmon which are not needed for spawning purposes, therefore an estimate of the amount of the return which cannot be harvested nor is required for spawning purposes needs to be made if the surplus can be sold. (Any value of spawned out carcasses should also be included).

9. Estimated Total Number of Harvestable Salmon - by Species.

The estimated total number of harvestable salmon is the estimated total return less spawning stock required and any surpluses.

B. Salmon Revenue Factors.

Salmon revenue estimates for the return on investment model should be based upon the estimated total number of harvestable salmon and estimates of the ex-vessel prices being paid for the salmon. Salmon revenue should also include any revenues received from the sale of spawned-out carcasses and spawning surpluses.

Considerable variations occur in Alaskan salmon ex-vessel prices by region. The quality of the fish harvested as well as the supply of salmon which is available also affect ex-vessel prices.

In addition to the regional price variations, total project revenues can be based upon a constant dollar basis or on a current dollar basis. A constant dollar basis for estimating revenues would, for example, be 1979 ex-vessel prices extended for the expected life of the project. The current dollar basis would be based upon estimates of future ex-vessel prices during the life of the project. There are advantages and disadvantages to both.

The use of a constant dollar basis works well for short-term projects where the returns tend to be immediate. It works less well when long term (20-30 years) pay-outs on investments are required and inflation is increasing operating costs at a rate which may or may not be commensurate with increases in the market price for salmon.

The use of the current dollar basis attempts to adjust for the effect of inflation on operating costs and to reflect future market prices for salmon based upon inflationary trends as well as the effects of supply and demand at various production levels. While the main advantage of the current dollar basis is that it is an attempt to take future prices and costs into consideration in evaluating the return on investment potential of a particular aquaculture project. A

primary disadvantage of the current dollar basis is the lack of reliable forecasts of future costs and prices for the salmon industry. A further disadvantage is that the relative merits of a project (in relation to an alternative investment choice) can become so obscured by price and cost change assumptions, which may or may not be reliable, that short-term choices tend to be selected over longer-term projects simply because of the uncertainty over future costs and prices.

Despite the advantages and disadvantages of both the constant dollar basis and current dollar basis for estimating costs and revenues, each can be effectively used in a return on investment model.

The following general guidelines may be helpful in selecting whether to use a constant dollar basis or a current dollar basis for use in a return on investment analysis.

1. During times of high rates of cost inflation and high levels of salmon production and where market prices are not increasing at a rate commensurate with inflation, the use of a current dollar basis in the return on investment model will help ensure that spiraling operating costs together with stable production and market prices do not create a future situation whereby all of the salmon production from a propagation project is required to pay operating costs, with no harvest allowance provided to fishermen.

2. If a choice is being made from among like projects (i.e., approximately the same level of capital investment, return timing, operating costs, depreciable facility life, and etc.) the use of a constant dollar basis would be suitable for inclusion in the return on investment model.

3. Short-term capital projects which require little or no continuing operating expense can be comparatively evaluated using the constant dollar basis.

4. When in doubt about which basis is more appropriate and the amount of the investment at risk is significant, use both the constant dollar basis and the current dollar basis and make any decisions on the set of data which indicates the least favorable return on investment.

The salmon revenue factors to be taken into consideration are as follows:

1. Estimated Total Number of Harvestable Salmon (as derived earlier).

2. The Value or Price Per Pound of the Salmon.

The regional ex-vessel price expressed in terms of constant dollars or current dollars over the useful life of the project.

3. The Estimated Weight Per Fish.

4. The Total Value of the Estimated Numbers of Harvestable Salmon.

Item 1, multiplied by item 2 multiplied by item 3.

5. The Value of Surplus and Spawners.

The estimated revenues resulting from the sale of spawned out carcasses and hatchery or other surpluses.

6. The Total Estimated Value of the Run.

Add item 4 and item 5.

C. Cost Factors.

There are a variety of categories of costs incurred by regional associations, not all of which are fully allocable nor attributable to a propagation project or facility. These cost categories, their allocability, and other characteristics are discussed as follows:

1. Regional Association Administration.

Regional Association Administration includes all expenses related to the selection of and expenses incurred by the directors of the regional association. Other allocable expenses (see 2 below) related to operating and maintaining the regional association belong in this category. Under the financing plan presented in Chapter II, none of the costs of Regional Association Administration would be charged to a propagation facility or project.

2. Administrative and Supportive Services.

Included in this cost category are the salaries and wages of the executive director, clerical and secretarial personnel and such expenses as newsletters, assessment bookkeeping activities, accounting, purchasing and payroll services, general planning (consulting) services, office

rent, office utilities and equipment. These costs are fully allocable to Regional Association Administration as well as to Technical Services, Full Production Hatchery Operations and other cost categories. The division in Administrative and Supportive Service Costs between Regional Association Administration and other cost categories should be based upon the proportion of payroll and other expenses attributable to the support of each activity.

3. Technical Services.

This cost category includes the salaries and wages of regional biologists and other technical personnel who perform regional planning activities, conduct stream surveys, conduct tagging and other research activities, plan and conduct egg takes and similar technical activities not involved with the day to day operation of hatcheries or other production enhancement activities. A portion of the Administrative and Supporting Service overhead costs should be allocated to this category in proportion to the services received or expenses incurred. The rental of aircraft, marine vessels and other similar expenses associated with egg takes, stream surveys and other related activities should be direct charges to the Technical Services category of expenses.

4. Full Production Hatchery Operations.

This category includes the direct salaries and wages of hatchery supervisory and operating personnel, fish

food, utilities and other expenses attendant to operating a hatchery or other propagation facility once full returns are being realized. Also included in this cost category are costs attendant to performing a terminal area harvest.

5. Hatchery & Enhancement Projects Start-Up Costs.

This cost category includes all hatchery or enhancement project costs similar to those listed for 4 above or 6 below which are incurred or must be paid during the period of time between initial start-up and when full returns are being realized. Recurring expenses related to a rehabilitation project, lake fertilization project or similar production improvement activity, occurring prior to the full returns being realized should be recorded as a direct start-up charge to each such project.

6. Capital Investment Program.

This cost category includes all capital investments for hatcheries and other propagation facilities as well as such one-time enhancement projects as stream rehabilitation. Costs included for each facility include land, buildings, utilities installation, architect's fees, interest and similar costs relating to the projects. One-time salaries and wages and other direct costs attributable to a stream rehabilitation or similar enhancement project should be recorded as a direct charge to each project.

7. Total Cost.

Includes all costs for cost categories 1-6.

8. Total Propagation Facility (Project) Cost.

Includes allocated administrative and supporting services overhead charges to categories 4 and 5 as well as direct charges to categories 4 and 5 plus the appropriate capital and interest charges from category 6.

D. Economic Analysis Factors.

Based upon the revenue resulting from a salmon propagation project and the project costs as previously defined, it is possible to identify the estimated net revenue (gross revenue less allocable costs), either on an annual basis or for the estimated total useful life of the facility. Net revenue divided by the total investment in the propagation facility (cost category 6) will provide an estimate of the percent return on investment resulting from the project.

E. Propagation Facility Run Breakdown Analysis Factors.

The final element of a Return on Investment Model for salmon aquaculture projects is an analysis of who harvests the runs from the facility. There are three main elements contained in the run breakdown analyses. These include: that part of the run required for spawning stocks; that part of the run harvested by fishermen; and, that part of the run harvested in the terminal area which is used to pay a portion of the facility operating costs.

In summary, the elements which need to be considered in a return on investment model for salmon aquaculture

projects are: Salmon Propagation Factors; Salmon Revenue Factors; Cost Factors; Economic Analysis Factors and Propagation Facility Run Breakdown Analysis Factors. Table II provides an example of how the return on investment model can be applied in evaluating a potential aquaculture propagation project.

TABLE II

Example Return on Investment Analysis

(25 Million Egg Facility)

Analysis of Annual Costs - 25 Year Facility Life

(Chum Salmon)

	Reference Section	Constant Dollars (1)	Current Dollars (2)
SALMON PROPAGATION FACTORS	(A)		
Eggs Propagated	(A-1)	25 Million	25 Million
Estimated Total Returns	(A-5)	500,000	500,000
Number Spawning Stock	(A-6)	14,218	14,218
Hatchery or other surplus	(A-8)	8,530	8,530
Estimated No. Harvestable Salmon	(A-9)	477,252	477,250
SALMON REVENUE FACTORS	(B)		
Regional Expressed price per pound	(B-2)	$0.75	$1.38
Estimated Average Weight per fish	(B-3)	6 lbs.	6 lbs.
Value of Harvestable Salmon	(B-4)	$2,147,634	$3,951,630
Value of Surplus and spawners	(B-5)	$ 38,385	$ 70,628
Total Estimated Value of run	(B-6)	$2,186,019	$4,022,258

TABLE II
(Continued)

	Reference Section	Constant Dollars[1]	Current Dollars[2]
ANNUAL COST FACTORS	(C)		
Technical Services[3]	(C-3)	$ 50,000	$ 92,000
Full production operations[4]	(C 4)	500,000	920,000
Hatchery start-up costs[5]	(C-5)	207,000	207,000
Capital Investment[6]	(C-6)	345,000	345,000
Total annual propagation Facility Cost	(C-8)	$1,102,000	$1,564,000
ANNUAL AVERAGE ECONOMIC ANALYSIS FACTORS	(D)		
Gross Income	(B-6)	$2,186,019	$4,022,258
Total Cost	(C-8)	1,102,000	1,564,000
Net Income		1,084,019	2,458,258
Return on Investment		27%	61%
ANNUAL AVERAGE RUN BREAKDOWN ANALYSIS FACTORS	(E)		
Spawners		14,218 (39%)	14,218 (3%)
Fishermen		240,893 (48%)	296,891 (59%)
Annual Costs		244,889 (49%)	188,891 (38%)
Total Run		500,000	500,000

TABLE II
(Continued)

(1) Item (B-2) based upon 1978 Southeast prices.

(2) Fish price and labor cost inflation estimated at 5% per year. Current dollars based upon average inflation over the 25 year life of the facility.

(3) Estimated annual professional fisheries biological services.

(4) Includes hatchery operations and an allowance to pay for the costs of harvesting that portion of the run for annual costs.

(5) Estimated at 6 years; cost capitalized and amortized over 19 years; 9 1/2% interest rate.

(6) Includes 25% run allowance of terminal area harvest; 2.5 million investment amortized over 25 years at 9 1/2% interest with interest and principal deferred for 6 years.

IV. Elements of a Cost Benefit Analysis Model for Salmon Aquaculture Projects.

Earlier in this Chapter in the general discussion about micro-economic evaluation techniques, it was pointed out that cost benefit models, like return on investment models can be designed to include some very complex refinements.

In a cost benefit analysis model, for example, such refinements as adding certain operating costs incurred by fishermen to the cost side of the equation as well as adding allowances for direct and indirect secondary employment effects beyond the fish processing activity to the benefit side of the equation, while technically correct, involve estimates which are so speculative that their inclusion would severely strain the credibility of the cost benefit analysis.

While cost benefit analysis models can be made overly complex, at the other end of the spectrum the current practices of using ex-vessel prices paid to fishermen and excluding interest costs on capital investments results in an equally inaccurate statement of costs and benefits.

It is also important to recognize that while some of the factors included in a return on investment model can be used in a cost benefit model, other return on investment factors do not apply. While both models can be used to measure the "value" of an aquaculture project, the term "value" has different meanings in each model.

Again, the value of an aquaculture project to a regional non-profit aquaculture corporation must be expressed in terms of ex-vessel prices paid to association fishermen for the salmon provided as a result of the project and harvested by association members if the corporation is to remain financially solvent. Prior interceptions by non-association fishermen and terminal area harvests to pay hatchery operating costs must be regarded as "losses" because they reduce the amount of revenue accruing to the fishermen.

A cost benefit analysis model, unlike the return on investment model, does not have a narrowly defined regional income criterion. Hence, the term value in a cost benefit analysis model is more encompassing. The value of a government sponsored aquaculture project should include for example, consideration of prior interceptions by other domestic commercial and sports fishermen. (The term domestic for a federal agency would include all American fishermen. Alaska state departments may wish to define domestic to include only Alaska's resident fishermen.)

The use of ex-vessel prices, while appropriate in a return on investment model for regional non-profit corporations, is not appropriate in a cost benefit analysis model. If the objective of a cost benefit analysis is to measure the domestic value of a salmon aquaculture project, the "value" must not only include money paid to fishermen but also the value added to the domestic economy as a result of

producing the run and processing the harvest. In other words, the salaries and wages paid to hatchery operating personnel, cannery workers and employees of firms who process fresh and frozen salmon are part of the value to the domestic economy from the aquaculture project which must be recognized in the cost benefit analysis model.

It might appear strange to include the salaries and wages of hatchery operating personnel in both the cost and benefit sides of an equation. Clearly such costs belong in computing the "cost" of an aquaculture project. It is equally clear that the employment of hatchery personnel is as valuable an addition to the domestic economy as the employment of fishermen or others, regardless of the fact that the form of compensation differs.

As can be demonstrated in the following simple example, it is not only important to include the salaries and wages of hatchery personnel as both a cost and a benefit, but further that these costs/benefits do not cancel out and therefore cannot be excluded from both sides of the equation.

Cost Benefit Analysis Example

Costs:

Hatchery operators salaries and wages:	$20,000
Other costs:	10,000
Total costs:	$30,000

Benefits:

Hatchery operators salaries and wages:	$20,000
Other benefits:	80,000
Total benefits:	$100,000

Cost Benefit Ratio: 3.33:1

If the $20,000 in hatchery operators salaries and wages is excluded from the perceived benefits to the domestic economy from the aquaculture project, and the benefits were valued at $80,000, the cost benefit ratio would be 2.67:1. Alternatively, if the hatchery operators salaries and wages were excluded from both sides of the equation leaving a cost of $10,000 and a benefit of $80,000, the resulting ratio would be 8:1 rather than the correct amount of 3.33:1.

In addition to identifying hatchery personnel salaries and wages as a benefit, or being of value to the domestic economy, the added one-time value of the stimulus to the domestic economy from the construction activity associated with an aquaculture project should be estimated and included as a part of the benefits to be desired from the project.

A most difficult issue in defining value in a cost benefit analysis has to do with predation. Some would argue that the salmon from an aquaculture project harvested by bears, eagles and other predators should be valued as a means of recognizing the social goal of preserving wildlife, which is often a stated goal of some government agencies.

While there is a certain amount of attractiveness to such a proposal, it presents several problems which are difficult to resolve.

First, the amount of predation is so uncertain and speculative that its explicit recognition would severely strain the credibility of the cost benefit analysis. Second, the value recommended for measurement in the cost benefit analysis model is the contribution made to the domestic economy by the aquaculture project. This definition would generally exclude consideration of imputting a value to predation except under unusual circumstances. It is conceivable that predators might be attracted to an artificially propagated run, thus providing a greater harvest opportunity on an adjacent natural run. To the extent that such a circumstance might occur, and further to the extent that the harvesters of the natural run benefit from the substitution, an argument could be developed for adding the number of additional natural salmon harvested to the predator reduced artificial run. Again, such technical refinements, though intellectually attractive, are so difficult to accurately quantify that the credibility and cost of the analysis would be highly questionable.

To conclude, perhaps the most difficult choice is establishing a readily available "price" per pound for salmon to be used in the cost benefit analysis model. As was discussed earlier, the ex-vessel price only partially

recognizes the contribution to the domestic economy from a salmon run. A substantially greater "price" per pound can be quoted for sport caught salmon while salmon used for domestic consumption are often not accorded a "price".

After weighing all of the possible "price" choices, the most representative price which should be used in the cost benefit model is the first level wholesale price for canned or frozen salmon, by species, by region in Alaska. Such an index is not now currently available for Alaskan salmon. However, such an economic valuation index could be regularly published by the Alaskan Department of Fish and Game (or the National Marine Fisheries Service) for use in economic planning by ADF&G and other state and federal agencies. By having a state agency prepare such an economic valuation index, the confidentiality of individual financial records can be maintained. Failure to develop such an index will force the state to assume value added for fish processed at ratios consistent with other industries. The most common estimate of this ratio is 2:1 over ex-vessel prices.

In summary, the factors contained in a cost benefit analysis model are somewhat different from those contained in the return on investment model. The reason for these differences largely results from the varying objectives each serve. The objective of the return on investment model is to provide a means for private non-profit corporations to make economic choices based upon their need to be economically

self-sufficient. The cost benefit analysis model on the other hand is directed at measuring the total domestic economic benefits to be derived from an aquaculture project.

A. Salmon Propagation Factors.

1. The Number of Eggs to be Propagated.

If green eggs are used for the initial planning basis, it will in turn (together with an estimate of the average number of eggs available per female spawner) provide a basis for estimating the number of salmon required for egg taking purposes.

2. Stage I Estimated Survival Rates by Species - (Green Egg to Emerge Stage).

(a) Natural production;

(b) Natural production rehabilitation (i.e., stream bed rehabilitation);

(c) Hatchery production;

(d) Incubation box;

(e) Other.

3. Stage II Estimated Survival Rates - by Species (Emergent Fry to Migrant Stage).

(a) Natural production;

(b) Natural production rehabilitation;

(c) Hatchery production

(1) Fed fry;

(2) Fingerling;

(3) Smolt.

(d) Hatchery production (out-station plants)

(1) Fed fry;

(2) Fingerling;

(3) Smolt.

(e) Incubation box;

(f) Lake fertilization (In combination with 2(a), (b), (c) or (d) above);

(g) Other.

4. Stage III Estimated Survival Rates - by Species (Marine Survival).

(a) Natural survival (no human intervention directed at increasing the survival rate of the particular run);

(b) Enhanced survival (human intervention i.e., predator controls applied).

5. Estimated Total Returns - by Species.

Estimate of the number of adult salmon which will return to the area of harvest as a result of propagation methods and any enhanced survival techniques employed.

6. Estimated Prior Interceptions by Domestic Fishermen by Species.

Include estimates of prior interceptions by domestic sports and commercial and domestic consumption fishermen.

7. Estimated Total Run Adult Run Strength - by Species.

Add together items 5 and 6.

8. Number of Spawning Stock Required for Run Maintenance - by Species.

Estimate the number of male and female spawners required to maintain the initial run size.

9. Hatchery or Other Surplus - by Species.

Often there are surplus male salmon not needed for spawning purposes, therefore, an estimate of the amount of the return which cannot be harvested nor is required for spawning purposes needs to be made if the surplus can be sold or used in domestic consumption. (Any value of spawned out salmon carcasses can also be included.)

10. Net Total Adult Run Strength - by Species.

Item 7 less item 8 plus 9.

B. Salmon Revenue Factors.

The salmon revenue price considerations for use in the cost benefit analysis model are similar to those for the return on investment model except that wholesale rather than ex-vessel prices are used.

The discussion on the use of the current dollar basis and constant dollar basis for evaluating projects using the return on investment model apply equally as well to the cost benefit analysis model.

The salmon revenue factors to be taken into consideration in the cost benefit analysis model are as follows:

1. Net Total Adult Run Strength.

As derived earlier.

2. The Value or Price Per Pound of the Salmon.

The regional wholesale price expressed in constant dollars or current dollars over the life of the project. If a portion of the run is to be destined for the frozen market, the wholesale price for frozen salmon should be used. If the market is largely for canning purposes, the canned wholesale price should be used.

3. The Estimated Weight Per Fish.

4. The Value of the Net Total Adult Salmon Run.

Item 1 multiplied by item 2 multiplied by item 3.

5. The Value of Surplus and Spawners.

Add in any value in terms of domestic consumption or revenue from this source.

6. The Total Estimated Value of the Run.

Add items 4 and 5.

C. Other Benefit Factors.

As discussed earlier, the salaries and wages associated with creating a salmon run are as economically beneficial as the salaries paid to fishermen and processing personnel. The net economic benefit of the one-time stimulus to the domestic economy from the construction of an aquaculture project is another benefit which should be included in Other Benefit Factors. (An estimate of the hatchery personnel salaries and wages and other similar benefits should be made and included in Table III, Other Benefit Factors).

D. Cost Factors.

There are several categories of costs to be included

in a cost benefit analysis. These are as follows:

1. Project Planning and Surveys.

Included in this category are all the costs associated with performing stream surveys, site research and selection, preliminary design and other work preceding construction.

2. Construction.

This category includes all of the costs to construct the facility, perform the stream rehabilitation or similar work.

3. Imputed or Actual Interest Expense.

If interest expense is being paid through a bond issue, for example, the bond interest rate should be applied to the amount of capital funds used for the project. If the project is being funded through a cash appropriation, a cost of capital rate should be included for the project. A typical state rate might be the going rate on state general obligation bonds. A typical federal rate might be the going rate on long term treasury notes.

4. Facility Operations.

This would include all salaries and wages, utilities, fish food and other expenses associated with operating the facility from inception of the operation through full production.

Table III, as follows, is an example of how a cost benefit analysis can be applied to an aquaculture project.

TABLE III

An Example Cost Benefit Analysis

(25 Million Egg Facility)

Analysis of Annual Costs - 25 Year Facility Life
(Chum Salmon)

Factors	Reference Section	Constant Dollars	Current Dollars(7)
SALMON PROPAGATION FACTORS	(A)		
Estimated Adult Run Strength	(A-7)	500,000	500,000
Number Spawning Stock	(A-8)	14,218	14,218
Hatchery or Other Surplus	(A-9)	8,530	8,530
Net Total Adult Run Strength	(A-10)	485,782	485,782
SALMON REVENUE FACTORS			
Regional Wholesale(1) Price Per Pound	(B-2)	$1.35	$2.48
Estimated Average, Weight Per Fish	(B-3)	6 lbs	6 lbs
Value of the Net Total Adult Salmon Run	(B-4)	$3,865,741	$7,101,510
Value of Surplus and Spawners	(B-5)	$ 69,093	$ 126,926
Total Estimated Value of the Rum	(B-6)	$3,934,834	$7,228,436
OTHER BENEFIT FACTORS(2)	(C)	$ 120,000	$ 220,800
TOTAL ESTIMATED BENEFITS		$4,054,834	$7,449,236

TABLE III
(Continued)

Factors	Reference Section	Constant Dollars	Current Dollars(7)
ANNUAL COST FACTORS			
Project Planning and Surveys(3)	(D-1)	$ 10,000	$ 10,000
Construction Costs(4)	(D-2)	$100,000	$100,000
Imputed/Actual Interest Expense(5)	(D-3)	$162,200	$162,200
Facility Operations(6)	(D-4)	$457,000	$667,000
Total Annual Propagation Facility Costs		$729,200	$939,200
Cost to Benefit Ratio		1:5.56	1:7.93

(1) Estimate wholesale price for frozen chum.

(2) Estimated annual salaries and wages paid to hatchery operating personnel.

(3) Estimated at 10% of construction costs.

(4) Estimated $2.5 million construction costs annualized over 25 years.

(5) Interest expense on construction costs at a rate of 9 1/2% annualized over 25 years.

(6) Hatchery operations only, excludes terminal area harvest costs; includes cost for six years start-up amortized over 19 years of production at 9 1/2% interest.

(7) Fish price and labor cost inflation estimated at 5% per year.

MACRO ECONOMIC EVALUATION TECHNIQUES

The return on investment and cost benefit analysis models are micro-economic evaluation techniques that are applicable to measuring the economic value of individual salmon aquaculture projects. While these models are useful in making economic choices on a project by project basis, equal attention should be given to the economic value of all such projects, collectively, as well as the overall economic value of the salmon fishery. There are several reasons why it is important to develop an economic understanding of the salmon industry as a whole. First, the salmon fishing and processing industry employs more people than any other element of the private sector, with the total value of the salmon harvest in 1978 exceeding 230 million dollars at ex-vessel prices.

Secondly, Alaska is currently overly dependent upon revenues from non-renewable resources, and the full development of the salmon fishery could aid in redressing the current disparity in tax revenues from renewable and non-renewable resource sources.

There are other perhaps more critical reasons to assess the economic benefits of the fishery from an overall state perspective. Alaska has a life-style which is in part characterized by the independence desired by its citizens. The capability to maintain this life-style is for many

people dependent upon earning all or part of their income as fishermen or working in seasonal fish processing jobs. Salmon fishing and/or processing provides the major source of income to communities like Ketchikan, Petersburg, Dillingham, Cordova and others. Without a strong, healthy fishery, many of these communities would suffer because their citizens would not have an alternative way of earning an income. Manufacturing and agriculture, which are the mainstays of many similar communities in the lower 48 states, are simply not an option open to citizens in these Alaskan communities.

Finally, if the state is to maintain its current prosperity, it must move out of the current raw material resource exploitation state of economic development to one which is more favorable to the state and its citizens in terms of the income to be realized from increasing the direct and secondary benefits derived from processing, marketing and consumption of salmon.

For these and other reasons, it is critically important that the state have the economic tools necessary to plan and administer its economic future. Currently, however, few economic planning tools are available and the capability to perform macro-economic analyses in Alaska is severely limited. The information and tools needed to perform the proposed macro-economic analysis are rather straight forward. These include:

1. State Tax Revenue Collection Reports Coded by the Standard Industrial Code and Geographic Region.

One of the best ways of measuring changes in economic conditions is through the state tax collection system. The change in the number of corporate and individual tax payers as well as changes in their earning status is critically important information for economic planning.

2. Development of a State Input/Output Economic Model.

An input/output model is a planning tool which can be used to identify the economic or employment multiplier effect of the various segments of industry. It can also be useful in examining the relative balance between imports and exports by industry segment.

3. Employment/Unemployment Reports by Standard Industrial Code.

In order to perform economic analysis it is important to know employment by type of industry within a region. Employment and unemployment characteristics should also include information on the age, sex and household dependency status.

With the development of at least these three economic planning tools, it would be possible to perform the following types of macro-economic analyses.

1. Assume that the State of Alaska is willing to invest some of its non-renewable resource tax revenue into producing future recurring income streams both as a means

for financing state and local government as well as providing a healthy economic climate for its citizens. Assume further that the interest rate on investment opportunities in the major capital money markets outside of Alaska or government securities is nine percent (9%). An investment in an in-state economic development project which yields an interest rate of only seven percent (7%) could be more financially attractive to the state than an out of state investment because of the additional revenue generated from the added in-state employment, personal and corporate taxes.

2. The State of Washington in 1972 received voter approval to invest 415 million dollars of state funds in a statewide capital investment program. Federal and local matching funds were expected to bring the total investment to approximately 1.5 billion dollars. According to the economic planners (Washington State Budget, 1972 Volume II, page 63) "... the construction impact alone will generate 240,000 full-time equivalent years of employment ... and help meet the projected employment needs of 23,000 net new labor force entrants each year." The budget document goes on to report that, "the Washington futures program will not require new taxes ... the expenditures on construction projects ... together with the turnover of those expenditures through suppliers and payrolls will provide additional state sales, and business and occupation tax revenue. Second, the new industries which can be established as a result of these

Washington future projects will also provide new state revenue." The Washington Futures Program represents the type of economic planning capability which the State of Alaska needs if it is to make informed economic choices on investment opportunities.

In summary, the consulting team makes the following findings and recommendations regarding the development of macro-economic evaluation tools for the State.

1. A key ingredient in evaluating the economic value of the salmon fishery to the State of Alaska is the ability to reasonably and accurately estimate the total tax revenue which annually accrues to the State from this industry.

2. Currently, the only information available on State tax receipts from the fishery concerns the raw fish tax. Personal and corporate income tax information for residents and non-residents is not available in a readily usable form.

3. Input/output analyses which identify the direct and secondary multiplier effect of employment and income from in the fishing industry, need to be conducted.

4. Based upon the current lack of reasonably accurate macro-economic information, the State of Alaska is not in a position to evaluate its investment opportunity in the fisheries. Moreover, the current lack of this information effectively precludes the State from explicitly formulating an economically sound fisheries development policy.

5. The State Departments of Revenue, Commerce and Economic Development and Labor should be authorized to develop the necessary macro-economic analysis information and tools so that the state can appropriately assess the economic value of its salmon fishery and formulate an economically sound fisheries development policy.

Chapter II - SOURCES AND METHODS FOR FINANCING SALMON AQUACULTURE PROGRAMS

Mandatory Assessments

Prior to discussing some of the other considerations involved with developing a stable financial basis for salmon aquaculture, the most critical financial issue currently pressing on the regional aquaculture associations is the recent Superior Court ruling in Wayne Alex etal., v. Southern Southeast Aquaculture Association etal. in which the court held that Alaska Statute 16.10.530, which establishes the funding mechanism for private aquaculture, is unconstitutional.

In a letter to Governor Hammond, as a result of the court ruling, the State Attorney General identified five "potential legislative alternatives to the now-unconstitutional statutory scheme for your consideration." These are as follows:

1. Regional aquaculture association programs could be funded through direct appropriation. We believe there would be no legal difficulties with this approach.

2. A statewide tax on the sale of salmon could be imposed, with proceeds of the tax deposited in the state's general fund and regional aquaculture association programs funded through annual appropriations in amounts based on the amounts collected in each region. While such a scheme conceivably could be challenged on the basis that it

violates the constitutional prohibition on the dedication of state tax revenues, we believe such a statute could be drawn artfully enough to pass constitutional scrutiny.

3. Regional taxes could be imposed on the sale of salmon to become effective only upon a majority vote of commercial fishermen in each region, proceeds of the tax would be deposited in the State's general fund and the regional association's programs would be funded through annual appropriations in amounts based on the amounts collected in the region. In addition to the dedicated fund problem, such a scheme could be challenged on the ground that it violates equal protection (treating commercial fishermen differently depending upon the region in which they are fishing) and on the ground that it constitutes an unconstitutional delegation of the power to levy a tax. While there are good arguments that such a program does not violate equal protection and does not constitute an unconstitutional delegation of the power to tax, we cannot predict with certainty how the issue would be resolved by the Alaska courts.

4. The program could be restructured to take advantage of the constitutional authorization of "service areas" -- in effect, utility districts. This approach would require agreements between the state and municipalities in each region, but would avoid the dedicated fund problem and (probably) the delegation problem as well.

5. The Fisheries Rehabilitation and Enhancement Division (F.R.E.D.) in the Department of Fish and Game could be restructured and directed to be more responsive to the concerns of the user groups in the various