Supplementation in the Columbia Basin

Part I: Rasp Summary Report Series

U.S. Department of Energy
Bonneville Power Administration
Division of Fish & Wildlife

16.4.1

SUPPLEMENTATION IN THE COLUMBIA BASIN

Part I

Rasp Summary Report Series

Background, Description, Performance Measures, Uncertainty, and Theory

Prepared For

Thomas S. Vogel and Thomas J. Clune, Project Managers
U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland, OR 97208-3621

Project Number 85-62
Contract Number DE-AC06-75RL01830

May 1992

RASP CONTRIBUTORS

Scientists with expertise and interest in supplementation have contributed to this report, among them are: Tom Backman, Ed Bowles, Craig Busack, Rich Carmichael, Duane Fickeisen, Larry Lestelle, Jim Lichatowich, Rich Lincoln, Lars Mobrand, Willa Nehlsen, Rich Turner, Tom Vogel, Harry Wagner, and Bruce Watson. Numerous constructive and insightful comments to previous drafts were also received from the Scientific Review Group.

TABLE OF CONTENTS

SUPPLEMENTATION IN THE COLUMBIA BASIN: PART I.

BACKGROUND, DESCRIPTION, PERFORMANCE MEASURES, UNCERTAINTY AND THEORY

INTRODUCTION

This progress report broadly defines the scope of supplementation plans and activities in the Columbia Basin. It provides the foundation for more detailed analysis of supplementation in subsequent reports in this series. Topics included in this report are: definition of supplementation, project diversity, objectives and performance standards, uncertainties and theory. Since this is a progress report, the content is subject to modification with new information. The supplementation theory will continue to evolve throughout the duration of RASP and beyond. The other topics in this report are essentially complete and are not expected to change significantly.

This is the first of a series of four reports which will summarize information contained in the larger, RASP progress and completion reports. Our goal is to make the findings of RASP more accessible by grouping related topics into smaller but complete narratives on important aspects of supplementation. We are planning to publish the following reports under the general title Supplementation in the Columbia River Basin: Part 1, Background, Description, Performance Measures, Uncertainty and Theory; Part 2, Theoretical Framework and Models; Part 3, Planning Guidelines; and Part 4, Regional Coordination of Research and Monitoring.

Supplementation is expected to be a major contributor to the planned increase in salmon and steelhead production in the Columbia Basin. The Fish and Wildlife Program of the Northwest Power Planning Council (NPPC) uses three approaches to protect and enhance salmon and steelhead in the Columbia Basin: 1) enhance fish production; 2) improve passage in the mainstem rivers; and 3) revise harvest management to support the rebuilding of fish runs (NPPC 1987). The fish production segment calls for a three-part approach focused on natural production, hatchery production, and supplementation. Supplementation is planned to provide over half of the total production increases. (Table 1).

Table 1. **Percent of production increases attributable to supplementation[1] in System Planning. Computed from System Planning Model output (data supplied by Duane Anderson, NPPC).**

Species/Stock	Columbia River Region				
	Lower	Mid	Snake	Upper	All
Late Coho	97.7%	-	-	-	97.7%
Early Coho	100.0%	100.0%	-	-	100.0%
Fall Chinook	0.0%	37.4%	51.2%	0.0%	8.6%
Spring Chinook	88.4%	64.0%	74.3%	34.7%	65.4%
Summer Chinook	-	6.3%	66.9%	38.4%	43.5%
Summer Steelhead A	100.0%	25.6%	95.5%	73.9%	71.8%
Summer Steelhead B	-	-	72.0%	-	72.0%
Winter Steelhead	48.0%	100.0%	-	-	60.2%
All	45.4%	47.5%	78.2%	34.5%	52.4%

[1]Supplementation projects in System Planning do not necessarily meet the RASP definition.

The Regional Assessment of Supplementation Project (RASP) was initiated as a result of a request by NPPC to address long-standing concerns about the need to coordinate supplementation research, monitoring and evaluation. Such coordination was also recommended by the Supplementation Technical Work Group.

In August 1990, the NPPC gave conditional approval to proceed with the final design of the Yakima Production Project. The Council called on the Bonneville Power Administration (BPA) to "fund immediately a supplementation assessment to reevaluate, prioritize and coordinate all existing and planned supplementation monitoring and evaluation activities in the basin... Provid[ing] for the participation of the fishery agencies and tribes and others having expertise in this area.

RASP addresses four principal objectives:

- provide an overview of ongoing and planned supplementation activities and identify critical uncertainties associated with supplementation,
- construct a conceptual framework and model which estimates the potential benefits and risks of supplementation and prioritizes uncertainties,
- provide guidelines for the development of supplementation projects,
- develop a plan for regional coordination of research and monitoring.

These objectives, once attained, will provide the technical tools fishery managers need to carry out the Council's direction to protect and enhance salmon and steelhead.

RASP has further divided the four broad objectives into 12 technical topics:

- definition of supplementation
- description of the diversity of supplementation projects
- objectives and performance standards
- identification of uncertainties
- supplementation theory
- development of a conceptual model of supplemented populations
- development of spreadsheet model of risks and benefits of supplementation

- classification of stocks, streams, and supplementation strategies
- regional design of supplementation evaluation and monitoring
- guidelines for planning supplementation projects
- application of the spreadsheet model to supplementation planning
- experimental design and decision making with uncertainty

Progress in each topic area is presented in regular progress reports which are available from the Bonneville Power Administration.

Historical Perspective

Recent supplementation initiatives in the Columbia River Basin are embedded in a larger historical context and a changing management paradigm. Policies that will guide the Council's program to rebuild salmon and steelhead populations in the Columbia Basin reflect evolving management standards. Those policies express concern over the conservation of genetic resources, the need to integrate natural and artificial propagation in the basin, a recognition of the need to address mainstem survival and harvest management, and the need to approach restoration with an integrated, system wide program within the framework of an adaptive management policy (NPPC 1987). Emphasis on conservation of genetic resources is consistent with the results of a Council-sponsored workshop which concluded that salmon production goals for the basin can only be achieved and sustained if the genetic resources of the basin's remaining salmon stocks are maintained (Riggs 1990). Developing and implementing production initiatives consistent with the Council's policies, in particular genetic conservation, clearly calls for new thinking, new approaches and new performance measures in the basin's salmon and steelhead restoration programs.

Salmonids have been artificially propagated in the Columbia Basin for over 100 years. Throughout that period hatcheries were the major tool of managers who used them to supply the fishing industry with commodity and replace production lost through habitat destruction. The early research focused on hatchery practices and the production of a healthy smolt in the hatchery. The interaction between hatchery programs and wild stock conservation was not given careful consideration.

The recent emphasis on supplementation to revitalize natural production in the basin (Table 1), the precarious status of several stocks of salmon and steelhead (Nehlsen et al. 1991), and the commitment to double total production in the basin (NPPC 1987), has reaffirmed the importance of hatcheries in the Columbia's salmon production system. Hatcheries will remain important in their traditional roles and supplementation will give them new roles. Hatchery

programs, especially supplementation, will be evaluated by new performance standards which will include ecological as well as genetic criteria. For examples of these changes, see the supplementation section of the Integrated System Plan (CBFWA 1991); Oregon's Natural Production and Wild Fish Management Rules (Oregon Administrative Rules 635-07-501 through 529 and 635-07-800 through 815) and Idaho's Anadromous Fishery Management Plan (Idaho Department of fish and Game 1991).

The hatchery program is facing its greatest challenge since the 1940's when it became generally accepted procedure to rear salmon to full term smolts to achieve the highest survival. The transition from making fry or sac fry releases to rearing full term smolts required better understanding of nutritional requirements of salmon and disease control, prevention, and treatment. In addition, many of the early hatcheries were designed for fry release and did not have the year-round water supplies needed for smolt production (Oregon Fish Commission 1955).

The manager's new challenge is to learn how to integrate the artificial and natural salmon production systems in the Columbia Basin to produce sustainable increases in total production. This will call for new ideas in the physical design and operation of hatcheries as well as a better technical understanding of genetics, behavior, competition, and predation – fields that were not strongly emphasized in the domain of artificial propagation until recently.

These fundamental changes in management strategies are not easy to accommodate. Managers are faced with major new challenges while at the same time the conventional wisdom they relied on is challenged and weakened.

Review of Recent Work

The emphasis on supplementation as a tool to restore natural production and concern about the erosion of genetic resources has produced a rapidly growing literature. RASP has summarized selected publications using a format that makes the information relevant to supplementation readily available to the manager. The summaries give each paper's contribution to eight areas of importance to supplementation: definition of supplementation, description of project diversity, planning recommendations, performance standards, genetic uncertainties, physiological and behavioral uncertainties, research and monitoring, and recommendations (see Appendix A).

DEFINITION OF SUPPLEMENTATION

The Scientific Review Group (SRG)[2] recognized the need for a clear definition and agreement on what is meant by supplementation (SRG 1990). Current definitions of supplementation vary and are not sufficiently specific to be helpful to the development of performance standards and the design of evaluation studies. RASP agreed with the findings of the SRG and recognized the need for a clear working definition of supplementation.

RASP developed the following definition of supplementation:

> ***"Supplementation is the use of artificial propagation in the attempt to maintain or increase natural production*** **while maintaining the long term fitness of the target population, and keeping the ecological and genetic impacts on non-target populations within specified biological limits."**

Recent publications have used other definitions, which are presented for comparison:

- "The release of fish from hatcheries at locations away from the hatchery to increase natural production in streams determined to be seeded or used at less than 'optimal levels'." (Smith et al. 1985)

- "Planting all life stages of hatchery fish to enhance wild/natural stocks of anadromous salmonids." (Miller et al. 1990)

- "Supplementation is usually undertaken to provide harvestable surpluses of fish from stocks that may not otherwise naturally produce sufficient fish to meet the demand from fishermen. Management opportunities range from rebuilding threatened or endangered wild stocks to bolstering already self sufficient natural runs. Hatchery fish used to supplement wild stocks of salmonids are stocked at egg, fry fingerling, smolt and adult life stages." (Steward and Bjornn 1990)

In its definition, RASP limited the scope of supplementation to those activities carried out with the explicit intention of maintaining or increasing natural production by means of artificial propagation. Excluded from the RASP definition is the unplanned addition of hatchery-reared fish to natural populations.

---

[2] The Scientific Review Group is a panel of senior-level scientists that provides scientific and technical advice and recommendations to BPA and the Policy Review Group on implementation of the Fish and Wildlife Program.

Supplementation Is...

Supplementation refers to strategies for increasing natural production by taking fish into a protected artificial environment for a portion of their life cycle and then releasing them, or their progeny, into streams where they are later expected to reproduce naturally.

Supplementation encompasses a wide range of management characterized by four general objectives (SRG 1990):

- Restoration: the restoration of a native species to habitats where it has been extirpated.
- Introduction: planting a species into habitat where it was not native.
- Rearing Augmentation: planting fish in habitat that is under utilized.
- Harvest Augmentation: planting fish for the purpose of increasing harvest.

Within the context of those broad objectives supplementation attempts to provide a net survival benefit to the target stock. To provide that benefit, supplementation must circumvent part of the early natural mortality while preserving the natural processes that maintain long term performance of the stock and sustainability of natural production.

What distinguishes supplementation from other management activities is the assumption that artificial propagation can be used to improve the production of naturally-spawning populations without adverse genetic or ecological effects. At a minimum, supplementation programs are designed to conserve the genetic identity and variability of the target population and to hold the competitive and predatory impacts on other populations within prescribed limits. Supplementation may employ one or more of many different strategies and life stages.

Supplementation Is Not...

Supplementation and conventional hatchery programs differ in the goals they set for the use of returning adults. The typical goal of the conventional hatchery is to maximize adult production for harvest while assuring the collection of adequate broodstock. In the past, there has been no acceptable limitation of the impacts of hatchery programs on natural production.

Supplementation is differentiated from other artificial attempts to increase natural production by the required elements of artificial spawning or rearing. We have defined "artificial" as "the substitution of human activity occurring in a man-made environment for voluntary behavior by fish in a natural stream."

DESCRIPTION OF SUPPLEMENTATION PROJECTS

A number of ongoing and planned supplementation projects in Washington, Idaho and Oregon which are called supplementation are summarized in Table 2. All the stocks/streams listed in Table 2 will be supplemented, however, in many of the supplementation projects, the associated evaluation includes unsupplemented control streams. Those streams are not included in the table, but they are included in the supplementation data base compiled by RASP.

A number of ongoing outplanting programs were excluded from Table 2 because they are intended *primarily* to augment harvest, not natural production. Some harvest augmentation programs will be replaced with "true" supplementation projects; in those instances, only the planned project was included.

Supplementation Data Base

A computer program ("SUPQUEST") was developed to gather data on stocks, streams and strategies for existing and planned supplementation projects. Copies of the program were distributed to project leaders for data collection. A disk containing the actual computerized questionnaire and the data base generated from it can be obtained from the Bonneville Power Administration. In addition to the questionnaire, data collected in the System Planning Process was incorporated into the supplementation data base.

Information collected to date shows that the purpose of most of the projects is to supplement spring, fall and summer chinook and summer steelhead (Figure 1). To provide a broad picture of supplementation in the basin, we have arranged the information from the questionnaire into three major categories: description of stocks to be supplemented, description of the stream and the supplementation strategies to be employed. Figures 2 - 7 display part of the information from the data base.

Table 2. Ongoing and planned supplementation projects

	River	Species/Race	Project	Status	In RASP Database
1	Alturas Lk. Cr. Salmon R., ID	Spring Chinook	ISS-First Generation	Planned	Yes
2	Alturas Lk. Cr. Salmon R., ID	Spring Chinook	ISS-Second Generation	Planned	Yes
3	East Fork Salmon R., ID	Spring Chinook	ISS-First Generation	Planned	Yes
4	East Fork Salmon R., ID	Spring Chinook	ISS-Second Generation	Planned	Yes
5	Upper South Fork Salmon R., ID	Spring Chinook	ISS-First Generation	Planned	Yes
6	Upper South Fork Salmon R., ID	Spring Chinook	ISS-Second Generation	Planned	Yes
7	W.Fork Yankee Fork Salmon R., ID	Spring Chinook	ISS-First Generation	Planned	Yes
8	W.Fork Yankee Fork Salmon R., ID	Spring Chinook	ISS-Second Generation	Planned	Yes
9	Pahsimeroi R. Salmon R., ID	Summer Chinook	ISS-First Generation	Planned	Yes
10	Pahsimeroi R. Salmon R., ID	Summer Chinook	ISS-Second Generation	Planned	Yes
11	Clear Cr. MF Clearwater,ID	Spring Chinook	ISS	Planned	Yes
12	Red R. SF Clearwater, ID	Spring Chinook	ISS-First Generation	Planned	Yes
13	Red R. SF Clearwater, ID	Spring Chinook	ISS-Second Generation	Planned	Yes
14	American R. SF Clearwater, ID	Spring Chinook	ISS	Planned	Yes
15	Crooked R. SF Clearwater, ID	Spring Chinook	ISS	Planned	Yes
16	Papoose Cr. Lochsa R., ID	Spring Chinook	ISS	Planned	Yes
17	Pete King Cr. Lochsa R., ID	Spring Chinook	ISS	Planned	Yes
18	Squaw Cr. Lochsa R., ID	Spring Chinook	ISS	Planned	Yes
19	White Sand Cr. Lochsa R., ID	Spring Chinook	ISS	Planned	Yes
20	Big Flat Cr. Lochsa R., ID	Spring Chinook	ISS	Planned	Yes
21	Crooked Fork Lochsa R., ID	Spring Chinook	ISS	Planned	Yes
22	Lemhi R. Salmon R., ID	Spring Chinook	ISS-Smolt Program	Planned	Yes
23	Lemhi R. Salmon R., ID	Spring Chinook	ISS-Parr Program	Planned	Yes
24	Lemhi R. Salmon R., ID	Spring Chinook	ISS-Smolt/Parr Program	Planned	Yes
25	Slate Cr. Clearwater R., ID	Spring Chinook	Nez Perce Tribal Program	Planned	incomplete
26	Eldorado Cr. Clearwater R., ID	Spring Chinook	Nez Perce Tribal Program	Planned	incomplete
27	Lolo Cr. Clearwater R., ID	Spring Chinook	Nez Perce Tribal Program	Planned	incomplete
28	Yoosa Cr. Clearwater R.,ID	Spring Chinook	Nez Perce Tribal Program	Planned	incomplete
29	Newsome Cr. Clearwater R., ID	Spring Chinook	Nez Perce Tribal Program	Planned	incomplete
30	Meadow Cr. Clearwater R., ID	Spring Chinook	Nez Perce Tribal Program	Planned	incomplete
31	Mill Cr. Clearwater R., ID	Spring Chinook	Nez Perce Tribal Program	Planned	incomplete
32	Clearwater R., ID	Fall Chinook	Nez Perce Tribal Program	Planned	incomplete
33	Imnaha R., OR	Spring Chinook	ODFW	Ongoing	Yes
34	Hood R., OR	Winter Steelhead	ODFW	Planned	Yes
35	Hood R., OR	Spring Chinook	ODFW	Ongoing	Yes
36	Hood R., OR	Summer Steelhead A-run	ODFW	Ongoing	Yes
37	Umatilla R., OR	Summer Steelhead A-run	ODFW/Umatilla Tribe	Ongoing	Yes
38	Umatilla R., OR	Spring Chinook	ODFW/Umatilla Tribe	Ongoing	Yes
39	Umatilla R., OR	Fall Chinook	ODFW/Umatilla Tribe	Ongoing	Yes
40	Catherine Cr. Gr.Ronde R., OR	Spring Chinook	ODFW	Planned	Yes
41	Lookinglass Cr. Gr.Ronde R., OR	Spring Chinook	ODFW	Planned	Yes
42	Lostine R. Gr.Ronde R., OR	Spring Chinook	ODFW	Planned	Yes
43	Little Sheep Cr. Imnaha R., OR	Summer Steelhead A-run	ODFW	Ongoing	Yes
44	Upper Yakima R., WA	Spring Chinook	Yakima Project (YKFP)	Planned	Yes
45	Naches R. Yakima R., WA	Spring Chinook	YKFP	Planned	Yes
46	Upper Yakima R., WA	Summer Steelhead A-run	YKFP	Planned	Yes
47	Naches/lower Yakima Yak.R., WA	Summer Steelhead A-run	YKFP	Planned	Yes
48	Lower Yakima R., WA	Fall Chinook	YKFP	Planned	Yes
49	Klickitat R., WA	Spring Chinook	YKFP	Planned	Yes
50	Klickitat R., WA	Summer Steelhead A-run	YKFP	Planned	Yes
51	Tucannon R., WA	Spring Chinook	WDF	Planned	incomplete
52	Asotin Cr. Snake R., WA	Spring Chinook	WDF	Planned	incomplete
53	Snake R., WA	Fall Chinook	WDF	Planned	incomplete
54	Chiwawa R. Wenatchee R., WA	Spring Chinook	Rock Island Recertification	Ongoing	incomplete
55	Wenatchee R., WA	Summer Chinook	Rock Island Recertification	Ongoing	incomplete
56	Wenatchee R., WA	Sockeye	Rock Island Recertification	Ongoing	incomplete
57	Wenatchee R., WA	Summer Steelhead A-run	Rock Island Recertification	Ongoing	incomplete
58	Methow R., WA	Summer Chinook	Rock Island Recertification	Ongoing	incomplete
59	Similkameen R., WA	Summer Chinook	Rock Island Recertification	Ongoing	incomplete
60	Methow R., WA	Spring Chinook	Douglas Co. PUD	Planned	incomplete
61	Chewuk R. Wenatchee R., WA	Spring Chinook	Douglas Co., PUD	Planned	incomplete
62	Twisp R. Methow R., WA	Spring Chinook	Douglas Co., PUD	Planned	incomplete
63	Okanogan R., WA	Sockeye	Doulas Co., PUD	Planned	incomplete

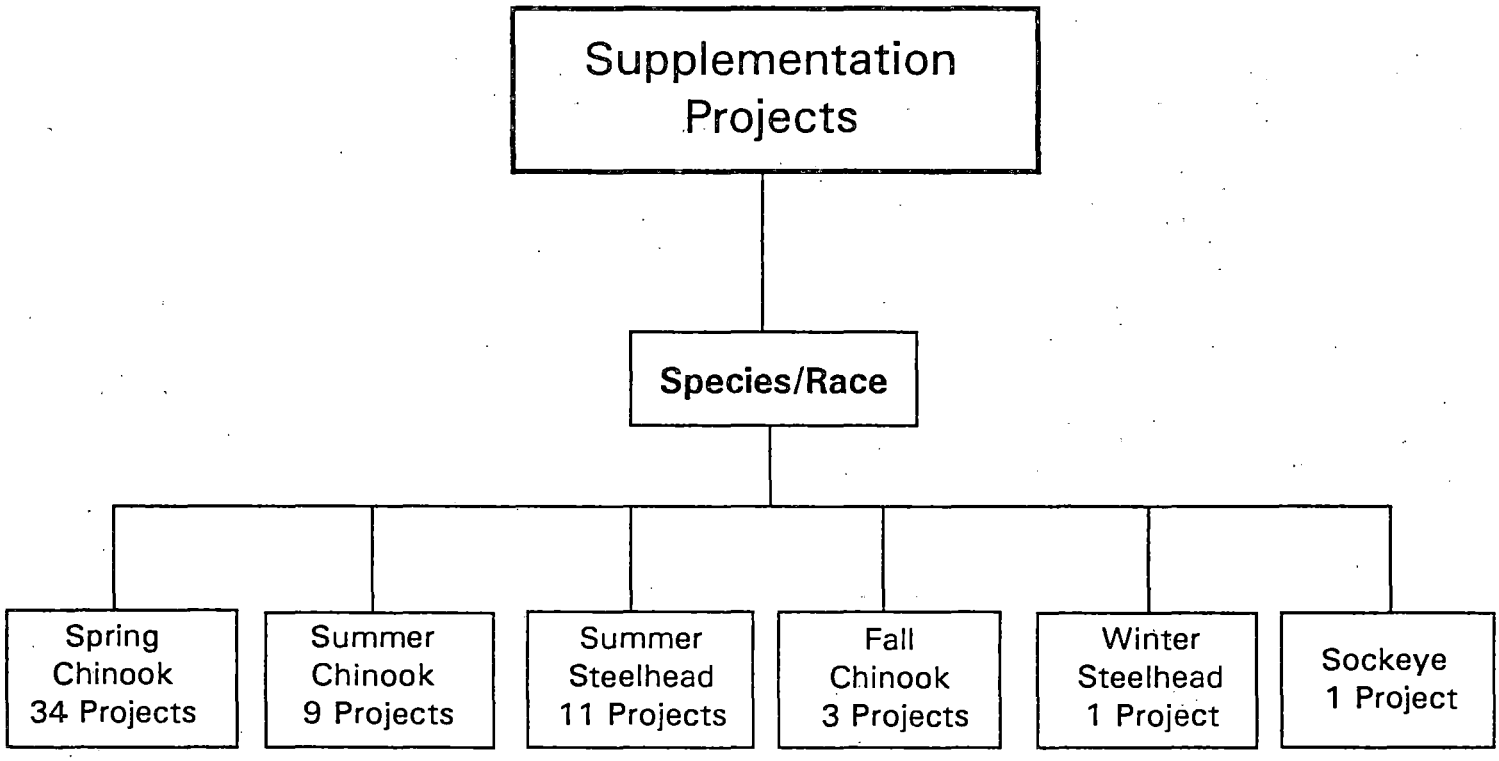


Figure 1. Distribution of supplementation projects among the species and races of salmon and steelhead.

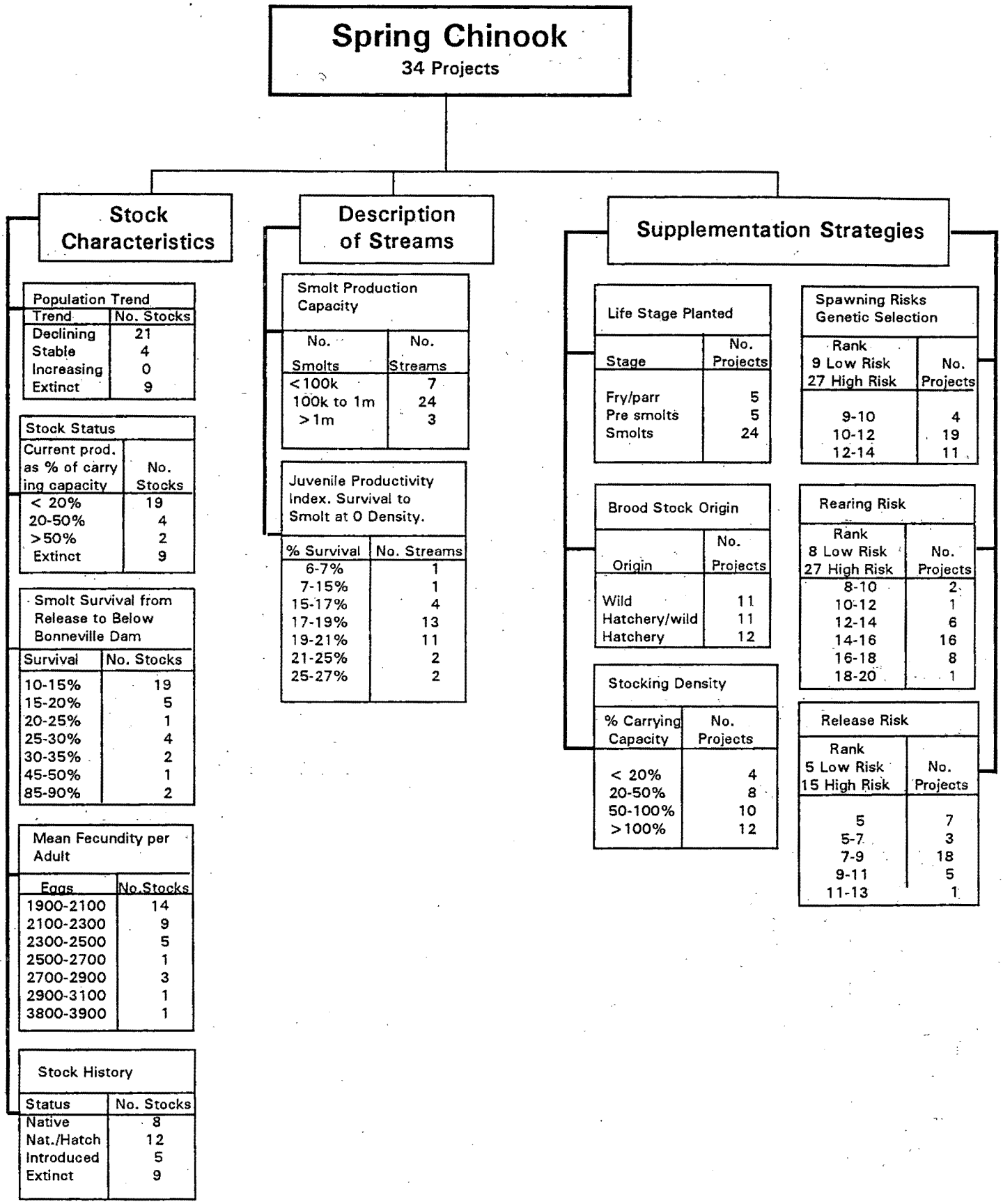


Figure 2. Stock and stream characteristics and strategies for 34 planned and ongoing spring chinoook supplementation projects.

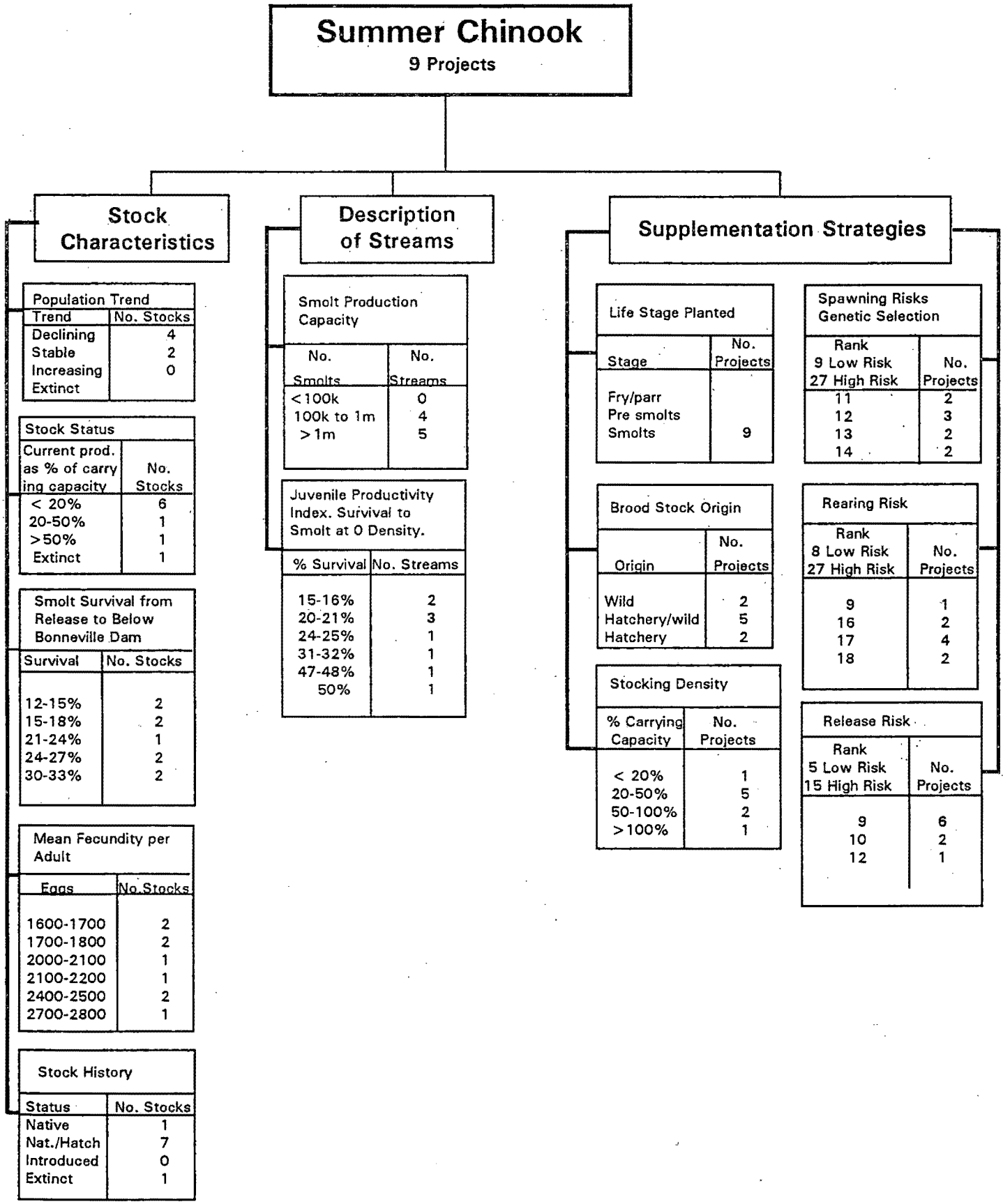


Figure 3. Stock and stream characteristics and strategies for 9 planned and ongoing summer chinook supplementation projects.

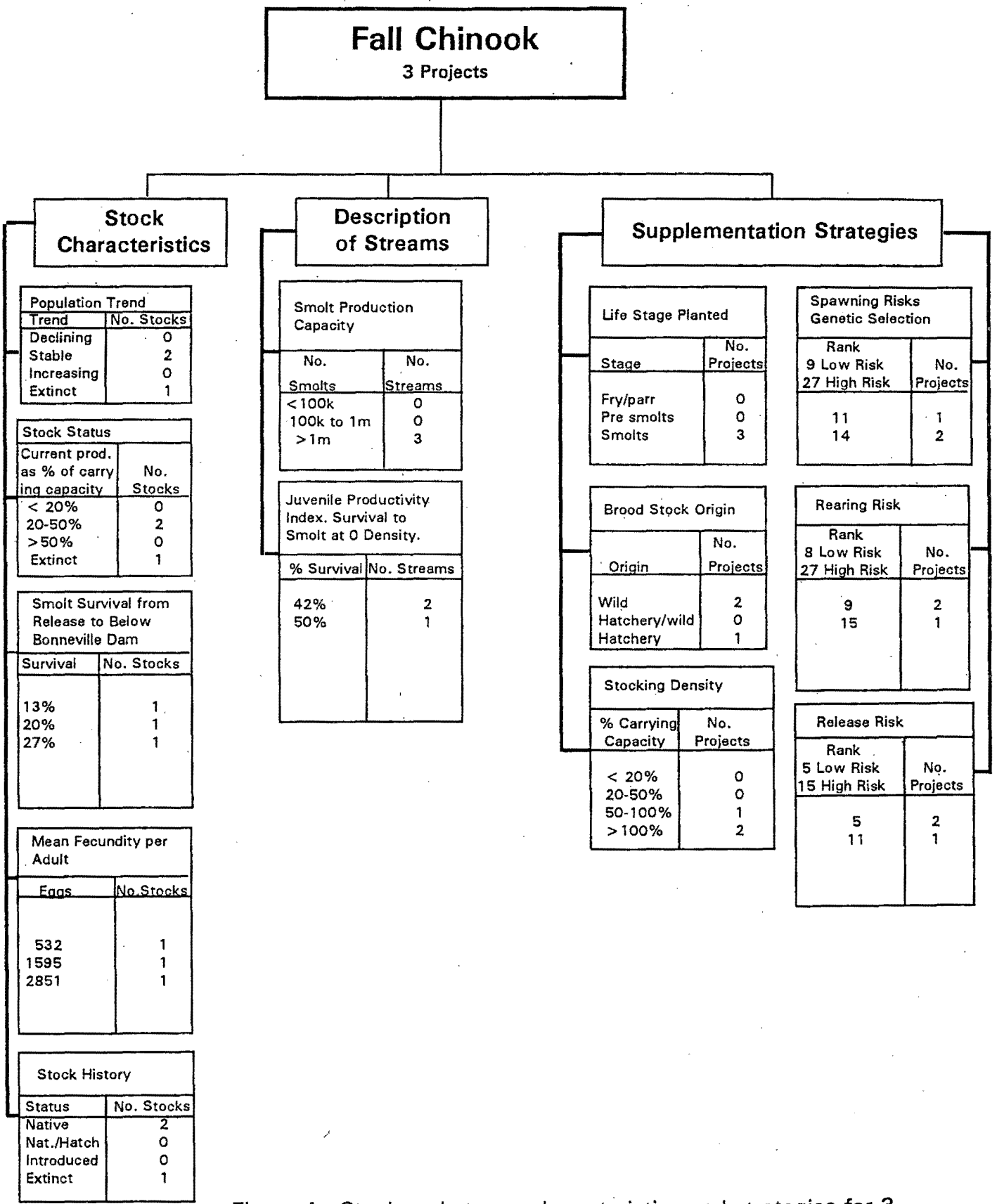


Figure 4. Stock and stream characteristics and strategies for 3 planned and ongoing fall chinook supplementation projects.

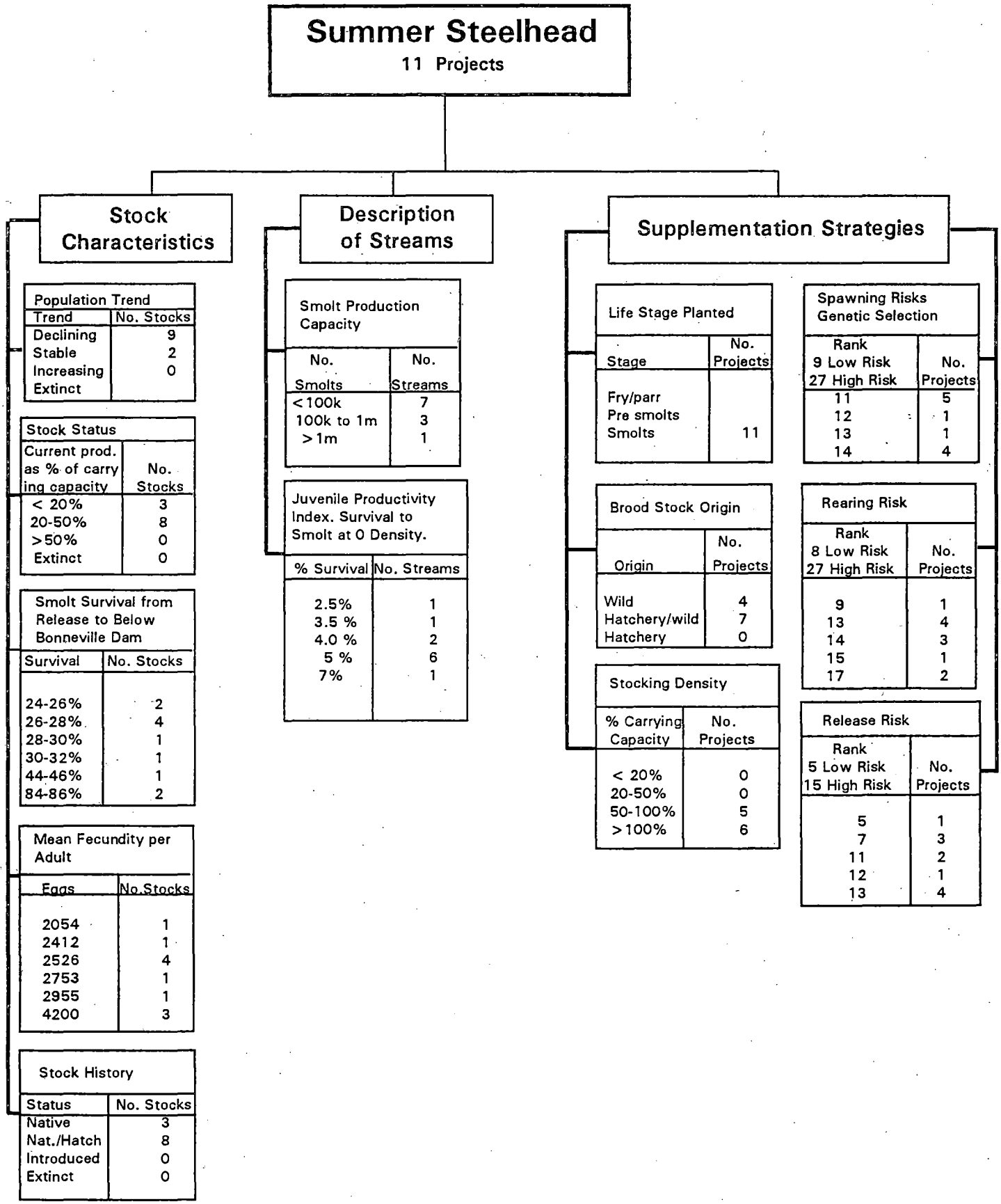


Figure 5. Stock and stream characteristics and strategies for 11 planned and ongoing summer steelhead supplementation projects.

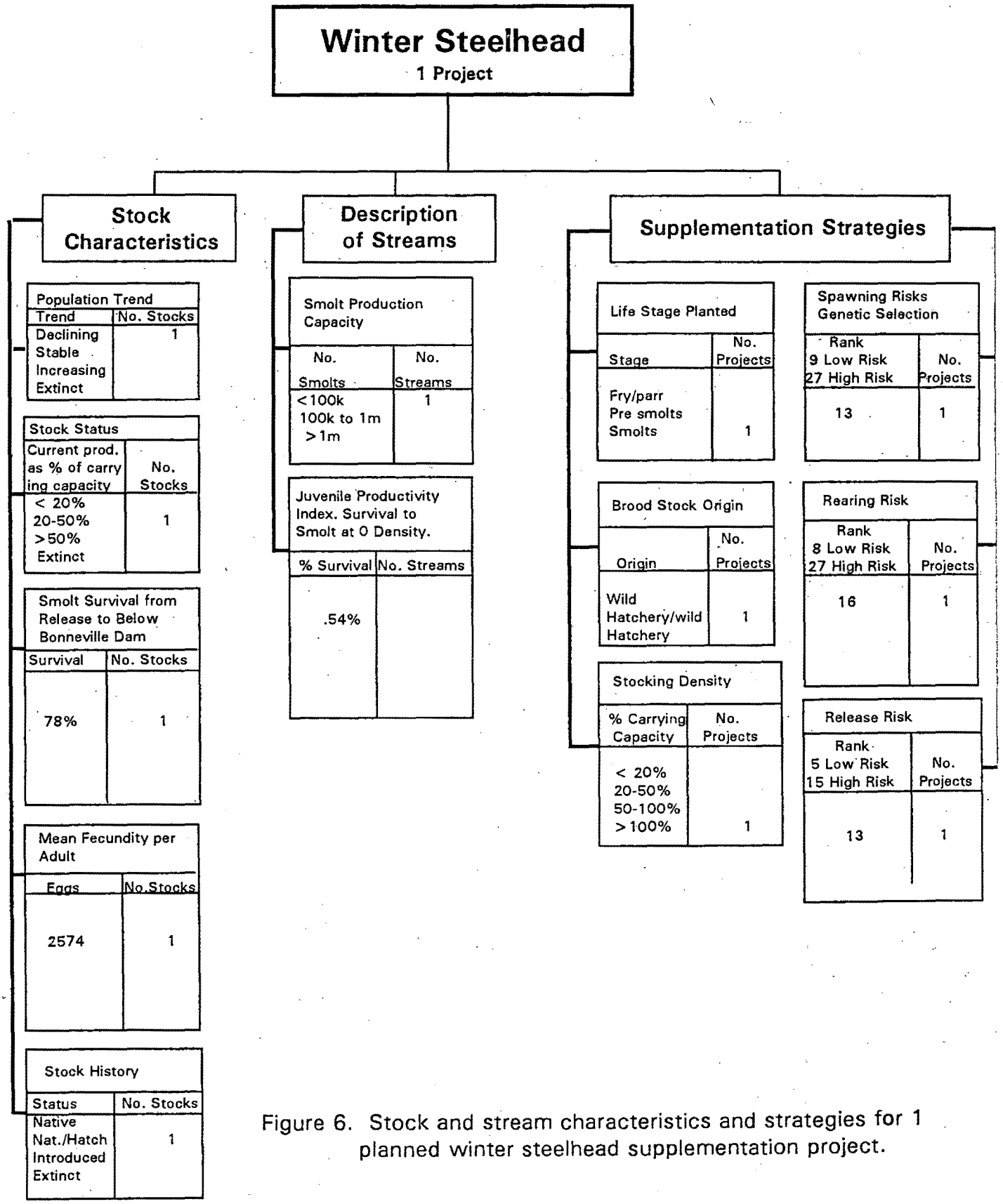


Figure 6. Stock and stream characteristics and strategies for 1 planned winter steelhead supplementation project.

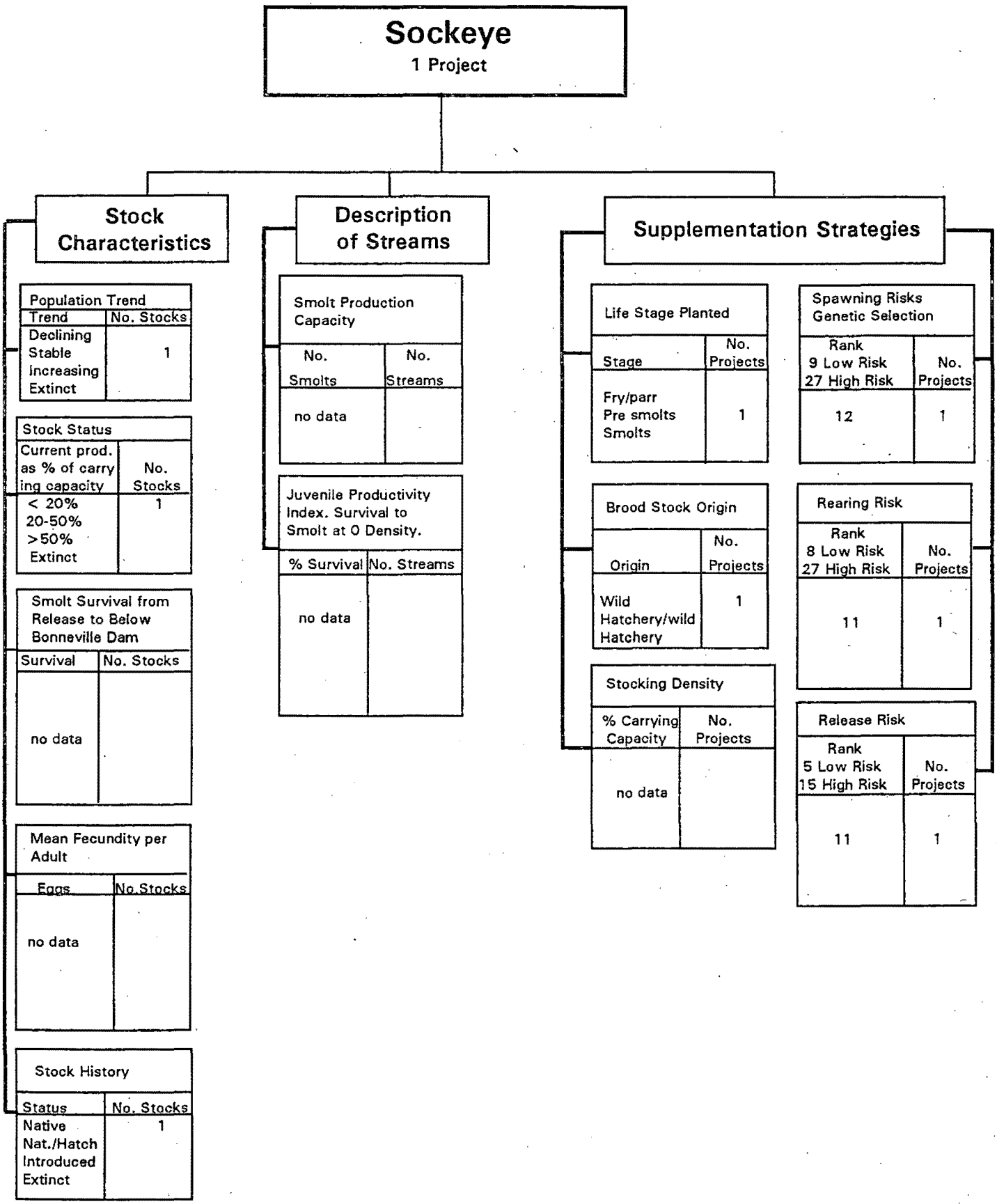


Figure 7. Stock and stream characteristics and strategies for 1 planned sockeye supplementation project.

OBJECTIVES AND PERFORMANCE STANDARDS

This section describes the objectives of supplementation and how progress toward the objectives will be measured. Supplementation planning must produce objectives that are socially useful and technically sound, and they must be stated in a way that permits measurement of performance and progress. Performance standards should provide insight into the mechanisms that determine success or failure. Performance standards therefore must reflect biological or ecological significance as well as economic and social benefit.

Supplementation is relatively new. It is a largely untested means of integrating natural and artificial production to achieve sustainable increases in productivity (CBFWA 1991). Since fishery managers do not have extensive experience in the implementation and evaluation of supplementation, project planning, in particular the development of objectives and performance standards, assumes increased importance.

The four general objectives of supplementation (restoration, introduction, rearing augmentation, and harvest augmentation) are useful in discriminating projects at a gross level, for example, in an overall survey of the types of supplementation projects in the basin. Objectives have another more important function: to define specific targets against which performance of the program can be measured. Objectives of hatchery programs have traditionally been limited to production targets - pounds of fish reared and released, contribution to fisheries, etc. Those targets are important, but the definition of supplementation adopted by RASP implies that other measures of performance must also be included in the objectives. RASP has proposed the routine addition of four new performance standards in all supplementation projects: post-release survival, reproductive success, long-term reproductive performance, and ecological interactions.

Post-Release Survival

Post-release survival is measured from the time of release to the time adults return to the subbasin or are harvested in a fishery. The system planning model discounts the contribution of hatchery fish by 50% to account for differential survival between wild and hatchery smolts (Monitoring and Evaluation Group 1989). Given the magnitude of the discount applied to

hatchery fish, improving post-release performance can make a large contribution to the success of a supplementation project. To improve post-release survival, evaluation projects should focus on learned behavior in the hatchery, physiological state of the hatchery fish, ecological factors such as predation and competition, and environmental factors such as flow and temperature patterns.

Reproductive Success

Reproductive success measures how well supplemented fish reproduce in the natural environment. It is limited to those changes in the natural reproductive process induced by the hatchery experience but that do not persist into the next generation. Reproductive success is broadly defined as the number of offspring produced per spawner and it is influenced by:

- changes in average fecundity of the stock
- pre-spawning mortality
- large- and small-scale spawning distribution (homing to appropriate drainage or selection of quality spawning bed)
- spawning effectiveness (mate acquisition, redd digging capability, spawning timing, and egg retention)
- survival of progeny of hatchery-reared fish across significant life history stages (egg-to-fry, fry-to-presmolt, and presmolt-to-smolt survival and recruit per spawner ratios).

Long-Term Performance

Long-term performance is defined as the capacity of a population to persist in the face of environmental variability while undergoing natural genetic change. Ultimately, long-term performance is demonstrated by the simple fact that a population has maintained its productivity over a long period of time. Long-term performance of a stock might be indexed by changes in the ratio of recruits to spawners, overall egg to adult survival and survival between life history stages, gene frequencies as measured by electrophoresis, by changes in life history patterns. Long-term performance is a relatively new approach to the evaluation of artificial propagation, hence new tools and methodologies are needed. Standards designed to measure long-term performance must consider the four genetic risks associated with supplementation: extinction, loss of within-population variability, loss of between-population variability and domestication (Busack 1990).

Ecological Interactions

Hatchery fish released into the natural stream immediately become a part of the ecological matrix comprised of the physical habitat and its biota, including predators and competitors. Hatchery-reared fish both affect and are affected by the ecological matrix of the stream. For example, one of the most controversial biotic effects is the impact of a successful supplementation program on non-target species or races. The inter- and intra-specific trade-offs implicit in any supplementation program and the performance standards used to measure those trade-offs must be made explicit. Performance standards designed to measure the interaction between ecological factors and supplementation may be derived from:

- factors limiting production, including identification of critical or unique seasonal patterns of habitat use by specific life history stages
- species-specific carrying capacities in mainstem reaches and tributaries;
- changes in critical habitat parameters (e.g., adult passage at dams and other obstructions; effectiveness of screening and bypass systems for irrigation diversions; adequate in-stream flows for spawning, rearing, and outmigration; and water quality, especially as impacted by such human activities as logging and grazing
- competitive and genetic interactions between resident (pre-existing) and anadromous trout (supplemented)
- interactions between pre-existing resident trout and other anadromous species
- interactions among supplemented and natural anadromous salmonids themselves (e.g., competition, predation, "pied piper" effects, and residualism)
- specific times and places associated with large losses of outplanted fish and development of compensatory release strategies
- multiple stability regions caused by depensatory mortality and development of plans intended to move the population into the higher stability region

UNCERTAINTIES

This section describes uncertainties associated with supplementation. In supplementation planning, as in other activities where a biological resource is to be manipulated, what we don't know is at least as important in shaping the program as what we do know and can control. This is because our ignorance often outweighs our knowledge about ecological systems.

The uncertainties associated with a supplementation project result from a combination of three factors: the productive processes in the stream ecosystem, or our perception of them; the supplementation strategies; and the objectives (performance targets) of the project (Figure 8).

Management decisions, whether to initiate programs or to take no actions, are often made with uncertainty. The presence of uncertainty automatically presents the manager with risk - risk of failure, risk of unintended impacts (genetic or ecological), and risk of future surprise outcomes. Uncertainty and risk are inseparable elements in fisheries programs: where you find one you will always find the other.

Risk can be estimated and assessed through models that substitute assumptions for the critical uncertainties. The accuracy of risk measured in this way depends on the accuracy of assumptions. Lesser uncertainties are usually ignored in the models. Risks can also be assessed by listing and reviewing of critical uncertainties. The nature of those uncertainties and the potential importance of their effect can be estimated qualitatively through experience and a review of the literature. This method cannot deal effectively with cumulative or synergistic interactions among uncertainties, but models can be designed to handle those kinds of interactions.

Uncertainties also play an important role in the design of monitoring and evaluation programs. One way to reduce risk to acceptable levels is to monitor the appropriate parameters in a way that gives early warning of a problem. RASP calls this "risk containment monitoring."

Since uncertainties are the product of factors that will vary from project to project, they must be evaluated on a case-by-case basis. However there is utility in displaying uncertainties that are generally applicable to supplementation. A general list of uncertainties and matrices that can be used to generate potential uncertainties are presented in the next two sections.

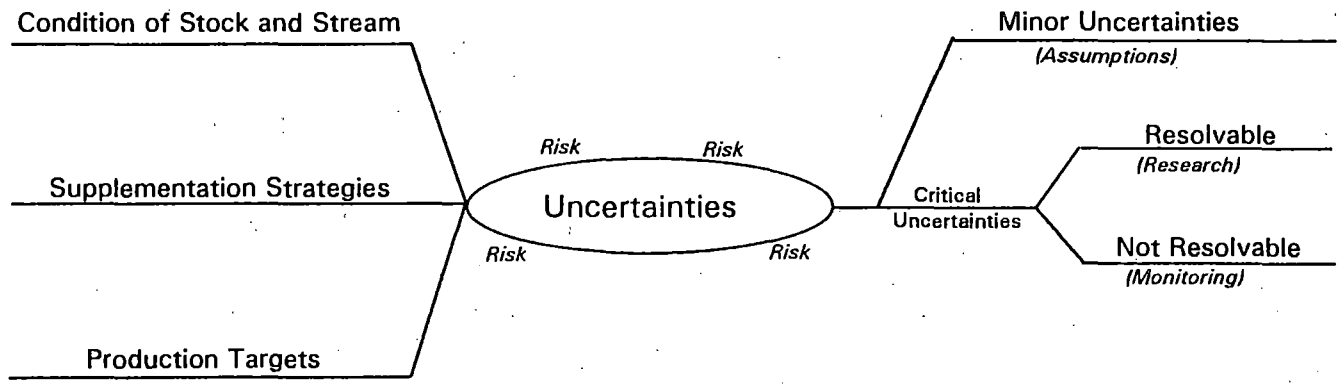


Figure 8. Schematic representation of the origin and treatment of supplementation uncertainties.

General Uncertainties

The SRG (1990) identified the central uncertainty or question regarding supplementation as: " Under what set of conditions will supplementation of natural and wild production with hatchery production add to the total production of salmon, steelhead or other targeted fishes over the long term?" All of the more specific uncertainties are related to that question. One source of the more specific uncertainties is the literature review by Steward and Bjornn (1990). The list presented below is our interpretation of the major uncertainties contained in that report. An exhaustive review is not intended: the original document should be consulted for details.

Genetic Uncertainties

1) Biochemical techniques for stock separation are not always conclusive and the genetic basis for the observed variability in stocks of Pacific salmon is not well documented.

2) It is not known whether some species or races of salmon or life histories within species are better suited to supplementation than others.

3) It is not known whether domestication and loss of performance in the wild is an inevitable consequence of artificial propagation. The kinds of hatchery environments and practices that preserve natural adaptations in hatchery-reared fish are unknown.

4) The impact of the use of foreign or distant broodstock on smolt-to-adult survival and fitness is unknown. A closely related uncertainty is the magnitude of outbreeding depression and the consequences of losing co-adapted gene complexes in wild stocks when exogenous stocks are used.

5) The amount of information on genetics, life history, ecological characteristics and interactions of hatchery and wild stocks necessary to employ artificial selection safely and beneficially in supplementation is unknown. Put another way, can "remedial selection" in a hatchery ever be safely employed on stocks that have already lost genetic variability or are poorly adapted to a modern environment?

6) The rate at which hatchery-reared fish adapt to natural environments is unknown. A related uncertainty with major implications for supplementation is the number of natural generations required before offspring of hatchery-reared parents achieve the fitness of the wild stock.

7) The conditions under which *beneficial* gene flow from hatchery to wild stocks occurs are unknown.

8) The maximum ratio of hatchery to wild spawners to ensure minimal deleterious genetic impacts is unknown. The minimum effective population size for hatchery breeding and natural spawning is unknown.

9) The environmental conditions (dam mortality, habitat degradation, etc.) under which supplementation will fail to achieve its goals - even when hatchery fish are genetically equivalent to wild fish - are unknown.

Ecological Uncertainties

10) The effects of hatchery practices on survival and production are unknown. For example, the combinations of release size, time, and density which stimulate natural production without displacing wild fish are unknown; the life stage and season of stocking that minimize hatchery-induced impairment of predator avoidance and feeding efficiency are unknown; the degree to which behavior learned in the hatchery predisposes hatchery fish to higher rates of predation, lower feeding efficiency, or suboptimal habitat use is not known; and the degree to which improved hatchery practices (size and time of release, disease prophylaxis, and reduced rearing density, etc.) can improve early marine survival is unknown.

11) It is not known whether interspecific competition or predation can prevent a depressed target population from responding to supplementation. A related uncertainty concerns the impacts of multiple stability regions. Assuming that multiple stock-recruitment stability regions exist, and that some populations are "trapped" in a lower region because of interspecific competition or predation, what combinations of hatchery release numbers and reductions of competitor or predator populations will allow the target population to regain its higher equilibrium level?

12) It is not known whether the magnitude or strategies employed by particular supplementation projects could *attract* predators and exacerbate predatory losses of wild fish.

13) The incidence of vertical transmission of disease from hatchery to wild fish is unknown, as is the impact such transmission has on wild stocks.

14) The conditions under which successful supplementation might selectively increase harvest of wild fish in a mixed population have not been determined.

Identifying Supplementation Uncertainties

This section describes potential sources of uncertainties related to supplementation. These are intended to provide guidance for identification of relevant uncertainties for specific supplementation projects. The section considers sources in the hatchery environment and from ecological interactions.

Hatchery Environment

The survival of first generation hatchery fish is influenced by the culture practices, the environmental conditions in the hatchery, the compatibility of the stock, and the size and time of release to the natural environment. Certain behavioral and physiological characteristics of fish, and in some cases genetically related traits, are apparently altered within the first generation of hatchery experience. Such changes explain why hatchery fish produced from wild parents exhibit significantly lower survival than natural fish in the same river system for the same life history phases. These changes in a fish's condition or characteristics, referred to here as its *attributes*, apparently cause the poor performance within the natural environment.

RASP identified 19 attributes of salmonids potentially altered by hatchery practices within the first generation of hatchery experience (Table 3). Each attribute can affect survival and therefore contribute to the differential in performance of hatchery and wild fish. RASP also developed a schematic model to illustrate the link between an attribute and survival during a particular life stage (Figure 9).

Figure 9 lists six potential fates, of hatchery produced fish that die before spawning. Clearly, death may be caused by several of these modes, acting in concert. For example, starvation, stress, and disease could all be contributors to a fish's demise. However, for descriptive purposes, it is useful to link attributes and fates as though they act independently (Table 4).

Figure 9 also illustrates that the life stage being supplemented is an important factor. The relative influence of a particular attribute on survival of hatchery produced fish differs between fish released as fry and fish released as smolts. Sorting out these life history effects will increase the complexity of the task significantly.

Numerous hatchery practices or treatments can potentially alter survival-related attributes. We focused our attention on 22 treatments considered of greatest importance (Table 5). This list will be modified as RASP continues its assessment. A very brief description of each treatment is provided in Table 5.

Many of the same hatchery practices that create the first generation effects identified in Tables 3-5 can also cause changes in the diversity or distribution of genetic information in

Table 3. Survival-related attributes of salmonids potentially altered by hatchery practices within the first generation of hatchery experience.

Attribute	Description
Aggressiveness	Extent of inter- or intra-specific aggressive behavior within the natural environment.
Dispersiveness	Extent and rate of dispersal within the natural environment.
Downstream emigration pattern	Timing and rate of travel of seaward migration.
Upstream immigration pattern	Timing and rate of travel of the upstream spawning migration.
Amount of body fat	Quantity of body fat related to nutrition and exercise.
Feeding behavior	Use of foraging areas, prey selection, and associated energetics of feeding.
Habitat selection	Use of habitats by season, including depth, velocity, substrate type, and shelter.
Health	Overall health related to history of nutrition, exposure to pathogens and stressors, and exercise.
Homing/straying	Degree of homing to the home spawning stream (or stream of release).
Disease resistance	Immunity to disease, either due to immunogenetic resistance or antibodies from prior exposure.
Maturation	Age at sexual maturity, or relative timing of sexual maturity within a particular season.
Predator recognition	Ability to detect both presence and associated danger of predators.
Prey recognition	Ability to locate suitable prey items.
Size	Length and associated condition factor of fish at time or age.
Smoltification	Timing and degree of physiological trsnsformation in preparation for seaward migration/entry.
Saltwater transfer efficiency	Effectiveness of successfully making transition from fresh to saltwater.
Swimming ability	Burst speed, maneuverability, and stamina associated with swimming.
Social interaction	Set of behaviors associated with dispersal, territoriality, hierarchial associations, and schooling.
Catchability	Effectiveness, or lack thereof, at avoiding capture by a fishery.

Table 4. **Potential fates, or modes of death, of hatchery produced salmonids unsuccessful at surviving to spawn and attributes which can contribution to a particular fate.**

Predation	Starvation	Disease	Environmental Impacts	Fishery	Stress
predator recognition	health	health	habitat selection	dispersiveness	health
swimming ability	feeding behavior	disease resistance	swimming ability	emigration pattern	amount of body fat
size	dispersiveness	smoltification	emigration pattern	immigration pattern	smoltification
dispersiveness	emigration pattern	emigration pattern	immigration pattern	homing/straying	aggressiveness
feeding behavior	social interaction	immigration pattern	homing/straying	smoltification	dispersiveness
emigration pattern	prey recognition	aggressiveness	smoltification	size	social interaction
habitat selection	amount of body fat	disperaiveness	size	aggressiveness	habitat selection
smoltification	aggressiveness	social interaction		prey recognition	
	smoltification	amount of body fat		catchability	
	saltwater transfer efficiency	saltwater transfer efficiency		maturation	
				feeding behavior	

Table 5. **List of hatchery treatments potentially affecting survival-related attributes of salmonids within the first generation of hatchery experience.**

Hatchery treatment	Component of treatment of potential concern
Broodstock origin	Indigenous natural stock or imported stock (hatchery or natural and source)
Broodstock capture/holding methods	Representiveness of timing and ages obtained by capture/holding methods
Mating practices	Random vs. non-random, representation by age classes, male-per-female ratio, etc.
Incubator type and substrate	Degree of interaction between substrate and alevin; emergence or removal
Diet	Type of food: dry vs. wet, buoyant vs. sinking, natural vs. manufactured
Growth schedule	Rate of desired growth and size projected; ration adjusted to meet schedule
Feeding method	Automatic feeders, demand feeders, broadcasting by humans, etc.
Density	Rearing density
Grading	Consolidation of sizes in rearing with or without culling of undesirable fish
Predation exposure	Extent of experience with natural predators: birds, otters, fish
Structural complexity	Exposure to variable habitat structure: overhanging cover, visual separators, etc.
Container design	Size, shape and depth of rearing unit: raceway vs. pond, meander vs. straight
Flow	Quantity and velocity of flow through rearing unit
Water temperature	Range of temperatures during either incubation or rearing compared to nature
Disease control	Extent of exposure to pathogens and treatments applied
Hygiene	Rearing vessel cleaning practices (frequency and methods)
Size of release	Number of fish released
Release method	Volitional vs. forced, degree of acclimation, mode of transportation
Release location	Distance from hatchery, single point release vs. multiple release sites, etc.
Release timing	Means of selecting date for release; relationship to natural timing

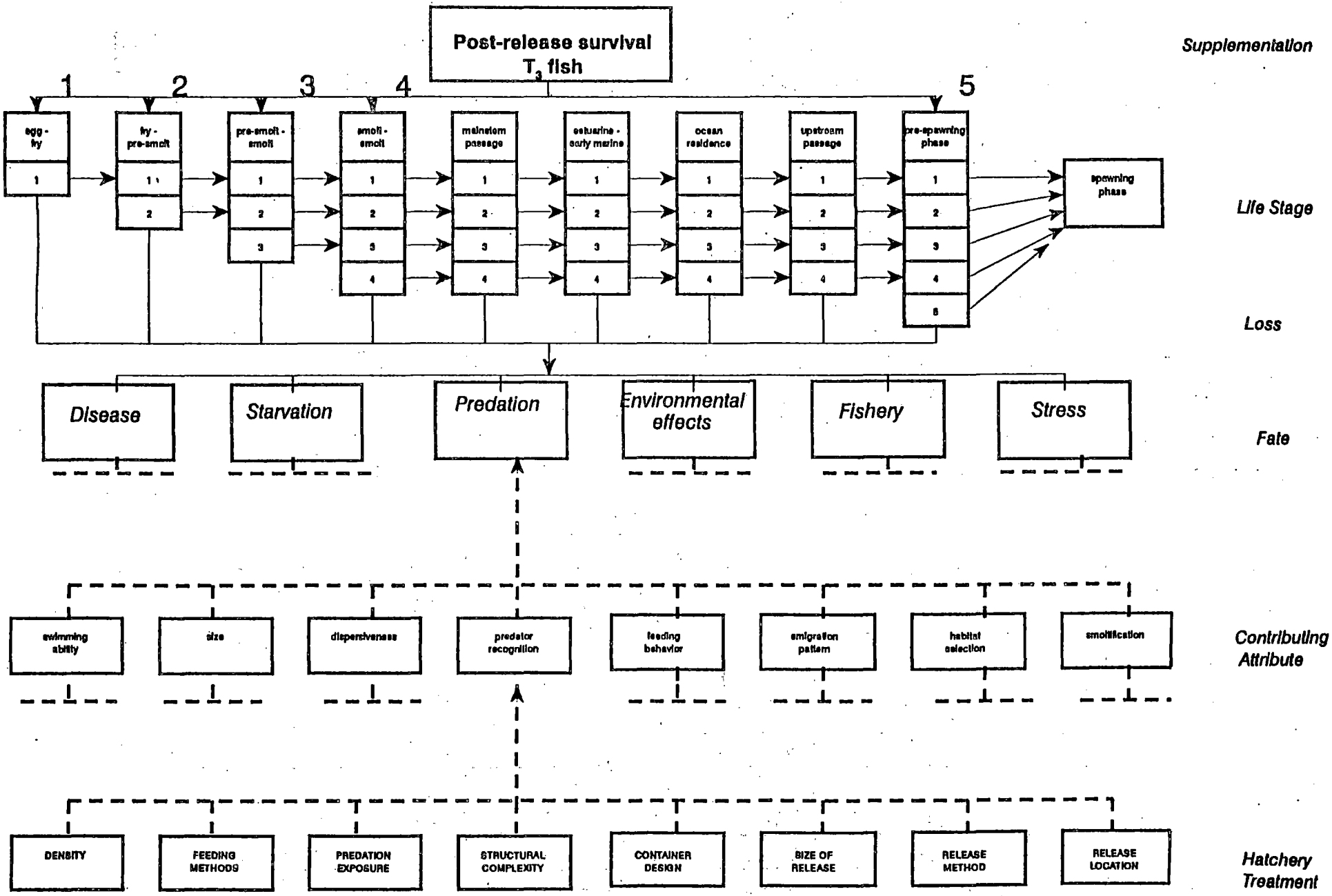


Figure 9. Schematic of effects of hatchery treatment on survival related attributes of first generation hatchery fish outplanted at different life stages.

the population and thus cause changes in the long-term performance. For example, all the attributes listed in Table 3 probably have a genetic, as well as an environmental component. The genetic component can be altered through selection exerted by hatchery treatments shown in Table 5.

Busack (1990) identified four types of genetic risk associated with supplementation projects. His risks included: extinction, loss of within-population variability, loss of between-population variability, and domestication. Table 6 displays the hatchery practices that can contribute to uncertainties associated with each type of genetic risk.

Ecological Interactions

Juvenile salmon and steelhead released into a stream as part of a supplementation project are expected to return to the stream, to spawn, and to contribute to natural production unless they are harvested. The rate at which they return (survive) is determined largely by their physiological state, their behavior (especially maladaptive behavior learned in the hatchery environment), their genetic fitness, the mainstem passage mortality and the ecological interactions between them and the physical and biological habitat. The last category is probably the one about which we know the least. Many of the first generation effects and genetic changes are expressed as reduced survival; however, the proximate cause of mortality in many of these cases is probably some type of "ecological interaction".

Ecological interactions are partitioned into three general types: interaction between salmonids and their habitat, biotic interactions that impact target species, and biotic interactions that impact non-target species/races (Table 7).

Habitat. Production may be severely limited by a suite of factors in the target stream which act at one or two specific life stages (production "bottlenecks"). Such production bottlenecks and mainstem passage mortality may have to be substantially reduced before the supplementation objectives can be met. For example, streams with headwater impoundments and regulated flows may have a seasonal hydrograph and temperature regime that severely compromises the performance of a targeted species. If the timing of life history events is entrained to natural rhythms of flow or temperature, critical events such as emergence, outmigration, and spawning will be disrupted and production will be reduced dramatically.

Table 6. Hatchery treatment and critical uncertainties associated with four genetic risks.[1]

Genetic Risk	Hatchery Treatment/Uncertainty
Extinction	• Donor population reduced below MVP by removal of hatchery broodstock • Supplemented population has different genetic makeup, life history or rearing environment than the hatchery stock • Hatchery stock strays into non-target spawning areas • Mixed stock fisheries reduce target or non-target population below MVP
Loss of Within-Population Variability	• Hatchery broodstock less than the minimum effective population size (N_e) • Mating design and fertilization protocol reduces N_e below minimum • Hatchery practices increase natural variation in family size • Non-random selection of brood fish from the donor population • Mixed-stock fisheries reduces non-target population below N_e • Failure to recognize and compensate (during brood selection) for the impact of a selective fishery
Loss of Between-Population Variability	• Occurrence and magnitude of outbreeding depression • Hatchery broodstock is taken from a genetically distant donor stock • Scale of the supplementation program causes excessive strays into non-target streams • Hatchery practices cause abnormal rates of straying into non-target streams • Failure to identify the smallest group of interbreeding individuals of evolutionary significance in a subbasin
Domestication	• Hatchery brood stock not collected from all portions of the run • Grading, ponding, outplanting or other hatchery practice causes non-random mortality • Broodstock not selected randomly among age classes and life histories • Rearing and release strategy is not consistent with natural life history pattern

[1]Adopted from Kapuscinski, A. R., C. R. Steward, M. L. Goodman, C.C. Krueger, J. Holt Williamson, E. Bowles and R. Carmichael (1991).

Table 7. Interaction uncertainties partitioned by habitat, target species, and non-target species.

Interaction Category	Uncertainty
Habitat	Habitat bottleneck limits natural production: • Access to spawning area blocked • Summer rearing limited • Winter rearing limited • Juvenile outmigration impeded Flows and/or temperatures not compatible with life history (juvenile and adult) Mainstem passage mortality Altered habitat better suited to non-target species
Target Population	Habitat previously used by target species colonized by non-target species/race which: • Preys on target species • Competes with target species • Forces target population into a lower stability region Supplementation strategy attracts predators
Non-Target Population	Successful supplementation displaces non-target species or race of economic or recreational value Resident, non-target species or race vulnerable to predators attracted by supplementation strategy

Non-Target Species. One cannot assume that a stream with a depleted salmon population has vacant habitat equivalent to the difference between the past and present population sizes. Depletion of an abundant and productive salmon population generally doesn't create production vacuums. In oligotrophic waters, the loss of salmon carcasses might result in a reduced productivity and production of potential prey. In more productive waters, vacant habitat will, in many cases, be colonized by another species/race. Consequently successful supplementation may displace a population of another species or a resident population of the same species (e.g. steelhead may displace resident rainbow trout). The displacement can have biological, economic and political consequences.

Target Species. The effect of ecological interactions on target species can be expressed by several uncertainties. For example, one set of uncertainties arise from the existence of multiple stability points in the stock-recruitment relationship. Managers proposing supplementation should be especially concerned when colonizing species compete with and/or prey on the supplemented species with sufficient intensity to lock the latter in a lower stability region. Peterman (1977) worked out the theoretical basis for multiple stability regions in salmon production functions and McIntyre et al. (1988) observed empirical support for the theory in the sockeye population of Karluk Lake, Alaska.

Shifts in dominance following the collapse of a dominate species have also been observed in marine populations. For example, the northern anchovy became dominant after the collapse of California sardine populations and Atlantic herring dominated after the collapse of the Atlantic mackerel (Skud 1982). Regarding the marine species, Skud (1982) quoted N. Daan's estimate that it would require a 50% reduction in the dominant species and a corresponding 50% increase in the depleted species maintained for several years to reestablish dominance.

McIntyre et al. (1988) concluded that a lower exploitation rate of 30% to 35% on Karluk Lake sockeye would have maintained the population in a higher stability region. These observations have important implications for supplementation planning. The concept of multiple stability regions is an important uncertainty that has generally been overlooked by managers.

ELEMENTS OF A SUPPLEMENTATION THEORY

The expectation that we can increase total production by adding artificially propagated fish to natural habitats, is based on our understanding of the artificial and natural production systems. Realizing the expected increases in production depends on how well the two systems are integrated. Supplementation theory is an attempt to generalize our understanding of natural and artificial production and to establish guidelines for integrating the two. Theory gives managers the tools needed to build conceptual models of supplemented stream/stock systems. The models permit managers to deduce hypotheses about the expectations (benefits and risks) of supplementation. The hypotheses are also the basis for performance evaluation and subsequent refinement of both theory and supplementation strategies (adaptive management).

A supplementation theory should describe the basis for assessing potential benefits, risks, applications and uncertainties of supplementation. Developing a supplementation theory is important to: narrow the range of potential risks, applications and uncertainties; track the rational for assessment of those parameters; and provide common ground from which discussions of supplementation can take place.

Consistent with the overall purpose of this report - to provide a general introduction to supplementation in the Columbia Basin and broadly describe the scope of the program - the purpose of this discussion of supplementation theory is limited to general concepts. More detailed development of theory and examples of its use will be discussed in later reports in this series.

Supplementation Concepts

Supplementation theory rests on three concepts:

- capacity: each stream/stock system has a capacity to produce salmon and steelhead determined by the interaction of abiotic and biotic factors operating through the stock's life history

- performance: performance of a stream/stock is that part of the capacity realized in any given time interval

- stock-recruit relationship: there is a relationship between the quality and quantity of a spawning population and recruitment of the adult progeny.

Capacity

The geomorphic setting, vegetation, climate and stock life histories determine the capacity of the system to produce salmon. Capacity is the product of the interaction of the biotic and abiotic factors and the stock life histories, therefore, it can rarely be measured directly as a fixed quantity. Capacity of a stock/stream system is not necessarily determined in the spawning or freshwater rearing habitats because capacity incorporates all life stages and associated habitats. For example, the ability of a stream system to produce emigrants may never be realized because of factors limiting capacity during the smolt to adult stage.

Supplementation introduces another determinate of capacity -- the physical size and operational practices of the hatchery. Hatcheries have a physical capacity to produce juvenile salmon. Because hatcheries circumvent much of the freshwater incubation and rearing mortality, they may be considered analogous to a super tributary from the standpoint of smolt production. Hatchery practices that alter long term fitness or life histories will change the interaction between the stock and its habitat and therefore influence capacity.

Performance

That part of a stream's capacity realized over a specified period is its performance and it is usually measured as the production of target species and races. Production is comprised of measures of abundance, post-release survival, reproductive success, long-term performance, and ecological interactions. Following supplementation, the performance of a stream /stock system is determined by the fitness of the supplemented stock and the density-dependent regulation of the combined natural/artificial population. Factors outside the subbasin such as mainstem passage mortality also influence performance. The goal of supplementation is to improve performance and increase natural production, but before supplementation can be considered an appropriate management strategy, the manager must conclude that the capacity of the system is greater than its current performance. However, a difference between capacity and performance does not automatically lead to supplementation. For example, if the difference between capacity and production is due to degradation of spawning, rearing and migrational habitat, supplementation may not improve performance without concurrent habitat improvement.

Stock-Recruit Relationship

Salmon mangers generally accept the existence of a relationship between the quantity and quality of spawners and recruitment in the next generation. In addition to biotic and abiotic components of the habitat and life history of the native stock, the performance of a stream/stock system is influenced by density-dependent population regulation. The stock-recruit model has served for 40 years as the primary tool for evaluating the nature of the density-dependent influence of stock size on subsequent recruitment and production. Various types of stock-production models have been proposed for salmon, including the Ricker (1954)

and Beverton and Holt (1957) models and the more complex forms proposed by Paulik (1973). Families of stock-recruitment curves may be used to show the range of performance levels of a stock/stream system.

In addition, salmon and steelhead typically exhibit discrete life history stages (egg to fry, fry to emigrant, emigrant to smolt, and smolt to adult). Specific productivity curves illustrating the performance relationship within each life history can be useful in evaluating the overall stock-recruitment relationship.

Stock-Recruitment Models

Stock-recruitment models of salmon populations have received extensive treatment since Ricker's (1954) treatise on the subject. However, the debate, refinement and use of the stock-recruitment models have focused on questions related to harvest management. Among the exceptions are Junge's (1970) use of stock-production models to determine the relative impact of smolt, adult and racial mortalities in freshwater on overall production. Ginzburg (1990) used a stock-recruit model to assess the effect of density-dependence on the risks of extinction. Reisenbichler and McIntyre (1977) illustrated the impact on production of interbreeding between hatchery and wild steelhead through hypothetical stock-recruit models. Reisenbichler (1984) used the stock-recruit model to show the theoretical response of a wild population to supplementation and the loss of fitness through the introduction of a maladapted allele.

In the development of a supplementation theory, we will assume that the shape of the stock-production curve describes the density-dependent regulation of numbers, that this regulation takes place predominately in freshwater, and therefore it reflects important constraints on production which supplementation must address. A criticism of the use of stock-production models to characterize salmonid populations is that they contain little or no allowance for evolutionary or other complex biological mechanisms (Slobodkin 1973). Also, changes in habitat can alter the relationship between stock size and subsequent production (Moussalli and Hilborn 1986). Some of these concerns can be addressed through modifications of the basic model.

Paulik (1973) and Peterman (1977) illustrated how stock-production relationships can have multiple stability regions. Paulik (1973) and Moussalli (1984) described ways of partitioning a stock-production relationship into life stages to address some of the complexities that arise in models based on full generations. The potential for multiple stability regions has important implications to the scale of supplementation projects. Use of multiple life stages can permit greater diversity of experimental approaches and designs.

Clinical Model

For descriptive purposes, the concepts of capacity and performance are embedded in a broader clinical model of the target stream and stock. The basic elements of the clinical model[3] are: Template, the healthy stream/stock system; patient, the current condition of the stream/stock in need of restoration; diagnosis, the comparison of template and patient that leads to identification of limiting factors; and treatment, the specific strategies to remove or circumvent the limiting factors.

A description of the stream/stock's capacity is a template against which proposed future states of system habitat and stock life histories are compared. The template is a historical reconstruction of the habitat and life histories in the healthy system. Because it is a historical reconstruction, the template analysis will often employ indirect evidence or findings from other streams reported in the literature. The template serves as a guide, a model or a pattern, to assist in planning the reconstruction of a degraded stream/stock system.

The current performance of the stream/stock system is analogous to a patient in the clinical model. In many cases only fragments of the template will remain in the patient stream/stock. Life histories and their associated habitats may be missing entirely or severely degraded. A comparison of the template with the patient leads to a diagnosis of not only the proximate causes of observed performance, but it suggests potential treatments that are likely to increase performance. The comparison of template and patient will also identify treatments that might decrease performance, for example, selection of a stock for supplementation that exhibits maladapted life histories for the target habitat.

When constructing the template and patient descriptions, it is important to include all life history stages including those that take place outside of the spawning and juvenile rearing habitats. This is particularly important where the patient's condition is primarily determined outside the subbasin where spawning takes place.

Summary

The stock-recruit model and the concepts of capacity and performance are the basis for a supplementation theory. Those concepts employed in a clinical model result in a description of the production process in a stream/stock system in a way that permits rational development of biologically appropriate treatments and the formulation of hypotheses that permit critical evaluation and adaptive management of the supplementation program.

---

[3]The clinical model is described in greater detail in the third report in this series dealing with planning guidelines

LITERATURE CITED

Busack, C. 1990. Yakima/Klickitat production project genetic risk assessment. Manuscript. Genetics Unit, Washington Department of Fisheries, Olympia, WA. 21 p.

Columbia Basin Fish and Wildlife Authority. 1991. Integrated system plan. Portland, OR. 527 p.

Currens, K. P., C. A. Busack, G. K. Meffee, D. P. Phillip, E. P. Pister, F. M. Utter, and S. Youndt. 1991. A hierarchical approach to conservation genetics and production of anadromous salmonids in the Columbia River Basin. Draft report from the Sustainability Workshop, January 24-26, 1991. Northwest Power Planning Council. Portland, OR. 30 p.

Junge, Charles O. 1970. The effect of superimposed mortalities on reproduction curves. *Research Reports of the Fish Commission of Oregon*, 2:1 56-63.

Idaho Department of Fish and Game. 1991. Idaho's anadromous fishery management plan. Boise, ID.

Kapuscinski, A. R., C. R. Steward, M. L. Goodman, C. C. Krueger, J. H. Williamson, E. Bowles and R. Carmichael. 1991. Genetic conservation guidelines for salmon and steelhead conservation. Draft report from the Sustainability Workshop, January 24-26, 1991. Northwest Power Planning Council. Portland, OR. 51 p.

McIntyre, J.D., R.R. Reisenbichler, J.M. Emlin and R.L. Wilmont. 1988. Predation of Karluk River sockeye salmon by coho salmon and char. Fishery Bulletin Vol. 36: 611-616.

Miller, W.H., T.C. Coley, H.L. Burge and T. T. Kisanuki. 1990. Analysis of salmon and steelhead supplementation: Emphasis on unpublished reports and present programs. U. S. Department of Energy Bonneville Power Administration project No. 88-100.

Moussalli, E.I. and R. Hilborn. 1986. Optimal stock size and harvest rate in multistage life history models. Can. J. Fish. Aquat. Sci. 43: 135-141.

Nehlsen, W., J.E. Williams and J. Lichatowich. 1991. Pacific salmon at the crossroads: stocks at risk from California, Oregon, Idaho and Washington. *Fisheries* 16: 4-21.

Northwest Power Planning Council. 1987. Columbia River Basin Fish and Wildlife Program (Amended). Portland, OR.

Oregon Fish Commission. 1955. Biennial report of the Fish Commission of the State of Oregon to the Governor and the Forty-eighth Legislative Assembly. 28 p.

Paulik, G.J. 1973. Studies of the possible form of the stock-recruitment curve. In B.B. Parrish, ed., *Fish Stocks and Recruitment,* Proceedings of a Symposium held in Aarhus July 7-10, 1970, Denmark, 302-315.

Peterman, R.M. 1977. A simple mechanism that causes collapsing stability regions in exploited salmonid populations. *J. Fish. Res. Board of Canada,* 34:1134-1142.

RASP. 1991. Regional assessment of supplementation project. Status Report September 30, 1991. In press. Bonneville Power Administration.

Reisenbichler, R.R. and J.D. McIntyre. 1977. Genetic differences in growth and survival of juvenile hatchery and wild steelhead trout, *Salmon gairdneri. J. Fish. Res. Board. Can.* 34: 123-128.

Reisenbichler, 1984. Outplanting: Potential for harmful Genetic change in naturally spawning populations. In J.M. Walton and D.B. Houston ed. Proceedings of the Olympic wild fish conference. Peninsula College, Port Angeles, WA.

Ricker, W.E. 1973. Critical Statistics from two reproduction curves. In B.B. Parrish, ed., *Fish Stocks and Recruitment,* Proceedings of a Symposium held in Aarhus July 7-10, 1970, Denmark, 331-338.

Ricker, W.E. 1954. Stock and recruitment. *J. Fish. Res. Board of Canada,* 11:5 559-623.

Riggs, L. 1990. Principles for genetic conservation and production quality. Northwest Power Planning Council Contract C 90-005. Portland, OR.

Scientific Review Group. 1991. Review of fisheries supplementation in the context of activities related to the Columbia River Basin Fish and Wildlife plan. Memorandum to Wally Steucke, IPP Coordinator, Portland, OR. 7 p.

Skud, E. B. 1982. Dominance in fishes: the relation between environment and abundance. *Science* 216: 144-149.

Slobodkin, L.B. 1973. Summary and discussion of the symposium. In B.B. Parrish ed., *Fish Stocks and Recruitment,* Proceedings of a Symposium held in Aarhus July 7-10, 1970, Denmark, 7-14.

Smith, E. M., B. A. Miller, J. D. Rodgers and M. A. Buckman. 1985. Outplanting anadromous salmonids - a literature survey. U. S. Department of Energy, Bonneville Power Administration Project No. 85-68. Portland, OR.

Steward, C. R. and T. C. Bjornn 1990. Supplementation of salmon and steelhead stocks with hatchery fish: A synthesis of published literature. U.S. Department of Energy, Bonneville Power Administration Project 88 -100. Portland, OR.

APPENDIX A

SUMMARY OF SELECTED

SUPPLEMENTATION LITERATURE

Table A.1. Information contained in recent report relevant to supplementation: Definition, Classification, and Planning

REPORTS (See Literature Cited for reference)	DEFINITION OF SUPPLEMENTATION	CLASSIFICATION OF PROJECT DIVERSITY	PLANNING RECOMMENDATIONS
Miller, W.H., et al. 1990 Analysis of Salmon and Steelhead Supplementation: Emphasis on Unpublished Reports and Present Programs	Planting all life stages of hatchery fish to enhance wild/natural stocks of anadromous salmonids	No stratification or classification of projects other than the separation between supplementation and non-supplementation projects. Provides a summary of 316 projects	Planning recommendations can be extracted from the report's conclusions. Recommends looking for factors that caused decline before supplementation
Kapuscinski, A.R., et al. 1991 Genetic Conservation Guidelines for Salmon and Steelhead Supplementation	The use of artificial propagation while conserving genetic resources, for the goal of restoring or augmenting self-sustaining populations. Broken into broad categories of restoration and augmentation	No classification other than the distinction found in definition between restoration and augmentation	Lists five steps in planning a supplementation project: set goals, present status, feasibility, propagation options, evaluate genetic risks. Lists five general steps in planning a management program: goals, objectives, identify problem, implement, and evaluate actions
Currens, K.P., et al. 1991 A Hierarchical Approach to Conservation Genetics and Production of Anadromous Salmonids in the Columbia River Basin	None	None	Recommends seven principals for designing genetic resources reserves: 1) must address regional, local human concerns; 2) hierarchy of reserves must parallel the hierarchy of genetic organizations; 3) maintain demographic stability; 4) identify and protect habitata corresponding to life history; 5) protect and restore historical complexity of migratory patterns; 6) harvest management must protect genetic reserves; 7) management goals and objectives must clearly define risks. Presents a schematic of the implementation steps

Table A.1 (cont'd).

REPORTS (See Literature Cited)	DEFINITION OF SUPPLEMENTATION	CLASSIFICATION OF PROJECT DIVERSITY	PLANNING RECOMMENDATIONS
Columbia Basin Fish and Wildlife Authority 1991 Integrated System Plan. Chapter C Supplementation	The stocking of fish into the natural habitat to increase the abundance of naturally producing fish populations. Adjuncts to this definition included in the report are: [supplementation] is oriented toward maintaining natural biological characteristics of the population and reliance on rearing capabilities of the natural habitat. The report gives three uses of supplementation: seed barren habitat, provide survival advantage to depressed stocks, and speed rebuilding to carrying capacity	No formal classification but life cycle analysis of a supplemented population, supplementation technology and guidelines (Table 57) could be used as a basis for classification	Gives planning guidelines or recommendations for several aspects of supplementation: Life cycle analysis of limiting factors, prerequisites for supplementation (sufficient habitat, suitable stock and appropriate technology), level of technology, hatchery practices, genetic risks and stock status
Smith, E., B. Miller, J. Rodgers, and M. Buckman 1985 Outplanting Anadromous Salmonids: A Literature Survey	The release of fish from hatcheries at locations away from the hatchery to increase natural production in streams determined to be seeded or used at less than optimal levels. The authors referred to this activity as out-planting, however, it appears to be close to the concept of supplementation	The literature review did not classify individual projects but summarized the information from different projects under the categories: density, survival, genetics, competition and carrying capacity models	The report goes through several planning steps in the design of a supplementation project for the Willamette River. The planning steps used by the authors were: 1) estimate adult returns and reproductive success, 2) identify underseeded streams and reservoirs 3) set criteria for selecting hatchery stocks, 4) evaluate the use of an artificial spawning channel, 5) evaluate harvest benefits, 6) describe design of evaluation, 7) sensitivity analysis, 8) describe sampling methods and budget
Scientific Review Group 1990 Review of Fisheries Supplementation in the Context of Activities Related to the Columbia River Basin Fish and Wildlife Plan	The report does not offer a formal definition but recognizes the need for a clear definition using specific terminology. Development of useful objectives and evaluation priorities are hampered by lack of clear definition of supplementation	Does not review specific projects but suggests that supplementation objectives could include: restoration, introduction, rearing augmentation, and habitat augmentation	The report recommended the following steps when developing a supplementation project: 1) clearly state hypotheses and objectives, 2) specify performance measures, 3) establish baseline knowledge of target stock, 4) use treatment and control streams to determine changes, 5) analyze seasonal habitat conditions, utilization, and carrying capacity
Riggs, L. 1990 Principals for Genetic Conservation and Production Quality	None. The report focuses on genetic conservation with reference to all management activities (harvest, passage, habitat and production) although hatcheries are given emphasis	None. The report does list management opportunities which is a general form of classification of the stream/stock subject to management action. The opportunities are stated here as objectives: 1) conserve native populations, 2) facilitate natural population productivity, 3) maintain natural stock identity and productivity, 4) improve hatchery stock naturalization, 5) increase hatchery stock productivity, and 6) introduce and test a new stock	The report describes seven steps in implementation to ensure production quality: 1) assess existing stock or population status, 2) identify production alternatives, 3) assess genetic impacts, 4) develop operational plans, 5) conduct monitoring and evaluation, 6) identify important research needs, and 7) facilitate information transfer

Table A.2. Information contained in recent reports relevant to supplementation: Performance Standards, Identification of Genetic Risks, and Behavioral Risk

REPORT (See Literature Cited)	PERFORMANCE STANDARDS	IDENTIFICATION OF GENETIC RISKS	IDENTIFICATION OF PHYSIOLOGICAL/BEHAVIORAL RISKS
Miller	Performance standards against which projects were evaluated were not clearly stated. For example, no genetic or natural production standards, although they did recognize genetic risks	Recognized general concept. Listed three ways to reduce genetic risks: 1) use some wild fish in brood stock, 2) stock in a way that mimics natural, and 3) limit density	Acknowledged presence and recommend research in this area
Kapuscinski	Does not explicitly state performance standards, but are inferred in the text especially conclusion section. For example, error on the side of caution, maintain life history patterns, maximize effective population size	Identified four genetic risks: 1) extinction, 2) loss of within-population diversity, 3) loss of between-population diversity (identity), 4) domestication divided into brood selection and differences in hatchery and natural environment that result in selection. Environmental components of traits negatively altered by the hatchery could increase genetic risks. Lists hatchery activity and genetic process involved in the four genetic risks	Recognized the impact of environmentally modified traits that could hamper survival, and inflict genetic risks. Hatchery fish should be qualitatively similar to wild
Currens	Monitoring and evaluation and, by implication, performance standards should be based on a program's specific objectives. Performance standards are implied in the text	Lists genetic risks associated with artificial production as: 1) loss of genetic diversity due to founder effects, genetic drift and hybridization, 2) selection of traits disadvantageous in nature, 3) removal of stimulus for habitat protection, 4) implementing programs with no definable end point, 5) financial uncertainty, 6) changing social values	None

Table A.2 (cont'd).

REPORT (See Literature Cited)	PERFORMANCE STANDARDS	IDENTIFICATION OF GENETIC RISKS	IDENTIFICATION OF PHYSIOLOGICAL & BEHAVIORAL RISKS
Columbia Basin Fish and Wildlife Authority	Performance standards should be identified for each objective. Some possible performance standards are indicated indirectly throughout the report (see spawning protocols for example). No specific list of performance standards	Recognizes four genetic risks: extirpation, loss of genetic variability between and within populations and genetic risks of other activities such as habitat degradation. The report gives detailed descriptions of each risk	Indirectly through general rearing and release guidelines
Smith	Adult returns in treatment streams compared to control streams appeared to be the measure of success of outplanting	The report reviewed selected literature on genetic interactions between wild and hatchery fish	None
Scientific Review Group	Recognized the need to develop performance measures consistent with objectives	Recognizes the need to detect and measure genetic change and recommends focusing attention on life history characteristics	None
Riggs	No specific performance measures	The entire report addresses genetic risks. However, it identifies three specific risks: 1) extinction, 2) loss of within-population genetic diversity, and 3) loss of between-population diversity	None

Table A.3. Information contained in recent reports relevant to supplementation: Research and Recommendations

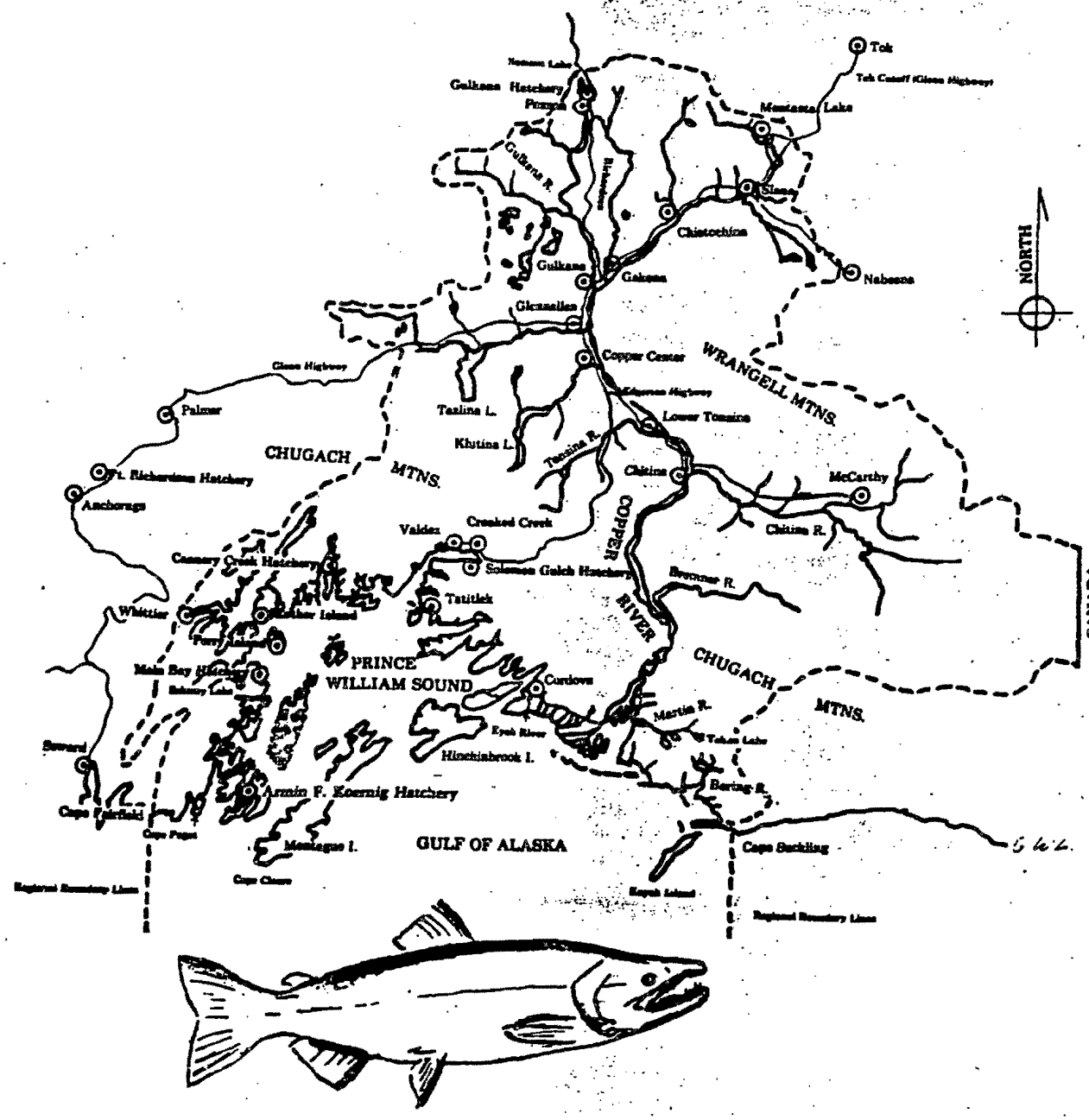
REPORT (See Literature Cited)	RECOMMENDED RESEARCH/MONITORING	RECOMMENDATIONS
Miller	Recommend R&D and monitoring listed specific research areas	GENERAL • Annual review of supplementation projects • Identify (mark) hatchery salmon • Factors related to survival need study R & D • Identify limiting factors for wild production • Impact of hatchery smolts on wild production & migration • Develop broodstock compatible with wild fish • Identify natural production parameters for supplementation stock • Explore use of streamside egg boxes
Kapuscinski	Favored the use of adaptive management. Other R&D identified: 1) causes of population decline, 2) population status, 3) proper mixes of hatchery and wild in the hatchery broodstock and natural spawning, 4) role of genetics and environment in life history, 5) several hatchery studies. Risks due to selection and environmentally altered fish. Rearing release and marking strategies, genetic risk of increased variance in family size. No overall global design	Supplementation should only be used with the goal of maintaining genetic resources as first priority. Gives detailed recommendations on choice of donor population (need to maintain similar genetic resources, life history patterns and nature of originating environments). Gives priorities for selecting target populations. Mating methods - life history, effective populations. Hatchery rearing - simulate natural incubation, simulate natural rearing, acclimate hatchery fish, monitor for fitness, resolve uncertainty. Release strategies - reduce stress, match natural age/dynamics, match size/time with natural, stocking densities. Handling returning adults
Currens	Recommend research on: theory of genetic population structure of the Columbia River salmon; develop tools for Population Viability Analysis, describing genetic diversity and addressing polygenetic variation. Also, need tools for describing historic genetic variation, studies of local and regional cultures to design education programs	Identify conservation units and set up genetic reserves

Table A.3 (cont'd).

REPORT (See Literature Cited)	RECOMMENDED RESEARCH & MONITORING	RECOMMENDATIONS
Columbia Basin Fish and Wildlife Authority	Discusses the importance of research and monitoring and gives seven steps: clearly define objective, identify, and develop experimental design, collect data, interpret results, make adjustments in program. The report also lists 11 genetic research areas	The entire report gives recommendations on several aspects of supplementation
Smith	Recommended research on outplanting but did not identify general topics	Listed recommendations obtained from the literature. The authors' own recommendations are: 1. In streams managed for wild fish, adding hatchery fish to streams to supplement natural production without affecting wild stocks may not be possible. However, these guidelines will improve the chance of success: a) use native or closely related stock, b) keep planting density within stream carrying capacity, c) introduce fish using methods that minimize hatchery-wild interactions, d) coordinate introductions of various life stages with existing wild populations, e) operate the hatchery to ensure genetic quality of the fish. 2. In streams managed for hatchery fish smolt releases can quickly increase adult abundance
Scientific Review Group	Does not list specific research priorities but strongly recommends timely organization of coordinated research on existing projects. Stream classification and modelling are recommended as aids to supplementation planning and evaluation	The report posses the central question regarding supplementation: "Under what set of conditions will supplementation of natural and wild production with hatchery production add to total production of salmon, steelhead or other target fishes over the long term?" Recommends research to answer the question
Riggs	Identifies the need for research but does not list specific research needs	The central recommendation of the report is to modify the Council's production (doubling) goal to include: maintaining the genetic resources of salmon and steelhead in native, naturalized and artificially propagated populations, with no avoidable and irreversible loss of genetic diversity resulting from management interventions or interactions

DOE/BP-01830-12
July 1992
425

16.4.1



Prince William Sound — Copper River Comprehensive Salmon Plan

Phase II 5-Year Plan (1986-1991)

Prince William Sound Regional Planning Team

16.4.1

BILL SHEFFIELD, GOVERNOR

DEPARTMENT OF FISH AND GAME

OFFICE OF THE COMMISSIONER

P.O. BOX 3-2000
JUNEAU, ALASKA 99802
PHONE: (907) 465-4100

July 22, 1986

Mr. Michael L. McCurdy
Prince William Sound
Regional Planning Team
P. O. Box 699
Cordova, AK 99574

Dear ~~Mr. McCurdy~~ Mike:

This letter is to inform the members of the Prince William Sound Regional Planning Team (PWSRPT) and you, as team chairman, of my formal approval of the final draft of the Prince William Sound - Copper River Comprehensive Salmon Plan, Phase II 5-Year Plan.

This plan has undergone a process of review and comment by the directors of the Alaska Department of Fish and Game (ADF&G) divisions responsible for managing, enhancing, and protecting Alaska's fisheries and their habitats. I understand that opportunities were also provided for extensive public review and comment and for review by ADF&G technical staff.

Based on three years of effort by the PWSRPT in preparing the plan and comments I have received on the quality of these efforts, I believe that a viable document has been produced. This Phase II Plan will be a valuable extension of the original plan, which was approved on September 20, 1983.

I offer my congratulations and appreciation to you and all members of the team for cooperating with me and the department in producing a comprehensive salmon plan for the Prince William Sound - Copper River area.

Sincerely,

Don W. Collinsworth
Commissioner

cc: Members, PWSRPT
Steven R. Behnke
Norman A. Cohen
Stanley A. Moberly
E. Richard Logan
W. Lewis Pamplin Jr.
Kenneth P. Parker
Beverly D. Reaume
Elizabeth A. Stewart

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

This is the first of a series of Phase II or 5-year salmon planning documents for the Prince William Sound, Copper-Bering River Region. This document describes projects that are needed to manage, rehabilitate and enhance the commercial, subsistence and sport salmon fisheries. The region encompasses Alaska Department of Fish and Game (ADF&G) Commercial Fisheries Management Area E and includes the marine waters and watersheds between Cape Suckling and Cape Fairfield (Figure 1, page 2). The communities of Valdez, Cordova, Glennallen, Whittier, Chitina, Copper Center, Gulkana, Gakona, Chistochina, Tatitlek, McCarthy, Paxson and Mentasta Lake are located within the region.

This document is a compilation of two Phase II plans, i.e. the Prince William Sound Area Plan and the Copper River Area Plan. The Prince William Sound Area encompasses the marine waters and watersheds from Cape Fairfield in Blying Sound to Hook Point on Hinchinbrook Island (Figure 2, page 3), and includes nine commercial salmon fishing districts, i.e. the Eastern, Northern, Unakwik, Coghill, Northwestern, Eshamy, Southwestern, Montague and Southeastern districts.

The Copper River Area encompasses the Copper River District and includes the marine waters and watersheds from Hook Point to Point Martin (Figure 3, page 4).

This plan does not include project recommendations for the Bering River Area. This area is comprised of the marine waters and watersheds of the Bering River District. This is the easternmost area in the region and is located between Pt. Martin and Cape Suckling (Figure 3, page 4). Opportunities to increase harvests are thought to be minimal at this time. Major factors limiting traditional management, rehabilitation and enhancement activities include the lack of road access, a major glacial influence in the watersheds and estuary and the lack of suitable hatchery water sources. To facilitate oil and coal development, construction of a road from Cordova has been proposed. Should this occur, the Prince William Sound Regional Fisheries Planning Team (PWSRPT) should reevaluate opportunities for improving the salmon fishery. Effort and harvest data for the Bering River Area are presented in Appendices 30 and 31 (pages A-66 through A-69).

Phase II plans are an extension of the Phase I Plan approved by the Commissioner of ADF&G in 1983. The Phase I Plan includes projections of salmon harvests and user demands, projections of shortfalls in salmon harvests, a discussion of gaps in knowledge and shortages of access routes and campground facilities, a compilation of 20-year goals and objectives and a list of alternative strategies and projects needed to achieve the goals and objectives.

Phase II plans encompass 5-year goals and objectives and describe projects that are needed during the next 5 years. Specifically, this Phase II Plan has been prepared to:

1) present an update of key data utilized or not included in the Phase I Plan;
2) establish evaluation, selection and prioritization criteria;
3) evaluate the management, rehabilitation and enhancement status of the fisheries;
4) establish 5-year goals and objectives as a start towards meeting the 20-year goals and objectives of the Phase I Plan;
5) evaluate needs and opportunities and describe potential projects for managing, rehabilitating or enhancing the salmon fishery;

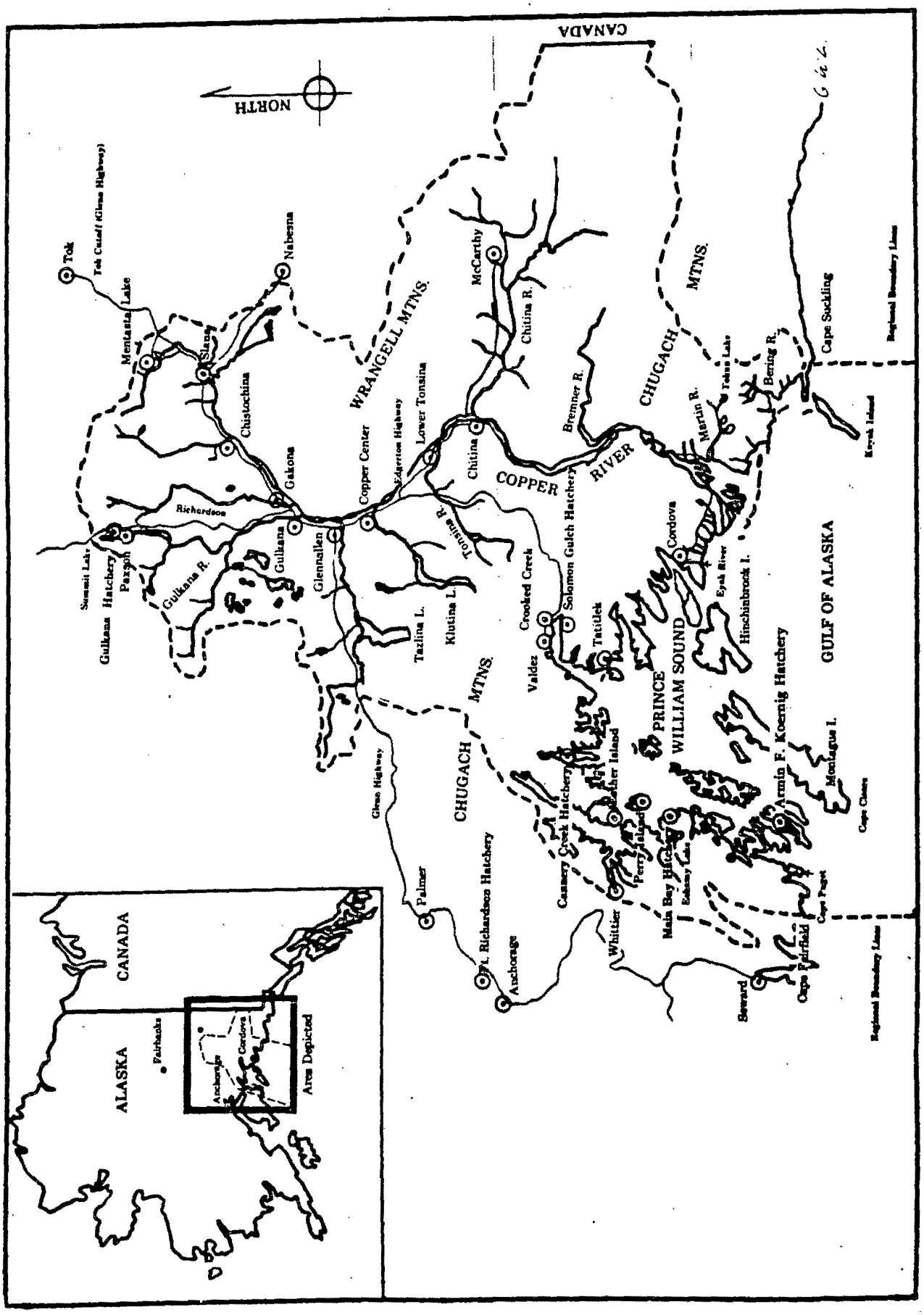


Figure 1. The Prince William Sound, Copper-Bering River Planning Region.

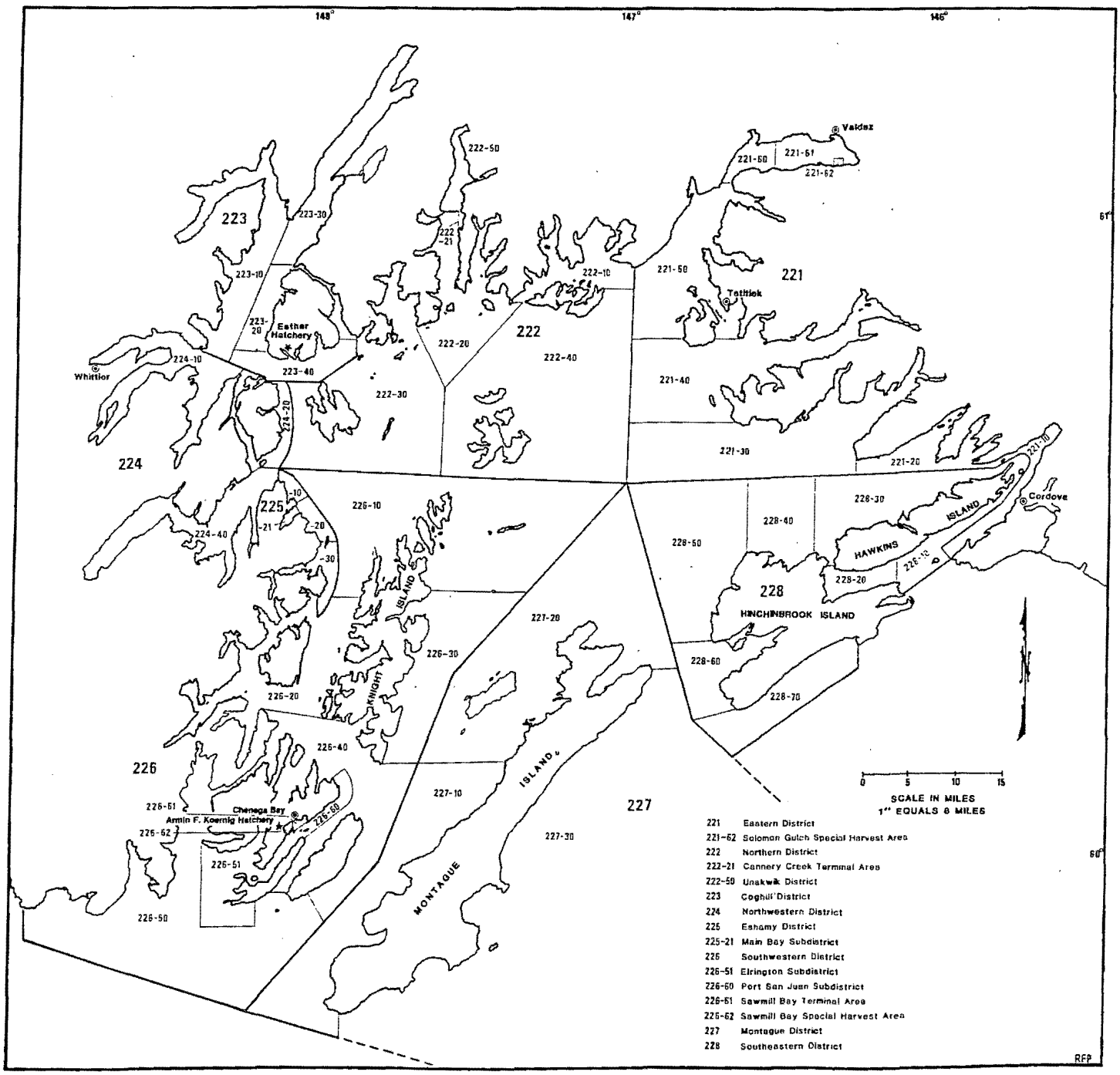


Figure 2. The Prince William Sound Area with the approximate district and subdistrict boundary lines. Lines are used for salmon fishery management and catch reporting purposes.

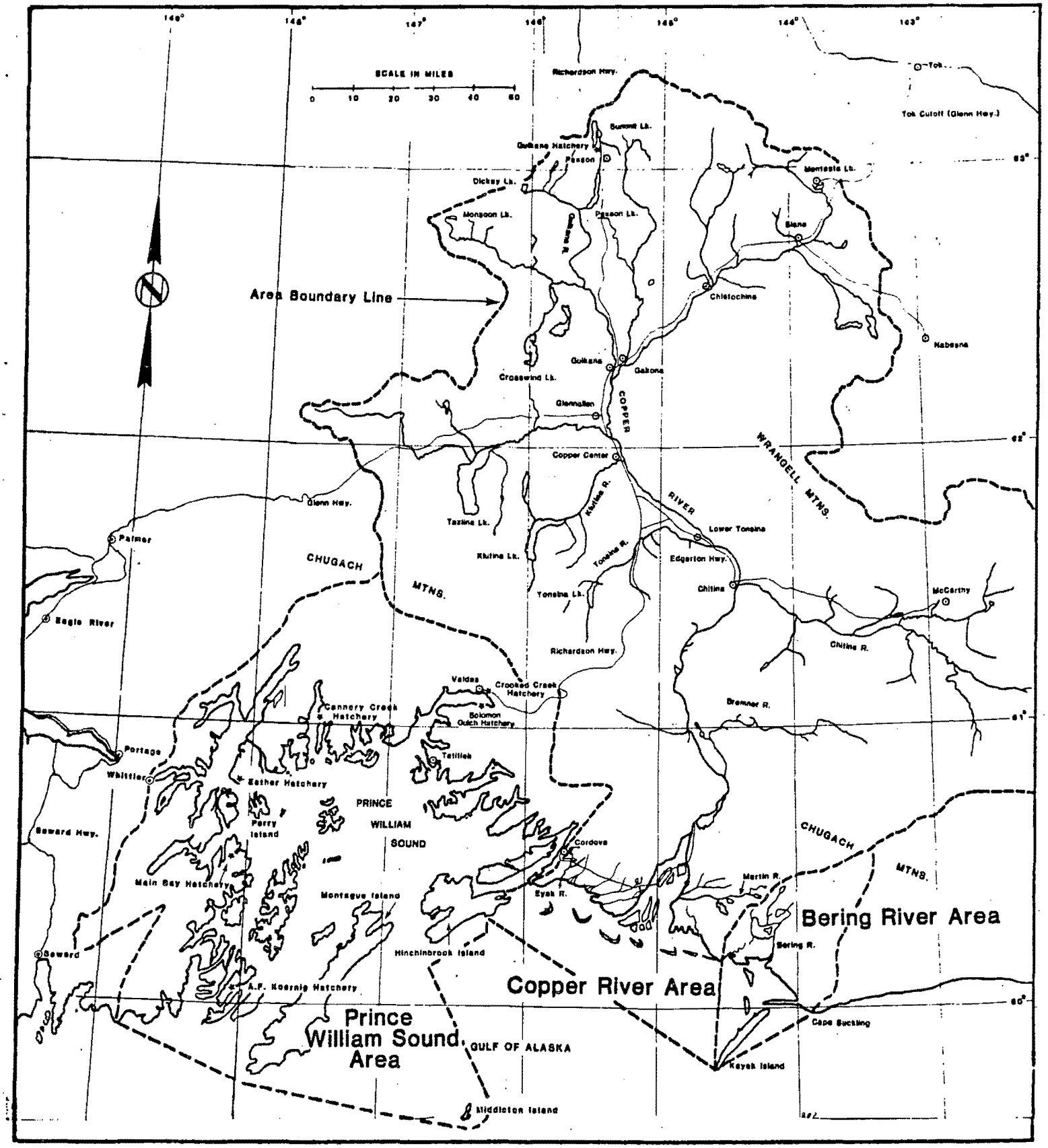


Figure 3. The Prince William Sound, Copper-Bering River Areas.

6) evaluate the potential impact of candidate projects on run timing, user-group harvests and management practices; and
7) set forth recommendations and establish priorities for new projects during the next 5 years.

Project documents contained within the Phase II plans include a listing of the agencies involved, a brief statement of the objectives and a brief narrative describing the location of the project and rationale behind the project. Phase II plans will be updated periodically during the 20-year planning period.

This document was prepared by the Prince William Sound Regional Fisheries Planning Team. According to the ADF&G Regional Planning Team Charter, each regional planning team (RPT) has a mission to "*plan for the long-term future of the salmon resource within its region. The RPT's primary responsibility is to initiate and continue an orderly process that examines the full potential of the region's salmon production capacity*" (Appendix 1 page A-1). The PWSRPT consists of a chairman, 3 representatives of the Prince William Sound Aquaculture Corporation (PWSAC) and 3 representatives of ADF&G. PWSAC also has 3 alternate members, any of whom fill in during absences of the regular PWSAC members. The following is a list of Team members as of Feb. 20, 1985. Connie Taylor was a regular PWSAC representative from the inception of the Team until February, 1985.

Mike McCurdy, Chairman, ADF&G, Division of Commercial Fisheries
Matt Luck, PWSAC
Armin Koernig, PWSAC
Bob Blake, PWSAC
Jerry McCune, PWSAC (alternate)
Ron Bowen, PWSAC (alternate)
Connie Taylor, PWSAC (alternate)
Paul Krasnowski, ADF&G, Fisheries Rehabilitation, Enhancement and Development (FRED) Division
Dennis Haanpaa, ADF&G, Division of Commercial Fisheries
Dave Watsjold, ADF&G, Sport Fish Division

The USDA Forest Service and USDI Fish and Wildlife Service are ex officio members. The Chairman has no voting power, subsequently, there are 6 voting members. The PWSRPT had a full time planner, Tom Namtvedt. He coordinated activities of the Planning Team and served as the principal writer of the plans.

Planning is an ongoing function, and the RPT will meet at least once annually and as many times as necessary to:

1) update the Phase I and Phase II plans;
2) evaluate ongoing rehabilitation and enhancement projects;
3) discuss new projects considered for implementation;
4) evaluate new opportunities which may be investigated as potential projects;
5) review and comment on both private non-profit (PNP) and ADF&G annual hatchery management plans;
6) review PNP hatchery permit applications and proposed permit alterations and make recommendations to the Commissioner;
7) review and comment to the Commissioner on PNP permit suspensions or revocations proposed by the Commissioner;
8) review the recent year's events relating to the salmon fishery of the region; and
9) discuss industrial development projects and potential impacts of these projects on salmon.

Appendix 2 (page A-9) presents State regulations governing PNP hatcheries, regional planning teams and regional and hatchery plans.

To assist the PWSRPT, the Prince William Sound Project Development Committee was formed on January 22, 1985. The Committee will provide the following support services to the PWSRPT.

1) Projects for short range implementation will be planned and developed to coordinate hatchery production, transport, marking, and evaluation among the various divisions and agencies involved.

2) Projects identified in the Regional Plan for possible future implementation will be reviewed periodically from a technical standpoint.

Committee members currently include:

Bill Hauser, current Chairman, ADF&G, FRED Division
Kelly Hepler, ADF&G, Sport Fish Division
Kurt Nelson, USDA Forest Service, Anchorage
Dennis Haanpaa, ADF&G, Division of Commercial Fisheries
Jeff Koenings, ADF&G, FRED Division, Limnology Section
Brian Allee, PWSAC
Tim McDaniel, ADF&G, FRED Division
others as needed

The public review draft of the Copper River Area Plan was completed in 1984 and the public review draft of the Prince William Sound Area Plan was completed in 1985. Because of time constraints, catch and hatchery data for 1985 are not included.

Public Participation in the preparation of this Phase II Plan was solicited through the use of open RPT meetings and the wide-spread distribution of the review draft plans.

RPT meetings were held in Anchorage and Cordova:

November 8-9, 1983	Anchorage
December 12-13, 1983	Cordova
January 19-20, 1984	Anchorage
February 21,22,29, 1984	Anchorage
April 17-18, 1984	Cordova
October 22-23, 1984	Cordova
November 27, 1984	Anchorage
January 21-22, 1985	Anchorage
February 20, 1985	Cordova
April 5-6, 1985	Cordova
January 7-8, 1986	Cordova

RPT meetings were advertised as public meetings in newspapers published in Anchorage, Cordova, Fairbanks, Copper Center and Valdez.

A total of 500 copies of Copper River Area Plan and 500 copies of the Prince William Sound Area Plan were distributed for public review. The Copper River Area Plan was available at ADF&G offices in Anchorage, Cordova, Glennallen and Fairbanks. Copies were also available at the offices of Cordova District Fishermen United (CDFU) and

PWSAC. The Prince William Sound Area Plan was available at ADF&G offices in Anchorage, Cordova and Glennallen as well as offices of CDFU, PWSAC and the Valdez Fisheries Development Assn. (VFDA). Readers of the Copper River Area Plan were instructed to submit comments to the RPT by November 30, 1884. Readers of the Prince William Sound Area Plan were instructed to submit comments by December 27, 1985. The RPT convened on January 7 and 8, 1986, and each comment was reviewed by the Team. The plan was amended as deemed necessary and was submitted to the Commissioner of ADF&G for review and approval.

2.0 AREA PROFILE

The Prince William Sound and Copper River areas combined contain approximately 34,000 sq. miles of land, streams, lakes and marine waters. Both areas were heavily glaciated in the past. The areas are, however, distinctly different.

The Prince William Sound Area is a coastal embayment encompassing approximately 9,000 sq. miles. It is characterized by numerous islands, numerous short streams, long fiords and spectacular mountains, snowfields and glaciers. Many tide-water glaciers are located in the Northern and Coghill districts, including one of the largest tide-water glaciers on the Pacific coast, the Columbia Glacier. Four species of Pacific salmon are indigenous. Pink salmon are dominant followed by chum, sockeye and coho salmon. King salmon are few in number and are not known to spawn in the streams of the Sound. Many of the 551 documented salmon spawning streams in the Sound are usable by salmon only near tide water. Pink and chum salmon stocks capable of successfully spawning in intertidal waters have subsequently evolved. A major commercial salmon fishery occurs in the area, and the area is popular for sport fishing, boating and other forms of recreation. The Sound presents an outstanding opportunity for wilderness recreation and tourism.

The Copper River Area encompasses approximately 25,000 sq. miles and is largely comprised of one major drainage, the Copper River drainage. The Copper River is the fifth largest river in Alaska and drains portions of Alaska's interior as well as the Yukon Territory, Canada. The Copper River has formed a broad delta at its terminus on the Gulf of Alaska. Three species of Pacific salmon have significant spawning populations in the area. Sockeye salmon are dominant followed by coho and king salmon. Sockeye salmon spawn in both the headwaters of the Copper River and in drainages of the Copper River Delta. Coho salmon occur in the lower reaches of the Copper River as well as the Delta. King salmon spawn near the headwaters of the Copper River. These salmon resources are heavily utilized by commercial, subsistence and sport fishermen. A major commercial fishery occurs in the estuary. The Upper Copper River drainage is popular for subsistence and sport fishing.

2.1 CLIMATE

The climate of Prince William Sound is largely influenced by the Gulf of Alaska and is characterized by relatively heavy precipitation, cool summers, moderate winters and strong surface winds in most locations. The northernmost ice-free ports in Alaska, i.e. Valdez and Whittier, are located in the Sound (Figure 4, page 9). The warm, moist climate is important to the maintenance of pink and chum salmon in numerous streams.

The climate of the Copper River Delta is similar to that of the Sound. The Upper Copper River, however, is characterized by greater temperature differences between summer and winter, light precipitation and light surface winds.[1/*]

2.2 EARTHQUAKE IMPACTS

The Prince William Sound Area contains numerous tectonic faults and experienced major elevation changes during the Good Friday earthquake of March 27, 1964. In the north-

*Footnotes to the text are presented in the Appendix on page A-81.

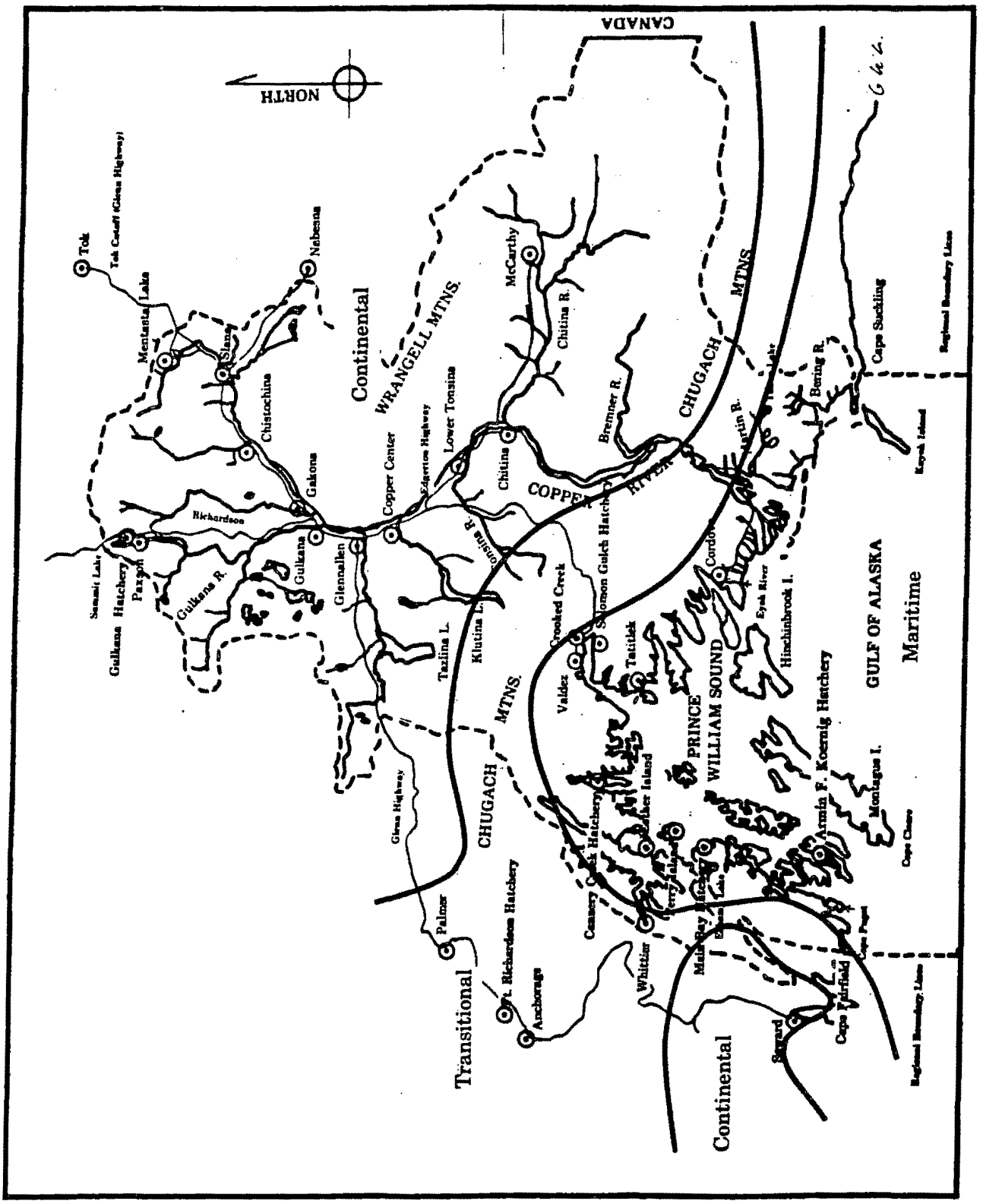


Figure 4. Climate zones of the Prince William Sound, Copper-Bering River Region (Adapted from the Joint Federal-State Land Use Planning Commission, 1974).

western corner of Prince William Sound, land subsided as much as 8 ft. (Figure 5, page 11). The majority of the Sound was raised; however, and an area on the southwest side of Montague Island was uplifted 38 ft. Salmon habitat was severely disrupted; and, as a result, salmon stocks were temporarily reduced in size or destroyed. Numerous streams on Montague Island that produced chum salmon prior to the earthquake are no longer productive.

The impact of the earthquake on salmon habitat in the Copper River Area was minimal. While the Copper River Delta was raised 6 to 10 ft., insignificant elevation changes occurred at the headwaters of the Copper River.

2.3 POPULATION

The Prince William Sound Area contains the communities of Valdez, Cordova, Whittier, Tatitlek and Chenega Bay (Figure 1, page 2). Minor settlements are also to be found at Ellamar, Cannery Creek, Main Bay, Knight Island, Evans Island, Latouche Island, Hinchinbrook Island and Hawkins Island. The population of the area in 1980 was 6,201 people.[2/]

The Copper River Area contains the communities of Glennallen, Chitina, Copper Center, Gulkana, Gakona, Chistochina, McCarthy, Paxon and Mentasta Lake. Cordova is situated on the watershed boundary between the Prince William Sound and Copper River areas. In 1980, the population of this area, excluding Cordova, was 1449 people.[2/]

2.4 LAND OWNERSHIP

The majority of the land area of Prince William Sound is contained within the Chugach National Forest (Figure 6, page 12). Major components in the northwestern corner of the area have been recommended for "Wilderness" classification under Wilderness Alternative J. Other land owners include the Chugach Natives, Inc., Eyak Village Corp., Tatitlek Village Corp., Chenega Village Corp., State of Alaska, municipal governments and private individuals. The USDA Forest Service maintains recreational cabins in 14 locations. The Eyak Village Corp. maintains one recreational cabin. State marine parks have been established in 7 locations (Figure 7, page 13).

The majority of land in the Copper River Area is also owned by the Federal Government (Figure 8, page 14). Land owners include the USDI Park Service, USDI Bureau of Land Management (BLM), USDA Forest Service, State of Alaska, AHTNA Native Corp., Chugach Alaska Corp., Eyak Village Corp., municipalities and private individuals. The USDA Forest Service maintains recreational cabins in 4 locations.

2.5 ACCESS

Access to the Prince William Sound and Copper River areas is available by car, commercial airlines, train, small aircraft and/or boat. Access within Prince William Sound is largely limited to small aircraft and boat. Whittier is accessible from Anchorage via the Seward Highway and the Alaska Railroad. Valdez and the communities of Upper Copper River drainage are accessible by car via the Richardson and Glenn highways from Anchorage and Fairbanks and the Alaska Highway from the lower 48 states (Figure 1, page 2). Cordova and Tatitlek are only accessible by boat and aircraft.

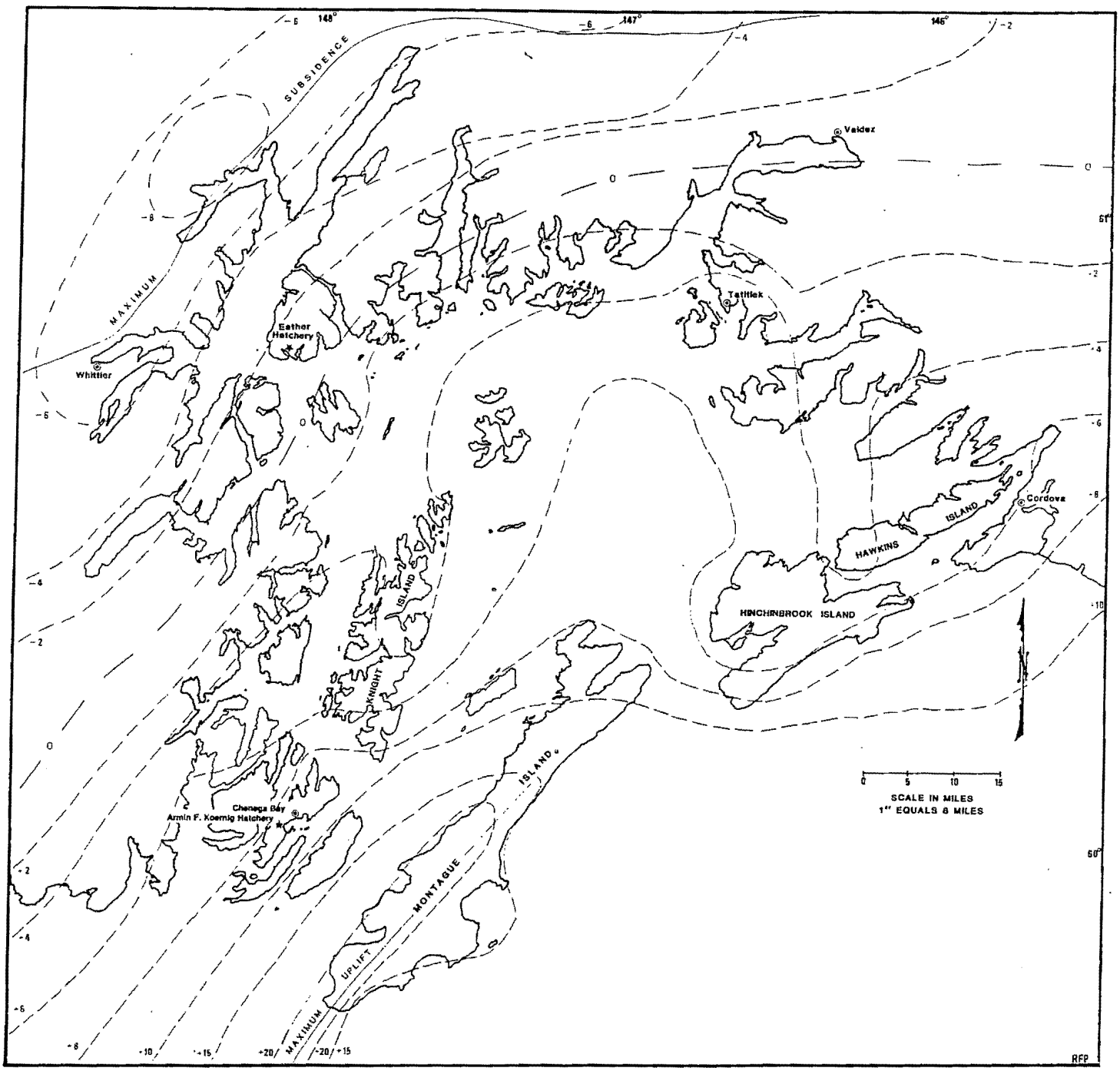


Figure 5. Approximate zones of uplift and subsidence (in feet) associated with the Good Friday earthquake of 1964 (Adapted from Blanchet, 1983).

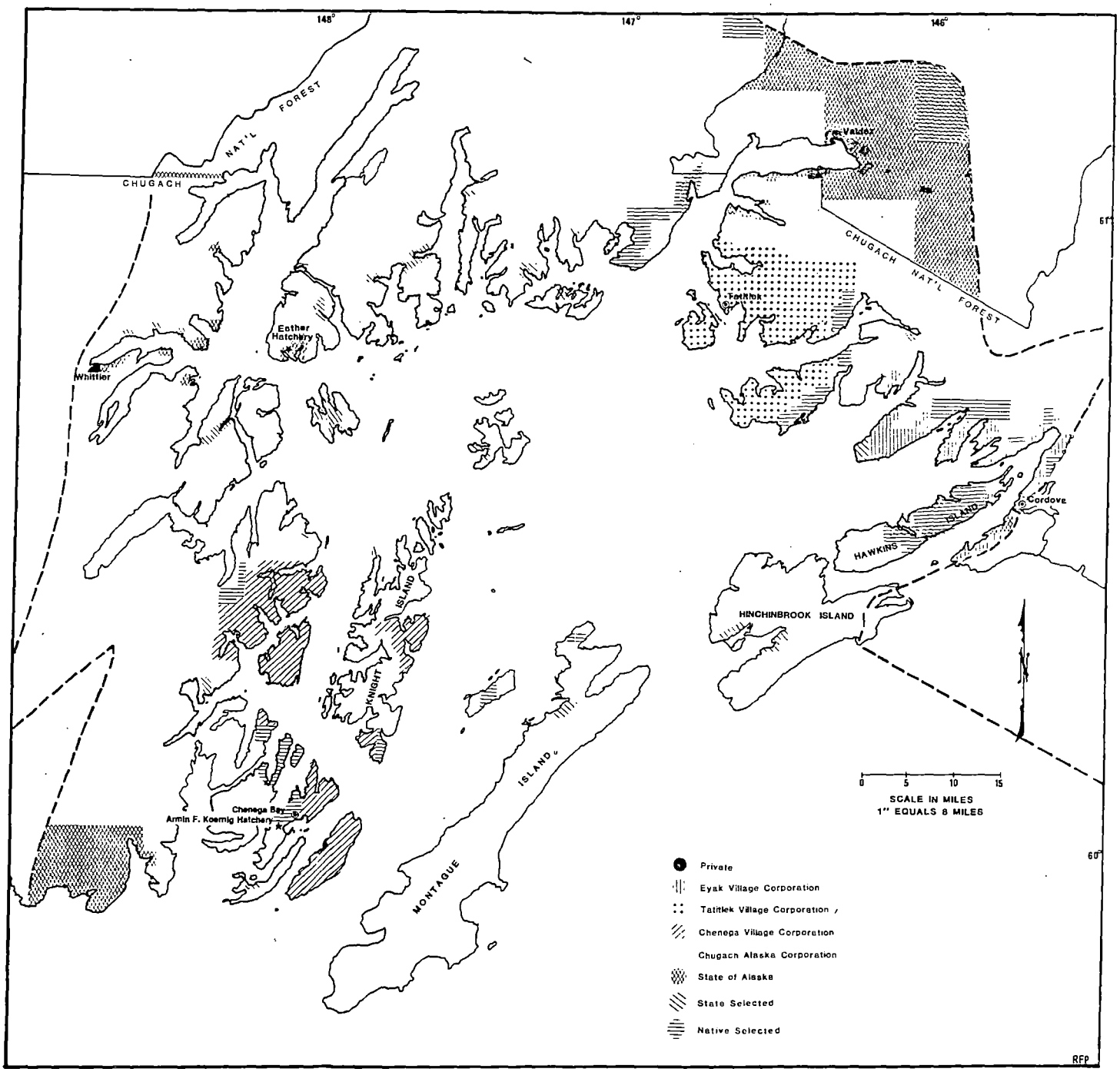


Figure 6. Land owners of the Prince William Sound Area.

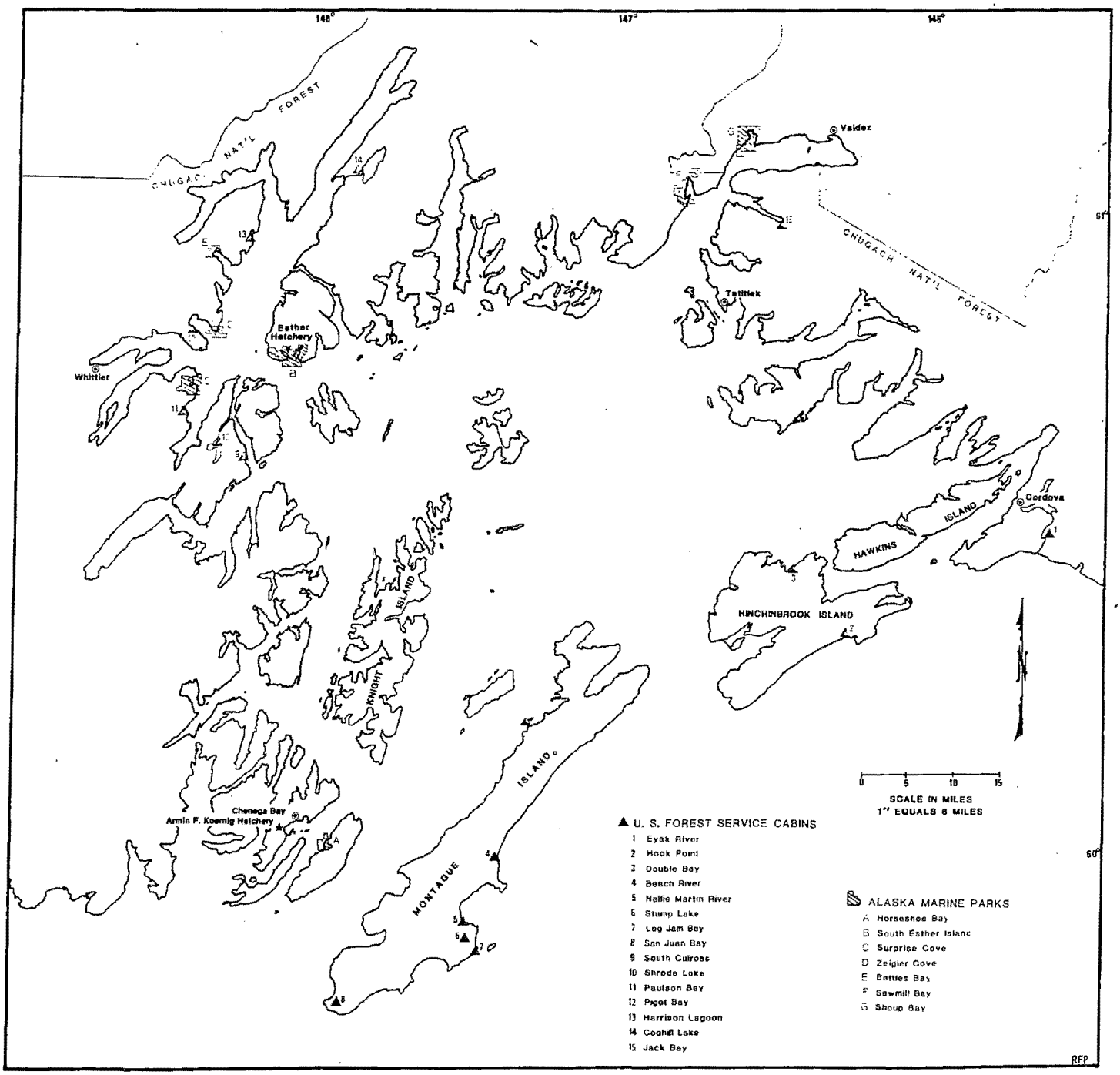


Figure 7. Public recreational facilities in the Prince William Sound Area.

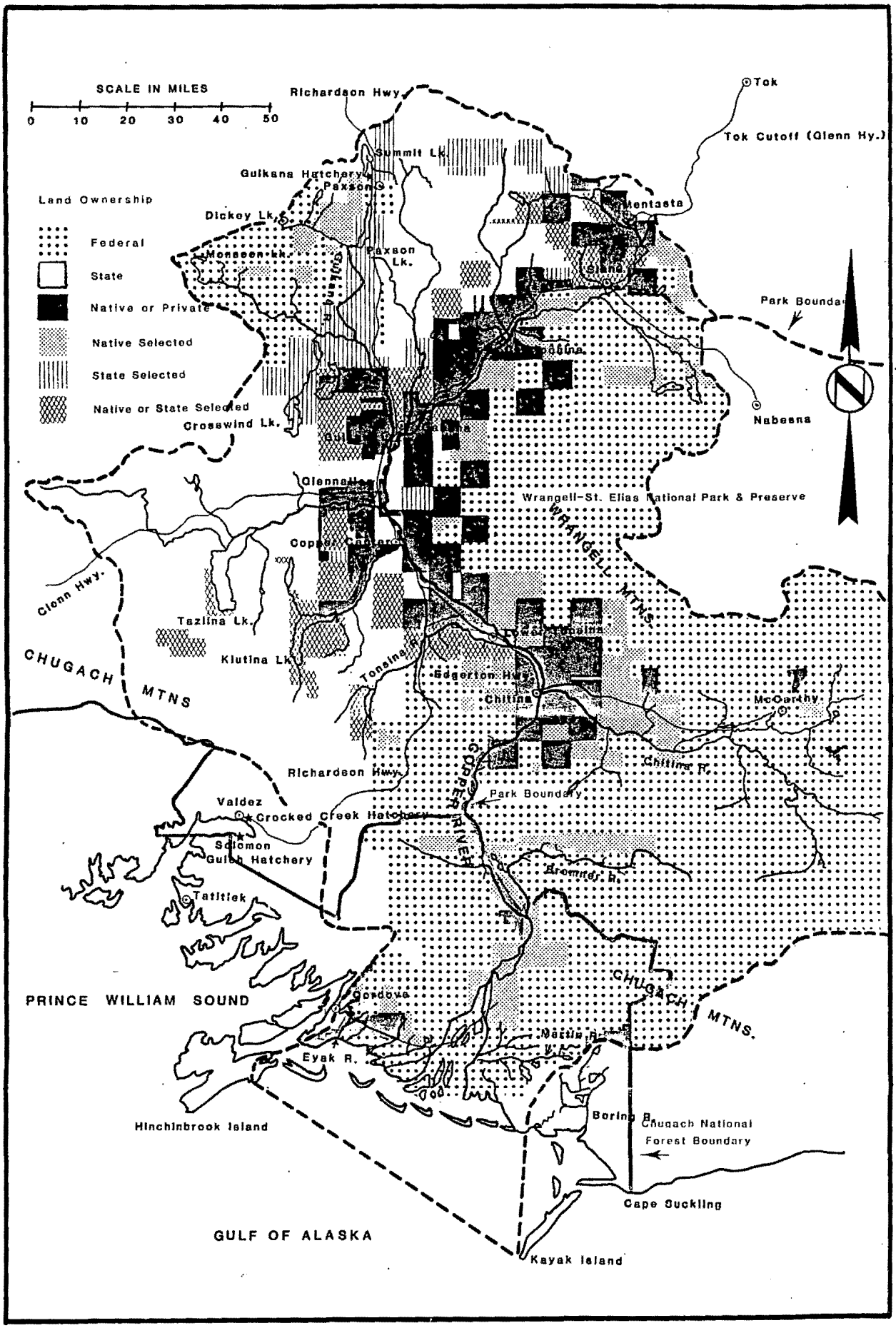


Figure 8. Land owners of the Copper River Area.

The Alaska Ferry system maintains scheduled service between Whittier, Valdez, Cordova and occasionally Seward. Construction of a highway tunnel between Portage and Whittier has been proposed, and this would greatly facilitate access to Whittier. Boat access, however, would still be limited because of the lack of moorage in Whittier. To alleviate this problem, construction of a new harbor at Shotgun Cove and an access road from Whittier has been proposed. Road access to Cordova may occur in the near future if funds are allocated to complete the Copper River Highway. This would link Cordova with the Richardson, Glenn and Alaska highways.

2.6 NONFISHERIES RESOURCES

Nonfisheries resources with development potential consist of timber and various minerals. No significant petroleum deposits are known to occur in the Prince William Sound or Copper River areas. An exploratory oil well is presently being drilled near Katalla in the Bering River District. Should major fields of oil be discovered in the Bering River District or the Gulf of Alaska, support bases may develop at Cordova and possibly Port Etches on Hinchinbrook Island.

Tracts of merchantable timber consisting of Sitka spruce and hemlock are located in numerous locations in Prince William Sound (Figure 9, page 16). Native corporations and the USDA Forest Service have plans to harvest timber. Tatitlek Village Corp. plans, during the next 5 years, to harvest 125,000,000 bd.ft. of timber in an area between Knowles Head and Irish Cove. Eyak Village Corp. is planning to sell 11,000,000 bd.ft. of timber in Simpson Bay and Sheep Bay. Chugach Alaska, Inc. owns large tracts of timber in the vicinity of Patton Bay and Beech River on Montague Island, and harvesting may occur in the near future. The Forest Service has tentative plans to sell, during a 10-year period, 27,000,000 bd.ft. of timber in the Eastern District and 10,000,000 bd.ft. of timber in the Coghill District.[3/]

Timber harvesting in the Copper River Area is largely restricted by lack of access and land classification. The Eyak Village Corp. is planning to sell 15,000,000 bd.ft. of timber in the Cabin Lake-Sheridan Glacier area. The State of Alaska has sold cutting rights to two small tracts of white spruce near Copper Center and Glennallen. These tracts total approximately 620,000 bd.ft. A large area of merchantable timber is located within the Chugach National Forest in the Martin River Valley. The USDA Forest Service has no plans at this time to sell any timber in this tract or in other areas east of the Copper River. No roads enter the Martin River Valley, and, without access, a sale in this area is not economically attractive.[3/4/]

Mineral resources of the Prince William Sound area include deposits of copper, zinc, gold, manganese, nickel, silver, antimony and lead. Mining was an important component of the area's economy during the first half of the twentieth century; however, there are no active mines at this time. Major portions of Knight and Latouche islands as well as small areas in the vicinity of Valdez Arm, Port Fidalgo and Port Wells have been classified as having moderate to high mineral potential (Figure 10, page 18). A prominent belt of copper-bearing volcanic rock traverses the area from Elrington Island across Knight Island to Valdez. Major copper mines were located at Latouche Island and Ellamar during the first part of the century. Numerous gold mines and prospects are located between Valdez and the Columbia Glacier. Three gold mines were worked in Coghill District.[5/]

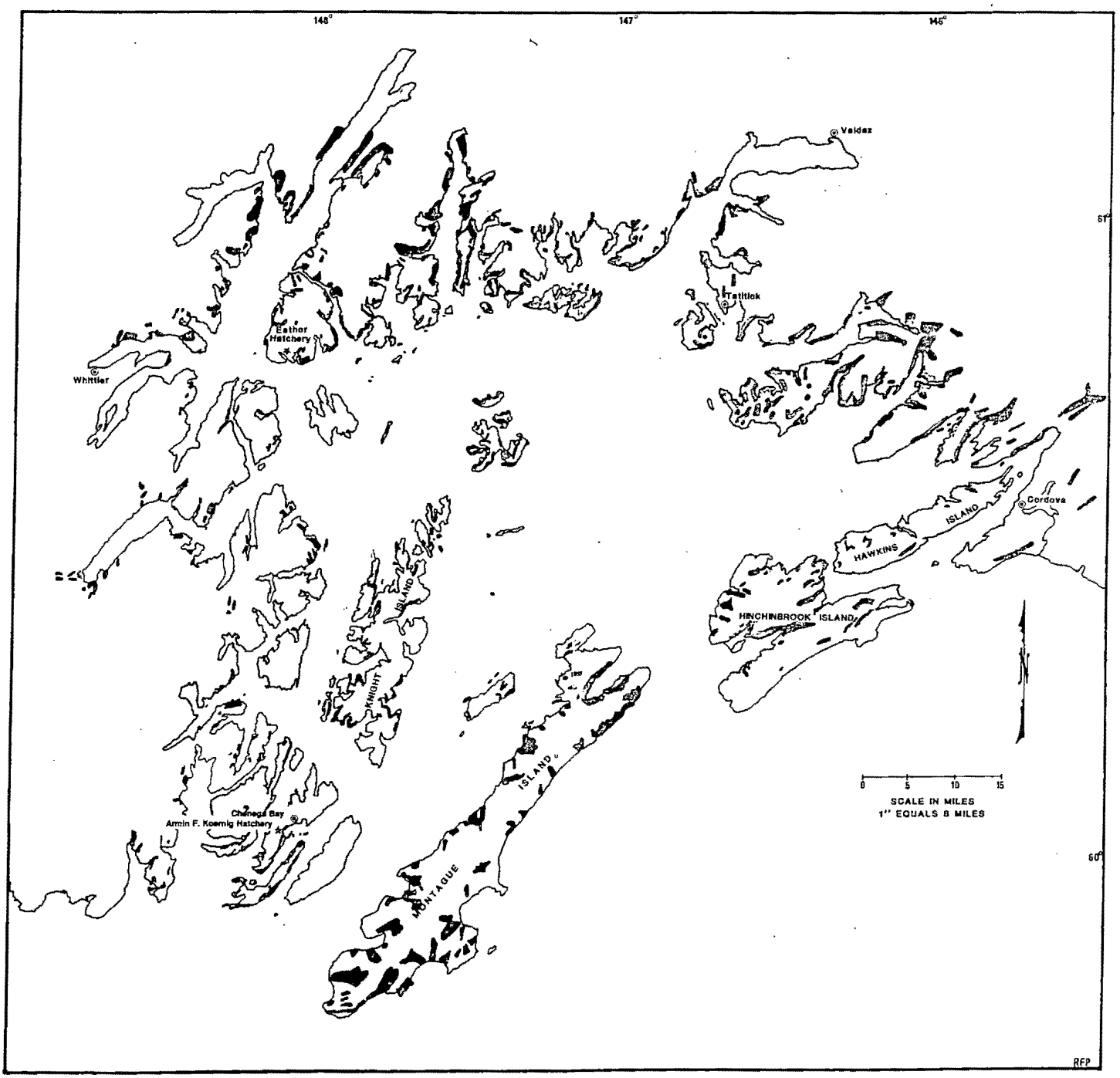


Figure 9. Areas containing merchantable timber in the Prince William Sound Area.

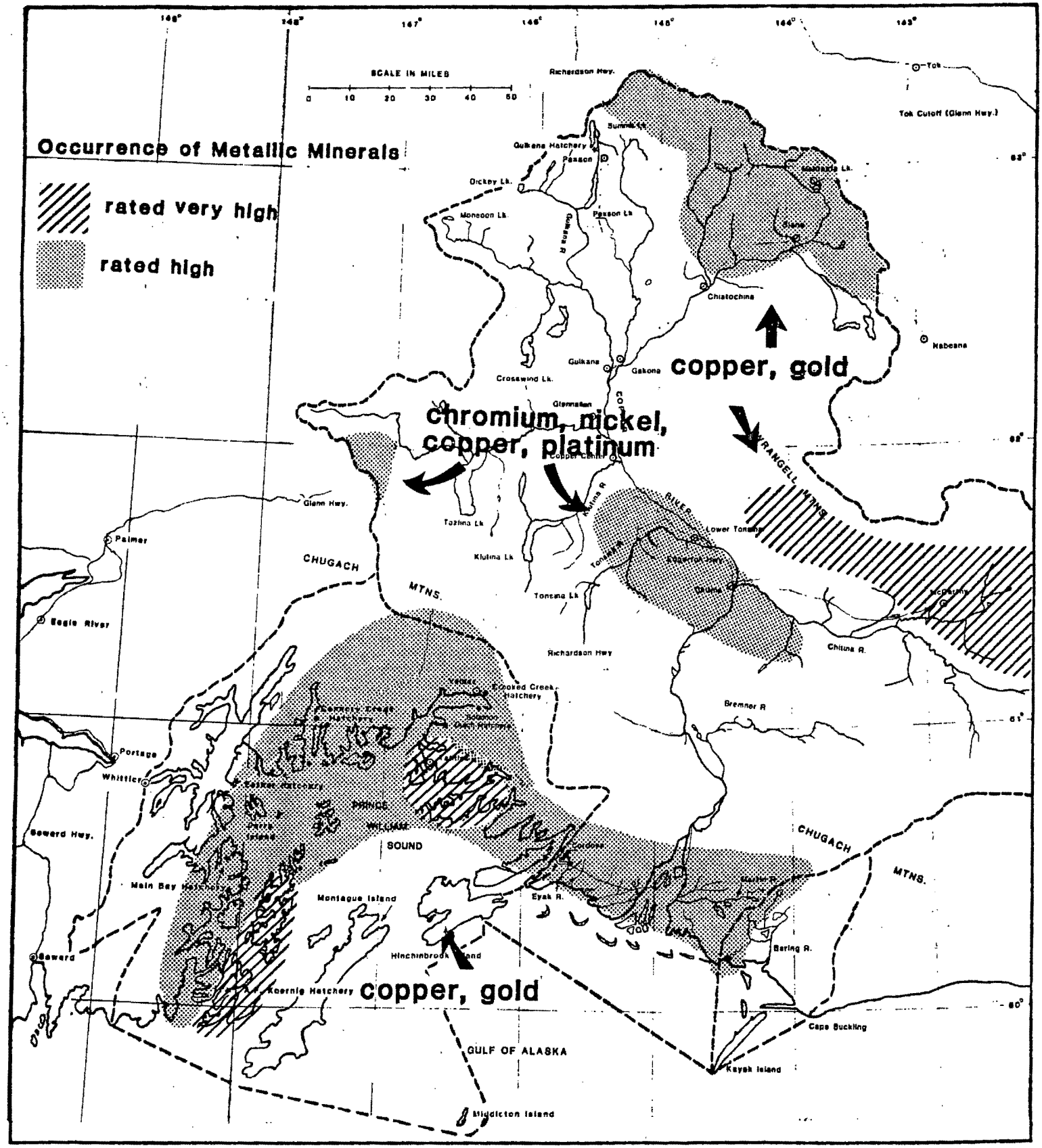


Figure 10. Areas containing mineral deposits in the Prince William Sound, Copper-Bering River Region (Adapted from the Joint Federal-State Land Use Planning Commission, 1974).

Minerals of the Copper River Area include copper, gold, platinum, chromium and nickel. Portions of the south slope of the Wrangell Mountains have been rated as having high to very high mineral potential (Figure 10, page 17). The Copper River Delta and a portion of the north slope of the Chugach Mountains in the Tonsina-Chitina area have been rated as having high mineral potential. A major copper mine was operated during the first part of this century at McCarthy.[1/]

2.7 FISHERIES RESOURCES

Fisheries resources of commercial value within Prince William Sound include salmon, herring, halibut, black cod, king crab, Tanner crab, Dungeness crab and shrimp. Large populations of juvenile pollock also occur within the Sound as do small concentrations of nearly all near-shore species.[6/]

Species of commercial value within the Copper River Area include salmon, halibut and Dungeness crab.

In the outside waters between Middleton Island and the outer islands of the Prince William Sound and Copper River areas, large populations of Pacific ocean perch, Pacific cod and black cod are present.[6/] These fish have been harvested and processed primarily by foreign fishermen.

2.7.1 Salmon Fishery

The presence of salmon has been documented in the following number of drainages in the Prince William Sound, Copper-Bering River Region.

Table 1. Number of drainages in which the presence of salmon has been documented in the Prince William Sound, Copper River and Bering River Region.[1/]

	Drainages[2/]				
Area	King	Sockeye	Coho	Pink	Chum
Prince William Sound		22	47	511	192[3/]
Copper River	1	6	10	4	2
Bering River		4	4	3	2
Total	1	32	61	518	196

[1/] Alaska Department of Fish and Game (1985).
[2/] In this table, a drainage is the entire stream system which flows directly into the ocean.
[3/] Includes 13 streams on Montague Island which, prior to the 1964 earthquake, were utilized by chum salmon. These streams, in recent years, have been devoid of chum salmon.

Salmon spawning and rearing areas in the Prince William Sound Area are depicted in Appendices 3 through 6 (pages A-27 through A-30). Salmon spawning and rearing areas in the Copper River area are depicted in Appendices 7 through 9 (pages A-31 through A-33).

2.7.1.1 Fishermen

Salmon resources of the region are of major importance to the local purse seine, drift gill net and set gill net fishermen as well as subsistence and sport fishermen of southcentral Alaska.

2.7.1.1.1 Commercial Fishermen

The total number of commercial fishermen participating annually in the salmon fishery is difficult to accurately determine. The following table defines the current number of limited entry permits for commercial salmon fishing in Area E, the Prince William Sound, Copper-Bering River Region.

Table 2. Number of limited entry permits for commercial salmon fishing in the Prince William Sound, Copper-Bering River Region, Area E, as of 4/17/85.[1/]

Gear Type	Permanent Permits	Interim Permits[2/]	Total
Power Purse Seine	264[3/]	3	267
Drift Gill Net	541	7	548
Set Gill Net	30	0	30

[1/] Data provided by the Alaska Commercial Fisheries Entry Commission.
[2/] Interim permits have been issued to fishermen whose qualification for permanent permits is being contested by the Commercial Fisheries Entry Commission.
[3/] These do not include PNP hatchery seine permits. PWSAC and the Valdez Fisheries Development Assn. (VFDA) each hold one hatchery seine permit. These are only usable in their special harvest areas.

The number of permits has been regulated at these approximate levels by the Alaska Commercial Fisheries Entry Commission since 1974. Numerous fishermen hold more than one type of permit and participate in various capacities during the season. Few data are available on the number of crew members taking part in the fishery. Estimates derived in 1979 suggest that the average seine boat has a crew of 4.2 fishermen, including the permit holder, and that the average drift gill net boat has a crew of 1.3 fishermen, including the permit holder.[7/] No estimates have been made of the number of set gill net crew members.

Commercial harvests in Prince William Sound and Copper River areas were first reported in 1889 (Appendix 10 and 11, pages A-34 through A-39). Legal commercial salmon fishing gear, prior to Statehood, consisted of fish traps, seines, gill nets and troll gear. Legal gear currently consists of power purse seines, drift gill nets and set gill nets. Seines are allowed in all districts except the Copper River, Bering River and Eshamy districts. Drift gill nets may be used in the Copper River, Bering River, Unakwik, Coghill and Eshamy districts. Set gill nets, within the region, are restricted to the Eshamy District. Set gill net permit holders may also fish in the Yakataga District of the Yakutat Area. This district is not included in the Prince William Sound, Copper-Bering River Region.[8/]

Since 1960, purse seine fishermen have generally harvested the majority of salmon caught annually in the region. Drift gill net harvests have generally been secondary in magni-

tude. The region's drift gill net fishermen have earned the majority of their salmon drift gill net income in the Copper River and Bering River districts (Appendix 12, page A-40).

The minimum income requirements or minimum demand of commercial fishermen were estimated in the Phase I Plan. A comparison of these data with estimates of recent earnings for each gear group indicates that shortfalls have occurred annually.

Table 3. A comparison of the earnings of seine, drift gill net and set gill net fishermen with estimates of minimum demand, Prince William Sound, Copper-Bering River Region, 1982 through 1984.[1/]

Gear	Estimated Gross Earnings 1982	1983	1984	Estimated Minimum Demand
Seine	$20,286,800	$14,122,500	$19,145,900	$32,940,000
Drift Gill Net	$22,019,400	$10,232,700	$20,031,700	$27,050,000
Set Gill Net	0	$194,500	$389,400	$480,000
Total	$42,306,200	$24,549,700	$39,837,000	$60,470,000

[1/] Estimates of minimum demand based on a fisherman's income survey conducted by Larsen (1980), a fisherman's survey conducted by the Prince William Sound Regional Planning Team (1983) and 1981 harvest data.

2.7.1.1.2 Subsistence Fishermen

Legal subsistence fishing gear in the region has consisted of dip nets, fishwheels, gill nets and seines. Dip nets and fishwheels have been restricted to the Upper Copper River and gill nets and seines have been restricted to marine waters open to commercial fishing with these gear types. Subsistence fishing is limited to Alaskan residents and is conducted on a permit basis.

Harvest data have been compiled for 3 locations within the region: the Upper Copper River, Copper River Delta and Prince William Sound. The majority of fishing effort and catches has occurred in the Upper Copper River drainage.

During 1960 through 1984, an average of 2,584 dip net permits, 303 fishwheel permits, 47 Copper River Delta gill net permits and 12 Prince William Sound permits were issued annually (Appendices 13 through 15, pages A-41 through A-43). It is estimated that dip net fishermen harvested an average of 18,131, salmon, fishwheel fishermen harvested an average of 12,228 salmon, Delta gill net fishermen harvested an average of 240 salmon and Prince William Sound seine or gill net fishermen harvested an average of 256 salmon.

In the Phase I Plan, subsistence demand in the year 2002 was estimated by use of a questionnaire, 1981 permit data and population projections. Fishermen were asked the following questions: "*How many subsistence salmon did you or your family catch in this region in 1981*", "*Was this adequate*?" and "*How many salmon do you and your family need per year*?"

The average catch of satisfied 1981 fishermen was estimated to have been the average "minimum demand". The average "need" of all respondents was estimated to have been the "high demand." These data were expanded by the number of 1981 permit holders for each gear type and by a population growth factor. It was projected that, by the year 2002, the population of southcentral Alaska and the number of permit holders would increase by 43 percent. Adjustments were made for the number of fishermen who also were sport fishermen. The number of subsistence permits issued annually since 1981 has generally been greater than the 20-year projected level.

Table 4. A comparison of subsistence permits issued in 1981 with the average number of permits issued during 1982 through 1984, Prince William Sound, Copper-Bering Region.

	Permits Issued		
User Group	1981	Average 1982-1984	Increase %
Dip Net	3,555	5,933	67%
Fishwheel	523	573	10%
Delta Gill Net	72	104	45%
PWS Gill Net/Seine	12	23	92%
Total	4,162	6,633	59%

A comparison of average harvest data for each gear group and estimates of minimum demand, indicates that only the minimum demand of one user group, i.e. fishwheel fishermen, has been attained in recent years (Table 5, page 22).

Table 5. A comparison of reported catch per subsistence permit, 1970-1981, 1982, 1983 and 1984 and estimates of minimum demand for the dip net, fishwheel and gill net/seine fishermen, Prince William Sound, Copper-Bering River Region.

	Dip Net	Fishwheel	Gill Net/ Seine
1970-1981			
average annual catch all species	17,648	10,502	227
average number of permits	3,242	380	50
catch per permit	5.4	27.6	8.9
1982			
catch of all species	62,614	38,120	945
number of permits issued	5,475	615	143
catch per permit	11.4	62.0	6.6
1983			
catch of all species	72,257	35,971	400
number of permits issued	6,911	630	113
catch per permit	10.5	57.1	3.5
1984			
catch of all species	47,306	20,597	572
number of permits issued	5,415	475	126
catch per permit	8.7	43.4	4.5
Estimated Minimum Demand	22.8	48.0	32.5

2.7.1.1.3 Sport Fishermen

Sport harvest and effort data have been derived for numerous areas since 1977. These data have been collected by use of state-wide harvest surveys. In the Phase I Plan, the minimum and high demand of sport fishermen were also estimated. These fishermen were asked: "*How many salmon did you catch on sport gear in 1981 in the region*?", "*Overall, was your 1981 sport salmon catch adequate*?" and "*As a sport fisherman, how many of the following fish do you need to catch per season to feel satisfied*?" The minimum demand was estimated to have been the average catch by species of satisfied respondents. The high demand was estimated to have been the average desired catch by species by all respondents. These data were expanded by estimates of the number of anglers who fished for salmon in the region in 1981 and by a 43 percent population growth factor.

Few data are available on the number of anglers and their average annual catch. The number of anglers who fished in the region has only been estimated for 1981. During that year, it was estimated that 5,000 anglers fished for salmon in the region. Estimates of fishing effort, i.e. the numbers of days or parts thereof spent fishing for all species of fish, indicate that sport fishing effort in both marine and freshwater areas reached record highs in 1984. An estimated 40,670 "days" were spent fishing in marine waters and 51,042 "days" were spent fishing in freshwater areas containing anadromous salmon (Appendix 16, page A-44).

In 1984, only chum salmon catches were of record high magnitude. Catches of other species were slightly above the 1977 through 1983 average (Appendix 16, page A-44).

Table 6. A comparison of sport fishing effort and harvest data for the Prince William Sound, Copper-Bering River Region, 1981 through 1984.[1/]

Year	Days Fished[2/]	King	Sockeye	Coho	Pink	Chum
1981	72,443	2,041	3,705	8,791	14,774	972
1982	71,021	2,201	7,639	11,392	12,924	1,204
1983	75,875	3,175	7,250	10,489	14,676	1,269
1984	91,712	3,198	7,344	10,859	14,488	1,770

[1/] Adapted from Mills (1982, 1983, 1984 and 1985).
[2/] Includes days spent fishing for non-salmon species.

2.7.1.2 Fishing Districts

The following is a brief description of the commercial salmon fishing districts in the region.

2.7.1.2.1 Eastern District

The Eastern District lies in the northeastern corner of Prince William Sound and spans an area between the Copper River District and Pt. Freemantle near the Columbia Glacier (Figure 2, page 3). The communities of Cordova, Valdez and Tatitlek are contained within the watershed boundary of the district. One major salmon hatchery, the Solomon Gulch Hatchery, is located in Valdez.

Escapement data suggest that this district is the major pink and chum spawning area within the Sound (Appendices 17 and 18, pages A-48 and A-49). It is difficult to determine the harvest and total production of stocks destined for individual districts. Fish are commonly intercepted at numerous locations throughout the Sound, and the ability to identify the origin of the numerous stocks harvested is lacking. The following table presents the number of drainages in which the presence of salmon has been documented.

Table 7. Number of drainages in which the presence of salmon has been documented in the Eastern District of the Prince William Sound Area.[1/]

	Sockeye	Coho	Pink	Chum
Drainages	6	19	143	62

[1/] Alaska Department of Fish and Game (1985).

Seines are the only legal commercial salmon fishing gear allowed in this district.[8/] The district contains the majority of early-run pink salmon stocks. Salmon run timing in

Prince William Sound is commonly defined as having three components, i.e. early, middle and late. Early-run fish are those that appear in bays near their natal streams during late June to mid July. Middle-run fish arrive in their natal bays during mid July to mid August. Late-run fish appear during mid August to early September. Salmon normally enter the streams within two weeks of first arriving in the bays.[10/11/]

The majority of early-run pink salmon stocks occur during odd years and are generally destined for the Eastern District. During odd years, this district is normally the first district to open for commercial fishing, opening in late June or early July. Early-run stocks are primarily harvested in Port Gravina and Valdez Arm. The fishery during even years opens normally in mid July. The even-year fishery is also the latest to occur. Late-run chum stocks are available for harvest during late August in Valdez Arm, Galena Bay, Duck River and parts of Port Fidalgo.[10/11/]

The Solomon Gulch Hatchery is presently incubating pink, chum and coho salmon. Pink salmon utilized at the hatchery have a peak harvest timing of early July. Hatchery-produced chum salmon will have a peak harvest timing in mid August. Coho salmon produced at the facility will have a peak harvest timing of late August.[12/]

2.7.1.2.2 Northern District

This district spans the area between Pt. Freemantle and the Coghill District (Figure 2, page 3). Seines are the only legal commercial salmon gear. A major pink salmon hatchery, the Cannery Creek Hatchery is located in Unakwik Inlet. Escapement data suggest that this district is a moderate producer of pink salmon and the second highest producer of chum salmon (Appendices 17 and 18, pages A-48 and A-49). The following table presents the number of drainages in which the presence of salmon has been documented.

Table 8. Number of drainages in which the presence of salmon has been documented in the Northern District of the Prince William Sound Area.[1/]

	Sockeye	Coho	Pink	Chum
Drainages	2	6	65	28

[1/] Alaska Department of Fish & Game (1985).

The earliest significant run of chums in the Sound occurs at Wells River in Wells Bay. Special openings have been utilized to harvest these fish. The run timing of pink salmon destined for the Northern District is normally later than pink salmon destined for the Eastern District. The Northern District, however, is commonly opened at the same time as the Eastern District. These openings have not been based on the abundance of Northern District stocks but because the Northern District is a primary migration route for fish heading to the Eastern District. Opening both districts is beneficial in spreading out fishing effort. Post-earthquake closures have occurred during odd years in Eaglek Bay in an unsuccessful attempt to build up pink salmon stocks. Currently, there is a transplant project underway to rebuild this run.[11/]

Pink salmon returning to the Cannery Creek Hatchery have a peak run timing in Unakwik Inlet in early August.

2.7.1.2.3 Unakwik District

This district comprises the northern half of Unakwik Inlet and was created in 1962 to provide additional area for drift gill net fishermen (Figure 2, page 3). Both seines and drift gill nets are legal commercial salmon fishing gear. Few escapement data are available; however, it is believed that this district is the least productive of salmon of all districts in the Sound. The following table depicts the number of drainages in which the presence of salmon has been documented.

Table 9. Number of drainages in which the presence of salmon has been documented in the Unakwik District of the Prince William Sound Area.[1/]

	Sockeye	Coho	Pink	Chum
Drainages	2	1	2	1

[1/] Alaska Department of Fish & Game (1985).

In recent years, harvests have primarily been attributed to drift gill nets (Appendix 19, page A-50). The fishery normally opens in mid June. Fishermen normally target on sockeye salmon returning to Miners and Cowpen lakes. Some pink salmon returning to the Cannery Creek Hatchery also have entered the district and have been harvested.

2.7.1.2.4 Coghill District

This district is located in the northwestern corner of the Sound and encompasses Esther Island and Port Wells (Figure 2, page 3). The district was created in 1961 to provide additional area for drift gill net fishermen. PWSAC is constructing a new hatchery at Lake Bay on Esther Island. Escapement data suggest that this district is the third greatest producing district of pink and chum salmon in the Sound (Appendices 17 and 18, pages A-48 and A-49). Harvest and escapement data indicate that this district is the foremost producer of sockeye salmon in the Sound (Appendices 20 and 21, pages A-51 and A-52). The following table presents the number of drainages in which the presence of salmon has been documented.

Table 10. Number of drainages in which the presence of salmon has been documented in the Coghill District of the Prince William Sound Area.[1/]

	Sockeye	Coho	Pink	Chum
Drainages	3	5	39	14

[1/] Alaska Department of Fish and Game (1985).

Seines and drift gill net are legal gear. The drift gill net fishery opens in mid June. The Board of Fisheries has recently adopted regulations that delay the opening date of the seine fishery in the district to July 6. This was done to allow drift gill net fishermen the

opportunity to harvest the majority of early-run chum salmon that will be returning to the new Esther Hatchery.

Peak harvests of sockeye salmon occur during the third and fourth weeks of June. Peak harvests of wild chum salmon have occurred approximately one month later. Peak harvests of wild pink salmon have occurred during the last week of July and first week of August.

The Esther Hatchery will utilize four brood sources for both pink and chum salmon. This will create pink and chum salmon runs of long duration. It is anticipated that hatchery-produced pink salmon will have a peak common property harvest timing of early to mid July. Hatchery-produced chum salmon will probably have a peak harvest timing of early July. Hatchery-produced king salmon will have a peak harvest timing of mid June, and hatchery-produced coho salmon will have a peak harvest timing of early September.

2.7.1.2.5 Northwestern District

This district lies in the northwestern corner of the Sound, immediately west and south of the Coghill District (Figure 2, page 3). The community of Whittier lies within the district. Escapement data suggest that this district is an intermediate producer of pink and chum salmon (Appendices 17 and 18, pages A-48 and A-49). Sockeye salmon and coho salmon populations are relatively minor. The following table presents the number of drainages in which the presence of salmon has been documented.

Table 11. Number of drainages in which the presence of salmon has been documented in the Northwestern District of the Prince William Sound Area.[1/]

	Sockeye	Coho	Pink	Chum
Drainages	2	2	40	33

[1/] Alaska Department of Fish and Game (1985).

Seines are the only legal commercial salmon fishing gear. The run timing of pink and chum salmon is relatively late. Even-year pink salmon runs tend to be weaker than odd-year runs. This may be an artifact of spawning area subsidence associated with the 1964 earthquake.[11/]

2.7.1.2.6 Eshamy District

The district is located in the midwestern portion of the Sound and contains the Main Bay Hatchery (Figure 2, page 3). Harvest and escapement data suggest that sockeye salmon and pink salmon are codominant in abundance (Appendices 22 through 24, pages A-53 through A-58). Minor populations of chum and coho salmon occur. The following table presents the number of drainages in which the presence of salmon has been documented.

Table 12. Number of drainages in which the presence of salmon has been documented in the Eshamy District of the Prince William Sound Area.[1/]

	Sockeye	Coho	Pink	Chum
Drainages	3	1	12	6

[1/] Alaska Department of Fish and Game (1985).

Sockeye salmon destined for Eshamy have a late run timing. Hatchery-produced chum salmon will have a peak harvest timing of early July, and hatchery-produced pink salmon will have a peak harvest timing of early August. Set and drift gill nets are the only legal gear in this district.

2.7.1.2.7 Southwestern District

This district is located in the southwestern portion of the Sound and encompasses numerous islands, including Knight, Chenega, Evans, Elrington, Bainbridge and Latouche Island (Figure 2, page 3). The Armin F. Koernig Hatchery (formerly Port San Juan Hatchery) is located on Evans Island. The Chenega Village Corp. has recently developed the new community of Chenega Bay.

Escapement data suggest that this district has a history of being a moderate producer of pink and chum salmon (Appendices 17 and 18, pages A-48 and A-49). Minor populations of sockeye and coho salmon occur. The following table identifies the number of drainages in which the presence of salmon has been documented.

Table 13. Number of drainages in which the presence of salmon has been documented in the Southwestern District of the Prince William Sound Area.[1/]

	Sockeye	Coho	Pink	Chum
Drainages	2	1	68	15

[1/] Alaska Department of Fish and Game (1985).

Natural runs of pink salmon are generally of middle run timing. Pink and chum salmon incubated at Port San Juan are of late run timing. Seines are the only legal commercial salmon fishing gear.[11/]

2.7.1.2.8 Montague District

This district is located in the southcentral portion of the Sound and encompasses Montague Island, Green Island and Middleton Island (Figure 2, page 3). Escapement data suggest that the district is a moderate producer of pink salmon. Prior to the earthquake of 1964, this district was the third or fourth largest chum salmon producing district within the Sound (Appendices 17 and 18, pages A-48 and A-49). Uplift associated with the earthquake caused chum salmon habitat to be severely disrupted and chum salmon stocks

have been totally depleted. Minor populations of sockeye and coho salmon occur in the district. The following table identifies the number of drainages in which the presence of salmon has been documented.

Table 14. Number of drainages in which the presence of salmon has been documented in the Montague District of the Prince William Sound Area.[1/]

	Sockeye	Coho	Pink	Chum
Drainages	1	2	78	12

[1/] Alaska Department of Fish and Game (1985).

Odd-year runs of pink salmon have been dominant over even-year runs.

Despite sizable returns of pink salmon, little fishing effort has occurred in recent years. The district is a difficult place to fish and tender coverage has been poor. Seines are the only legal commercial salmon fishing gear.[11/]

2.7.1.2.9 Southeastern District

This district is located in the southeastern portion of the Sound and encompasses Hinchinbrook Island and Hawkins Island (Figure 2, page 3). According to escapement data, this district is the second highest producer of pink salmon, and it is a moderate producer of chum salmon. Only minor populations of sockeye and coho salmon occur. The following table identifies the number of drainages in which the presence of salmon has been documented.

Table 15. Number of drainages in which the presence of salmon has been documented in the Southeastern District of the Prince William Sound Area.[1/]

	Sockeye	Coho	Pink	Chum
Drainages	1	10	64	20

[1/] Alaska Department of Fish and Game (1985).

Pink and chum salmon are mainly of middle-run timing. Seines are the only legal commercial salmon fishing gear.[11/]

2.7.1.2.10 Copper River District

The Copper River District is located east of Prince William Sound and includes the Copper River Delta and estuary (Figure 2, page 3). Harvest and escapement data indicate that the watersheds of this district produce the majority of king, sockeye and coho salmon in the region (Appendices 10, 11 and 26 through 28, pages A-34, A-37 and A-60 through A-63). Only minor populations of pink and chum salmon occur in this district. Maps of

spawning and rearing areas are presented in Appendices 7 through 9 (page A-31 through A-33).

King and sockeye salmon enter the district in early to mid May. The king salmon migration terminates in late June; whereas, the sockeye salmon migration continues through July. Sexually-immature coho salmon are commonly harvested in the offshore waters during June. Mature coho salmon enter the district from early August into early October.

One hatchery is located within the district's watershed. The Gulkana Hatchery, a FRED Division sockeye salmon hatchery, is located in the headwaters of the Copper River near Gulkana (Figure 3, page 4).

2.7.1.2.11 Bering River District

This district is the easternmost district in the region and is a secondary producer of coho and sockeye salmon (Figure 3, page 4, Appendices 30 and 31, pages A-66 through A-70). Several small populations of chum salmon also spawn in the district.

Salmon fishing has been conducted by drift gill net fishermen and minor numbers of sport fishermen. No estimates are available on the number of fish harvested by sport fishermen. No subsistence harvests have been documented.

2.7.1.3 Salmon Rehabilitation and Enhancement

Rehabilitation entails the restoration of depressed stocks to previous high levels of abundance. Enhancement involves the introduction of nonindigenous stocks and the building of indigenous stocks to production levels beyond their former capabilities.

Rehabilitation and enhancement in the region has, since Statehood, consisted of various forms of stream rehabilitation, lake and stream stocking and hatchery construction. The majority of these activities have taken place in the Prince William Sound Area.

2.7.1.3.1 Prince William Sound Area

Stream rehabilitation projects have entailed the construction of fishpasses, the construction of stream diversion and flow control structures and the removal of logs and debris from spawning areas (Appendix 32, page A-71 and Figure 11, page 30). The USDA Forest Service and ADF&G have, since 1962, performed rehabilitation projects in 52 streams.

Fry and smolt stocking has occurred in recent years in western Prince William Sound. Pink salmon fry have been released at the site of the Hobo Creek fishpass, the Main Bay Hatchery and streams in Eaglek Bay. Coho salmon juveniles have been released at Whittier, Culross Lake and Otter Lake. King salmon smolt have been released at Whittier.

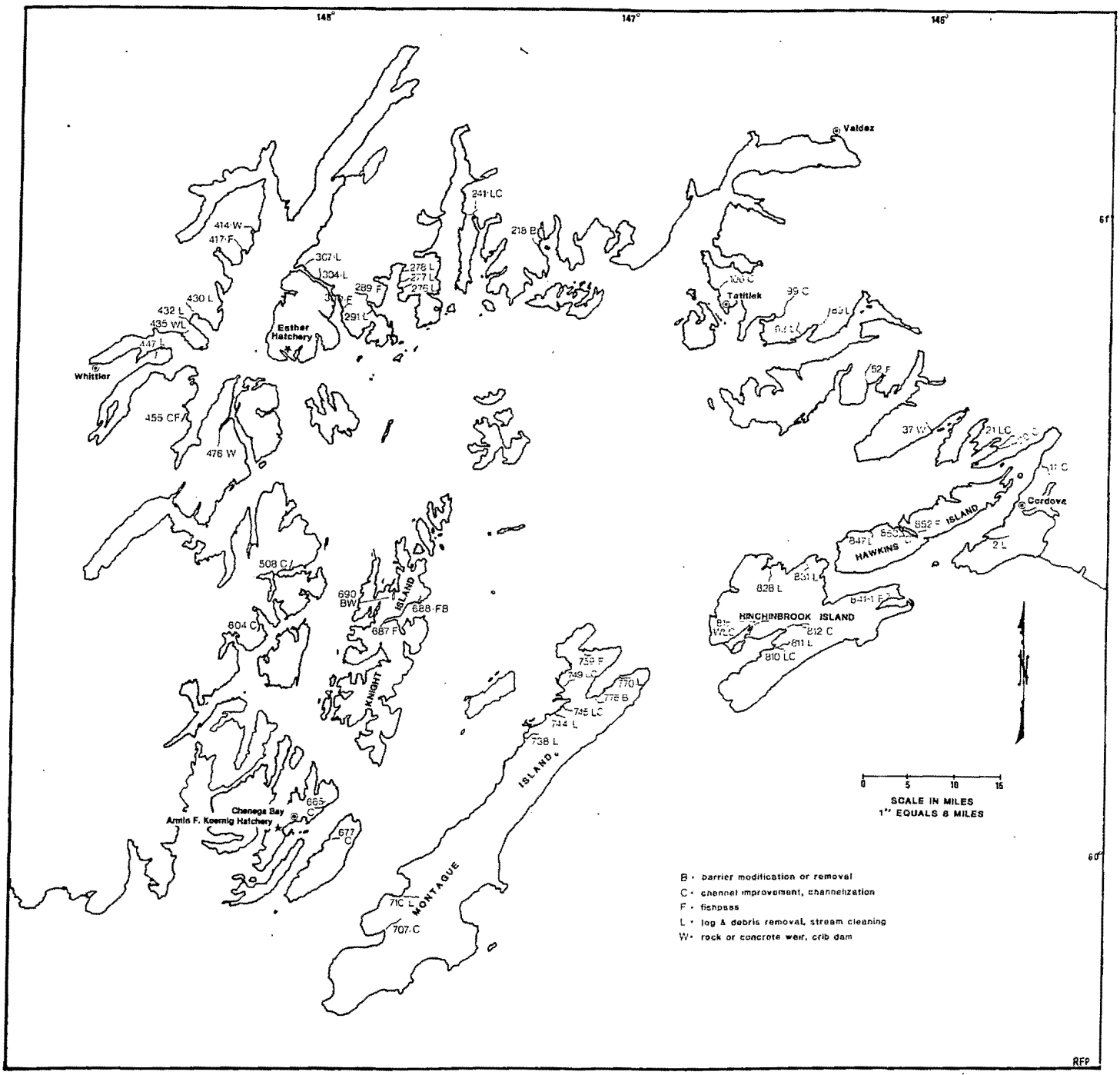


Figure 11. Rehabilitation and enhancement sites within the Prince William Sound Area.

Table 16. Lake and stream stocking of coho and king salmon in western Prince William Sound, 1978 through 1984.[1/]

		No. Released			Estimated Harvest or Expected Return	
Year	Location	Species	Fingerling	Smolt	Year	Adults
1978	Whittier	coho		78,000	1979	815[2/]
1979	Whittier	coho		81,000	1980	1,800[2/]
1980	Whittier	coho		50,000[3/]	1981	20[2/]
1981	Whittier	coho		202,000[3/]	1982	1,635[2/]
	Whittier	king		110,000	1984	400[2/]
1982	Whittier	coho		77,000	1983	300[2/]
	Whittier	king		112,000	1985	4,500[4/]
1983	Whittier	coho		93,500	1984	1,400[2/]
	Whittier	king		100,000	1986	4,000[4/]
	Culross L.	coho	97,430		1985	1,000[5/]
	Otter L.	coho	65,000		1985	700[5/]
1984	Whittier	coho		60,000	1985	3,000[6/]
	Whittier	king		100,000	1987	4,000[4/]
	Culross L.	coho	61,261		1986	600[5/]

[1/] Data provided by Hepler (personal communication).
[2/] Sport harvest estimates only.
[3/] Age 0 smolt. All other smolt were age 1.
[4/] This number represents the total adult return. The majority of fish will return in this year. Lesser numbers will return during the previous and following years. It is assumed that the marine survival will be 4 percent.
[5/] Based on a fingerling to smolt survival of 20 percent and a marine survival of 5 percent.
[6/] Based on a marine survival of 5 percent.

Both the State of Alaska and private non-profit (PNP) corporations operate hatcheries in the area. The State operates the Cannery Creek and Main Bay hatcheries. PWSAC operates the Armin F. Koernig (formerly Port San Juan) Hatchery and is completing construction of the Esther Hatchery at Lake Bay on Esther Island. The Valdez Fisheries Development Assn. (VFDA) operated a small hatchery at Crooked Creek in Valdez from 1979 through 1981. Since 1982, VFDA has operated the Solomon Gulch Hatchery in Valdez. The Crooked Creek facility is presently being operated as a scientific and educational hatchery by the Prince William Sound Community College. The facility has been used to incubate 50,000 chum salmon eggs.

FRED hatcheries located on Ft. Richardson and Elmendorf AFB have provided coho and king salmon juveniles for stocking streams and lakes near Whittier.

One small PNP hatchery was operated by NERKA, Inc. at Perry Island from 1976 through 1982. NERKA, Inc. has a PNP permit to incubate 10,000,000 pink salmon eggs and 10,000,000 chum salmon eggs at Lambert Lagoon on Perry Island. They do not, however, have a suitable hatchery building at this time. NERKA, Inc. is attempting to obtain hatchery financing.

The McClure Bay Hatchery Assn. filed a preliminary application to operate a PNP hatchery at McClure Bay in the Northwestern District (Figure 2, page 3). The preliminary application was approved by the Commissioner of ADF&G in 1984; however, no further action has taken place by the applicant.

Incubation capacity of these individual hatcheries vary and is determined by numerous factors, including quantity of freshwater, availability of investment capital, number of incubators, amount of floor space and the desires of fishermen and public officials.

Egg-to-adult survival rates undoubtedly have and will continue to vary between hatcheries. It is believed that the primary source of variability lies in zooplankton abundance during and after the release of juvenile salmon. Factors which control zooplankton abundance include sunlight, nutrient upwelling and water temperature. The majority of hatchery stocks have been reared for varying periods in an attempt to enhance survival by increasing the size of the juveniles and by coordinating the release of fish with the bloom of zooplankton. The effectiveness of this practice at each location has not been fully evaluated. It subsequently has not been possible to confidently project the number of adults returning to each hatchery. Various survival assumptions have been used for planning FRED and PNP facilities in the past. These survival assumptions will be updated as data are collected.

ADF&G requires that annual management plans be prepared for FRED and PNP facilities. These plans consist of operational plans, donor stock management plans, hatchery return management plans and marking study plans (Appendix 33, page A-75).

Overall basic management plans have also been prepared for some facilities. These plans state the goals and objectives of the hatchery and describe in detail the brood stock and operational plans, donor stock management plans, hatchery return management plans and marking study plans (Appendix 34, page A-77).

2.7.1.3.1.1 Cannery Creek Hatchery

This pink salmon hatchery has been operated and funded by FRED Division since 1979 and is located on the east shore of Unakwik Inlet, immediately south of the boundary between the Unakwik and Northern districts (Figure 2, page 3). Cannery Creek is a short, coastal stream with a 3.34 sq. mile watershed containing a 130 surface-acre lake.

In 1984, the facility had sufficient incubation trays to incubate approximately 79,000,000 pink salmon eggs from the "green-egg" to "eyed-egg" stage and approximately 50,000,000 eggs from the eyed stage to the fry stage. Green eggs are newly fertilized eggs, and eyed eggs are those that have reached the stage of development in which the larval eye is visible. The eyed-egg capacity is less than the green-egg capacity because oxygen needs of larvae increase over time, and a lower egg density facilitates circulation of oxygenated water. Upon reaching the eyed-egg stage, eggs are commonly placed in incubators containing irregular-shaped substrate, i.e. plastic "saddles." These saddles, while taking up incubator space, help to insure proper water circulation and provide a substrate for eggs and fry.[13/14/]

Adequate floor space exists to increase the capacity to 100,000,000 eyed eggs. A State-wide Capital Improvement Project (CIP) request entitled "State-wide Incubators" has been submitted to increase the total eyed-egg capacity to 100,000,000 eggs. The Legislature failed to act on this request in 1985.

It is estimated that the hatchery from 1978 through 1984 contributed a minimum of 2,224,000 pink salmon and 13,100 chum salmon. These fish were worth approximately $2,775,000 to the commercial fishery of the region (Table 17, page 34). These data are based on harvest estimates for Unakwik Inlet only.

The marine survival rate is difficult to accurately determine due to the lack of tag recovery efforts in most areas of the Sound. Tag recovery data in Unakwik Inlet suggest an average marine survival rate of 4.7 percent for pink salmon and 4.9 percent for chum salmon. It is conceivable that significant harvests of this stock have occurred in other areas of the Sound. Harvest estimates of pink salmon returning to the Armin F. Koernig Hatchery suggest that pink salmon fry released at Port San Juan have experienced an average marine survival rate of 5.3 percent. Considering the relative magnitude of Cannery Creek survival rates and the lack of harvest estimates for most areas of the Sound, it is possible that there may be no difference between average marine survival rates of pink salmon estimated for the Port San Juan stock and survival rates of the Cannery Creek stock.

Chum salmon returns to the Cannery Creek and Armin F. Koernig facilities have been difficult to gauge and data are minimal.

Egg takes at the Cannery Creek Hatchery have been limited primarily by the lack of an adequate brood fish holding area. To overcome this problem and achieve full utilization of the Cannery Creek Hatchery, Cannery Creek pink salmon eggs were transported to Main Bay in 1984 for development of a run of the Cannery Creek stock at Main Bay. No eggs were taken from the Port San Juan stock of fish returning to Main Bay in 1984. The Main Bay site is more conducive to egg takes than the Cannery Creek site.

Development of a significant chum salmon brood stock at Cannery Creek has been thwarted primarily because of an intense seine fishery that has been conducted in the terminal area of the hatchery. Seine boats have been targeting on pink salmon returning to the hatchery, and insufficient chum salmon have escaped to provide needed eggs.

Water temperatures in Cannery Creek have been too warm to hold adult chum salmon during ripening without experiencing significant mortalities. Early-run chum salmon stocks could be employed; however, early-run fish would emerge early and would require long-term feeding. Raceway temperatures are thought to be too cold in spring for effective rearing.

No short-term rearing facilities are available for pink salmon fry at Cannery Creek. Pink salmon require saltwater rearing early in their life history. The freshwater raceways, subsequently, are not suitable. An experiment to evaluate the benefits of short-term rearing at this location has been proposed.

It is projected that the hatchery at its present capacity will produce a total return of 2,517,500 pink salmon annually. This projection is based on a marine survival rate equal to the estimated survival rate of Port San Juan pink salmon. Approximately 2,448,100 fish will be surplus to egg take needs and will be available for harvest. Approximately 69,400 fish from Cannery Creek would be used for propagation.

Chum salmon production is expected to be minimal.

Immediate goals for the Cannery Creek Hatchery are to increase the incubation capacity to 100,000,000 eyed pink salmon eggs and to obtain 75,000,000 eyed eggs from Cannery Creek and 25,000,000 eyed eggs from Main Bay. At this level and an assumed survival

Table 17. Pink and chum salmon production data for the Cannery Creek Hatchery, 1978 through 1984.

Brood Year	Stock	Green Eggs Taken	Fry Released	Estimated Fishery Contribution	Estimated Adult Return	Estimated Ocean Survival
pink salmon released at Cannery Creek						
1978	Cannery Creek	4,039,000	2,826,000	53,300[1/]	90,300[1/]	3.2%
1979	Cannery Creek	1,189,000	999,000	71,800[1/]	84,700[1/]	8.5%
1980	Cannery Creek	17,299,000	14,389,000	688,800[1/]	760,000[1/]	5.3%
1981	Cannery Creek	14,544,000	13,933,000	348,100[1/]	469,400[1/]	3.4%
1982	Cannery Creek	23,759,000	22,123,000	1,062,000[1/]	1,139,000[1/]	5.2%
1983	Cannery Creek	34,300,000	31,200,000			
1984	Cannery Creek	79,900,000[2/]				
Total		175,030,000	85,470,000	2,224,000[1/]	2,543,400[1/]	4.7%
pink salmon released at Hobo Creek						
1979	Jonah Creek	2,370,000	1,695,000	no estimate	56,700[3/]	3.3%
1980	Port San Juan	6,925,000[4/]	6,900,000	no estimate	4,200	0.1%
Total		9,295,000	8,595,000	no estimate	60,900	0.7%
chum salmon released at Cannery Creek						
1978	Wells River	667,000[5/]	21,000	no estimate		
1979	Siwash Creek	613,000	429,000	13,100[1/]	21,000[1/]	4.9%
1980	Siwash Creek	673,000	485,000	no estimate		
1980	Eaglek	2,100,000	1,960,000	no estimate		
1981	Siwash Creek	950,000	867,000	no estimate		
1982		0				
1983	Cannery Creek	1,830,000	1,600,000			
1984	Cannery Creek	866,000				

1/ Estimate based on escapements and harvests in Unakwik Inlet only. No estimates have been made of the number of fish intercepted by seine fishermen in other districts.
2/ 28,500,000 eyed eggs were transferred to the Main Bay Hatchery.
3/ Estimated 49,660 adults returned to Port San Juan and 7,000 fish returned to Hobo Creek.
4/ Eyed eggs from the Armin F. Koernig Hatchery (Port San Juan Hatchery).
5/ Eggs transferred to egg boxes at Main Bay. Many eggs died as a result of freezing. Surviving larvae were transferred to Port San Juan and the resultant fry were released at Cannery Creek.

rate of 5.3 percent, it is expected that of the fish returning to Cannery Creek, approximately 4,919,300 fish will be available for harvest.

2.7.1.3.1 Main Bay Hatchery

The hatchery is operated and funded by FRED Division and has been operational since 1982. The facility is located at the head of Main Bay in the Eshamy District and utilizes water from Main Lake, a 826 surface-acre lake contained within a 3,900 acre watershed (Figure 2, page 3). Water is transported from the lake via a single pipeline. The pipe has two intakes allowing overall control of hatchery water temperatures.

This site was chosen as a hatchery site because of the quantity and quality of available water and its location in a set and drift gill net district. The two major hatcheries constructed prior to this facility, the Armin F. Koernig and Cannery Creek hatcheries, are located in areas open only to seining.

The hatchery was originally conceived as an early-run chum salmon facility. Pink salmon have been the primary species propagated to date, however (Table 18, page 36). The initial brood stock utilized at the hatchery was the Port San Juan pink salmon stock. This is a late-run stock which has a peak arrival timing in mid August. Pink salmon fry were transported from Port San Juan and released at the Main Bay Hatchery site in 1981 and 1982. Adults returning from the 1982 release and a subsequent release of fry incubated at Main Bay in 1983 provided the adults for the set and drift gill net fishery in 1983 and 1984.

Harvest contribution estimates have been made for the set and drift gill net fishery, and it is estimated that the hatchery contributed 363,300 fish in 1983 and 306,000 fish in 1984. During 1982, approximately 35,000 fish returned to the hatchery, and these fish were used for brood purposes. During 1983, approximately 133,600 fish escaped to the hatchery. Of these, approximately 76,400 were used for brood fish purposes. During 1984, approximately 300,000 fish escaped to the hatchery. The large escapement was caused by a combination factors including late-run timing, lack of effort and lack of tender service. Because of the decision to change the brood source to Cannery Creek stock, no eggs were taken at Main Bay in 1984. Gill net harvest and escapement data suggest an average marine survival of 2.0 percent. The total ex vessel value of these fish is estimated to have been $752,000.

Seine harvests of returning adults have not been estimated, and, therefore, return estimates are conservative. Pink salmon returning to Main Bay have the same run timing as fish returning to Port San Juan, and they may be intercepted by seine fishermen in the same areas as pink salmon returning to Port San Juan. It is conceivable that major components of returns to Main Bay have been harvested by seine fishermen. The estimated seine interception rates of pink salmon returning to Port San Juan during 1983 and 1984 were 80.3 and 79.5 percent, respectively. These data suggest that the marine survival rate of Main Bay pink salmon may be similar to those survival rates estimated for Port San Juan pink salmon.

The first chum salmon egg take for the Main Bay Hatchery occurred in 1982. The Wells River stock, an early-run stock, has been utilized. The first returns of 3-year old chum salmon adults occurred in 1985.

Pink salmon egg takes were conducted at Main Bay in 1982 and 1983 but were temporarily discontinued in 1984. The brood stock was changed in 1984 to the Cannery Creek

Table 18. Pink and chum salmon production data for the Main Bay Hatchery, 1980 through 1984.

Brood Year	Stock	Green Eggs Taken	Fry Released	Estimated Fishery Contribution	Estimated Adult Return	Estimated Ocean Survival
pink salmon						
1980	Port San Juan		2,900,000[1]	no estimate	35,000[2]	1.2%[2]
1981	Port San Juan		29,222,000[3]	363,300[4]	496,900[5]	1.7%[5]
1982	Port San Juan	[5]	25,752,000	306,000[4]	606,000[6]	2.4%[6]
1983	Main Bay	55,032,000	41,900,000			
1984	Cannery Creek	[6]				
Total		55,032,000	99,774,000	666,300[4]	1,137,900[6]	2.0%[6]
chum salmon						
1982	Wells River	8,926,000	8,644,000	[8]	[8]	
1983	Wells River	21,600,000	7,494,000[9]			
1984	Wells River	32,800,000				

1/ Fry transported from Port San Juan and released in Main Bay.
2/ Based only on the number of fish that escaped to the hatchery. No estimate is available on the number of fish harvested by commercial fishermen.
3/ Fry transported from Cannery Creek and released at Main Bay.
4/ Estimated based on set and drift gill net catches in Main Bay. No estimate has been made of the number of fish harvested by seine fishermen.
5/ 31,400,000 eyed eggs were transferred from the Armin F. Koernig Hatchery (Port San Kuan Hatchery).
6/ Includes fishery contribution estimate and escapement to the hatchery.
7/ No eggs were taken at Main Bay in 1984. Approximately 28,500,000 eyed pink salmon eggs were transferred from the Cannery Creek Hatchery to the Main Bay Hatchery for continued incubation and release at Main Bay.
8/ Age 3 fish returned in 1985.
9/ In addition to these fry released at Main Bay, approximately 7,355,000 fry were transported to Esther Lake for release.

stock. Eggs were taken at Cannery Creek and a portion of the eyed eggs, approximately 28,500,000 eggs, was transported to Main Bay for incubation and release at Main Bay.

In 1984, the Main Bay Hatchery had sufficient incubators to rear approximately 41,000,000 pink and 47,000,000 chum salmon eggs from the green-egg to the eyed-egg stage and 28,500,000 pink and 29,500,000 chum salmon from their eyed-egg stage to the fry stage.

Short-term rearing of emergent fry is presently limited to indoor, freshwater raceways. Freshwater rearing is only suitable for chum salmon as pink salmon fry generally require a brackish environment upon emergence. It is estimated that 100,000,000 chum salmon fry can be reared on a staggered basis in these raceways.

Assuming a marine survival rate of 5.3 percent for pink salmon and 2.0 percent for chum salmon, it is projected that the hatchery at its present capacity will produce a total return of 1,435,000 pink and 505,900 chum salmon. The pink salmon projection is based on estimates of Port San Juan survival rates. The chum salmon projection is based on FRED Directive No. 3, an ADF&G planning guideline. Approximately 1,391,000 pink and 472,800 chum salmon will be surplus to egg take needs and will be available for harvest. Approximately 44,000 pink and 33,100 chum salmon will be used for propagation.

An immediate goal for the Main Bay Hatchery is to increase the green-egg incubation capacity to incubate 111,000,000 chum and 56,000,000 pink salmon eggs. This would provide approximately 25,000,000 eyed eggs for incubation and release at the Cannery Creek Hatchery. When this goal is achieved, the Main Bay Hatchery will contribute approximately 1,602,700 chum salmon and 1,181,000 pink salmon to the fisheries of the region. Additional goals for Main Bay are to obtain short-term rearing facilities for pink salmon and evaluate the potential for expanding the hatchery.

2.7.1.3.1.3 Armin F. Koernig Hatchery

The Armin F. Koernig Hatchery (formerly Port San Juan Hatchery) is operated by the Prince William Sound Aquaculture Corporation (PWSAC) and is located on Evans Island (Figure 2 page 3). PWSAC is a non-profit organization concerned with the planning, rehabilitation, enhancement and maintenance of the salmon fisheries of the Prince William Sound, Copper-Bering River Region. The Corporation is controlled by a 45-member board of directors comprised of fishermen and representatives of local processors, municipalities and native corporations.

The Armin F. Koernig Hatchery is located on the site of a cannery formerly operated by the San Juan Fishing and Packing Company. Construction and operation of the hatchery began in 1975. This site was chosen because of low initial cost, favorable land status and the time that would be saved by utilizing the old cannery buildings, dock and water system. Following closures of the seine fishery in 1972 and 1974, organizers of PWSAC were anxious to get a hatchery functioning to aid the fishery and to lend credibility to the enhancement program.

PWSAC has been permitted by the State to incubate 150,000,000 pink salmon eggs and 13,000,000 chum salmon eggs at Port San Juan. The permitted pink salmon egg capacity was increased from 115,000,000 to 150,000,000 green eggs in 1982 to allow the collection of 35,000,000 eggs for transfer to the Main Bay Hatchery.

The eyed-egg capacity in 1984 was 108,000,000 pink and 12,000,000 chum salmon eggs (Table 19, page 39). Sufficient space was available in 1984 to rear 105,000,000 pink salmon fry and 10,000,000 chum salmon fry to fingerling size.

From 1976 through 1984, a total of 377,271,222 pink and 26,936,101 chum salmon fry were released at Port San Juan (Table 20, page 40). An additional 2,900,000 pink salmon fry were released at Main Bay in 1981. In 1980, approximately 6,925,000 eyed pink salmon eggs were transferred from Port San Juan to Cannery Creek. Approximately 6,900,000 pink salmon fry were released at the site of the new Hobo Creek fishpass in 1981 (Table 17, page 34). In 1981, 35,288,000 eyed pink salmon eggs were transferred from Port San Juan to the Cannery Creek Hatchery. Resultant fry were released at the Main Bay Hatchery (Table 18, page 36). In 1982, 31,400,000 eyed pink salmon eggs were transferred to the Main Bay Hatchery for continued incubation and release.

It is estimated that from 1976 through 1984, a total of 16,166,774 pink salmon and an unknown number of chum salmon have returned to the region as a result of fry releases at Port San Juan. Commercial fishermen during these years harvested an estimated 11,508,341 pink salmon and an undetermined number of chum salmon.

It is estimated that the average marine survival rate of pink salmon has been 5.3 percent. These data are based on harvest estimates for portions of the Southwestern District and actual returns to the hatchery.

As a private non-profit corporation, PWSAC has acquired operating revenues through the sale of fish in the Port San Juan Special Harvest Area and through voluntary contributions from fishermen, processors and other interested parties. Prior to 1985, members of the Cordova Aquatic Marketing Assn. (CAMA), a regional fishermen's association, assessed themselves on a voluntary basis. This self-imposed tax has served as collateral for State loans to PWSAC and provided operating funds for the hatchery. From 1975 through 1984, fishermen contributed $2,071,133, processors contributed $1,337,322 and tender operators contributed $7,307. Personal services and surplus equipment were also contributed.
PWSAC, as the qualified regional aquaculture association in the Prince William Sound, Copper-Bering River Region, requested in 1984 that a vote be taken of commercial salmon permit holders to impose a mandatory 2 percent assessment on salmon harvested in the region. Ballots were cast during January 1985, and the measure was adopted. Assessment funds will be used to offset the costs of operating the Port San Juan and Esther hatcheries. Fish will be sold at both facilities to amortize loans, pay administrative costs and make up shortfalls in hatchery operating revenues.

Annual variations in harvest magnitude and fish prices make it difficult to accurately project the amount of revenues that will be obtained annually with a 2 percent assessment. Long-range projections of natural harvests as well as harvests attributed to rehabilitation and enhancement projects can be used to demonstrate probable incomes in the distant future. Many rehabilitation and enhancement projects, as proposed in this plan, will not, however, be in place for some years to come. Recent harvest and ex vessel price data can be used to demonstrate probable assessment values in the near future. The total ex vessel value of salmon harvested by commercial fishermen in the Prince William Sound, Copper-Bering River Region in 1984 was approximately $39,837,000. Had a 2 percent assessment been in force in 1984, approximately $797,000 would have been collected. Should catches be similar to average catches that have occurred during the past 25 years, then approximately $450,000 would be collected through assessments.

It is projected that the Armin F. Koernig Hatchery at the 1984 eyed-egg capacity will produce total annual returns of 4,907,600 pink and 308,700 chum salmon annually (Table

Table 19. A comparison of the 1984 eyed-egg capacity of the Armin F. Koernig Hatchery (formerly Port San Juan Hatchery) and the projected total adult return, brood needs, sales needs and harvestable surplus, 2002.

	pink salmon	chum salmon
1984 Eyed-Egg Capacity[1/]	108,000,000	12,000,000
Projected Adult Return	4,907,600[2/]	308,700[3/]
Brood Needs	166,700	13,500
Sales Needs[4/]	1,101,400	69,300
Harvestable Fish	3,639,500	225,900

1/ In 1984, the permitted green egg capacity was 150,000,000 pink salmon and 13,000,000 chum salmon eggs.
2/ Based on FRED Directive No. 3 and a fingerling marine survival of 5.3 percent.
3/ Based on FRED Directive No. 3 and a fingerling marine survival of 3.0 percent.
4/ Assuming full utilization of the Armin F. Koernig Hatchery at the 1984 eyed-egg capacity, full utilization of the Esther Hatchery at the 1984 permitted capacity, an assessment of $797,000, a revenue goal in the year 2002 for the Armin F. Koernig Hatchery of $1,281,500 and a similar exploitation rate for pink and chum salmon returning to Port San Juan.

Table 20. Pink and chum salmon production data for the Armin F. Koernig Hatchery (formerly Port San Juan Hatchery), 1975 through 1984.

Brood Year	Green Eggs Taken	Fry Released	Return Year	Estimate: Fishery Contribution	Interception Rate	Brood Fish[2/]	Fish Sold by PWSAC	Total Return[1/]	Ocean Surv.
pink salmon									
1975	6,254,460[3/]	1,000,000	1977	4,000	9.1%	15,155	24,845	44,100	4.4%
1976	14,733,530[4/]	11,010,577	1978		0.0	40,432	114,188	154,620	1.4%
1977	23,424,000[5/]	16,950,784	1979	275,000	49.7%	54,207	223,748	552,955	3.3%
1978	28,645,626[6/]	22,774,739	1980	1,038,700	69.5%	108,061	346,728	1,493,489	6.6%
1979	28,401,415[6/]	21,500,000	1981	1,358,907	60.0%	198,901	707,037	2,264,845	10.5%
1980	94,689,000[6/7/]	69,787,000[8/]	1982	3,615,086	70.4%	164,545	1,354,732	5,134,363	7.4%
1981	143,500,000[6/9/]	70,118,000	1983	2,990,225	80.3%	124,278	607,999	3,722,502	5.3%
1982	129,615,000[6/10/]	87,384,000	1984	2,226,423	79.5%	186,431	387,146	2,800,000	3.2%
1983	89,473,968[6/]	76,746,122	1985						
1984	117,767,702[6/]		1986						
Total	676,504,701	377,271,222		11,508,341	71.2%	892,010	3,766,423	16,166,774	5.3%
chum salmon									
1977	1,445,700[11/]	1,014,000	1980	no estimate		143	no estimate		
1978	441,192[11/]	247,548	1981	no estimate		8,152	no estimate		
1979	570,556[11/]	395,000	1982	no estimate		496	no estimate		
1980	3,317,000[12/]	751,261	1983	no estimate		815	no estimate		
1981	8,593,000[12/]	7,294,000	1984	no estimate		6,682	no estimate		
1982	11,403,508[12/]	9,580,000	1985						
1983	9,058,751[12/]	7,654,292	1986						
1984	12,072,688[12/]		1987						
Total	46,902,402	26,936,101				16,288			

1/ Based on returns to special harvest area and estimates of the number of fish harvested by seine fishermen.
2/ Includes fish allowed to spawn in Larsen Creek.
3/ From stocks in Stream 603 Ewan Creek.
4/ From stocks in Stream 115 (Millard Creek), Stream 116 (Duck River) and Stream 669 (Larsen Creek).
5/ From stocks in Crab Bay, Hardins Bay, Port Ashton and Port San Juan.
6/ From the Larsen Creek stock.
7/ Includes 6,925,000 eyed eggs transferred to Cannery Creek.
8/ An additional 2,900,000 fry were transported to Main Bay for release in 1981.
9/ Includes 35,288,000 eyed eggs transferred to Cannery Creek and Main Bay hatcheries.
10/ Includes 31,400,000 eyed eggs transferred to the Main Bay Hatchery.
11/ From stocks in Stream 84 (unnamed), Stream 85 (unnamed) and Stream 87A (Sunny River) in Port Fidalgo.
12/ From stocks in Stream 83 (Keta Creek), Sunny River and Larsen Creek.

19, page 39). This projection is based on the continuation of pink salmon survival rates experienced to date and a projected 3.0 percent marine survival rate of chum salmon. Approximately 166,700 pink and 13,500 chum salmon will be needed annually for egg takes. The number of fish required annually for sales purposes will be dependent on the exploitation rate of each species, the revenue goal of the hatchery, ex vessel prices and the projections of assessment revenues. The hatchery revenue goals will be based on the annual loan payment and operating and administrative costs. It is projected that in the year 2002, the end year in Phase I planning process, the revenue goal of the Armin F. Koernig Hatchery will be approximately $1,281,500. Assuming full utilization of the Koernig and Esther hatcheries and earnings and ex vessel prices similar to those experienced in 1984, it may be projected that PWSAC will need to sell approximately 1,101,400 pink salmon and 69,300 chum salmon. Approximately 3,639,500 pink and 225,900 chum salmon will be available for commercial harvest.

The Board of Fisheries recently adopted an economic escapement plan for the hatchery (Appendix 35, page A-79). This plan grants the fishery manager authority to make special closures during times that the total escapement into the Special Harvest Area has been insufficient for brood fish and revenue needs.

2.7.1.3.1.4 Esther Hatchery

PWSAC has recently completed construction of a new hatchery at Lake Bay on Esther Island (Figure 2, page 3). PWSAC has been granted a State permit to incubate the following number of green eggs at this facility:

Table 21. Permitted green-egg capacity by species of the Esther Hatchery, 1984.

pink salmon	211,000,000 eggs
chum salmon	111,000,000 eggs
king salmon	1,000,000 eggs
coho salmon	1,000,000 eggs

Four brood sources will be used for both pink and chum salmon. This will create pink and chum salmon runs of long duration. It is anticipated that hatchery-produced pink salmon will have a peak common property harvest timing of early to mid July. Hatchery-produced chum salmon will probably have a peak harvest timing of early July. Hatchery-produced king salmon will have a peak harvest timing of mid June, and hatchery-produced coho salmon will have a peak harvest timing of early September.

During 1984, 7,500,000 chum salmon fry of Wells River origin were transported from Main Bay and released at the Esther Hatchery site. These fish will be the nucleus of the chum salmon brood stock. The first returns will occur in 1986. The first pink salmon return will occur in 1987.

King and coho salmon will be reared to age 0 smolt size and released at the hatchery for harvest and brood stock maintenance.

It is projected that the Esther Hatchery at its 1984 permitted capacity will produce total annual returns of 8,629,200 pink, 2,569,600 chum, 37,500 coho and 30,000 king salmon (Table 22 page 42). This projection is based on assumed marine survival rates of 5.3 percent for pink salmon, 3.0 percent for chum salmon, 5.0 percent for coho salmon and 4.0 percent for king salmon. Approximately 293,100 pink, 112,100 chum, 800 coho and 300

Table 22. A comparison of the 1984 permitted green-egg capacity of the Esther Hatchery and the projected total adult return, brood needs, sales needs and harvestable surplus, 2002.

	pink salmon	chum salmon	coho salmon	king salmon
1984 Permitted Green Egg Capacity	211,000,000	111,000,000	1,000,000	1,000,000
Total Adult Return	8,629,200[1/]	2,569,600[2/]	37,500[3/]	30,000[4/]
Brood Needs	293,100	112,100	800	300
Sales Needs[5/]	805,600	239,900	3,500	2,800
Harvestable Fish	7,530,500	2,217,600	33,200	26,900

1/ Based on FRED Directive No. 3 and a fingerling marine survival of 5.3 percent.
2/ Based on FRED Directive No. 3 and a fingerling marine survival of 3.0 percent.
3/ Assuming a green egg to age 0 smolt survival of 75 percent and a marine survival of 5.0 percent.
4/ Assuming a green egg to age 0 smolt survival of 75 percent and a marine survival of 4.0 percent.
5/ Assuming full utilization of the Esther Hatchery at the 1984 permitted capacity, full utilization of the Port San Juan Hatchery at the 1984 eyed-egg capacity, an assessment of $797,000, a revenue goal in the year 2002 for the Esther Hatchery of $1,502,800 and a similar exploitation rate for pink, chum and king salmon returning to the hatchery.

king salmon will be needed annually for egg takes. The number of fish required annually for sales purposes will be dependent on the exploitation rate of each species, the revenue goal of the hatchery, ex vessel prices and the projections of assessment revenues. The hatchery revenue goals will be based on the annual loan payment and operating and administrative costs. It is projected that in the year 2002, the end year in Phase I planning process, the revenue goal of the Esther Hatchery will be approximately $1,502,800. Assuming full utilization of the Esther and Port San Juan hatcheries and earnings and ex vessel prices similar to those experienced in 1984, it may be projected that PWSAC will need to sell approximately 805,600 pink salmon, 239,900 chum salmon, 3,500 coho salmon, and 2,800 king salmon. Approximately 7,530,500 pink salmon, 2,217,600 chum salmon, 33,200 coho salmon and 26,900 king salmon will be available for harvest.

The majority of chum and king salmon will probably be harvested by drift gill net fishermen. Seine fishermen will probably harvest the majority of pink and coho salmon. All salmon will be available for harvest by sport and subsistence fishermen.

2.7.1.3.1.5 Solomon Gulch Hatchery

This multispecies hatchery is operated by a private non-profit corporation, the Valdez Fisheries Development Association (VFDA) and is located near the Alyeska Pipeline Terminal in Valdez (Figure 2, page 3). VFDA operated a small scientific and education hatchery at Crooked Creek in Valdez from 1979 through 1981 and has operated the Solomon Gulch Hatchery since 1982. The State has granted VFDA a permit to incubate the following number of eggs at the Solomon Gulch Hatchery.

Table 23. Final permitted green egg capacity, by species, of the Solomon Gulch Hatchery.

pink salmon	136,000,000 eggs
chum salmon	18,000,000 eggs
king salmon	300,000 eggs
coho salmon	1,000,000 eggs

Water for the hatchery comes from a hdyroelectric plant reservoir on Solomon Creek.

Approximately 20,890,000 pink and 2,040,000 chum salmon fry have been released to date (Table 24, page 44). An estimated 311,000 adult pink salmon have returned from 12,500,000 fry released in 1982 and 1983. Return data suggest that pink salmon fry have experienced an average marine survival of 2.5 percent. Total return estimates have been based solely on returns to Port Valdez and, the estimates subsequently are thought to be conservative.

Operating revenues have been derived through loans and the sale of fish surplus to brood stock needs. Fish have been harvested in the Special Harvest Area at the mouth of Solomon Creek.

The actual eyed-egg capacity in 1984 was 70,000,000 pink salmon eggs, 6,000,000 chum salmon eggs and 1,000,000 coho salmon eggs.[12/]

It is projected that the Solomon Gulch Hatchery at its final permitted capacity will produce total annual returns of 5,562,000 pink, 416,700 chum, 27,800 coho and 9,000 king salmon (Table 25, page 45). This projection is based on assumed marine survival rates of

Table 24. Pink, chum and coho salmon production data for the Solomon Gulch Hatchery, 1981 through 1984.1/

Brood Year	Green Eggs Taken	Fry Released	Return Year	Estimate[2/] Fishery Contribution	Interception Rate	Brood Fish	Fish Sold by VFDA	Total Return	Ocean Surv.
pink salmon									
1981	9,970,000[3/]	7,000,000	1983	19,000	16.6%	19,000	76,000	114,000	1.6%
1982	8,430,000[4/]	5,500,000	1984	119,000	60.4%	47,000	31,000	197,000	3.6%
1983	12,930,000[3/]	8,390,000	1985						
1984	66,650,000[4/]		1986						
Total	97,980,000	20,890,000		138,000	44.4%	66,000	107,000	311,000	2.5%
chum salmon									
1981	600,000[5/]	500,000	1985						
1982	1,900,000[5/]	640,000	1986						
1983	1,900,000[5/]	900,000	1987						
1984	2,700,000[5/]		1988						
Total	7,100,000	2,040,000							
coho salmon									
1982	115,000[6/]	[7/]	1986						
1983	143,000[6/]		1987						
1984	300,000[6/]		1988						
Total									

1/ Data provided by Paul McCollum of VFDA.

2/ Based on returns to the special harvest area and estimates of the number of fish harvested by seine fishermen.

3/ from stocks in Stream 143 (Siwash Creek).

4/ From stocks in Stream 123 (Gregoreff Creek) and Stream 129 (Vlassoff Creek).

5/ From stocks in Stream 145 (Crooked Creek).

6/ From stocks in Stream 137 (Corbin Creek).

7/ System failure and total loss.

Table 25. A comparison of the 1984 and the final permitted green-egg capacity of the Solomon Gulch Hatchery and the projected total adult return, brood needs, sales needs and harvestable surplus, 2002.

	pink salmon	chum salmon	coho salmon	king salmon
1984 Green Egg Capacity	70,000,000	6,000,000	1,000,000	0
Final Permitted Green Egg Capacity	136,000,000	18,000,000	1,000,000	300,000
Total Adult Return at Final Capacity	5,562,000[1/]	416,700[2/]	27,800[3/]	9,000[4/]
Brood Needs	188,900	18,200	800	100
Sales Needs[5/]	822,300	61,600	4,100	1,300
Harvestable Fish	4,550,800	336,900	22,900	7,600

1/ Based on FRED Directive No. 3 and a fingerling marine survival of 5.3 percent.
2/ Based on FRED Directive No. 3 and a fingerling marine survival of 3.0 percent.
3/ Assuming age 1.0 smolt released at the Hatchery. Adult return based on FRED Directive No. 3 and a marine survival of 5.0 percent.
4/ Adult return based on a green egg to age 0.0 smolt survival of 75 percent and a marine survival of 4.0 percent.
5/ It is assumed that the hatchery revenue goal in the year 2002 will be $1,041,000 and that the exploitation rate of each species returning to the hatchery will be similar.

5.3 percent for pink salmon, 3.0 percent for chum salmon, 5.0 percent for coho salmon and 4.0 percent for king salmon. Approximately 188,900 pink, 18,200 chum, 800 coho and 100 king salmon will be needed annually for egg takes. The number of fish required annually for sales purposes will be dependent on the relative escapement of each species, the revenue goal of the hatchery and ex vessel prices. The hatchery revenue goals will be based on the annual loan payment and operating and administrative costs. It is projected that in the year 2002, the end year in Phase I planning process, the revenue goal of the Solomon Gulch Hatchery will be approximately $1,041,000. Assuming full utilization of the hatchery and ex vessel prices similar to those experienced in 1984, it may be projected that VFDA will need to sell approximately 822,300 pink, 61,600 chum, 4,100 coho and 1,300 king salmon. Approximately 4,550,800 pink, 336,900 chum, 22,900 coho and 7,600 king salmon will be available for harvest.

The majority of these fish will probably be harvested by seine fishermen. Each species will be available for harvest by sport and subsistence fishermen.

2.7.1.3.2 Copper River Area

Rehabilitation and enhancement activities in the Copper River area have been limited to the operation of a sockeye salmon hatchery near Gulkana, fertilization of Tokun Lake on the Copper River Delta, construction of a fishpass at Boswell Bay Creek on Hinchinbrook Island and excavation of a spawning channel at Mile 18 of the Copper River Highway (Appendix 32, page 71).

2.7.1.3.2.1 Gulkana Hatchery

The facility presently consists of plywood incubation boxes situated near a spring tributary to the Gulkana River and Paxson Lake (Figure 3, page 4). The facility is designed to operate without electricity and is unmanned during late fall and winter.

The hatchery site was selected because of various key factors, such as water temperature, water quantity and quality, ease of access, brood stock availability and proximity to major underutilized rearing areas. The spring flows at a minimum rate of 9 cfs and has a temperature of 37 to 42 degrees F. The hatchery is across the Gulkana River from the Richardson Highway. A small population of sockeye salmon spawned in the spring area before the hatchery commenced operation.

Eggs and sperm have, to date, been collected from fish that have returned to the spring-fed stream to spawn. Fertilized eggs have been "seeded" on a bed of gravel or plastic material, and spring water has been distributed by gravity via a system of pipes. Fry have been counted and collected as they leave the boxes and have either been released on site or have been transported to distant lakes.

The incubation box concept has proven successful at this location for incubating sockeye salmon, and the number of incubators has gradually been increased during the past 12 years. It is estimated that the hatchery at its 1984 capacity of 25,000,000 green eggs will produce 173,200 adult fish annually.

Major underutilized lakes are located near the facility, including: Summit, Paxson, Crosswind, Tazlina and Klutina Lakes. Limnological data suggest that it may be feasible to increase the production from these lakes by as many as 819,000 adult sockeye salmon annually.

Table 26. Sockeye salmon production data for the Gulkana Hatchery, 1973-1984.

Brood Year	Eggs Taken	Fry Produced	Survival Rate %	Fry Released on Site	Fry Transferred for Release
1973	225,800	179,311	79.4	79,691	99,620 TML
1974	1,266,552	886,556	70.0[1/]	785,110	101,446 TML
1975	1,276,570	727,607	57.0	626,007	101,600 TML
1976	1,288,142	628,575	48.8	516,327	112,248 TML
1977	1,361,149	583,922	42.9	479,864	104,058 TML
1978	1,320,472	1,040,255	78.8	940,666	99,589 TML
1979	3,563,568	2,446,257	68.6[2/]	1,105,397	1,340,660 SL
1980	6,228,897	5,249,173	84.2	3,388,682	1,860,491 SL
1981	9,166,596	8,033,217	87.6	5,985,270	2,047,947 SL
1982	10,931,889	9,782,684	89.5[3/]	5,470,056	4,312,628 SL
1983	13,033,894	10,902,160	83.6[3/]	6,160,401	4,741,759 SL
1984	26,771,104				
Total less 1984	49,663,529	40,459,717		25,537,471	13,582,726
Weighted Average			81.5		

TML Ten Mile Lake
SL Summit Lake
1/ One incubation box froze due to insufficient water flow.
2/ One incubation box was disturbed by a bear.
3/ One incubation box had an outbreak of IHN virus.

Fry have been released at the facility, at Ten Mile Lake and at Gunn Creek, a tributary to Summit Lake (Table 26, page 48). On-site plants have been conducted to develop hatchery brood stock. Ten Mile Lake was a lake barren of sockeye salmon and was stocked with fry during 1974 through 1978. Peak escapement data suggest that possibly 1.0 percent of released fry returned to the lake and fisheries of the area. Gunn Creek fry transplants have been conducted to evaluate the optimum stocking density of Summit Lake and to evaluate the potential for increasing the optimum population density and smolt production through nutrient enrichment.

Disease has not proven to be a major factor at this facility due in part to the modular nature of the egg box system. Outbreaks of IHN virus disease caused the loss of approximately 400,000 fry in both 1983 and 1984 (Table 26, page 48). The parallel intake system limited these outbreaks to one incubation unit. Despite the IHNV outbreaks, the egg-to-fry survival rate was 89.0 percent in 1983 and 83.6 percent in 1984. The average survival of all eggs incubated at the site has been 81.5 percent.

2.7.1.3.3 Outside of the Region

2.7.1.3.3.1 Elmendorf Hatchery

This FRED hatchery, located on Elmendorf Air Force Base near Anchorage, is a central incubation facility and has been used to incubate and rear coho and king salmon. The smolt rearing capacity of the hatchery in 1984 was 500,000 coho and 1,000,000 king salmon. Smolt have been released in locations around Cook Inlet and Cove Creek (Stream 442) and Whittier Creek (Stream 441) in Prince William Sound. From 1978 through 1983, approximately 581,500 coho salmon smolt were released. It has been estimated that 5,970 adult coho salmon representing 1.0 percent of smolt released have been harvested by sport fishermen. No estimates are available of harvests by commercial fishermen.

Beginning in 1981, king salmon smolt have been released in Cove Creek. The first major return occurred in 1984 when an estimated 400 fish were harvested.

ADF&G has proposed the following stocking schedule.

Table 27. Proposed stocking schedule of coho and king salmon juveniles produced at the Elmendorf and Ft. Richardson hatcheries, 1985 through 1989.

Species	Size	Run Timing	Release Site	Number Released	Beginning Year
coho	smolt	late	Cove Creek	100,000	ongoing
coho	finger.	late	Culross Lake	100,000	ongoing
coho	finger.	late	Surprise Cove lakes	155,000	1985
coho	finger.	late	Pass Lake	120,000	1987
coho	smolt	late	Poe River	50,000	1987
coho	finger.	early	N. Nellie Juan lks.	180,000	1988
coho	smolt	early	Cove Creek	100,000	1989
king	smolt	early	Cove Creek	100,000	ongoing
king	smolt	early	Anderson Bay	200,000	1985
king	finger.	early	Granite Bay lakes	75,000	1986
king	smolt	early	Poe River	100,000	1986
king	smolt	early	Shotgun Cove	100,000	1988

2.7.1.3.3.2 Ft. Richardson Hatchery

This FRED central incubation facility is located on Ft. Richardson, an Army installation near Anchorage. The hatchery, in 1984, had the following capacity.

Table 28. Rearing capacity of the Ft. Richardson Hatchery, 1984.

Species	Release Size	Number
coho salmon	fingerling	2,500,000
coho salmon	smolt	2,000,000
king salmon	fingerling	2,500,000
king salmon	smolt	1,000,000

Coho salmon fingerlings, incubated and reared at Ft. Richardson, have been used for stocking Culross Lake (Stream 478) and Otter Lake (Stream 688). At Culross Lake approximately 97,430 fingerlings were released in 1983 and 61,261 fingerlings were released in 1984. Approximately 65,000 coho salmon fingerlings were released in Otter Lake in 1983. The first return of adults occurred in 1985. Approximately 600 coho salmon returned to Culross Lake and an unknown number of fish returned to Otter Lake. Table 27 presents the proposed stocking schedule of fish incubated and reared at Ft. Richardson and Elmendorf.

3.0 FISHERY STATUS

This section presents an evaluation of the management, rehabilitation and enhancement status of the salmon fishery and presents projections of harvests of wild, rehabilitated and enhanced stocks. Harvest projections serve as a baseline, and when compared with goals presented in the Phase I Plan, help to define our rate of progress in resolving gaps in user-group harvests. These projections will be added to estimates of the output of the quantifiable projects recommended in Chapter 7.0 to determine the total harvests that may be anticipated if these new projects are implemented.

Projections of harvests resulting from hatchery projects are difficult to compile because hatchery capacities are generally not fixed but rather increase in time as additional capital is raised to purchase new incubators and additional floor space is made available for incubators. Hatchery harvest projections prepared in this chapter are based on the number of eyed eggs actually incubated in 1984. Data on the maximum eyed-egg capacity, in 1984, are included to provide a measure of our rate of progress in achieving egg procurement goals and acquiring necessary incubators.

3.1 PINK SALMON FISHERY

3.1.1 Prince William Sound Area

The commercial fishery for pink salmon has been managed by use of run forecast, escapement and catch data. Forecasts have been predictions of total run size for the entire Sound and have been based on densities of pre-emergent fry in 25 index streams. Individual district forecasts have not been attempted due to the lack of funds for increased sampling and the lack of a means to determine the harvest and total run of fish destined for natal streams in individual districts. Harvests commonly occur at headlands or capes located in districts other than natal districts. The total harvest of individual district stocks is needed to establish the relationship between fry indices and total returns, i.e. catch and escapement. The magnitude of the forecasted run is used in conjunction with early-season aerial survey and escapement data to determine the opening date of the fishery and which districts are to be open. Subsequent catch and escapement data are used to determine allowable weekly fishing time and to make open and closed area adjustments. Forecasts have had an average error of 25 percent.[10/11/]

Escapement data have been derived by weekly aerial and ground surveys in 196 index streams. Total counts for the estimated 511 streams in which pink salmon spawning has been documented have not been available due to the expense and manpower required to visit each location multiple times annually. It is believed, however, that approximately 75 percent of the area's pink salmon spawn within index areas.[10/] Index counts have been adjusted by stream-life factors to estimate total escapement in each index stream (Appendix 17, page A-48).

Index escapement goals have been established for each district except the Unakwik District. Pink salmon spawners have only been observed in two drainages within the Unakwik District.

Table 29. Pink salmon index area escapement goals by district in the Prince William Sound Area, 1984.[1/]

District	Escapement Goal		
Eastern	403,750	to	484,500
Northern	140,000	to	168,000
Coghill	125,000	to	175,000
Northwestern	104,000	to	172,000
Eshamy	9,000	to	12,000
Southwestern	69,000	to	115,000
Montague	106,250	to	127,500
Southeastern	225,000	to	270,000
Total	1,200,000	to	1,524,000

[1/] Adapted from Randall et al. (1984).

Goals have been based on historic escapement data and do not reflect the amount or quality of available spawning area. Escapements equaling or exceeding the present goal for the entire area have been achieved 11 years during the past 25 years.

The ability to identify individual pink salmon stocks in commercial harvests has yet to be developed. Tagging studies have been attempted, but these have been conducted to determine migration areas of various stocks of pink salmon in the vicinity of FRED and PNP hatcheries in Prince William Sound.

Commercial harvests have exhibited a major upward trend since 1978 (Appendix 10, page A-34). The average harvest by all gear groups during the period 1960 through 1978 was 3,310,368 fish. From 1979 through 1984, the average harvest of wild stocks* was 17,079,500 fish. Harvests of these recent high magnitudes are not expected to continue indefinitely. It is assumed that these high catches are attributed to short-term climatological phenomena. It is projected that harvests in the year 2002 will be similar to average harvests that occurred during the period 1960 through 1984. It is projected that seine fishermen will harvest an average of 5,754,900 fish, drift gill net fishermen will harvest an average of 268,500 fish and set gill net fishermen will harvest an average of 12,700 fish.

Subsistence fishing for pink salmon has been allowed during open commercial fishing periods. Reported harvests of pink salmon have been minor. The average reported harvest from 1960 through 1984 was 162 fish (Appendix 15, page A-43). It is projected that subsistence harvests of wild pink salmon in the year 2002 will be similar to historic levels.

The sport fishery has been managed by regulated methods and bag limits. Total sport harvest estimates have only been available since 1977. From 1977 through 1984, the average harvest of pink salmon was 14,120 fish (Appendix 16 page A-44). No upward or downward trends in overall effort or catch are apparent. It is projected that the average sport harvest of wild pink salmon in the year 2002 will be 14,100 fish.

*Wild stocks are those that have not been augmented through enhancement or rehabilitation measures.

Pink salmon rehabilitation to date has consisted of fishpass installation, rechanneling and channel improvement, stream diversions and revetments, stream cleaning, log removal and fry transplants (Appendix 32, page A-71). It is estimated that these projects will, in the near future, contribute approximately 121,000 harvestable pink salmon annually to the fisheries of the region. The useful life of these varied projects is difficult to estimate. While fishpasses may, if maintained properly, last beyond the year 2002, other projects such as rechannelization will have a much shorter useful period. It is estimated that the long-term projects, i.e. fishpass projects, will contribute approximately 80,000 harvestable fish annually in the year 2002.

Four hatcheries in the Sound incubated pink salmon eggs in 1984. Table 30 (page 53) presents projections of adult production based on the number of eyed eggs that were incubated in 1984. Various projects listed in this plan will be aimed at increasing the capacity of these facilities beyond these baseline levels.

Table 30 also presents projections of total numbers of pink salmon available for harvest by all user groups and a hypothetical distribution of these fish among users. These data do not constitute an allocation scheme; however, they serve to demonstrate the outcome of one of many possible scenarios. Only after multiple years of returns will any predictable harvest patterns be apparent.

Table 31 (page 54) presents a summary of the projected harvest status of wild pink salmon and pink salmon produced through rehabilitation and through artificial incubation.

3.1.2 Copper River Area

Pink salmon harvests have been minor and have occurred incidentally to the harvests of sockeye and king salmon. The average harvest from 1960 through 1984 was 5,718 fish (Appendix 11, page A-37). No upward or downward trends in harvests are apparent and it is projected that in the year 2002, drift gill net fishermen will harvest an average of 5,700 fish.

Subsistence harvests of pink salmon have been negligible. From 1960 through 1984, the total reported harvest was 34 fish (Appendix 13 and 14, pages A-41 and A-42). It is projected that in the year 2002 the subsistence harvest of pink salmon will be minimal.

Sport harvests of pink salmon have also been minimal. From 1977 through 1984, it is estimated that a total of 12 fish were harvested (Appendix 16, page A-44). It is projected that the sport harvest of pink salmon in the year 2002 will be minimal.

No rehabilitation or enhancement projects have been directed toward pink salmon in this area.

Table 30. Projected common property harvests of pink salmon produced by four hatcheries in the Prince William Sound Area based on the actual number of eyed eggs incubated in 1984.

Hatchery	Maximum Eyed-Egg Capacity in 1984	Eyed Eggs Incubated in 1984	Projected Total Return Based on Actual No. of Eyed Eggs Incubated in 1984	Brood Needs[1/]	PNP Fish Sales	Hypothetical Harvest Distribution				
						Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence
Cannery Creek	50,000,000	43,000,000	2,165,100[2/]	77,200	0	1,879,100	208,800	0	0	0
Main Bay	28,500,000	28,500,000	1,435,000[2/]	44,000	0	695,500	347,800	347,800	0	0
A. F. Koernig	108,000,000	107,820,000	4,899,400[3/]	166,700	1,539,200[4/]	3,193,500	0	0	0	0
Solomon Gulch	70,000,000	49,980,000	2,271,100[3/]	108,000	959,400[5/]	1,191,700	0	0	12,000[6/]	0
Total	256,500,000	229,300,000	10,770,600	395,900	2,498,600	6,959,800	556,600	347,800	12,000[6/]	0

1/ The number of brood fish required to fill the maximum eyed-egg capacity in 1984.
2/ Assuming an eyed-egg to fry survival of 95 percent and a marine survival of 5.3 percent.
3/ Assuming an eyed-egg to fingerling survival of 85.7 percent and a marine survival of 5.3 percent.
4/ Assuming that $797,000 are collected through assessments and a total hatchery revenue goal of $1,782,000. It is also assumed that the common property fishery exploitation rate will be similar for each species returning to the hatchery.
5/ Assuming a hatchery revenue goal of $1,041,000 and that the common property fishery exploitation rate will be similar for each species returning to the hatchery.
6/ These fish represent an opportunity for sport harvest, and the number of fish harvested will be dependent on sport fishing effort.

Table 31. Summary of projected common property harvests of pink salmon in the Prince William Sound and Copper River areas based on average wild harvests, rehabilitation production codfficients and the number of eyed eggs incubated in 1984.[1/]

Area	Stocks	Hypothetical Harvest Distribution					
		Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence	Total
Prince William Sound	Wild[2/]	5,754,900	268,500	12,700	14,100	200	6,050,400
	Rehabilitation Projects[1/]	59,000	21,000	0	0	0	80,000
	Hatchery	6,959,800	556,600	347,800	12,000	0	7,876,200
	Total Fish	12,773,700	846,100	360,500	26,100	200	14,006,600
	Commercial Value[3/]	$12,952,500	$857,900	$365,500			$14,175,900
Copper River	Wild[2/]	0	5,700	0	0	0	5,700
	Rehabilitation Projects[1/]	0	0	0	0	0	0
	Hatchery	0	0	0	0	0	0
	Total Fish	0	5,700	0	0	0	5,700
	Commercial Value[4/]	$0	$6,700	$0			$6,700
Both Areas	Total Fish	12,773,700	851,800	360,500	26,100	200	14,012,300
	Commercial Value	$12,952,500	$864,600	$365,500			$14,182,600

1/ Rehabilitation production coefficients are USDA Forest Service estimates of the productive capabilities of a unit of habitat. It is estimated that an acre of natural spawning area is capable of producing approximately 6,100 harvestable adult pink salmon.

2/ Based on average harvest data.

3/ Assuming an average weight of 3.9 lbs. and an average price of $0.26/lb.

4/ Assuming an average weight of 4.5 lbs. and an average price of $0.26/lb.

3.2 CHUM SALMON FISHERY

3.2.1 Prince William Sound Area

The chum salmon fishery occurs, with several exceptions, incidentally to the pink salmon fishery. Fisheries for early and late-run stocks of chum salmon in isolated areas have been managed, but the main component of the run, which coincides with the dominant pink salmon fishery, has essentially not been managed.[11/] Escapement has been monitored by aerial and ground surveys in 94 index streams (Appendix 18, page A-49). Escapement goals have been established for each district except the Unakwik District. Chum salmon spawners have been observed in one drainage within the Unakwik District.

Table 32. Chum salmon index area escapement goals by district in the Prince William Sound Area, 1984.[1/]

District	Escapement Goal		
Eastern	87,200	to	109,000
Northern	29,400	to	36,750
Northwestern and Coghill	48,600	to	60,750
Southwestern and Eshamy	3,400	to	4,250
Montague	11,400	to	14,250
Southeastern	20,000	to	25,000
Total	200,000	to	250,000

[1/] Adapted from Randall et al. (1984).

Escapements have equaled or exceeded the present goals 12 years during the past 25 years. Goals have been based on historic escapement data and do not reflect the amount and quality of available spawning area.

Forecasts of chum salmon runs for all of Prince William Sound have been made; however, no forecasts for individual districts have been attempted. Forecasts have been based on indices of pre emergent fry abundance in 19 streams. Currently, brood-year return age data are used to forecasts runs. The average error of forecasts has been 28 percent.[10/]

Commercial harvests have exhibited a major upsurge since 1980 (Appendix 10, page A-34). The average harvest by all gear groups during the period 1960 through 1980 was 435,864 fish. From 1981 through 1984, the average harvest of wild chum salmon was 1,398,253 fish. Harvests of these recent high magnitudes are not expected to continue indefinitely. It is assumed that these high returns are attributed to short-term climatological phenomena. It is projected that harvests of wild stocks in the year 2002 will be similar to average harvests that occurred during the period 1960 through 1984. It is projected that seine fishermen will harvest an average of 581,800 fish, drift gill net fishermen will harvest an average of 161,100 fish and set gill net fishermen will harvest an average of 2,700 fish.

Subsistence fishing for chum salmon has been allowed during open commercial fishing periods. Reported harvests of chum salmon have been minor. The average reported har-

vest during 1960 through 1984 was 18 fish (Appendix 15, page A-43). It is projected that subsistence harvests of wild chum salmon in the year 2002 will be minimal.

The sport fishery has been managed by regulated methods and bag limits. Total sport harvest estimates have been available since 1977. From 1977 through 1984, the average harvest of chum salmon was 1,179 fish (Appendix 16, page A-44). No upward or downward trends in overall effort or catch are apparent. It is projected that the harvest of wild chum salmon in the year 2002 will be 1,200 fish.

Chum salmon rehabilitation to date has consisted of rechanneling and channel improvement, stream diverting, construction of revetments, stream cleaning and log removal (Appendix 32, page A-71). It is estimated that these projects contribute a minimum of 14,900 chum salmon annually to the fisheries of the region. The useful life of these projects is expected to be 5 to 10 years, and, without periodic maintenance, it may be projected that production will decline to zero by the year 2002.

Table 33 (page 57) presents projections of total numbers of harvestable chum salmon produced by the area's hatcheries based on the number of eyed eggs incubated in 1984. Hypothetical harvests for each user group are included.

Table 34 (page 58) presents a summary of the projected harvest status of wild chum salmon and chum salmon produced through rehabilitation and artificial incubation.

3.2.2 Copper River Area

Chum salmon harvests have been minor and have occurred incidentally to the harvests of sockeye and king salmon. The average harvest from 1960 through 1984 was 946 fish (Appendix 11, page A-37). No upward or downward trends in harvests are apparent and it is projected that in the year 2002, drift gill net fishermen will harvest an average of 900 fish.

Subsistence harvests of chum salmon have been negligible. From 1960 through 1984, the total reported harvest was 1 fish (Appendix 13 and 14, pages A-41 and A-42). It is projected that in the year 2002, the subsistence harvest of chum salmon will be minimal.

No sport harvests of chum salmon have been documented.

No rehabilitation or enhancement projects have been directed towards chum salmon in this area.

Table 33. Projected common property harvests of chum salmon produced by four hatcheries in the Prince William Sound Area based on the actual number of eyed eggs incubated in 1984.

Hatchery	Maximum Eyed-Egg Capacity in 1984	Eyed Eggs Incubated in 1984	Projected Total Return Based on Actual No. of Eyed Eggs Incubated in 1984	Brood Needs[3/]	PNP Fish Sales	Hypothetical Harvest Distribution				
						Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence
Cannery Creek	779,000[4/]	779,000	20,000[1/]	900	0	19,100	0	0	0	0
Main Bay	29,500,000	29,500,000[5/]	505,900[2/]	33,100	0	47,300	212,800	212,800	0	0
A. F. Koernig	12,000,000	11,521,900	296,400[1/]	13,500	93,100[6/]	189,800	0	0	0	0
Solomon Gulch	6,000,000	2,450,000	63,000[1/]	6,700	26,600[7/]	29,700	0	0	0	0
Total	48,279,000	44,250,900	885,300	54,200	119,700	285,900	212,800	212,800	0	0

1/ Assuming an eyed-egg to fingerling survival of 85.7 percent and a marine survival of 3.0 percent.
2/ Assuming an eyed-egg to fingerling survival of 85.7 percent and a marine survival of 2.0 percent.
3/ The number of brood fish required to fill the maximum eyed-egg capacity in 1984.
4/ Chum salmon are an incidental species at Cannery Creek and it is difficult to develop a brood stock while an intense seine fishery is conducted on Cannery Creek pink salmon stocks in Unakwik Inlet.
5/ Some fry were released at the Esther Hatchery site in 1985.
6/ Assuming that $797,000 are collected through assessments and a total PWSAC revenue goal of $1,782,000. It is also assumed that the common property fishery exploitation rate will be similar for each species returning to the hatchery.
7/ Assuming a hatchery revenue goal of $1,041,000 and that the common property fishery exploitation rate will be similar for each species returning to the hatchery.

Table 34. Summary of projected common property harvests of chum salmon in the Prince William Sound and Copper River areas based on average wild harvests, rehabilitation production codfficients and the number of eyed eggs incubated in 1984.[1/]

Area	Stocks	Hypothetical Harvest Distribution					
		Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence	Total
Prince William Sound	Wild[2/]	581,800	116,100	2,700	1,200	0	701,800
	Rehabilitation Projects[1/]	0	0	0	0	0	0
	Hatchery	285,900	212,800	212,800	0	0	711,500
	Total Fish	867,700	328,900	215,500	1,200	0	1,413,300
	Commercial Value[3/]	$2,061,700	$781,500	$512,000			$3,355,200
Copper River	Wild[2/]	0	900	0	0	0	900
	Rehabilitation Projects[1/]	0	0	0	0	0	0
	Hatchery	0	0	0	0	0	0
	Total Fish	0	900	0	0	0	900
	Commercial Value[4/]	$0	$1,800	$0			$1,800
Both Areas	Total Fish	867,700	329,800	215,500	1,200	0	1,414,200
	Commercial Value	$2,061,700	$783,300	$512,000			$3,357,000

1/ Rehabilitation production coefficients are USDA Forest Service estimates of the productive capabilities of a unit of habitat. It is estimated that an acre of natural spawning area is capable of producing approximately 4,500 harvestable adult chum salmon.

2/ Based on average harvest data.

3/ Assuming an average weight of 8.8 lbs. and an average price of $0.27/lb.

4/ Assuming an average weight of 7.4 lbs. and an average price of $0.27/lb.

3.3 SOCKEYE SALMON FISHERY

3.3.1 Prince William Sound Area

Commercial harvests of sockeye salmon have only been managed in the Coghill, Unakwik and Eshamy districts. No major sockeye salmon stocks occur in other districts within the Sound. Escapement goals have only been established for Coghill Lake and Eshamy Lake. The Coghill Lake escapement goal is 40,000 to 50,000 sockeye salmon, and the Eshamy Lake escapement goal is 20,000 to 30,000 sockeye salmon. Goals have been based on escapement estimates and harvest data. While Coghill Lake sockeye salmon are early-run fish and are generally all harvested in the Coghill District, Eshamy Lake sockeye salmon are late-run fish, and unknown numbers of these fish are harvested in other districts. The Eshamy Lake escapement goals subsequently have been based on incomplete data. Escapement enumeration in the lesser systems elsewhere in Prince William Sound is difficult and relatively costly. With the exception of occasional aerial escapement counts, no individual efforts have been made to monitor sockeye salmon escapement nor have escapement goals been developed.[11/]

Run forecasting has been limited to the Coghill District. Informal "projections" have been made of harvests in the Eshamy and Southwestern districts. No harvest projections have been prepared for other districts within the Sound.

Run modeling has yet to be attempted on sockeye salmon stocks of Prince William Sound. Scale analysis suggests that it may be feasible to identify Eshamy Lake and Coghill Lake sockeye salmon stocks in commercial harvests of the area.

Commercial harvests have overall exhibited a slight upward trend since 1960 (Appendix 10, page A-34). The average harvest by all gear groups during 1960 through 1984 was 178,954 fish. It is projected that harvests in the year 2002 will be similar to these harvests. The data base for drift and set gill net harvests in the Eshamy District extends only back to 1967 (Appendix 23, page A-56). Prior to 1967, harvests of these gear types were combined. Average harvest data for the Eshamy District includes 9 years of complete closures. The data base for the drift gill net harvests in the Unakwik District begins in 1971 (Appendix 19, page A-50). From 1962, the first year the district was open to drift gill net fishing, through 1970, drift gill net harvest data were combined with seine data. It is projected that in the year 2002, seine fishermen will harvest an average of 54,600 fish, drift gill net fishermen will harvest an average of 172,300 fish and set gill net fishermen will harvest an average of 8,500 fish.

Subsistence fishing is allowed during open commercial periods. Legal gear consists of drift and set gill nets and purse seines. Reported harvests have been minor. The average reported catch from 1960 through 1984 was 13 fish (Appendix 15, page A-43). It is projected that subsistence harvests of sockeye salmon in the year 2002 will be of approximately the same magnitude.

The sport fishery has been managed by regulated methods and bag limits. A policy was recently adopted to restrict snagging in Eshamy Lagoon when it is projected that the sockeye salmon escapement will be insufficient to allow a commercial fishery. Total sport harvest estimates have only been available since 1977. From 1977 through 1984, the average harvest of sockeye salmon in Prince William Sound was 3,292 fish (Appendix 16, page A-44). No upward or downward trend in effort or catch is apparent. It is projected that the harvest in the year 2002 will be 3,200 fish.

Sockeye salmon rehabilitation to date has consisted of fishpass installation at five locations: Billy's Hole Creek (Stream 218), Red Creek (Stream 300), Shrode Creek (Stream 476), Sockeye Creek (Stream 687) and Rocky Creek (Stream 759). It is estimated that the new habitat made accessible by these structures will contribute approximately 23,300 sockeye salmon annually to the fisheries of the region (Appendix 32, page A-71). It is assumed that the useful life of these fishpasses may, if maintained properly, extend beyond the year 2002.

None of the hatcheries in the Sound incubate sockeye salmon eggs at this time. Potential problems with IHN virus have precluded the use of existing facilities. Numerous potential hatchery sites exist in Prince William Sound and numerous barren or underutilized lakes are available for stocking.

Table 35 (page 61) presents a summary of the projected harvest status of wild sockeye salmon and sockeye salmon produced through rehabilitation projects.

3.3.2 Copper River Area

Management of the sockeye salmon commercial, subsistence and sport fisheries is difficult because of the apparent mixed nature of stocks in the commercial fishery and poor water clarity in the estuary and numerous drainages in which sockeye salmon migrate upstream to spawn.

The sockeye salmon commercial fishery has been managed primarily on the basis of commercial catch data, escapement sonar counts and Delta index escapement counts. The fishery is comprised of two major components, an upriver component and a Delta component.

The upriver run is the only component that has been intensively managed. Weekly and seasonal escapement goals have been established for the upriver run; however, escapement goals for the Delta stocks are essentially seasonal index goals. Goals have been based on historic escapement data. Knowledge of the optimum capacity of spawning and rearing areas is incomplete.

The upriver goal, commencing in 1984, is an escapement of 411,000 fish, as measured by sonar counters (Table 36, page 62). Efforts to apportion counts according to species composition have been limited. The timing of the upriver run coincides with the king salmon run; however, the king salmon run has been considered to be a fraction of the sockeye salmon run, and it is believed that not all king salmon have been counted. King salmon, unlike sockeye salmon, commonly do not demonstrate a strong affinity for nearshore waters where the counters have been located. Commercial and dip net harvest data suggest that at least 95 percent of the counts have been sockeye salmon.

Some coho salmon stocks also migrate upriver. The coho salmon migration, however, occurs after the sockeye salmon migration, and these fish area not included in the escapement goal.

Table 35. Summary of projected common property harvests of sockeye salmon in the Prince William Sound and Copper River areas based on average wild harvests, rehabilitation production coefficients and eyed eggs incubated in 1984.[1/]

Area	Stocks	Hypothetical Harvest Distribution					
		Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence	Total
Prince William Sound	Wild[2/]	54,600	172,300	8,500	3,200	0	238,600
	Rehabilitation Projects[1/]	21,300	2,600	0	0	0	23,900
	Hatchery	0	0	0	0	0	0
	Total Fish	75,900	174,900	8,500	3,200	0	262,500
	Commercial Value[3/]	$491,800	$1,133,400	$55,100			$1,680,300
Copper River	Wild[2/]	0	600,000	0	2,600	79,100	681,700
	Rehabilitation Projects[1/]	0	149,200	0	0	0	149,200
	Hatchery	0	92,700	0	1,400	46,300	140,400
	Total Fish	0	841,900	0	4,000	125,400	971,300
	Commercial Value[4/]	$0	$6,768,900	$0			$6,768,900
Both Areas	Total Fish	75,900	1,016,800	8,500	7,200	125,400	1,233,800
	Commercial Value	$491,800	$7,902,300	$55,100			$8,449,200

1/ Rehabilitation production coefficients are USDA Forest Service estimates of the productive capabilities of a unit of habitat. It is estimated that an acre of natural spawning area is capable of producing approximately 50 harvestable adult sockeye salmon. It is assumed that barren lakes stocked with fingerlings are capable of producing 100 harvestable adult sockeye salmon per acre of lake surface area.

2/ Based on average harvest data.

3/ Assuming an average weight of 7.2 lbs. and an average price of $0.90/lb.

4/ Assuming an average weight of 6.7 lbs. and an average price of $1.20/lb.

Table 36. Upper Copper River escapement goals and harvest guidelines.

spawning escapement	320,000 sockeye 15,000 king
subsistence harvest	80,000 salmon
hatchery brood stock	10,000 sockeye
sport fishery	3,500 sockeye 2,500 king
total	411,000 salmon

Index goals are escapement goals based on "peak" counts of spawners in 7 select Delta spawning areas (Appendix 28, page A-62). The goal is a peak count of 80,000 to 90,000 sockeye salmon. Counts have been derived generally by periodic aerial surveys. Peak counts do not represent the total number of fish that spawned in an area. Fish commonly enter a spawning area over an extended period of time, and all spawners are not necessarily present at the peak period of abundance. Index areas are not inclusive of all spawning areas. Index areas are selected because of considerations such as consistent water clarity and relative size of the population.

Spawner surveys have also been conducted in 20 index areas in the Upper Copper River (Appendix 29, page A-62). Other known spawning areas are also commonly counted. Fish don't arrive in these areas until the fishery is virtually over, and subsequently these peak counts serve only as indicators of spawner distribution.

The average travel time of salmon migrating from the fishery to the sonar counters is approximately 8 days, and this, in relation to the long entry pattern of upstream stocks, has been sufficiently brief to allow management of the upriver run. First indications of escapement magnitude of the Delta component have not been available until mid June, approximately one month after the fishery opens. River ice conditions commonly have precluded installation of counters until late May. Catch data subsequently have been used in conjunction with "harvest projections" and average timing data to provide means of gauging the probable magnitude of early escapements.

Run projections have been based on averages of recent annual harvests, expansions of parent year index escapement counts, commonly observed return per spawner ratios, age composition data, and age-at-maturity schedules. Harvest projections have been derived by subtracting the desired escapement from the run projection. Historic harvest projections and actual harvests are summarized below.

Table 37. A comparison of commercial harvest projections of sockeye salmon and actual harvests, Copper River area, 1977 through 1984.[1/]

Year	Projected Harvest -range-	Actual Harvest
1977	400,000-450,000	619,140
1978	no projection	249,872
1979	500,000-600,000	80,528
1980[2/]	0	18,451
1981	350,000-450,000	486,982
1982	700,000-900,000	1,193,584
1983	350,000-550,000	633,010
1984	600,000-800,000	899,776

[1/] Randall (personal communication).
[2/] Improved methods were employed commencing in 1980.

The ability to identify stocks is presently limited to the two major components of the sockeye salmon run, the upriver component and the Delta component. Accuracy is less than 100 percent and is expected to vary annually with changing growth conditions. The technique employed entails scale pattern analysis. The ability to identify individual stocks or spawning populations of sockeye salmon has been limited to a few stocks exhibiting unique scale patterns.

Stock identification research indicates that both upriver and Delta stocks are harvested throughout the sockeye salmon season. It may be possible to detect shortfalls in Delta escapements and adjust fishing time; however, stock identification research has yet to demonstrate distinct spatial segregation. Extended district-wide closures may subsequently be required to increase escapements. Closures or reductions in fishing time based on low sonar counts or aerial counts may, however, reduce the harvest of the stronger run component.

Run modeling, a systematic means of continually gauging run strength, timing and spatial distribution through test fishing, has not proven to be feasible. Test fishing was conducted during 1968 through 1970; however, no relationship was apparent between test fish catches and other indicators of run strength and timing. Escapements during these years were monitored by means of fishwheels located on the mainstem of the Copper River and aerial surveys of index areas. The total upriver escapement was estimated by tag-recapture methods.

Commercial harvests have exhibited no significant upward or downward trends since 1960 (Appendix 11, page A-37). The average harvest during 1960 through 1984 was 600,042 fish. It is projected that harvests of wild stocks in the year 2002 will be similar to these harvests and that drift gill net fishermen will harvest an average of 600,000 fish.

The subsistence fishery in the Upper Copper River has been managed by use of projected escapement data and the harvest guidelines presented in the Copper River Management Plan (Table 36, page 62). Sonar counts at Miles Lake have been compared to historic data to project seasonal escapement. The fishing season opens June 1 and closes September 30. Effort and harvests increased significantly commencing in about 1981. The average

reported harvest from 1981 through 1984 was 78,970 sockeye salmon (Appendix 13, page A-41). It is projected that harvests of wild stocks will be similar to harvests that have occurred since 1981 and that in the year 2002 the subsistence harvest in the Upper Copper River drainage will be approximately 79,000 sockeye salmon.

Subsistence fishing in the commercial fishing district has been allowed during open commercial fishing periods. This fishery has been conducted incidentally to the commercial fishery and no attempts have been made to manage harvests. Harvests since 1960 have remained relatively stable. The average reported catch from 1960 through 1984 was 146 sockeye salmon (Appendix 14, page A-42). It is projected that Delta subsistence harvests in the year 2002 will be of approximately the same magnitude or 100 sockeye salmon.

The sport fishery has been managed by regulated methods and bag limits. From 1977 through 1984, the average harvest of sockeye salmon in the Copper River Area was 2,602 fish (Appendix 16, page A-44). No upward or downward trend in effort or catch is apparent. It is projected that the harvest in the year 2002 will be 2,600 fish.

Sockeye salmon rehabilitation to date has consisted of the installation of a fishpass at Boswell Bay Creek (Stream 841-1) and the fertilization of Tokun Lake. It is estimated that the new habitat made accessible by the fishpass will contribute approximately 4,200 sockeye salmon annually to the gill net fishery (Appendix 32, page A-71). It is assumed that the useful life of the fishpass may, if maintained properly, extend beyond the year 2002. It is estimated that the fertilization project at Tokun Lake will contribute 145,000 sockeye salmon annually. Application of fertilizer may be required on an annual basis.

One hatchery is located in the area, the Gulkana Hatchery. This facility, in 1984, had the capacity to incubate approximately 24,100,000 eyed sockeye salmon eggs. It is estimated that the facility at this capacity will produce approximately 160,200 adults (Table 38, page 65).

Table 35 (page 61) presents a summary of the projected harvest status of wild sockeye salmon and sockeye salmon produced through rehabilitation and enhancement projects.

Table 38. Projected common property harvests of sockeye salmon from the Gulkana Hatchery based on the estimated number of eyed eggs incubated in 1984.

Hatchery	Maximum Eyed-Egg Capacity in 1984	Eyed Eggs Incubated in 1984	Projected Total Return Based on Actual No. of Eyed Eggs Incubated in 1984	Brood Needs	PNP Fish Sales	Hypothetical Harvest Distribution				
						Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence
Gulkana	24,100,000	24,094,000[1/]	160,200[2/]	19,800	0	0	92,700	0	1,400	46,300

1/ Approximately 26,770,000 eggs were taken. It is assumed that 90 percent survived to the eyed-egg stage.

2/ Based on FRED Directive No. 3.

3.4 COHO SALMON FISHERY

3.4.1 Prince William Sound Area

Only minor populations of coho salmon occur in the Sound, and, with the exception of late-season closures of Valdez Arm and Port Valdez, no efforts have been made to manage the harvest. No systematic attempts have been made on an area-wide basis to monitor escapement, and there are no escapement goals. Some escapement data exist for Robe River and other Port Valdez streams.[11/]

Commercial harvests have exhibited a downward trend since 1960 (Appendix 10, page A-34). The average harvest of all gear groups during 1960 through 1984 was 15,958 fish. It is thought that this decline is associated with a relative decrease in ex vessel prices. Beginning in 1973, the price of coho salmon in the Sound dropped below the price of chum salmon (Appendix 36, page A-80). It is believed that some coho salmon have been sold as chum salmon. It is projected that harvests in the year 2002 will be similar to harvests that have occurred during 1960 through 1984. It is projected that seine fishermen will harvest an average of 15,500 fish, drift gill net fishermen will harvest an average of 500 fish and set gill net fishermen will harvest an average of 100 fish.

Subsistence fishing for coho salmon has been open during commercial fishing periods with purse seines and drift and set gill nets. Reported harvests have been minor. From 1960 through 1984, the average reported harvest was 66 fish (Appendix 15, page A-43). It is projected that subsistence harvests of wild coho salmon to the year 2002 will remain at historic levels.

The sport fishery has been managed by regulated methods and bag limits. Total sport harvest estimates have only been available since 1977. From 1977 through 1984, the average harvest of wild stocks of coho salmon was 7,305 fish (Appendix 16, page A-44). No upward or downward trend in effort or catch is apparent. It is projected that the average annual harvest in the year 2002 will be 7,300 wild fish.

Coho salmon rehabilitation to date has consisted of fishpass installation at five locations: Red Creek (Stream 300), Sockeye Creek (Stream 687), Otter Creek (Stream 688), Rocky Creek (Stream 759) and Forest Service Trail Creek (Stream 852). It is estimated that the new habitat made accessible by these structures will contribute 2,500 coho salmon to the fisheries of the region (Appendix 32, page A-71).

Coho salmon destined for release in Prince William Sound have been artificially incubated and reared in three hatcheries: Ft. Richardson, Elmendorf and Solomon Gulch. A fourth facility, the Esther Hatchery, will also incubate and rear coho salmon. Table 39 (page 67) presents a projection of adult production from these hatcheries. Hypothetical harvests for each user group are included.

Table 40 (page 68) presents a summary of the projected harvest status of wild coho salmon and coho salmon produced through rehabilitation and artificial incubation.

3.4.2 Copper River Area

Coho salmon spawn in numerous streams, sloughs and lakes on the Delta as well as portions of the Copper River drainage downstream from Klutina Lake. Management of the

Table 39. Projected common property harvests of coho salmon in the Prince William Sound Area based on the actual number of juveniles reared in three hatcheries in 1984.

Hatchery	Maximum Rearing Capacity in 1984	Juveniles Reared in 1984	Projected Total Return Based on Juveniles Reared in 1984[1/]	Brood Needs[2/]	PNP Fish Sales	Hypothetical Harvest Distribution				
						Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence
Ft. Richardson	[3/]	255,000[4/]	2,600	0[5/]	0	800	300	100	1,400[6/]	0
Elmendorf	[7/]	100,000[8/]	5,000[4/]	0[5/]	0	1,800	300	0	3,000[6/]	0
Solomon Gulch	100,000	100,000[9/]	5,000	100	2,100[10/]	1,700	0	0	1,100[6/]	0
Total	100,000	455,000[11/]	12,600	100 5/	2,100	4,300	600	100	5,500[6/]	0

1/ Assuming a fingerling to smolt survival of 20 percent in lakes and a marine survival of 5.0 percent.

2/ The number of brood fish required to provide the number of juveniles reared in 1984.

3/ The maximum rearing capacity was 2,500,000 fingerlings and 2,000,000 smolt. This is a central incubation facility and the capacity is not specifically devoted to Prince William Sound enhancement.

4/ Includes 100,000 fingerlings released at Culross Lake and 155,000 fingerlings released at Surprise Cove lakes.

5/ Brood fish will probably be obtained from fish other than those stocked.

6/ These fish represent an opportunity for sport harvest, and the number of fish harvested will be dependent of sport fishing effort.

7/ The maximum rearing capacity was 500,000 smolt. This is a central egg incubation facility and is not specifically devoted to Prince William Sound enhancement.

8/ Includes 100,000 smolt released at Cove Creek.

9/ Smolt to be released at the hatchery.

10/ Assuming a hatchery revenue goal of $1,041,000 and that the common property fishery exploitation rate will be similar for each species returning to the hatchery.

11/ Includes fingerling and smolt.

Table 40. Summary of projected common property harvests of coho salmon in the Prince William Sound and Copper River areas based on average wild harvests, rehabilitation production coefficients and the number of juveniles reared in 1984.[1/]

Area	Stocks	Hypothetical Harvest Distribution					
		Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence	Total
Prince William Sound	Wild[2/]	15,500	500	100	7,300	100	23,500
	Rehabilitation Projects[1/]	2,300	200	0	0	0	2,500
	Hatchery	4,300	600	100	5,500	0	10,500
	Total Fish	22,100	1,300	200	12,800	100	36,500
	Commercial Value[3/]	$51,900	$3,100	$500			$55,500
Copper River	Wild[2/]	0	180,800	0	2,300	1,200	184,300
	Rehabilitation Projects[1/]	0	0	0	0	0	0
	Hatchery	0	0	0	0	0	0
	Total Fish	0	180,800	0	2,300	1,200	184,300
	Commercial Value[4/]	$0	$1,841,400	$0			$1,841,400
Both Areas	Total Fish	22,100	182,100	200	15,100	1,300	220,800
	Commercial Value	$51,900	$1,844,500	$500			$1,896,900

1/ Rehabilitation production coefficients are USDA Forest Service estimates of the productive capabilities of a unit of habitat. It is estimated that an acre of natural spawning area is capable of producing approximately 165 harvestable adult coho salmon. It is that barren lakes stocked with fingerlings are capable of producing 50 harvestable adult coho salmon per acre of lake surface area.

2/ Based on average harvest data.

3/ Assuming an average weight of 8.7 lbs. and an average price of $0.27/lb.

4/ Assuming an average weight of 9.7 lbs. and an average price of $1.05/lb.

fishery is difficult due to the wide geographical distribution of spawning populations and the lack of escapement counts for the mainstem of the Copper River.

The commercial coho salmon fishery occurs after the sockeye and king salmon fisheries have waned. The fishery has been managed on the basis of catch per unit effort data and aerial escapement counts in 19 index areas on the Delta (Appendix 29, page A-64). Mark-recapture methods were employed during the late 1960's on the mainstem of the Copper River to estimate total escapement. Data suggest that escapements of 15,000 to 25,000 coho salmon occurred during that time. Sonar counters have not been utilized for estimating coho salmon escapements. The counters have been removed from the river prior to the onset of the upstream migration.

The commercial fishery has largely been self regulated. Fishing effort has commonly diminished when harvests have been poor. Increasing effort in recent years suggest that this pattern may be changing.

There are only informal escapement goals for coho salmon. Aerial escapement estimates in index areas have been employed to manage the commercial fishery. Inclement weather during the coho salmon fishing season, however, has often curtailed or limited aerial escapement estimation.

Coho salmon harvest projections have been based on the average of recent annual harvests and parent year escapement estimates when available.

Stock identification research was initiated in 1983. Coho salmon scales were collected from commercially-harvested fish to monitor age structure and variability in growth patterns. No efforts have been made to collect samples from spawning populations, and subsequently no attempts have been made to identify the stock composition of harvests or spatial or temporal distribution in the fishery.

The average commercial harvest from 1960 through 1984 was 180,775 fish (Appendix 11, page A-37). It is projected that harvests of wild stocks in the year 2002 will be similar to these harvests and that drift gill net fishermen will harvest an average of 180,800 fish.

The coho salmon subsistence fishery in the Upper Copper River has occurred after the sockeye salmon fishery and harvests have not been managed. Harvests of coho salmon occur in August and September. The fishing season has closed September 30 annually.

Effort and harvests increased significantly commencing in about 1981. The average reported harvest from 1981 through 1984 was 1,144 coho salmon (Appendix 13, page A-41). It is projected that harvests of wild stocks will be similar to harvests that have occurred since 1981 and that in the year 2002, the subsistence harvest in the Upper Copper River drainage will be approximately 1,100 coho salmon.

Subsistence fishing in the commercial fishing district has been allowed during open commercial fishing periods. This fishery has been conducted incidentally to the commercial fishery and no attempts have been made to manage harvests. Harvests since 1960 have been negligible. The average reported catch from 1960 through 1984 was 51 salmon (Appendix 14, page A-42). It is projected that Delta subsistence harvests in the year 2002 will be of the same magnitude or 100 coho salmon.

The sport fishery has been managed by regulated methods and bag limits. From 1977 through 1984, the average harvest of anadromous coho salmon in the Copper River Area

was 2,335 fish (Appendix 16, page A-44). No upward or downward trend in effort or catch is apparent. It is projected that the harvest in the year 2002 will be 2,300 fish.

Few rehabilitation or enhancement projects have been targeted at anadromous coho salmon in the Copper River Area. The USDA Forest Service has excavated spawning channels in the Mile 18 drainage. This is located along the Copper River Highway. Two spawning experimental channels were excavated in 1971 and one experimental channel was excavated in 1984. The potential benefits from the channels have not been quantified. The Tokun Lake fertilization project may favorably impact the coho population in that lake but the benefits also have not been quantified.

Table 40 (page 68) presents a summary of projected common property harvests of all stocks of coho salmon in the Copper and Prince William Sound areas.

3.5 KING SALMON FISHERY

3.5.1 Prince William Sound Area

No spawning populations of king salmon have been observed in the area, and the relatively few fish harvested annually have been feeding juveniles destined for natal streams in other areas. The average commercial harvest from 1960 through 1984 was 1,356 fish (Appendix 10, page A-34). Commercial harvests occur incidentally to the harvest of other species.

It is projected that harvests in the year 2002 will be similar to harvests that have occurred during 1960 through 1984. It is projected that seine fishermen will harvest an average of 1,100 fish and drift gill net fishermen will harvest an average of 300 fish. The set gill net harvest is anticipated to be negligible.

Subsistence fishing for king salmon is open during commercial fishing periods with purse seines and drift and set gill nets. From 1960 through 1984, a total of 4 king salmon were reportedly harvested (Appendix 15, page A-43). It is projected that the reported subsistence harvest of wild king salmon in the year 2002 will remain minimal.

The sport fishery has been managed by regulated methods and bag limits. Total sport harvest estimates have only been available since 1977. From 1977 through 1984, the average harvest of wild stocks of king salmon was 277 fish (Appendix 16, page A-44). No upward or downward trend in effort or catch is apparent, and it is projected that the harvest in the year 2002 will be 300 wild fish.

King salmon destined for release in Prince William Sound have been incubated and reared at the Elmendorf Hatchery. Table 41 (page 71) presents a projection of adult harvests of these fish. Hypothetical harvest estimates for each user group are included.

Table 42 (page 72) presents a summary of the projected harvests of wild king salmon and king salmon produced through artificial incubation.

Table 41. Projected common property harvests of king salmon in the Prince William Sound Area based on the actual number of juveniles reared at one hatchery in 1984.

Hatchery	Maximum Rearing Capacity in 1984	Juveniles Reared in 1984	Projected Total Return Based on Juveniles Reare in 1984[1/]	Brood Needs[2/]	PNP Fish Sales	Hypothetical Harvest Distribution				
						Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence
Elmendorf	[2/]	300,000	12,000	0[3/]	0	600	5,400	0	6,000[4/]	0

1/ Assuming a marine survival of 4.0 percent.

2/ The maximum rearing capacity was 1,000,000 smolt. This is a central egg incubation facility and is not specifically devoted to Prince William Sound enhancement. Approximately, 100,000 smolt will be released at Cove Creek and 200,000 smolt will be released at Anderson Bay near Valdez.

3/ Brood fish will probably be obtained from fish other than those stocked.

4/ These fish represent an opportunity for sport harvest, and the number of fish harvested will be dependent on sport fishing effort.

Table 42. Summary of projected common property harvests of king salmon in the Prince William Sound and Copper River areas based on average wild harvests, rehabilitation production coefficients and the number of juveniles reared in 1984.[1/]

Area	Stocks	Hypothetical Harvest Distribution					
		Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence	Total
Prince William Sound	Wild[2/]	1,100	300	0	300	0	1,700
	Hatchery	600	5,400	0	6,000	0	12,000
	Total Fish	1,700	5,700	0	6,300	0	13,700
	Commercial Value[3/]	$31,400	$105,400	$0			$136,800
Copper River	Wild	0	19,900	0	1,900	3,000	24,800
	Rehabilitation Projects[1/]	0	0	0	0	0	0
	Hatchery	0	0	0	0	0	0
	Total Fish	0	19,900	0	1,900	3,000	24,800
	Commercial Value[4/]	$0	$765,700	$0			$765,700
Both Areas	Total Fish	1,700	25,600	0	8,200	3,000	38,500
	Commercial Value	$31,400	$871,100	$0			$902,500

1/ Rehabilitation production coefficients are USDA Forest Service estimates of the productive capabilities of a unit of habitat. It is estimated that an acre of natural spawning area is capable of producing approximately 165 harvestable adult king salmon. It is that barren lakes stocked with fingerlings are capable of producing 50 harvestable adult king salmon per acre of lake surface area.

2/ Based on average harvest data.

3/ Assuming an average weight of 13.7 lbs. and an average price of $1.35/lb.

4/ Assuming an average weight of 28.5 lbs. and an average price of $1.35/lb.

3.5.2 Copper River Area

Management of the king salmon fishery has been limited by turbid water conditions throughout most of the drainage and by the lack of sonar counters capable of distinguishing and accurately counting king salmon in the Copper River. Escapement counts have been derived primarily by aircraft after all fisheries have occurred.

Regardless of the adequacy of the present counting system, it may not be practical to implement complete restrictions of the commercial fishery in instances where a weak king salmon escapement were to be detected. Reductions in fishing time to protect king salmon would create a significant impact on the sockeye salmon catches of commercial fishermen. During the peak week of the commercial sockeye and king salmon fisheries, the ratio of sockeye salmon to king salmon has, since 1966, been approximately 25 to 1. Approximately 25 sockeye salmon would escape commercial harvest for every king salmon that were to escape.

Table 43. Average weekly commercial harvests of king and sockeye salmon in the Copper River Area, 1966 through 1978 and 1981 and 1982.

Statistical Week	King Salmon	Sockeye Salmon	Ratio of Sockeye to King Salmon
20	2,196	31,992	15:1
21	4,009	131,064	33:1
22	6,719	164,697	25:1
23	5,581	142,689	26:1
24	3,803	88,343	23:1
25	1,684	64,498	38:1
26	428	44,755	104:1

During years when poor king salmon returns are projected and low harvests occur, restrictions may be required to allow an adequate escapement of king salmon while at the same time allowing the harvest of sockeye salmon.

There has been no escapement goal for king salmon. Estimates of the peak number of spawners obtained in 9 index areas have been compared with historic counts to determine the relative success of management practices (Appendix 26, Page A-60).

Run predictions have been based on the average of recent annual harvests, spawner index counts and return per spawner data.

Stock identification research was initially conducted in 1983 when scales were collected from commercially harvested fish to determine age structure and monitor variability in growth patterns. No efforts have been made to collect samples from spawning populations, and subsequently no attempts have been made to identify stock composition of harvests or spatial and time distribution in the fishery.

Commercial harvests have exhibited no significant upward or downward trends since 1960 (Appendix 11, page A-37). The average harvest during 1960 through 1984 was 19,889 fish.

It is projected that harvests of wild stocks in the year 2002 will be similar to these harvests and that drift gill net fishermen will harvest an average of 19,900 fish.

The subsistence fishery in the Upper Copper River has been managed by use of projected escapement data and the harvest guidelines presented in the Copper River Management Plan (Table 36, page 62). Sonar counts at Miles Lake have been compared to historic data to project seasonal escapement. The fishing season opens June 1 and closes September 30. Effort increased significantly commencing in about 1981. The average reported harvest from 1981 through 1984 was 2,968 king salmon (Appendix 13, page A-41). It is projected that harvests of wild stocks will be similar to harvests that have occurred since 1981 and in the year 2002, the subsistence harvest in the Upper Copper River drainage will be approximately 3,000 king salmon.

Subsistence fishing in the commercial fishing district has been allowed during open commercial fishing periods. This fishery has been conducted incidentally to the commercial fishery and no attempts have been made to manage harvests. Harvests since 1960 have remained relatively stable. The average reported catch from 1960 through 1984 was 42 king salmon (Appendix 14, page A-42). It is projected that Delta subsistence harvests in the year 2002 will be of approximately the same magnitude.

The sport fishery has been managed by regulated methods and bag limits. From 1977 through 1984, the average harvest of king salmon in the Copper River Area was 1,888 fish (Appendix 16, page A-44). No upward or downward trend in effort or catch is apparent. It is projected that the harvest in the year 2002 will be 1,900 fish.

No rehabilitation or enhancement projects have been targeted at king salmon in the Copper River Area. Table 42 (page 72) presents a summary of projected common property harvests all stocks of king salmon in the Copper River and Prince William Sound areas.

3.6 SUMMARY

Projections of harvests and ex vessel values of wild stocks and fish produced through rehabilitation and enhancement in the Prince William Sound and Copper River areas are presented in Tables 44 through 47 (pages 75 and 76). These data when combined with wild harvest projections prepared for the Bering River area (Table 48, page 77) and user demand estimates from the Phase I Plan, suggest that shortfalls in harvests and incomes will generally prevail if prices remain at the 1984 level and if no increases in rehabilitation and enhancement projects occur (Tables 49 and 50, pages 77 and 78).

Goals for commercial fishermen were based on revenue requirements, and average ex vessel prices paid in 1984 were used to define the baseline level. Ex vessel prices in 1984 were generally below those that have been paid since 1977 (Appendix 36, page A-80). It is not known if this trend in prices will continue; however, for planning purposes, it is assumed that prices will, when compared with the inflation rate, remain unchanged. Price data as well as harvest projections will be periodically updated.

Projects recommended for implementation during the next 5 years will hopefully resolve the majority of these shortfalls. Impacts of these projects are summarized in Chapter 9.0.

Table 44. Summary of projected common proqerty harvests of wild salmon stocks in the Prince William Sound and Copper River areas, by species and user group.1/

	Historic Average Catch2/					
Species	Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence	Total
pink	5,754,900	274,200	12,700	14,100	200	6,056,100
chum	581,800	117,000	2,700	1,200	0	702,700
sockeye	54,600	772,300	8,500	5,800	79,100	920,300
coho	15,500	181,300	100	9,600	1,300	207,800
king	1,100	20,200	0	2,200	3,000	26,500
Ex vessel Value:						
pink	$5,835,500	$278,900	$12,900			$6,127,300
chum	$1,382,400	$277,700	$6,400			$1,666,500
sockeye	$353,800	$5,940,500	$55,100			$6,349,400
coho	$36,400	$1,842,600	$200			$1,879,200
king	$20,300	$771,200	$0			$791,500
Total	$7,628,400	$9,110,900	$74,600			$16,813,900

1/ Does not include the Bering River District.
2/ Based generally on harvests that occurred during 1960 through 1984.

Table 45. Summary of projected common property harvests of salmon produced through rehabilitation projects in the Prince William Sound and Copper River areas, by species and user group.1/

	Hypothetical Harvest Distribution					
Species	Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence	Total
pink	59,000	21,000	0	0	0	80,000
chum	0	0	0	0	0	0
sockeye	21,300	151,800	0	0	0	173,100
coho	2,300	200	0	0	0	2,500
king	0	0	0	0	0	0
Exvessel Value:						
pink	$59,800	$21,300	$0			$81,100
chum	$0	$0	$0			$0
sockeye	$138,000	$1,216,400	$0			$1,354,400
coho	$5,400	$500	$0			$5,900
king	$0	$0	$0			$0
	$203,200	$1,238,200	$0			$1,441,400

1/ Does not include the Bering River District.

Table 46. Summary of projected common property harvests of hatchery salmon stocks in the Prince William Sound and Copper River areas, by species and user group.[1/]

Species	Hypothetical Harvest Distribution					
	Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence	Total
pink	6,959,800	556,600	347,800	12,000	0	7,876,200
chum	285,900	212,800	212,800	0	0	711,500
sockeye	0	92,700	0	1,400	46,300	140,400
coho	4,300	600	100	5,500	0	10,500
king	600	5,400	0	6,000	0	12,000
Exvessel Value:						
pink	$7,057,200	$564,400	$352,700			$7,974,300
chum	$679,300	$505,600	$505,600			$1,690,500
sockeye	$0	$745,300	$0			$745,300
coho	$10,100	$1,400	$200			$11,700
king	$11,100	$99,900	$0			$111,000
Total	$7,757,700	$1,916,600	$858,500			$10,532,800

1/ Does not include the Bering River District.

Table 47. Summary of projected common property harvests of all salmon stocks in the Prince William Sound and Copper River areas, by species and user group.[1/]

Species	Hypothetical Harvest Distribution					
	Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence	Total
pink	12,773,700	851,800	360,500	26,100	200	14,012,300
chum	867,700	329,800	215,500	1,200	0	1,414,200
sockeye	75,900	1,016,800	8,500	7,200	125,400	1,233,800
coho	22,100	182,100	200	15,100	1,300	220,800
king	1,700	25,600	0	8,200	3,000	38,500
Ex vessel Value:						
pink	$12,952,500	$864,600	$365,600			$14,182,700
chum	$2,061,700	$783,300	$512,000			$3,357,000
sockeye	$491,800	$7,902,200	$55,100			$8,449,100
coho	$51,900	$1,844,500	$400			$1,896,800
king	$31,400	$871,100	$0			$902,500
Total	$15,589,300	$12,265,700	$933,100			$28,788,100

1/ Does not include the Bering River District.

Table 48. Summary of projected common property harvests of wild salmon stocks in the Bering River Area, by species and user group.

	Historic Average Catch[1]					
Species	Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence	Total
pink	0	900	0	0	0	900
chum	0	3,000	0	0	0	3,000
sockeye	0	45,600	0	0	0	45,600
coho	0	73,300	0	0	0	73,300
king	0	200	0	0	0	200
Ex vessel Value:						
pink[2]	$0	$1,100	$0			$1,100
chum[3]	$0	$6,000	$0			$6,000
sockeye[4]	$0	$366,600	$0			$366,600
coho[5]	$0	$746,600	$0			$746,600
king[6]	$0	$7,700	$0			$7,700
Total	$0	$1,128,000	$0			$1,128,000

1/ Based on harvests that occurred from 1960 through 1984.
2/ Based on an average weight of 4.5 lbs. and an average price of $0.26 per lb.
3/ Based on an average weight of 7.4 lbs. and an average price of $0.27 per lb.
4/ Based on an average weight of 6.7 lbs. ane an average price of $1.20 per lb.
5/ Based on an average weight of 9.7 lbs. and an average price of $1.05 per lb.
6/ Based on an average weight of 28.5 lbs. and an average price of $1.35 pr lb.

Table 49. Summary of projected common property harvests of all salmon stocks in the Prince William Sound, Copper River and Bering River areas, by species and user group.

	Hypothetical Harvest Distribution					
Species	Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence	Total
pink	12,773,700	852,700	360,500	26,100	200	14,013,200
chum	867,700	332,800	215,500	1,200	0	1,417,200
sockeye	75,900	1,062,400	8,500	7,200	125,400	1,279,400
coho	22,100	255,400	200	15,100	1,300	294,100
king	1,700	25,800	0	8,200	3,000	38,700
Ex vessel Value:						
pink	$12,952,500	$865,700	$365,600			$14,183,800
chum	$2,061,700	$789,300	$512,000			$3,363,000
sockeye	$491,800	$8,268,800	$55,100			$8,815,700
coho	$51,900	$2,591,100	$400			$2,643,400
king	$31,400	$878,800	$0			$910,200
Total	$15,589,300	$13,393,700	$933,100			$29,916,100

Table 50. A comparison of the potential common property harvests of all salmon stocks in the Prince William Sound, Copper-Bering River Region with the 20-year objectives for each user group, without the recommended Phase II projects.

User Group	King	Sockeye	Coho	Pink	Chum	Income
Seine:						
Goal	5,300	204,300	36,900	27,082,200	1,874,600	$32,940,000
Potential Catch	1,700	75,900	22,100	12,773,700	867,700	$15,589,300
Gap	3,600	128,400	14,800	14,308,500	1,006,900	$17,350,700
Drift Gill Net:						
Goal	62,600	1,290,400	259,200	4,267,000	3,432,200	$27,050,000
Potential Catch	25,800	1,062,400	255,400	852,700	332,800	$13,393,700
Gap	36,800	228,000	3,800	3,414,300	3,099,400	$13,656,300
Set Gill Net:						
Goal	0	55,200	1,400	0	62,900	$480,000
Potential Catch	0	8,500	200	360,500	215,500	$933,100
Gap	0	46,700	1,200	(360,500)	(152,600)	($453,100)
Subsistence:[1/]						
Goal	0	155,500	100	200	0	
Potential Catch	3,000	125,400	1,300	200	0	
Gap	(3,000)	30,100	(1,200)	0	0	
Sport:						
Goal	8,600	25,700	28,600	17,200	8,600	
Potential Catch	8,200	7,200	15,100	26,100	1,200	
Gap	400	18,500	13,500	(8,900)	7,400	
Total:						
Goal	76,500	1,731,100	326,200	31,366,600	5,378,300	$60,470,000
Potential Catch	38,700	1,279,400	294,100	14,013,200	1,417,200	$29,916,100
Gap	37,800	451,700	32,100	17,353,400	3,961,100	$30,553,900

1/ Includes fishermen who utilize fishwheel, dip nets, gill nets and seines.

4.0 MANAGEMENT NEEDS AND REHABILITATION AND ENHANCEMENT OPPORTUNITIES

The following is a brief listing of the various needs of fishery management and opportunities that may exist for producing additional salmon in the area.

Fishery management requires refined knowledge of the optimum escapement levels of pink, sockeye and chum salmon, additional knowledge of the escapement of sockeye, king and coho salmon and additional knowledge of the harvest magnitude and migration habits of wild and hatchery-produced salmon. Knowledge is also needed of the number of salmon produced and harvested as a result of rehabilitation projects.

Refined knowledge of optimum escapement is needed to maximize the production of wild stocks. Escapement goals have been based on historic escapement data and do not reflect the quantity or quality of available spawning area.

In-season escapement data is lacking for sockeye salmon stocks of the Unakwik District and Copper River Delta. The ability to count king salmon in the Lower Copper River has yet to be developed. The coho salmon escapement up the Copper River has yet to be monitored.

Knowledge of the harvest magnitude and migration habits of both wild and hatchery-produced fish is needed to detect the occurrence of weak wild runs and implement the area and time restrictions required to obtain the desired escapements.

Data on the number of salmon produced and harvested as a result of hatchery and rehabilitation projects are needed to perform accurate benefit-cost analyses of individual projects.

Opportunities exist to expand existing hatcheries, construct additional hatcheries, stock lake and streams, install fishpasses and improve stream habitat. The feasibility of capitalizing on many of these opportunities is unknown and should be investigated. Several sites have potential for more than one activity, the highest and best use of the site should be considered prior to committing sites to a given rehabilitation or enhancement activity.

5.0 FISHERY GOALS AND OBJECTIVES

The overall goals of this Phase II Plan are to:

1) initiate action towards achieving the 20-year goals and objectives set forth in the Phase I Plan;

2) recommend procedures to protect, maintain and improve fisheries habitat and natural stocks of salmon; and

3) list and recommend biologically sound rehabilitation and enhancement opportunities and projects necessary to:

   a) address the needs and demands of each user group;
   b) minimize user group conflicts;
   c) improve harvestability and marketability through the selection of stocks of favorable run timing; and
   d) maximize or optimize the production of salmon based on the capabilities of the area.

It is an overall objective to provide the following number of salmon to the region's fishermen by the year 2002.

Table 51. Summary of species harvest objectives for each user group in the Prince William Sound, Copper-Bering River Region, 2002.

	Species Harvest Objectives					
User Group	King	Sockeye	Coho	Pink	Chum	Revenue Objective
Purse Seine Fishermen	5,300	204,300	36,900	27,082,200	1,874,600	$32,940,000
Drift Gill Net Fishermen	62,600	1,290,400	259,200	4,267,000	3,432,200	$27,050,000
Set Gill Net Fishermen	0	55,200	1,400	0	62,901	$480,000
Upper Copper River Subsistence Fishermen	0	151,900	0	0	0	
Saltwater Subsistence Fishermen	0	3,600	100	200	0	
Sport Fishermen	8,600	25,700	28,600	17,200	8,600	
Total	76,500	1,731,100	326,200	31,366,600	5,378,300	$60,470,000

Table 52. Objectives stated in terms of net increases in harvests over projections of harvests of wild, rehabilitated and hatchery stocks based on the 1984 capacities.

User Group	King	Sockeye	Coho	Pink	Chum	Income
Purse Seine	10,300	460,700	23,500	11,314,600	382,900	$15,819,600
Drift Gill Net	88,900	367,600	2,100	3,244,600	2,388,100	$12,411,800
Set Gill Net	0	117,700	200	323,100	508,400	$2,298,800
Subsistence	0	49,800	0	0	0	
Sport	24,100	1,500	28,100	33,500	0	
Total	123,300	997,300	53,900	14,915,800	3,279,400	$30,530,200

The following is a list of specific goals and objectives for each recommended project in the Prince William Sound Area during the next 5 years. Given adequate funding, harvest objectives may not be reached within the 5-year period. The amount of time required for brood stock development and the eventual return of adults may forestall the realization of some harvest objectives until 1995.

5.1 PRINCE WILLIAM SOUND AREA

Esther Hatchery:

a) to complete construction of the hatchery;
b) to complete brood stock development; and
c) to provide the region's commercial, sport and subsistence fishermen with 7,509,700 pink salmon, 2,211,400 chum salmon, 33,100 coho salmon and 107,100 king salmon annually.

Solomon Gulch Hatchery:

a) to increase the number of incubators to achieve the final permitted capacity and
b) to provide seine, sport and subsistence fishermen with 4,550,800 pink salmon, 336,900 chum salmon, 22,900 coho salmon and 7,600 king salmon annually.

Main Bay Hatchery:

a) to increase the eyed-egg capacity to 100,000,000 chum salmon, and 50,000,000 pink salmon;
b) to provide 25,000,000 eyed pink salmon eggs for continued incubation and release at the Cannery Creek Hatchery;
c) to increase the short-term rearing capacity to include all emergent fry; and
d) to provide the region's commercial, sport and subsistence fishermen with 1,181,600 pink salmon and 1,602,600 chum salmon annually.

Cannery Creek Hatchery:

a) to increase the eyed-egg capacity to 100,000,000 pink salmon eggs and
b) to provide the region's seine, drift gill net, sport and subsistence fishermen with 4,919,300 pink salmon annually.

Pink and Chum Salmon Hatchery Planning:

a) to plan the siting and construction of a new pink and/or chum salmon hatchery;
b) to increase the pink and chum salmon harvest of commercial, subsistence and sport fishermen; and
c) to develop management schedules or plans to insure that proper harvest levels are achieved.

Sockeye Salmon Hatchery Construction and Lake Stocking

a) to stock barren or underutilized lakes in Prince William Sound with sockeye salmon fry;
b) to provide commercial, sport and subsistence fishermen with 803,900 sockeye salmon annually; and
c) to develop management schedules or plans to insure that proper harvest levels are achieved.

King and Coho Salmon Lake Stocking:

a) to stock lakes in western Prince William Sound and
b) to provide commercial, sport and subsistence fishermen with 5,600 coho salmon and 600 king salmon annually.

Stream Stocking:

a) to stock streams in Prince William Sound and
b) to provide commercial, sport and subsistence fishermen with 12,500 coho salmon, 20,000 king salmon and 10,000 pink salmon annually.

Fishpass Construction:

a) to provide salmon access to unutilized habitat at Derickson Creek (Stream 289) and
b) to provide seine, sport and subsistence fishermen with 10,000 pink salmon annually.

Fishpass Maintenance:

a) to maintain the continued operation of 10 fishpasses and
b) to provide commercial, sport and subsistence fishermen with 23,900 sockeye salmon, 2,100 coho salmon and 80,400 pink salmon annually.

Escapement Counting at Eshamy, Miners and Cowpen Lakes:

a) to monitor salmon escapement and obtain optimum escapement data at Eshamy Lake, Miners Lake and Cowpen Lake.

Stream Channelization and Improvement:

a) to improve production of salmon through the manipulation and improvement of stream habitat.

Assessment of Exploitation Rates and Ocean Survival of Hatchery-Produced Pink and Chum Salmon in Prince William Sound:

a) to develop estimates of the contribution of individual hatcheries to the commercial fishery in Prince William Sound;
b) to estimate the marine survival of pink and chum salmon fry released from each hatchery;
c) to estimate the proportion of different hatchery stocks that are harvested in each district;
d) to detect potential shortages of fish returning to PNP hatcheries;
e) to analyze area-specific tag-recovery data to generate migration-route data and run-timing models for each hatchery stock; and
f) to develop guidelines for in-season management strategies based on the temporal and spatial distribution of the various hatchery stocks in the fishery.

Evaluating Potential Projects:

a) to evaluate the feasibility of implementing additional rehabilitation and enhance ment projects.

5.2 COPPER RIVER AREA

Gulkana Hatchery Expansion, Lake Stocking and Evaluation:

a) to expand and improve the hatchery to a capacity of 50,000,000 eyed sockeye salmon eggs;
b) to stock underutilized lakes in the Upper Copper River drainage; and
c) to provide fishermen with approximately 291,300 harvestable sockeye salmon; and
d) to evaluate the production of smolts and adults.

Sockeye Salmon Hatchery Site Evaluations:

a) to evaluate sites for construction of a new sockeye salmon hatchery in the Upper Copper River drainage.

Coho and Sockeye Salmon Spawning and Rearing Habitat Development:

a) to enhance the production and harvests of salmon through the excavation of spawning channels and the development of rearing areas.

Tokun Lake Fertilization

a) to fertilize Tokun Lake;
b) to monitor the production of smolt and adults; and
c) to produce an additional 145,000 sockeye salmon annually by 1988.

King and Sockeye Salmon Disease Evaluation

a) to evaluate the disease history of potential hatchery donor stocks.

Summit Lake Prefertilization and Stocking Studies

a) to determine the optimum stocking capacity of Summit Lake in an unfertilized state and
b) to determine the potential for maximizing the production of sockeye salmon smolt through the application of fertilizer.

Optimum Escapement Studies

a) to determine the optimum escapement levels of sockeye, king and coho salmon in the Copper River Area.

Stock Identification Studies

a) to determine the upriver and Delta composition of the catch and escapement of sockeye salmon over time and
b) to monitor the age composition of the catch and escapement of sockeye, king and coho salmon.

6.0 EVALUATION, SELECTION AND PRIORITIZATION CRITERIA

To proceed logically and expeditiously with this 5-year segment of the 20-year planning process, the RPT must decide which species or stocks to rehabilitate or enhance, and the RPT must establish criteria for evaluating management and research needs and rehabilitation and enhancement opportunities. The RPT must also establish a means to develop, select and prioritize projects.

The RPT has a statutory responsibility to review and comment on hatchery permit applications and other proposed non-regulatory enhancement and rehabilitation projects; however, the RPT in a de facto sense also reviews ideas, proposals or projects that are generated by the public, regional aquaculture associations and the RPT during the Phase II planning process. Private nonprofit (PNP) hatchery organizations may obviously apply for hatchery permits independent of the species and stock selection procedures set forth herein. Review criteria for PNP applications and Phase II planning have been established, and these are presented in Appendix 2 (page A-9). The end product of the review process will be recommendations to the Commissioner of Fish and Game. The RPT may recommend approval of PNP permit applications and priority projects set forth in Phase II plans.

6.1 SPECIES OR STOCK SELECTION CONSIDERATIONS

In the selection of species or stocks, various aspects should be considered, including:

1) the desires of user or gear groups;

2) species or stock manageability;

3) state of the science of fisheries management;

4) the availability of unused or underutilized spawning and rearing areas;

5) the ability to protect and improve spawning and rearing areas;

6) the availability of suitable hatchery sites; and

7) accessibility for sport and subsistence fishermen.

The desires of various user groups should be considered whenever possible. In some instances, it may not be feasible to enhance or rehabilitate the runs of a preferred species or provide fish in a preferred area or at a preferred time. Alternate species, areas or times may be recommended as feasibility dictates.

Manageability of a species or stock encompasses biological characteristics and physical factors that the fisheries manager must deal with when attempting to regulate a harvest to achieve an optimal escapement. Characteristics of major importance include adult migration habits, timing and spawning habits. Stocks or species that are segregated from other stocks or species in harvest areas or by time are more readily manageable than fish that mix with other stocks or species in the harvest area. Stocks or species that spawn close to harvest areas are easier to manage than those that migrate long distances to spawn. Escapement counting is limited by turbid water, ice and storms.

Manageability is a prime concern because the fisheries manager must be able to achieve optimal escapements and the fishermen must be able to maximize the harvest of available fish.

State of the science of fisheries management deals with the projects, tools, data and funding that the fisheries manager currently has to work with. Ideally, the manager should be able to predict run strength, acquire timely escapement data, establish and attain escapement goals, identify the stock composition of the harvest, determine spatial and temporal distribution and strength of stocks in the fishing districts, and open or close the fishery or portions thereof to achieve the desired escapement.

The availability of unused or underutilized spawning and rearing areas is of concern because areas should be selected with ample room for significant increases in fish.

The ability to protect and improve spawning and rearing areas is important in the maintenance and rehabilitation of natural stocks. Some stocks may inhabit areas having potential for major industrial development. These areas subsequently may not be suitable for major enhancement efforts. It may be feasible in some instances to alter or improve spawning or rearing areas. Spawning channels, stream diversions, stream impoundment and lake fertilization are some examples of alteration and improvement projects.

The location of potential hatchery sites is important because of the costs and logistical problems associated with transporting eggs or fry long distances. Ideally, hatcheries should be located as close to the major stocking sites as possible.

Accessibility to enhanced or rehabilitated salmon stocks is an obvious concern to sport and subsistence fishermen. Stocks that spawn or migrate near existing roads or trails should be selected so that fishermen can readily reach these fish.

6.2 PRIORITIZATION CONSIDERATIONS

Proposed projects should be prioritized by use of criteria such as the following:

1) Does the project address user-group gaps identified in the Phase I Plan?

2) Does the project favorably enhance the harvest timing of a given species?

3) Is the project desired or preferred by user groups?

4) Does the project have a favorable benefit-cost ratio?

5) Does it make the most appropriate use of the site's potential?

7.0 RECOMMENDED PROJECTS

The following projects have been identified as desirable undertakings during the next five years. This compilation of projects is not inclusive of all things that could be done nor is it prioritized. Some locations present opportunities for more than one activity. Each site should be be evaluated to determine the highest and best use of the site. Projects under funding consideration are generally presented first.

7.1 **PRINCE WILLIAM SOUND**

7.1.1 **PROJECT:** Esther Hatchery Construction.

AGENCY: PWSAC.

FUNDING STATUS: A construction loan has been provided by the Alaska Department of Commerce.

LOCATION: Coghill District.

OBJECTIVES:

a) to complete construction of the hatchery;
b) to complete brood stock development; and
c) to provide the region's commercial, sport and subsistence fishermen with 7,509,700 pink salmon, 2,211,400 chum salmon, 33,100 coho salmon and 107,100 king salmon annually.

NARRATIVE: The hatchery is currently under construction and will be operational in 1986. The following table describes the present and planned permitted egg capacity, the projected adult returns, the brood and sales needs in the year 2002 and the number of fish that will be available for harvest by seine, drift gill net, sport and subsistence fishermen.

Table 53. A comparison of the 1984 and revised egg capacity of the Esther Hatchery and the projected total adult return, brood needs, sales needs and harvestable surplus, 2002.

	pink salmon	chum salmon	coho salmon	king salmon
1984 Permitted Green Egg Capacity	211,000,000	111,000,000	1,000,000	1,000,000
Revised Capacity[1/]	211,000,000	111,000,000	1,000,000	4,000,000[2/]
Total Adult Return at Revised Capacity	8,629,000[3/]	2,569,600[4/]	37,500[5/]	120,000[6/]
Brood Needs	293,100	112,100	800	1,400
Sales Needs[7/]	826,400	246,100	3,600	11,500
Harvestable Fish	7,509,700	2,211,400	33,100	107,100

[1/] A request for a permit alteration has yet to be submitted.
[2/] PWSAC may request a permit alteration to allow the incubation of 7,500,000 king salmon eggs. Juveniles may be released as Age 0 smolt.
[3/] Based on FRED Directive No. 3 and a fingerling marine survival of 5.3 percent.
[4/] Based on FRED Directive No. 3 and a fingerling marine survival of 3.0 percent.
[5/] Based on a green egg to age 0 smolt survival of 75 percent and a marine survival of 5.0 percent.

[6/] Based on a green egg to age 0 smolt survival of 75 percent and a marine survival of 4.0 percent.

[7/] Assuming that $797,000 will be collected through assessments, full utilization of the PWSAC hatcheries, an Esther sales goal of $1,873,400 in the year 2002 and a similar exploitation rate for pink, chum, coho and king salmon returning to the hatchery.

7.1.2 **PROJECT:** Solomon Gulch Hatchery Completion.

AGENCY: VFDA.

FUNDING STATUS: Unfunded.

LOCATION: Eastern District.

OBJECTIVES:

a) to increase the number of incubators to achieve the final permitted capacity and
b) to provide seine, sport and subsistence fishermen with 4,550,800 pink salmon, 336,900 chum salmon, 22,900 coho salmon and 7,600 king salmon annually.

NARRATIVE: The hatchery needs additional incubators to achieve the permitted capacity. The following table describes the current egg capacity, the permitted egg capacity, the projected adult returns, the brood and sales needs in the year 2002 and the number of fish that will be available for harvest by seine, sport and subsistence fishermen.

Table 54. A comparison of the 1984 and final permitted egg capacity of the Solomon Gulch Hatchery and the projected total adult return, brood needs, sales needs and harvestable surplus, 2002.

	pink salmon	chum salmon	coho salmon	king salmon
1984 Green Egg Capacity	70,000,000	6,000,000	1,000,000	0
Final Permitted Green Egg Capacity	136,000,000	18,000,000	1,000,000	300,000
Total Adult Return at Final Capacity	5,562,000[1/]	416,700[2/]	27,800[3/]	9,000[4/]
Brood Needs	188,900	18,200	800	100
Sales Needs[5/]	822,300	61,600	4,100	1,300
Harvestable Fish	4,550,800	336,900	22,900	7,600

[1/] Based on FRED Directive No. 3 and a fingerling marine survival of 5.3 percent.
[2/] Based on FRED Directive No. 3 and a fingerling marine survival of 3.0 percent.
[3/] Assuming age 1 smolt released at the hatchery. Adult return based on FRED Directive No. 3 and a marine survival of 5.0 percent.
[4/] Adult return based on a green egg to age 0 smolt survival of 75 percent and a marine survival of 4.0 percent.
[5/] It is assumed that the hatchery revenue goal in the year 2002 will be $1,041,000 and that the exploitation rate of each species returning to the hatchery will be similar.

7.1.3 **PROJECT:** Increased Incubators at the Main Bay Hatchery.

AGENCY: ADF&G, FRED Div.

LOCATION: Eshamy District.

FUNDING STATUS: Unfunded.

GOALS AND OBJECTIVES:

a) to increase the eyed-egg capacity to 100,000,000 chum salmon and 25,000,000 pink salmon;
b) to provide 25,000,000 eyed pink salmon eggs for continued incubation and release at the Cannery Creek Hatchery;
c) to increase the short-term rearing capacity to include all emergent fry; and
d) to provide the region's commercial, sport and subsistence fishermen with 1,181,600 pink salmon and 1,602,600 chum salmon annually.

NARRATIVE: The hatchery, in 1985, had sufficient capacity to incubate 41,000,000 pink and 47,000,000 chum salmon from the green-egg to eyed-egg stage. From the eyed-egg to fry stage, the hatchery had capacity to hold 25,000,000 pink and 29,000,000 chum salmon eggs. Plans are to continue the incubation and release of chum and pink salmon at Main Bay and to use the hatchery as a donor egg take site for the Cannery Creek Hatchery.

The number of eggs taken at the Cannery Creek Hatchery have been limited because of the lack of adult holding area and high water temperatures. The Main Bay Hatchery is conducive to larger egg takes, and to develop a supplementary brood source of the Cannery Creek stock, pink salmon eggs were transported from Cannery Creek to Main Bay in 1984. Propagation of the Port San Juan stock of pink salmon was discontinued in 1984. It is an ultimate goal to take 111,000,000 chum and 56,000,000 pink salmon eggs at Main Bay and transport 25,000,000 eyed pink salmon eggs to the Cannery Creek Hatchery. Approximately 25,000,000 eyed eggs will be retained at Main Bay for brood stock maintenance.

It is estimated that the facility at its present capacity will produce returns of 1,435,000 pink and 505,900 chum salmon. These data are based on average marine survival estimates of 5.3 percent for Port San Juan pink salmon and 2.0 percent (FRED Directive No. 3) for chum salmon.

It is estimated that the facility at an eyed-egg capacity of 25,000,000 pink salmon and 100,000,000 chum salmon eggs will produce total returns of 1,258,800 pink salmon, 1,714,800 chum salmon. Brood needs will require the use of 77,200 pink salmon, and 112,200 chum salmon. Approximately 1,181,600 pink salmon and 1,602,600 chum salmon will be available for harvest.

7.1.4 **PROJECT:** Increased Incubators at the Cannery Creek Hatchery.

AGENCY: ADF&G, FRED Div.

FUNDING STATUS: Unfunded.

LOCATION: Northern District.

OBJECTIVES:

a) to increase the eyed-egg capacity to 100,000,000 pink salmon eggs and
b) to provide the region's seine, drift gill net, sport and subsistence fishermen with 4,919,300 pink salmon annually.

NARRATIVE: The hatchery currently has sufficient incubators to incubate approximately 50,000,000 eyed pink salmon eggs. Enough floor space is available, however, to increase the incubation capacity to 100,000,000 eyed pink salmon eggs. An increase in total capacity to 100,000,000 eyed eggs would, assuming an average marine survival rate of 5.3 percent, produce a total return of 5,035,000 fish. Approximately 115,700 fish would be needed for brood purposes, and 4,919,300 fish would be available for harvest.

7.1.5 **PROJECT:** Pink and Chum Salmon Hatchery Planning.

AGENCY: ADF&G, FRED Div., PWSAC and other interested PNP hatchery corporations.

FUNDING STATUS: Unfunded.

LOCATION: Prince William Sound.

OBJECTIVES:

a) to plan the siting and construction of a new pink and/or chum hatchery;
b) to increase the pink and chum salmon harvest of commercial, subsistence and sport fishermen; and
c) to develop management schedules or plans to insure that proper harvest levels are achieved.

NARRATIVE: Numerous sites for hatchery construction are located in the Sound. Three sites are noteworthy for the quantity and quality of their water sources and locations. These sites offer opportunities to incubate as many as 300,000,000 salmon eggs.

Following a complete survey of candidate stocking lakes and a review of the manageability of adults returning to candidate lakes or streams, a general survey of the sites is needed to derive the following general information:[17/]

1) size of the watershed (reflects water storage capacity);
2) drainage pattern of watershed (e.g. dendritic vs. radial or parallel networks can indicate stability of subsurface geology);
3) watershed topography (e.g. low lying terrain will result in more stable discharge patterns than steep terrain);
4) number and size of lakes (buffer sediment load, temperature and magnitude of discharges);
5) type and extent of vegetation (buffering effects similar to lakes);
6) actual stream flow versus flood channel size and amount of meandering (indicators of stream stability);
7) streambed materials, gradient, and amount of braiding (indicators of rearing and spawning potential);
8) water quality;
9) potential for power generation;
10) competing resource activities in watershed (logging and mining);
11) land ownership;
12) area available for buildings;
13) proximity to faults and geologic hazards; and
14) protected moorage and docking area.

The following is a description of three of the most suitable hatchery sites.

Northern District

Stream 285 Cascade River, Cascade Bay, Eaglek Bay, National Forest land: Of all potential hatchery sites in Prince William Sound, this site probably has the greatest potential for hatchery operation. The river has a small run of pink salmon, and it offers a major opportunity for incubation of early-run pink and chum salmon. The watershed encompasses 8,100 acres and contains three lakes with a combined surface area of 410 acres. Sufficient water is available to operate a 300,000,000 egg capacity hatchery. Two other

minor pink salmon streams are located in Cascade Bay, unnamed streams 284 and 287. Management problems with these natural stocks may be inconsequential.

Stream 289 Derickson Creek, Derickson Bay, Eaglek Bay, National Forest land: This is also an excellent site for a hatchery; however, it is not as good a site as Cascade River. This stream has a barrier falls, and the Forest Service is planning to construct a fishpass at this location in 1986. Pink salmon fry stocking will occur in 1985 and 1986. This stream and another stream in Derickson Bay, Stream 288 High Creek, have a small run of pink salmon.

Southwestern District

Stream 617 Princeton Creek, unnamed lake, Icy Bay, proposed wilderness land: This site also has potential for major hatchery development. The stream like other streams in Icy Bay is devoid of salmon. The watershed encompasses 2,100 acres and contains a 422 acre lake. The lake contains Dolly Varden. Salmon are prevented from entering the lake by a major cascade at the outlet. Icy Bay provides an ample harvest area. Pipeline construction may be expensive because of cliffs.

7.1.6 **PROJECT:** Sockeye Salmon Hatchery Construction and Lake Stocking.

AGENCY: PWSAC.

FUNDING STATUS: A construction loan has been approved by the Alaska Department of Commerce.

LOCATION: Coghill District near the Esther Hatchery.

OBJECTIVES:

a) to stock barren or underutilized lakes in Prince William Sound with sockeye salmon fry;
b) to provide commercial, sport and subsistence fishermen with 803,900 sockeye salmon annually; and
c) to develop management schedules or plans to insure that proper harvest levels are achieved.

NARRATIVE: Limnological data suggest that the numerous barren or underutilized lakes in Prince William Sound have capacity to rear approximately 28,662,000 supplementally-produced sockeye salmon fry (Table 55, page 96). PWSAC is planning to construct a facility similar in design to the Gulkana Hatchery. The hatchery will be located near the Esther Hatchery and will consist of exposed incubation boxes. The water distribution system will be designed to prevent the spread of IHN virus. Table 55 presents the proposed stocking schedule. Early-run stocks will be utilized in districts open to gill net fishing. Late-run stocks will be utilized in districts open to seine fishing. The majority of the lakes are inaccessible to adult salmon and fry stocking will have to be conducted annually in these systems. It may be economically feasible to build fishpasses or modify the outlet streams of some lakes to provide access to adult salmon. Native populations of sockeye salmon occur in three lakes: Cowpen, Miners and Eshamy lakes. Fry will be stocked to rebuild and possibly augment the natural runs.

Table 55. Proposed stocking schedule of sockeye salmon fingerlings produced by the PWSAC sockeye salmon hatchery Prince William Sound Area.

Run Timing	District	Lake or location	Stream No.	Estimated Fry Capacity[1/]	Projected Adult Return
Early	Unakwik	Cowpen	242	511,000	12,700[2/]
		Miners	244	800,000	33,700[3/]
	Coghill	Davis	311	1,870,000	67,300[4/]
		Pass	329	702,000	12,600[5/]
		Shoestring	344	567,000	20,400[4/]
		unnamed	345	173,000	3,00[5/]
		Quillian Bay	000A	28,000	500[5/]
	Eshamy	Pt. Nellie Juan	500	120,000	2,200[5/]
		Foul Bay	501	184,000	6,600[4/]
		Falls	505 A&B	3,951,000	142,300[4/]
		unnamed	516	264,000	4,700[5/]
Late	Eastern	Millard	115	522,000	9,400[5/]
		Silver	116	1,339,000	83,700[6/]
	Northern	Columbia Bay	202 A&B	1,430,000	25,700[5/]
		Cedar Bay	228 A	701,000	25,200[4/]
	Eshamy	Eshamy	511	5,000,000	90,000[5/]
	Northwestern	Cochrane Bay	459 A&B	216,000	7,800[4/]
		N. Nellie Juan	481 A,B&C	681,000	24,500[4/]
		Derickson	492	2,544,000	46,000[5/]
		Perry Passage	000 A	84,000	3,000[4/]
		Perry Passage	000 D&E	724,000	13,000[5/]
		Hidden Bay	000 B&C	1,035,000	37,300[4/]
	Southwestern	Ewan	603	1,396,000	25,100[5/]
		Bainbridge	638	148,000	5,300[4/]
		Bainbridge	655 A	995,000	35,800[4/]
		Louis Bay	689	287,000	5,200[5/]
		Solf	690	987,000	35,500[4/]
		Marsha Bay	000	1,403,000	25,300[5/]
		Total		28,662,000	803,900

[1/] Based on the euphotic volume of the lake, Pellissier (personal communication).
[2/] This is a clearwater lake containing a native population of sockeye salmon. It is assumed that the fry to smolt survival will be 21 percent and that the marine survival will be 12 percent.
[3/] This is a glacial lake containing a native population of sockeye salmon. It is assumed that the fry to smolt survival will be 35 percent and that the marine survival will be 12 percent.
[4/] This is a fishless lake. It is assumed that the fry to smolt survival will be 30 percent and that the marine survival will be 12 percent.
[5/] This lake contains resident fish populations. It is assumed that the fry to smolt survival rate will be 15 percent and that the marine survival rate will be 12 percent.
[6/] This is a glacial lake. It is assumed that the fry to smolt survival will be 52 percent and that the marine survival will be 12 percent.

7.1.7 **PROJECT:** King and Coho Salmon Lake Stocking.

AGENCIES: ADF&G, FRED Div. and Sport Fish Div., USDA FS and PWSAC.

FUNDING STATUS: Partially funded. Operational funds are required annually.

LOCATION: Western Prince William Sound.

OBJECTIVES:

a) to stock lakes in western Prince William Sound and
b) to provide commercial, sport and subsistence fishermen with 5,600 coho salmon and 600 king salmon annually.

NARRATIVE: Numerous lakes in Prince William Sound are fishless or are not utilized by salmon. Many of these lakes have the potential to rear king and/or coho salmon. Outlet streams of these lakes are impassable for upstream migrating salmon due to falls or cascades. Many outlet streams can be safely negotiated by salmonid juveniles migrating to sea. These lakes offer opportunities to increase harvests through annual or periodic stocking of coho or king salmon fry. The rate of stocking will be dependent on growth rate of juveniles in preceding transplants. If fish stocked in a given lake grow slowly, significantly reduce the available prey population or remain in the lake for excessive years, then the restocking may be reduced or delayed until prey populations rebuild. Some lakes offer opportunity to establish a self-perpetuating run after a barrier to upstream migration is either removed or overcome by means of a fishpass. These lakes may only need to be stocked for a few years to establish a viable brood source.

Stocking schedules have been developed for 10 lakes contained in 5 drainages in western Prince William Sound (Table 56, page 98). These lakes are all inaccessible by adult salmon due to barriers; however, it is anticipated that smolt will generally be able to safely outmigrate from these systems. One lake, Culross Lake, was initially stocked in 1983 and stocking is scheduled to continue through at least 1988. Additional lakes listed below may be added to the program in 1985 through 1988.

Table 56. Proposed stocking schedule of coho and king salmon fingerlings produced by FRED Division hatcheries, Prince William Sound area.

Species	Run Timing	Release Site	Number Released	Year Released	Returning Adults	Return Year
coho	late	Culross Lake	100,000	ongoing	varies[1/]	1986
coho	late	Surprise Cove lakes	155,000	ongoing	1,600	1987
coho	late	Pass Lake	120,000	1987	1,200	1989
coho	early	N. Nellie Juan lks.	180,000	1988	1,800	1990
king	early	Granite Bay lakes	75,000	1986	600	varies[2/]
Total Adult Coho Salmon					5,600	
Total Adult King Salmon					600	

1/ It is projected that 600 adults will return in 1986 and 1,000 adults will return annually thereafter.
2/ King salmon rear 1 to 5 years in the ocean and adults will begin to return in 1988.

7.1.8 **PROJECT:** Stream Stocking.

AGENCY: ADF&G, FRED Div. and Sport Fish Div., USDA FS and PWSAC.

FUNDING STATUS: Partially funded. Operational funds are required annually.

LOCATION: Prince William Sound.

OBJECTIVES:

a) to stock streams in Prince William Sound and
b) to provide commercial, sport and subsistence fishermen with 12,500 coho salmon, 20,000 king salmon and 10,000 pink salmon annually.

NARRATIVE: Streams that are barren, depleted, slow to rebuild naturally or underutilized by rearing fry can be stocked to establish a run or enhance the existing run of salmon. Beginning in 1978, coho salmon smolt have been released in Whittier Creek (Stream 441) and Cove Creek (Stream 442) in an effort to create sport fishing opportunities in the vicinity of Whittier (Table 16, page 31). King salmon stocking initiated at Whittier in 1981. From 1979 through 1983, anglers spent an average of 4,678 angler-days fishing in Passage Canal and harvested an average of 853 coho salmon. Adult king salmon initially returned in 1984. Pink salmon fry have been stocked in Eaglek Bay streams in an attempt to rebuild odd-year runs.

Plans are to continue stocking Cove Creek with king and coho salmon and it has been proposed that 3 additional streams be stocked in the near future. Incubation and rearing of king and coho salmon have been conducted at the Elmendorf Hatchery. The Bear Lake stock are "middle" run fish with a peak entry timing of mid August. The Bear Lake donor source will be discontinued in favor of early-run fish from northern Cook Inlet. These fish will have an entry-run timing of mid July and will be harvested by seine, drift gill net and sport fishermen. Coho salmon eggs will be incubated and reared at the Elmendorf Hatchery and/or the Main Bay Hatchery. King salmon from Crooked Creek at Kasilof or the Upper Copper River will be the brood source for king salmon plants. These fish are of early-run timing, with a peak entry timing of early June. King salmon will be incubated and reared at the Elmendorf or Esther facilities.

Stocking schedules have been developed for 4 streams in western Prince William Sound and 1 stream near Valdez (Table 57, page 100). Three streams are located in Passage Canal, and because of their relatively large discharges, they offer good opportunities for imprinting of smolt and harvesting by sport fishermen. These streams offer limited rearing potential for king and coho salmon fry, and stocking of smolt will be required annually to maintain the fishery. Considering that sport fishermen interest and participation in the fishery will take time to develop, a step-wise stocking schedule has been proposed. A fourth stream considered for stocking is a high-priority fishpass construction candidate. Use of new habitat created through the installation of a fishpass would be expedited and maximized through the introduction of pink salmon fry.

Table 57. Proposed stocking schedule of coho and king salmon smolt produced by FRED Division hatcheries, Prince William Sound area.

Species	Run Timing	Release Site	Number Released	Year Released	Returning Adults	Return Year
pink	late	Eaglek Bay[1/]	2,000,000	ongoing	10,000	1986
coho	late	Poe River	50,000	1987	2,500	1988
coho	late	Cove Creek	100,000	ongoing	5,000	ongoing
coho	early	Cove Creek	100,000	1989	5,000	1990
king	early	Anderson Bay	200,000	ongoing	8,000	1986[2/]
king	early	Poe River	100,000	1986	4,000	1987[2/]
king	early	Cove Creek	100,000	ongoing	4,000	ongoing[2/]
king	early	Shotgun Cove	100,000	1986	4,000	1987[2/]
Total Adult Pink Salmon					10,000	
Total Adult Coho Salmon					12,500	
Total Adult King Salmon					20,000	

1/ The USDA Forest Service plans to construct a fishpass at Stream 289 Derickson Creek in 1986. To expedite and maximize the use of the structure by pink salmon, 2,000,000 pink salmon fry were released at the site in 1985. It has been proposed that the same number of fry be released in 1986. Fry would be incubated and transported from the Cannery Creek Hatchery. The fishpass will provide access to approximately 73,000 sq.ft. of excellent spawning area as well as one-half mile of moderate quality spawning area. It is estimated that the combined fry stocking and fishpass project will create a minimum of 10,000 harvestable pink salmon annually.

2/ King salmon rear 1 to 5 years in the ocean and the years that adults return will vary.

7.1.9 **PROJECT:** Fishpass Construction.

AGENCY: USDA Forest Service and ADF&G, FRED Div.

FUNDING STATUS: In USDA Forest service funding request for FY 86.

LOCATION: Prince William Sound.

OBJECTIVES:

a) to provide salmon access to unutilized habitat at Derickson Creek (Stream 289) and
b) to provide seine, sport and subsistence fishermen with 10,000 pink salmon annually.

NARRATIVE: Fishpasses (fish ladders, steep passes or fish ways) allow salmon to utilize habitat upstream of falls or velocity barriers. The following stream has been evaluated for fishpass construction.

Northern District

Stream 289 Derickson Creek, Eaglek Bay, National Forest land: The Forest Service has evaluated this site for fishpass construction and has requested $149,400 to construct a fishpass near tidewater in 1986. An estimated 73,000 sq.ft. of excellent spawning area will be made available as well as one-half mile of moderate quality stream. ADF&G stocked the creek with 2,000,000 pink salmon fry in 1985, and the same number of fry will be released in 1986. Fry were transported from the Cannery Creek Hatchery. It is estimated that the combined fishpass and stocking project will create a minimum of 10,000 harvestable pink salmon annually.

8.3 POTENTIAL STREAM STOCKING SITES

The 1964 earthquake caused Montague Island to raise 8 to 38 ft. Streams on Montague Island and other uplifted areas were readily subject to scouring as streams flowed through the soft materials of former sea floors. The action of scouring and resultant filling of downstream areas often resulted in braided and abandoned channels. As a result of these and possibly other causes, chum salmon were depleted in all streams on Montague Island. From 1960 through 1967, the last year of returns of non earthquake impacted stocks, the average chum salmon escapement in 12 index streams was 24,169 fish. Escapements beginning in 1968 dwindled and no chum salmon have been observed in these streams in recent years. Streams, which following the earthquake experienced rapid downcutting and braided channels are now becoming relatively stable. It may be feasible to reestablish chum salmon populations in many streams through short-term stocking with fry. It is estimated that the reestablishment of chum salmon on Montague Island to their former level of abundance would create an average annual harvestable surplus of 44,500 fish worth approximately $155,000.

The following streams have potential for stocking with various species. The majority of these are reintroduction stocking with chum or pink salmon fry in areas devastated by the 1964 earthquake. Reintroduction stockings will generally be of a short-term nature. Once sufficient adults return to perpetuate and rebuild the stock, then fry stocking will be discontinued. The limiting factor in many stream stocking projects may be the availability of hatchery incubators and funds for transportation.

Northern District

Streams 282 Good Creek and Stream 283 Bad Creek, Eaglek Bay, National Forest land: Odd year pink salmon stocks in Eaglek Bay were depleted following the 1964 earthquake. The commercial fishery in Eaglek Bay subsequently has generally been closed during odd years to rebuild the odd year component. This has been unsuccessful, and as a result, pink salmon fry have been released to rebuild the brood stock.

Coghill District

Stream 427 Chasm Creek and Stream 428 Pirate Creek, Pirate Cove, Port Wells, National Forest land: These streams are located approximately 18 miles from Whittier and may have potential for sport fishing enhancement. Maintenance stocking of coho salmon smolt has been proposed.

Northwestern District

Stream 438 Billings Creek, Stream 444 Clean Creek and Stream 445 Barge Creek, Passage Canal, National Forest land: These streams are located approximately 5 miles from Whittier. Maintenance stocking with coho salmon smolt has been proposed.

Montague District

Stream 701 Trap Creek, 702 Point Creek, 707 Macleod Creek, 710 Hanning Creek, 711 Quadra Creek, 739 Swamp Creek, 741 Chalmers River, 745 Wild Creek, 746 Schuman Creek, 747 Cabin Creek.

8.4 POTENTIAL FISHPASS SITES

Fishpasses (fish ladders, steep passes or fish ways) allow salmon to utilize habitat upstream of falls or velocity barriers. The following streams may have potential for fishpass construction. Information is needed on the size of barriers to salmon migration, engineering possibilities and costs of overcoming these barriers and the quality of habitat upstream of the barriers.

Eastern District

Stream 38 Waterfall Stream, Sheep Bay, Eyak Corp. land: This stream has a small run of pink salmon that spawn below a falls near the high tide level. Salmon production could be enhanced by the installation of a fishpass and drop structures.

Stream 54 Carlsen Creek, Port Gravina, National Forest land: This stream is a moderate producer of pink salmon and a minor producer of chum salmon. A small falls blocks most of the watershed to salmon.

Stream 119 Johnson Cove Creek, Valdez Arm, Tatitlek Corp. land: This stream has a small run of pink salmon.

Stream 123 Gregorioff Creek, Jack Bay, State land selection: This stream is a moderate producer of pink salmon and a minor producer of chum salmon.

Northern District

Stream 202 Chuck's Creek, unnamed lake, Columbia Bay, Tatitlek Corp. land: This large lake system has falls 15 and 18 ft. in height at the mouth of the outlet stream. Fishpass construction is considered to be feasible.

Stream 231 unnamed creek and lakes, Cedar Bay, National Forest land: This drainage system contains two lakes blocked by a low falls at the outlet of the lower lake. The lower lake has Dolly Varden, and the upper lake is fishless. No salmon spawn in this system. The site also has potential for development of a small hatchery.

Stream 239 unnamed creek, Unakwik Inlet, National Forest lane: A falls at tidewater presently blocks access of pink salmon.

Stream 292 Papoose Creek, Squaw Bay, Esther Passage, National Forest land: This stream has two 4-ft. falls which may be a barrier to salmon. Evaluation is needed.

Coghill District

Stream 427 Chasm Creek, Pirate Cove, Port Wells, National Forest land: This system has a 17-acre lake at its headwaters and is blocked by a series of falls near the tidal zone. The stream has a small run of pink salmon.

Northwestern District

Stream 492 Derickson Creek, Derickson Lake, Port Nellie Juan, National Forest land: The 185-acre lake is inaccessible to salmon because of a barrier falls. The lake, however, contains residual sockeye salmon and Dolly Varden. The Forest Service has proposed to construct a fishpass on the stream pending the outcome of spawning area evaluations. There

is little stream spawning habitat available for coho salmon. It is not known yet if adequate lake shore spawning habitat for sockeye salmon is available.

Eshamy District

Stream 500 Point Nellie Juan Creek, Lighthouse Reserve; This lake has a surface area of 54 acres, and the euphotic volume is estimated to be 1,427 acre-ft. The outlet is blocked by a falls preventing adult salmon from entering the lake. The lake contains Dolly Varden and stickleback.

Stream 510 Eleshansky Creek, Native land.

Southwestern District

Stream 667 Anderson Creek, Sawmill Bay, Evans Island: Chenega Corp. land: A fishpass could be installed at falls near the upper tidal zone to allow pink salmon access.

Southeastern District

Stream 853 Whiskey Creek, Whiskey Cove, Hawkins Island, Eyak Corp. land.

8.5 POTENTIAL STREAM CHANNELIZATION AND IMPROVEMENT SITES

Eastern District

Stream 11 Humpy Creek, Orca Inlet, Eyak Corp. land.

Stream 16 Rude River, Nelson Bay, Orca Inlet, Chugach Alaska Corp. land: A portion of the water from a non-productive major glacial river could be diverted through a system of dikes and settling basins and combined with small creeks on the south hillside to form a spawning channel for pink and chum salmon. Pink and coho salmon have been observed. Numerous small historic sites are located on this parcel and coordination with Chugach Alaska Corp. would be required.

Stream 20 Spring Creek, East Arm of Simpson Bay, Eyak Corp. land: Channel improvement was performed in 1968 and 1971. Additional channel work is needed every 5 to 10 years.

Stream 26 Simpson River, Simpson Bay, National Forest land.

Coghill District

Stream 314 Avery River, Port Wells, National Forest land: The 1964 earthquake caused the land to subside about 6 ft., and the chum salmon run was depleted. The former chum salmon spawning areas are now in the 0 to 6-ft. tidal range which prevents egg survival. Placement of 8 ft. of gravel could reinstate 250,000 sq. ft. of spawning area. Approximately 80,000 cubic yards of gravel are needed. A large spit is located one-half mile distance from the site, and this gravel could be moved by barge.

Streams 318 through 321, Port Wells, National Forest land: These streams have potential for spawning channel excavation.

Stream 421 Mill Creek, Bettles Bay, Port Wells, State land: This stream has pink and chum salmon and has gravel shifting problems. It should be evaluated for ground water spawning channel excavation.

Stream 424 Old Creek, Hummer Bay, Port Wells, National Forest land: A small area is available for spawning channel excavation. Groundwater flows during winter need to be evaluated.

Southwestern District

Stream 665 Bjorn Creek, Evans Island, native land: Water from this small creek flows under a broad gravel flat at its mouth during low water flows. As a result, hundreds of salmon get accidentally stranded and die unspawned. The creek needs to be channelized across the tidal flat.

Stream 681 Hogan Creek, Hogan Bay, Knight Island, native land: This is a high gradient stream. The lower streambed is so shallow during average summer water flow that spawners cannot enter the stream. The stream occasionally has large runs of pink salmon. The streambed could be regraded and channelized to stabilize fish production.

Stream 698 Mallard Creek, Mallard Bay, Knight Island, National Forest land: This is a lake-fed stream that flows under a talus slope for a long distance. It emerges as a spring near tidewater. The unique water supply could be put to better use if a spawning channel was constructed from the spring to the intertidal zone.

Montague District

Stream 702 through 707 MacLeod Harbor, Stream 711 Quadra Creek, Hanning Bay, Montague Island, native and National Forest land: A 35-ft. uplifting during the 1964 earthquake has caused streams to cut new channels. Stabilization could be expedited by building man-made spawning channels.

Stream 712 through 737 central west coast of Montague Island, National Forest land: This location is the largest non-productive area in the inside waters of Prince William Sound. The lack of productivity is caused by the heavy surf pounding the exposed beach. This phenomenon causes stream instability and barriers to form at some creek mouths. Periodic channelization of creeks could enhance fish production.

Stream 741 Chalmers River, Port Chalmers, Montague Island, National Forest land: This river was a major chum salmon producer before the 1964 earthquake disrupted a spring tributary to the lower reach of the stream. The main river channel has become highly unstable. Chum salmon production could be greatly improved by collecting the spring water into a carefully constructed spawning channel and by developing other diversion channels out of the main river channel.

Southeastern District

Stream 810, 811, 812 and 815 Port Etches, Hinchinbrook Island, National Forest land: These are unstable streams that suffer from gravel movement during floods. Channel stabilization to safeguard against floods would prevent gravel movement and greatly increase salmon production.

Stream 817, 818 and 819 southwest Hinchinbrook Island: These streams are unstable, and a stabilization project could significantly increase coho and pink salmon production.

Stream 828 Cook Creek, Anderson Bay, Hinchinbrook Island, National Forest land: This stream is silting in at the 8 to 10-ft. tide level.

Stream 831 Double Creek, Double Bay, Hinchinbrook Island, National Forest land: This is an unstable stream that meanders and changes channels frequently in its lower reach which formerly was productive of salmon. Stream stabilization is needed.

8.6 OTHER POTENTIAL PROJECTS

Copper River District

Copper River Coho Salmon Escapement Counting: The mainstream escapement of coho salmon is currently not monitored. Mark-recapture data collected during the late 1960's indicated the occurrence of escapements numbering 15,000 to 25,000 fish. a comparison of these data with coho salmon index area escapement counts suggests that the mainstream run is a major component of the coho salmon run as a whole.

Sonar counters are employed to enumerate the escapement of sockeye salmon in the Copper River, but, because of funding constraints, these counters are not operated during the coho salmon migration period.

9.0 IMPACTS OF RECOMMENDED PROJECTS

9.1 NUMBER OF FISH HARVESTED

It is projected that the projects described in Chapter 7.0 may dramatically increase the harvests of commercial, sport and possibly subsistence fishermen. It is estimated that the net increase in overall harvests may be 123,300 king salmon, 997,300 sockeye salmon, 53,900 coho salmon, 14,915,800 pink salmon and 3,279,400 chum salmon (Table 60, page 126). These fish may be available for harvest, but, depending on the ability and desires of the fishermen, may or may not be entirely harvested. These projections do not include benefit calculations for numerous unquantifiable projects.

Tables 61 through 65 (pages 128 through 132) present estimates of total potential harvests by each user group of five species of hatchery-produced salmon based on the recommended hatchery capacities, survival assumptions, brood needs and sales fish needs.

Tables 66 through 72 (pages 133 through 143) present estimates of the net increase and total potential harvests of each species and user group. These harvest estimates do not represent an allocation scheme, but rather are only hypothetical estimates based on one harvest distribution scenario. Only the Board of Fisheries and State Legislature have authority to allocate salmon resources among user groups.

Table 73 (page 144) presents the 20-year harvest objectives for each user group, the potential catch based on the harvest scenario previously described and the resultant gaps in harvests. These data suggest that the quantifiable projects described in Chapter 7.0 may overall resolve the majority of the gaps in harvestable salmon. It is anticipated that there may be sufficient king, sockeye and coho salmon to meet the overall minimum demands. It is estimated that there may be a shortfall of 2,437,600 pink salmon and 681,800 chum salmon.

It is projected that the ex vessel value of commercial harvests may approach the overall income goal of commercial fishermen. It is estimated that commercial harvests of all stocks may equal $60,446,300 or virtually 100 percent of the overall revenue objective for all commercial salmon permit holders of $60,470,000. These data are based on price assumptions in Table 31 (page 54), Table 34 (page 58), Table 35 (page 61), Table 40 (page 68) and Table 42 (page 72). Seine fishermen may realize an average total annual income of $31,408,900 or 95 percent of their minimum revenue goal. Drift gill net fishermen may realize an average total annual income of $25,805,500 or 95 percent of their minimum revenue goal. Set gill net fishermen may realize an average total annual income of $3,231,900 or 673 percent of their minimum revenue goal (Table 73, page 144).

Subsistence fishermen may realize an average total annual harvest of 179,700 salmon or 115 percent of their minimum objective (Table 73). The majority of fish harvested are expected to be the preferred species, i.e. sockeye and king salmon.

Sport fishermen may have an opportunity to exceed the minimum harvest objective of king and pink salmon. The greatest shortfall may occur in sockeye salmon (Table 73). Sport fishermen may potentially achieve harvests of 32,300 king salmon, 8,700 sockeye salmon, 43,000 coho salmon, 59,600 pink salmon and 1,100 chum salmon.

Table 60. A comparison of the projected output of harvestable adult salmon from hatchery and rehabilitation projects in the Prince William Sound and Copper River areas according to 1984 production levels and the recommended production levels.

Project	Production	Adults Surplus to Brood and Revenue Needs				
		King	Sockeye	Coho	Pink	Chum
Cannery Creek Hatchery:	1984 level	0	0	0	2,087,900	19,100
	recommended level	0	0	0	4,919,300	0
	net increase	0	0	0	2,831,400	(19,100)
Main Bay Hatchery:	1984 level	0	0	0	1,391,100	472,900
	recommended level	0	0	0	1,181,600	1,602,700
	net increase	0	0	0	(209,500)	1,129,800
A. F. Koernig Hatchery:	1984 level	0	0	0	3,193,500	189,800
	recommended level	0	0	0	4,620,600	0
	net increase	0	0	0	1,427,100	(189,800)
Esther Hatchery:	1984 level	0	0	0	0	0
	recommended level	107,100	0	33,200	7,509,700	2,211,400
	net increase	107,100	0	33,200	7,509,700	2,211,400
Solomon Gulch Hatchery:	1984 level	0	0	2,800	1,203,700	189,800
	recommended level	7,600	0	22,900	4,550,800	336,900
	net increase	7,600	0	20,100	3,347,100	147,100
Gulkana Hatchery:	1984 level	0	140,400	0	0	0
	recommended level	0	291,300	0	0	0
	net increase	0	150,900	0	0	0
Elmendorf Hatchery:	1984 level	12,000	0	5,100	0	0
	recommended level	20,000	0	2,600	0	0
	net increase	8,000	0	(2,500)	0	0
Ft. Richardson Hatchery:	1984 level	0	0	2,600	0	0
	recommended level	600	0	5,700	0	0
	net increase	600	0	3,100	0	0
New Sockeye Hatchery:	1984 level	0	0	0	0	0
(Esther II)	recommended level	0	846,400	0	0	0
	net increase	0	846,400	0	0	0
Fishpass Construction:	1984 level	0	0	0	0	0
	recommended level	0	0	0	10,000	0
	net increase	0	0	0	10,000	0
Fishpass Maintenance:	1984 level	0	26,400	2,500	80,000	0
	recommended level	0	26,400	2,500	80,000	0
	net increase	0	0	0	0	0

continued

Table 60. A comparison of the projected output of harvestable adult salmon from hatcheries and rehabilitation projects in the Prince William Sound Area according to the 1984 production levels and the recommended production levels (cont'd).

Project	Production	Adults Surplus to Brood and Revenue Needs				
		King	Sockeye	Coho	Pink	Chum
Lake Fertilization:	1984 level	0	145,000	0	0	0
	recommended level	0	145,000	0	0	0
	net increase	0	0	0	0	0
Total at the 1984 level		12,000	311,800	13,000	7,956,200	871,600
Recommended level		135,300	1,309,100	66,900	22,872,000	4,151,000
Total net increase		123,300	997,300	53,900	14,915,800	3,279,400

Table 61. Total returns, brood needs, sales fish needs and hypothetical common property harvests of pink salmon from hatchery projects recommended in the Phase II Plan for the Prince William Sound and Copper River areas.

Hatchery	Maximum Eyed-Egg Capacity in 1984	Recommended Total Eyed-Egg Capacity	Projected Total Return Based on the Recommended Capacity	Brood Needs[1/]	PNP Fish Sales	Hypothetical Harvest Distribution				
						Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence
Cannery Creek	50,000,000	100,000,000	5,035,000[2/]	115,700	0	4,427,400	491,900	0	0	0
Main Bay	28,500,000	25,000,000	1,258,800[2/]	77,200	0	590,800	295,400	295,400	0	0
Esther	0	189,900,000	8,629,200[3/]	293,100	826,400[4/]	4,130,300	3,003,900	375,500	0	0
A. F. Koernig	108,000,000	137,000,000	6,225,400[3/]	211,400	1,393,400[5/]	4,620,600	0	0	0	0
Solomon Gulch	70,000,000	122,400,000	5,562,000[3/]	188,900	822,300[6/]	4,505,300	0	0	45,500[7/]	0
Total	256,500,000	574,300,000	26,710,400	886,300	3,042,100	18,274,400	3,791,200	670,900	45,500[7/]	0

1/ The number of brood fish required to fill the recommeded eyed-egg capacity.

2/ Assuming an eyed-egg to fry survival of 95 percent and a marine survival of 5.3 percent.

3/ Assuming an eyed-egg to fingerling survival of 85.7 percent and a marine survival of 5.3 percent.

4/ Assuming that $797,000 are collected through assessments and a hatchery sales goal of $1,866,000. It is also assumed that the common property fishery exploitation rate will be similar for each species returning to the hatchery.

5/ Assuming that $797,000 are collected through assessments and a hatchery sales goal of $1,404,000. It is also assumed that the common property fishery exploitation rate will be similar for each species returning to the hatchery.

6/ Assuming a hatchery revenue goal of $1,041,000 and that the common property fishery exploitation rate will be similar for each species returning to the hatchery.

7/ These fish represent an opportunity for sport harvest, and the number of fish harvested will be dependent on sport fishing effort.

Table 62. Total returns, brood needs, sales fish needs and hypothetical common property harvests of chum salmon from hatchery projects recommended in the Phase II Plan for the Prince William Sound and Copper River areas.

Hatchery	Maximum Eyed-Egg Capacity in 1984	Recommended Total Eyed-Egg Capacity	Projected Total Return Based on the Recommended Capacity	Brood Needs[1/]	PNP Fish Sales	Hypothetical Harvest Distribution				
						Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence
Cannery Creek	779,000[2/]	0	0	0	0	0	0	0	0	0
Main Bay	29,500,000	100,000,000	1,714,800[3/]	112,200	0	160,300	721,200	721,200	0	0
Esther	0	99,900,000	2,569,600[4/]	112,100	246,100[5/]	331,700	1,879,700	0	0	0
Solomon Gulch	6,000,000	16,200,000	416,700[4/]	18,200	61,600[6/]	336,900	0	0	0	0
Total	36,279,000	216,100,000	4,701,100	242,500	307,700	828,900	2,600,900	721,200	0	0

1/ The number of brood fish required to fill the recommended eyed-egg capacity.

2/ This was the actual number of eyed eggs incubated in 1984.

3/ Assuming an eyed-egg to fingerling survival of 85.5 percent and a marine survival of 2.0 percent.

4/ Assuming an eyed-egg to fingerling survival of 85.5 percent and a marine survival of 3.0 percent.

5/ Assuming that $797,000 are collected through assessments and a hatchery sales goal of $1,866,000. It is also assumed that the common property fishery exploitation rate will be similar for each species returning to the hatchery.

6/ Assuming a hatchery revenue goal of $1,041,000 and that the common property fishery exploitation rate will be similar for each species returning to the hatchery.

Table 63. Total returns, brood needs, sales fish needs and hypothetical common property harvests of sockeye salmon from a hatchery project recommended in the Phase II Plan for the Prince William Sound and Copper River areas.

Hatchery	Maximum Eyed-Egg Capacity in 1984	Recommended Total Eyed-Egg Capacity	Projected Total Return Based on the Recommended Capacity	Brood Needs[1/]	PNP Fish Sales	Hypothetical Harvest Distribution				
						Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tence
Gulkana	24,100,000	50,000,000[1/]	332,500[2/]	41,200	0	0	192,300	0	2,900	96,100
Esther II	0	30,170,500	803,900[3/]	24,800	0	460,700	268,000	117,700	0	0
Total	24,100,000	80,170,500	1,136,400	66,000	0	460,700	460,300	117,700	2,900	96,100

1/ Approximately 26,770,000 eggs were taken. It is assumed that 90 percent survived to the eyed-egg stage.

2/ Based on FRED Directive No. 3.

3/ Based on survival rates in Table 55, page 97.

Table 64. Total returns, brood needs, sales fish needs and hypothetical common property harvests of coho salmon from hatchery projects recommended in the Phase II Plan for the Prince William Sound and Copper River areas.

Hatchery	Maximum Rearing Capacity in 1984	Recommended Total Rearing Capacity	Projected Total Return Based on the Recommended Capacity[1/]	Brood Needs[2/]	PNP Fish Sales	Hypothetical Harvest Distribution				
						Seine	Drift Gill Net	Set Gill Net	Sport	Subsis tence
Ft. Richardson	[3/]	555,000	5,600	0[5/]	0	1,700	600	300	3,100[6/]	0
Elmendorf	[4/]	250,000	2,500	0[5/]	0	800	400	0	1,400[6/]	0
Esther	0	750,000	37,500[7/]	800	3,600[8/]	11,600	1,700	0	19,900[6/]	0
Solomon Gulch	555,600	555,600	27,800[9/]	800	4,100[10/]	13,700	0	0	9,200[6/]	0
Total	555,600	2,110,600	73,400	1,600	7,700	27,800	2,700	300	33,600[6/]	0

1/ Assuming a fingerling to smolt survival of 20 percent in lakes and 72 percent in raceways. The marine survival is assumed to be 5.0 percent.

2/ The number of brood fish required to fill the recommended rearing capacity.

3/ The maximum rearing capacity in 1984 was 2,500,000 fingerlings and 2,000,000 smolt. This is a central facility and is not specifically devoted to Prince William Sound enhancement.

4/ The maximum rearing capacity in 1984 was 500,000 smolt. This is a central facility and is not specifically devoted to Prince William Sound enhancement.

5/ Brood fish will probably be obtained from fish other than those stocked.

6/ These fish represent an opportunity for sport harvest, and the number of fish harvested will be dependent of sport fishing effort.

7/ Assuming a green egg to age 0 smolt survival rate of 75 percent. Smolt to be released at the hatchery.

8/ Assuming that $797,000 are collected through assessments and a hatchery sales goal of $1,866,000. It is also assumed that the common property fishery exploitation rate will be similar for each species returning to the hatchery.

9/ Age 1 smolt to be released at the hatchery.

10/ Assuming a hatchery revenue goal of $1,041,000 and that the common property fishery exploitation rate will be similar for each species returning to the hatchery.

Table 65. Total returns, brood needs, sales fish needs and hypothetical common property harvests of king salmon from hatchery projects recommended in the Phase II Plan for the Prince William Sound and Copper River areas.

Hatchery	Maximum Rearing Capacity in 1984	Recommended Total Rearing Capacity	Projected Total Return Based on the Recommended Capacity[1/]	Brood Needs[2/]	PNP Fish Sales	Hypothetical Harvest Distribution				
						Seine	Drift Gill Net	Set Gill Net	Sport	Subsistence
Ft. Richardson	[3/]	75,000	600	0[5/]	0	0	300	0	300 6/	0
Elmendorf	[4/]	500,000	20,000	0[5/]	0	4,000	3,000	0	13,000 6/	0
Esther	0	3,000,000[7/]	120,000[8/]	1,400	11,500 9/	5,400	91,000	0	10,700 6/	0
Solomon Gulch	0	225,000[7/]	9,000	100	1,300 10/	1,500	0	0	6,100 6/	0
Total	0	3,800,000	149,600	1,500	12,800	10,900	94,300	0	30,100 6/	0

1/ Assuming a fingerling to smolt survival of 20 percent in lakes and 72 percent in raceways. The marine survival is assumed to be 4.0 percent.

2/ The number of brood fish required to fill the recommended rearing capacity.

3/ This is a central facility and is not specifically devoted to Prince William Sound enhancement.

4/ The maximum rearing capacity in 1984 was 1,000,000 smolt. This is a central facility and is not specifically devoted to Prince William Sound enhancement.

5/ Brood fish will probably be obtained from fish other than those stocked.

6/ These fish represent an opportunity for sport harvest, and the number of fish harvested will be dependent on sport fishing effort.

7/ To be released at the hatchery.

8/ Assuming a green egg to age 0 smolt survival of 75 percent.

9/ Assuming that $797,000 are collected through assessments and a hatchery sales goal of $1,866,000. It is also assumed that the common property fishery exploitation rate will be similar for each species returning to the hatchery.

10/ Assuming a hatchery revenue goal of $1,041,000 and that the common property fishery exploitation rate will be similar for each species returning to the hatchery.

Table 66. A comparison of the projected output of harvestable pink salmon from hatcheries and rehabilitation projects in the Prince William Sound and Copper River areas according to the 1984 production levels and the recommended production levels.

Project	Production	Hypothetical Harvest Distribution				
		Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tense
Cannery Creek Hatchery:	1984 level	1,879,100	208,800	0	0	0
	recommended level	4,427,400	491,900	0	0	0
	net increase	2,548,300	283,100	0	0	0
Main Bay Hatchery:	1984 level	695,500	347,800	347,800	0	0
	recommended level	590,800	295,400	295,400	0	0
	net increase	(104,700)	(52,400)	(52,400)	0	0
A. F. Koernig Hatchery:	1984 level	3,193,500	0	0	0	0
	recommended level	4,620,600	0	0	0	0
	net increase	1,427,100	0	0	0	0
Esther Hatchery:	1984 level					
	recommended level	4,130,300	3,003,900	375,500	0	0
	net increase	4,130,300	3,003,900	375,500	0	0
Solomon Gulch Hatchery:	1984 level	1,191,700	0	0	12,000	0
	recommended level	4,505,300	0	0	45,500	0
	net increase	3,313,600	0	0	33,500	0
Gulkana Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Elmendorf Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Ft. Richardson Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
New Sockeye Hatchery:	1984 level	0	0	0	0	0
(Esther II)	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Fishpass Construction:	1984 level	0	0	0	0	0
	recommended level	0	10,000	0	0	0
	net increase	0	10,000	0	0	0
Fishpass Maintenance:	1984 level	59,000	21,000	0	0	0
	recommended level	59,000	21,000	0	0	0
	net increase	0	0	0	0	0

continued

Table 66. A comparison of the projected output of harvestable pink salmon from hatcheries and rehabilitation projects in the Prince William Sound and Copper River areas according to the 1984 production levels and the recommended production levels (cont'd).

Project	Production	Hypothetical Harvest Distribution				
		Seine	Drift Gill Net	Set Gill Net	Sport	Subsistense
Lake Fertilization:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Total at the 1984 level		7,018,800	615,600	368,800	12,000	0
Recommended level		18,333,400	3,860,200	691,900	45,500	0
Total net increase		11,314,600	3,244,600	323,100	33,500	0

Table 67. A comparison of the projected output of harvestable chum salmon from hatcheries and rehabilitation projects in the Prince William Sound and Copper River areas according to the 1984 production levels and the recommended production levels.

Project	Production	Hypothetical Harvest Distribution				
		Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tense
Cannery Creek Hatchery:	1984 level	19,100	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	(19,100)	0	0	0	0
Main Bay Hatchery:	1984 level	47,300	212,800	212,800	0	0
	recommended level	160,300	721,200	721,200	0	0
	net increase	113,000	508,400	508,400	0	0
A. F. Koernig Hatchery:	1984 level	189,800	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	(189,800)	0	0	0	0
Esther Hatchery:	1984 level	0	0	0	0	0
	recommended level	331,700	1,879,700	0	0	0
	net increase	331,700	1,879,700	0	0	0
Solomon Gulch Hatchery:	1984 level	189,800	0	0	0	0
	recommended level	336,900	0	0	0	0
	net increase	147,100	0	0	0	0
Gulkana Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Elmendorf Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Ft. Richardson Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
New Sockeye Hatchery: (Esther II)	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Fishpass Construction:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Fishpass Maintenance:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0

continued

Table 67. A comparison of the projected output of harvestable chum salmon from hatcheries and rehabilitation projects in the Prince William Sound and Copper River areas according to the 1984 production levels and the recommended production levels (cont'd).

Project	Production	Hypothetical Harvest Distribution				
		Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tense
Lake Fertilization:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Total at the 1984 level		446,000	212,800	212,800	0	0
Recommended level		828,900	2,600,900	721,200	0	0
Total net increase		382,900	2,388,100	508,400	0	0

Table 68. A comparison of the projected output of harvestable sockeye salmon from hatcheries and rehabilitation projects in the Prince William Sound and Copper River areas according to the 1984 production levels and the recommended production levels.

		Hypothetical Harvest Distribution				
Project	Production	Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tense
Cannery Creek Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Main Bay Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
A. F. Koernig Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Esther Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Solomon Gulch Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Gulkana Hatchery:	1984 level	0	92,700	0	1,400	46,300
	recommended level	0	192,300	0	2,900	96,100
	net increase	0	99,600	0	1,500	49,800
Elmendorf Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Ft. Richardson Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
New Sockeye Hatchery:	1984 level	0	0	0	0	0
(Esther II)	recommended level	460,700	268,000	117,700	0	0
	net increase	460,700	268,000	117,700	0	0
Fishpass Construction:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Fishpass Maintenance:	1984 level	19,600	6,800	0	0	0
	recommended level	19,600	6,800	0	0	0
	net increase	0	0	0	0	0

continued

Table 68. A comparison of the projected output of harvestable sockeye salmon from hatcheries and rehabilitation projects in the Prince William Sound and Copper River areas to the 1984 production levels and the recommended production levels (cont'd).

Project	Production	Hypothetical Harvest Distribution				
		Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tense
Lake Fertilization:	1984 level	0	145,000	0	0	0
	recommended level	0	145,000	0	0	0
	net increase	0	0	0	0	0
Total at the 1984 level		19,600	244,500	0	1,400	46,300
Recommended level		480,300	612,100	117,700	2,900	96,100
Total net increase		460,700	367,600	117,700	1,500	49,800

Table 69. A comparison of the projected output of harvestable coho salmon from hatcheries and rehabilitation projects in the Prince William Sound and Copper River areas according to the 1984 production levels and the recommended production levels.

Project	Production	Hypothetical Harvest Distribution				
		Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tense
Cannery Creek Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Main Bay Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
A. F. Koernig Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Esther Hatchery:	1984 level	0	0	0	0	0
	recommended level	11,600	1,700	0	19,900	0
	net increase	11,600	1,700	0	19,900	0
Solomon Gulch Hatchery:	1984 level	1,700	0	0	1,100	0
	recommended level	13,700	0	0	9,200	0
	net increase	12,000	0	0	8,100	0
Gulkana Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Elmendorf Hatchery:	1984 level	1,800	300	0	3,000	0
	recommended level	800	400	0	1,400	0
	net increase	(1,000)	100	0	(1,600)	0
Ft. Richardson Hatchery:	1984 level	800	300	100	1,400	0
	recommended level	1,700	600	300	3,100	0
	net increase	900	300	200	1,700	0
New Sockeye Hatchery:	1984 level	0	0	0	0	0
(Esther II)	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Fishpass Construction:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Fishpass Maintenance:	1984 level	2,300	200	0	0	0
	recommended level	2,300	200	0	0	0
	net increase	0	0	0	0	0

continued

Table 69. A comparison of the projected output of harvestable coho salmon from hatcheries and rehabilitation projects in the Prince William Sound and Copper River areas according to the 1984 production levels and the recommended production levels (cont'd).

Project	Production	Hypothetical Harvest Distribution				
		Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tense
Lake Fertilization:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Total at the 1984 level		6,600	800	100	5,500	0
Recommended level		30,100	2,900	300	33,600	0
Total net increase		23,500	2,100	200	28,100	0

Table 70. A comparison of the projected output of harvestable king salmon from hatcheries and rehabilitation projects in the Prince William Sound and Copper River areas according to the 1984 production levels and the recommended production levels.

Project	Production	Hypothetical Harvest Distribution				
		Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tense
Cannery Creek Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Main Bay Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
A. F. Koernig Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Esther Hatchery:	1984 level	0	0	0	0	0
	recommended level	5,400	91,000	0	10,700	0
	net increase	5,400	91,000	0	10,700	0
Solomon Gulch Hatchery:	1984 level	0	0	0	0	0
	recommended level	1,500	0	0	6,100	0
	net increase	1,500	0	0	6,100	0
Gulkana Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Elmendorf Hatchery:	1984 level	600	5,400	0	6,000	0
	recommended level	4,000	3,000	0	13,000	0
	net increase	3,400	(2,400)	0	7,000	0
Ft. Richardson Hatchery:	1984 level	0	0	0	0	0
	recommended level	0	300	0	300	0
	net increase	0	300	0	300	0
New Sockeye Hatchery: (Esther II)	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Fishpass Construction:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Fishpass Maintenance:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0

continued

Table 70. A comparison of the projected output of harvestable king salmon from hatcheries and rehabilitation projects in the Prince William Sound and Copper River areas according to the 1984 production levels and the recommended production levels (cont'd).

Project	Production	Hypothetical Harvest Distribution				
		Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tense
Lake Fertilization:	1984 level	0	0	0	0	0
	recommended level	0	0	0	0	0
	net increase	0	0	0	0	0
Total at the 1984 level		600	5,400	0	6,000	0
Recommended level		10,900	94,300	0	30,100	0
Total net increase		10,300	88,900	0	24,100	0

Table 71. Summary of potential net increase in common property harvests of all salmon stocks in the Prince William Sound and Copper River areas by species and user group based on projects recommended in the Phase II Plan.

	Hypothetical Harvest Distribution					
Species	Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tense	Total
pink	11,314,600	3,244,600	323,100	33,500	0	14,915,800
chum	382,900	2,388,100	508,400	0	0	3,279,400
sockeye	460,700	367,600	117,700	1,500	49,800	997,300
coho	23,500	2,100	200	28,100	0	53,900
king	10,300	88,900	0	24,100	0	123,300
Ex vessel Value:						
pink	$11,473,000	$3,290,000	$327,600			$15,090,600
chum	$909,800	$5,674,100	$1,208,000			$7,791,900
sockeye	$2,985,300	$2,537,400	$762,700			$6,285,400
coho	$55,200	$4,900	$500			$60,600
king	$396,300	$905,400	$0			$1,301,700
Total	$15,819,600	$12,411,800	$2,298,800			$30,530,200

Table 72. Summary of potential total common property harvests of all salmon stocks in the Prince William Sound, Copper River and Bering River areas by species and user group based on projects recommended in the Phase II Plan.

	Hypothetical Harvest Distribution					
Species	Seine	Drift Gill Net	Set Gill Net	Sport	Subsis-tense	Total
pink	24,088,300	4,097,300	683,600	59,600	200	28,929,000
chum	1,250,600	2,720,900	723,900	1,100	0	4,696,500
sockeye	536,600	1,430,000	126,200	8,700	175,200	2,276,700
coho	45,600	257,500	400	43,000	1,300	347,800
king	12,000	114,700	0	32,300	3,000	162,000
Ex vessel Value:	$0	$0	$0			
pink	$24,425,500	$4,155,700	$693,200			$29,274,400
chum	$2,971,500	$6,463,400	$1,720,000			$11,154,900
sockeye	$3,477,100	$10,806,200	$817,800			$15,101,100
coho	$107,100	$2,596,000	$900			$2,704,000
king	$427,700	$1,784,200	$0			$2,211,900
Total	$31,408,900	$25,805,500	$3,231,900			$60,446,300

Table 73. A comparison of the potential common property harvests of all salmon stocks with the 20-year objectives for each user group, with the recommended Phase II projects.

User Group	King	Sockeye	Coho	Pink	Chum	Income
Seine:						
Goal	5,300	204,300	36,900	27,082,200	1,874,600	$32,940,000
Potential Catch	12,000	536,600	45,600	24,088,300	1,250,600	$31,408,900
Gap	(6,700)	(332,300)	(8,700)	2,993,900	624,000	$1,531,100
Drift Gill Net:						
Goal	62,600	1,290,400	259,200	4,267,000	3,432,200	$27,050,000
Potential Catch	114,700	1,430,000	257,500	4,097,300	2,720,900	$25,805,500
Gap	(52,100)	(139,600)	1,700	169,700	711,300	$1,244,500
Set Gill Net:						
Goal	0	55,200	1,400	0	62,900	$480,000
Potential Catch	0	126,200	400	683,600	723,900	$3,231,900
Gap	0	(71,000)	1,000	(683,600)	(661,000)	($2,751,900)
Subsistence:[1/]						
Goal	0	155,500	100	200	0	
Potential Catch	3,000	175,200	1,300	200	0	
Gap	(3,000)	(19,700)	(1,200)	0	0	
Sport:						
Goal	8,600	25,700	28,600	17,200	8,600	
Potential Catch	32,300	8,700	43,000	59,600	1,100	
Gap	(23,700)	17,000	(14,400)	(42,400)	7,500	
Total:						
Goal	76,500	1,731,100	326,200	31,366,600	5,378,300	$60,470,000
Potential Catch	162,000	2,276,700	347,800	28,929,000	4,696,500	$60,446,300
Gap	(85,500)	(545,600)	(21,600)	2,437,600	681,800	$23,700

1/ Includes fishermen who utilize fishwheel, dip nets, gill nets and seines.

9.2 HARVEST TIMING

Figure 12 (page 146) depicts a one-dimensional comparison of the timing of wild salmon stocks and the probable harvest timing of salmon created through four major hatchery projects, i.e. the Esther, Main Bay, Solomon Gulch and Gulkana projects. The Tokun Lake fertilization project is also included. Early-run fish incubated at these facilities would have a major impact on harvest timing and, possibly, harvests in other areas. All user groups will benefit from an earlier fishery in Prince William Sound.

Drift gill net fishermen, upon the opening of the Coghill District in May, would have the option to participate in either the Copper River or Coghill fisheries. The reduction in fishing effort in the Copper River District would enhance the harvests of those fishermen who elect to remain in the Copper River District and will facilitate management of the Copper River fishery. The fishing power of the Copper River fleet would be reduced and it may be easier to attain the weekly and annual escapement goals.

Drift and set gill net fishermen would be able to fish in the Main Bay Subdistrict of the Eshamy District beginning in early or mid June. Fishing effort in the Copper River, Bering River, Coghill and Unakwik districts would be further reduced and individual catches indirectly enhanced. Set gill net fishermen would benefit by a fishing season that opens a month earlier than normal.

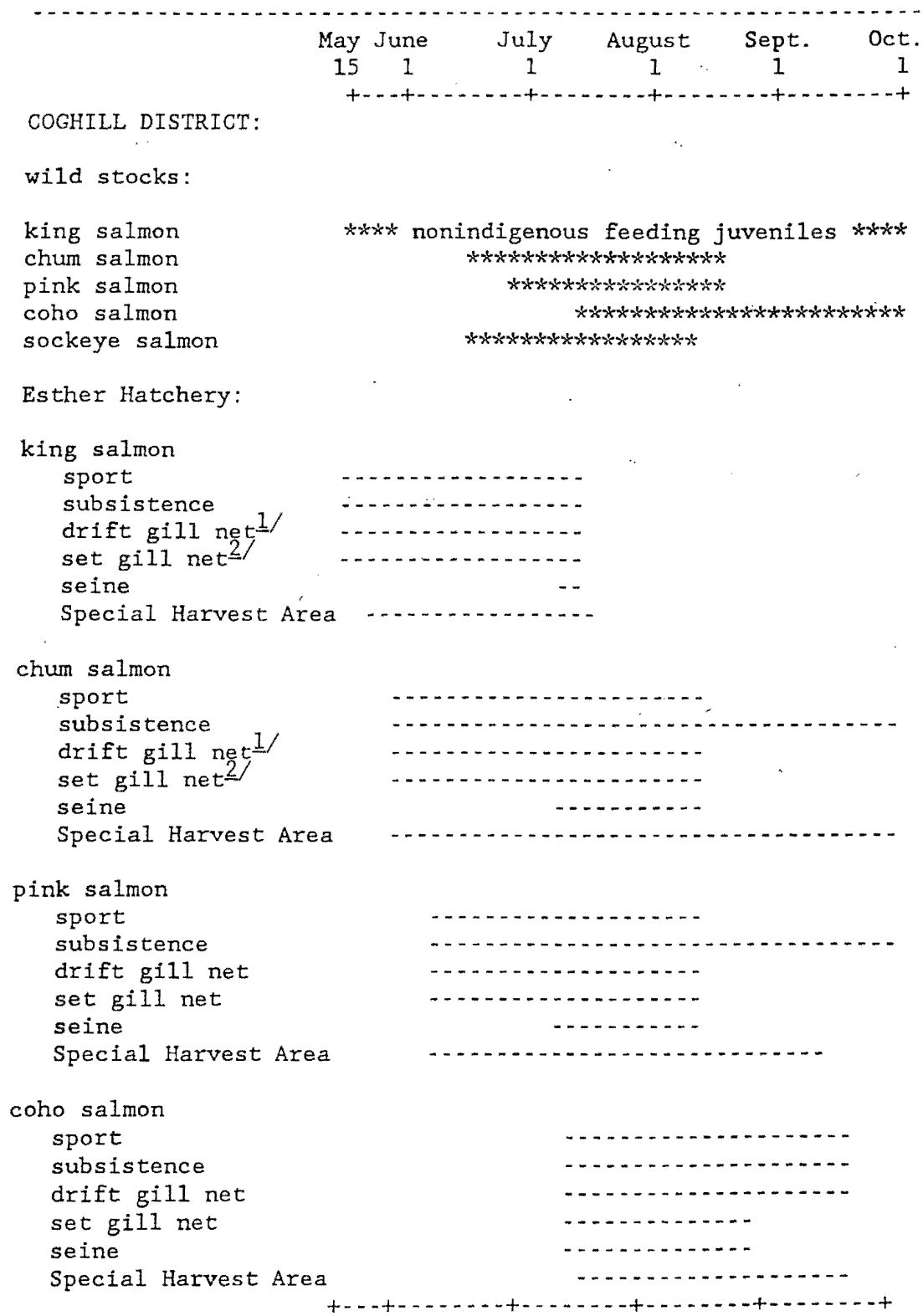
Seine fishermen would benefit from the harvest of additional early-run pink salmon returning to Valdez Arm.

Early-run pink and chum salmon would be the first pink and chum salmon to be harvested in the State annually, and these fish should be relatively easy to process and market.

The four major hatchery projects would, from an overall standpoint, create a broader or longer duration peak in the processing season. Additional processing crews and equipment could be utilized and overtime costs could be reduced.

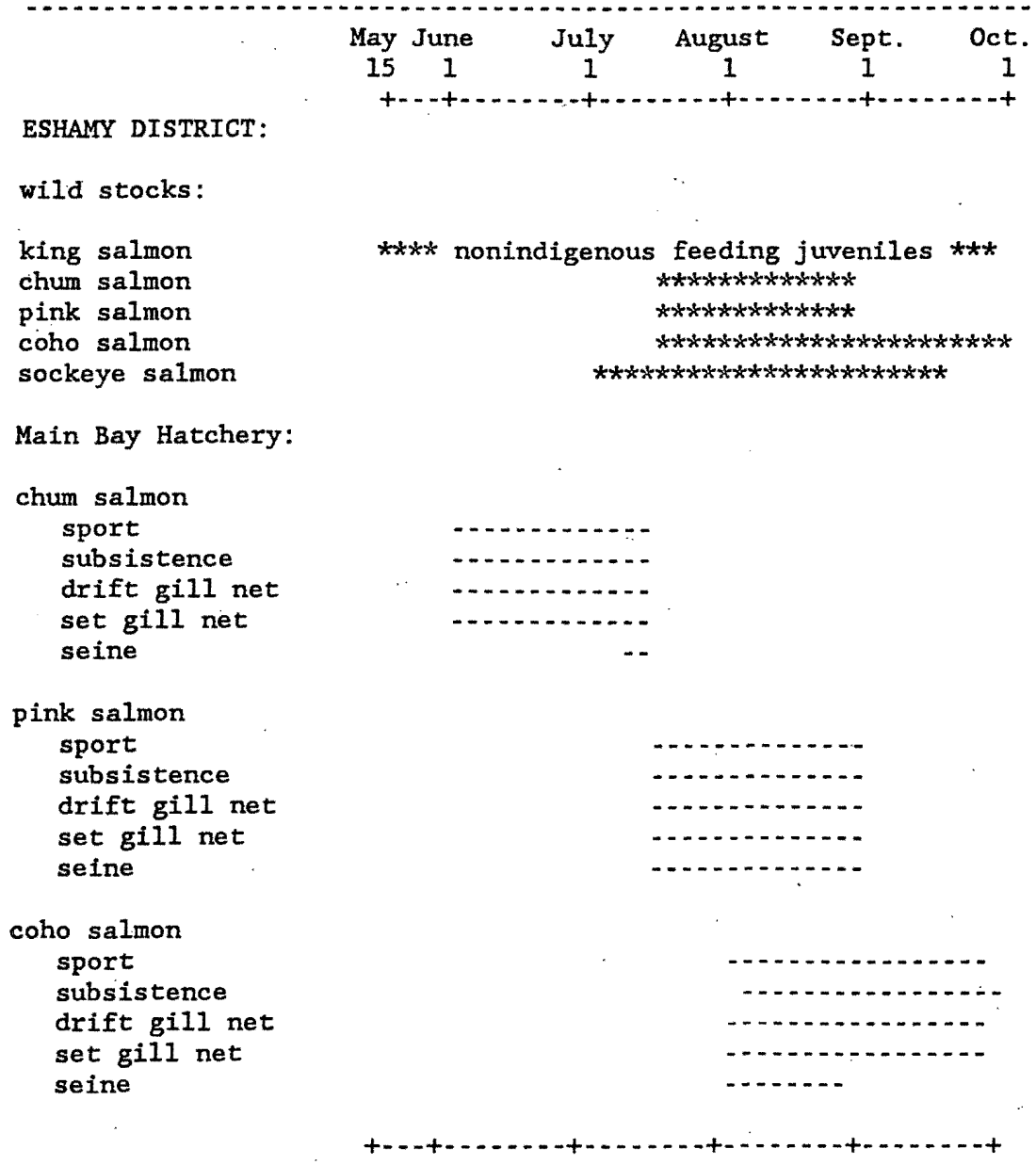
Sport and subsistence fishermen would benefit from major king and coho salmon runs returning to the Coghill, Northwestern and Eastern districts. Opportunities to harvest king salmon in late May and June may lead to a reduction in sport and subsistence fishing effort in the Upper Copper River drainage.

Figure 12. Probable harvest timing by user group of salmon returning to the Esther, Main Bay, Solomon Gulch and Gulkana hatcheries.



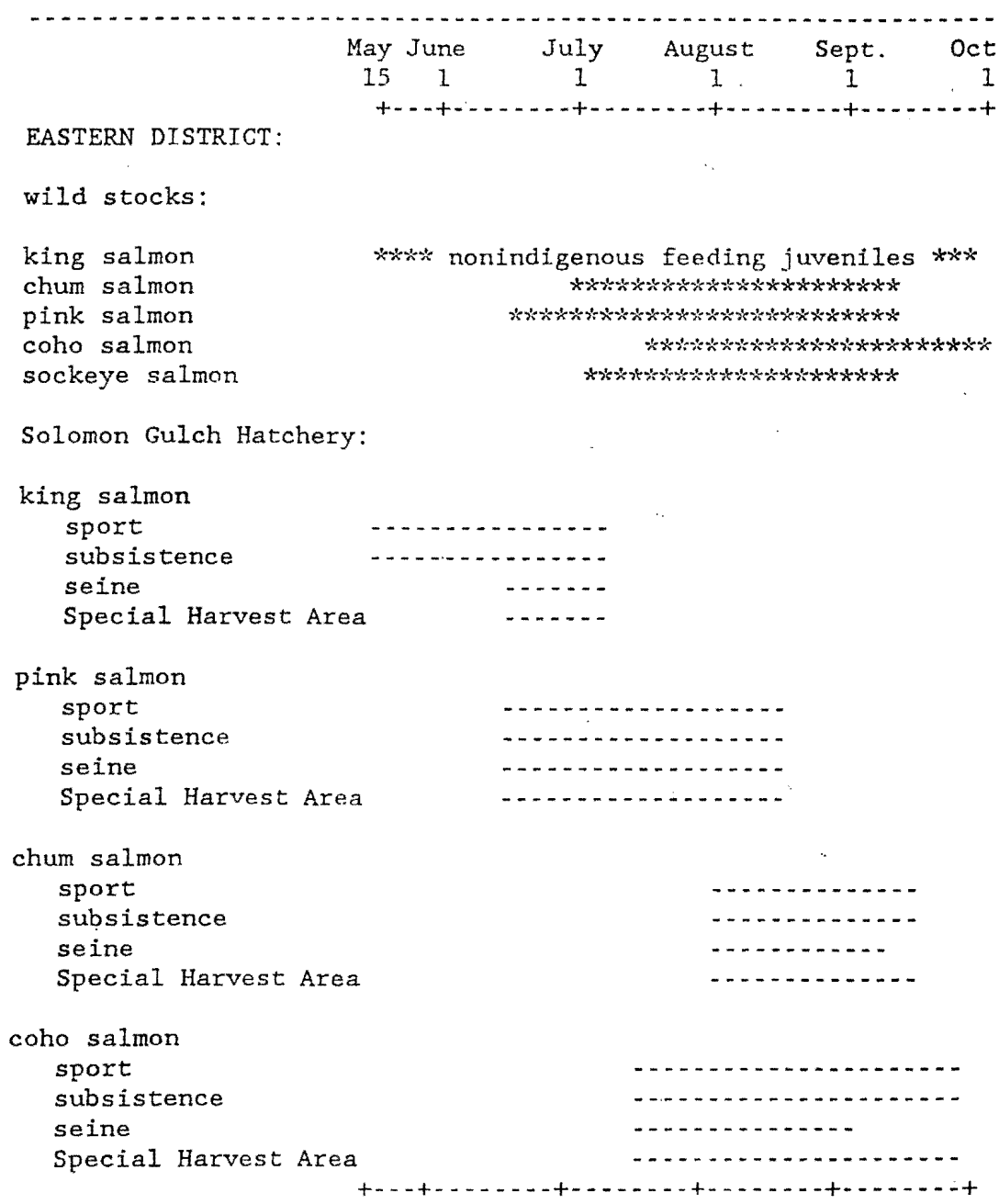
continued

Figure 12. Probable harvest timing by user group of salmon returning to the Esther, Main Bay, Solomon Gulch and Gulkana hatcheries (cont'd).



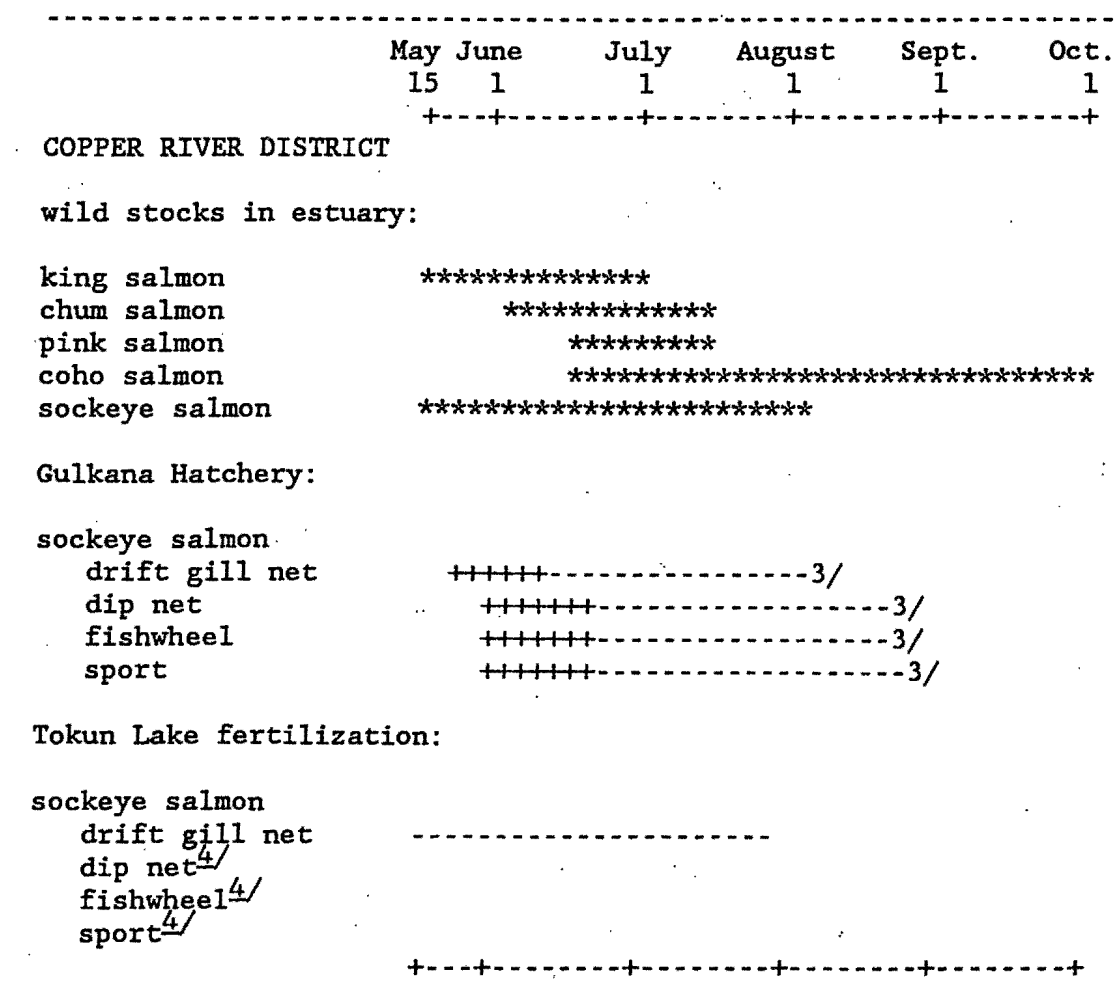
continued

Figure 12. Probable harvest timing by user group of salmon returning to the Esther, Main Bay, Solomon Gulch and Gulkana hatcheries (cont'd).



continued

Figure 12. Probable harvest timing by user group of salmon returning to the Esther, Main Bay, Solomon Gulch and Gulkana hatcheries (cont'd).



1/ It is assumed that the drift gill net fishery will be open in mid May.
2/ It is assumed that some fish destined for the Esther Hatchery will be intercepted by set net fishermen in the Eshamy District.
3/ Dashed line (--) indicates run timing of fish at the 1984 capacity. Crossed line (++) indicates that the salmon run may be prolonged if the hatchery is expanded and an early run stock is utilized to fill the increased capacity.
4/ Tokun Lake is located south of the area open to dip net and fishwheel fishing. The area is accessible only by float plane and sport harvests are not anticipated to be significant.

10.0 RECOMMENDATIONS

Recommendations of the Prince William Sound Regional Planning Team are as follows:

1. With the completion of the Prince William Sound, Copper-Bering River Phase II Plan, it is recognized that fish production is directly linked and driven by demand for fish and its utilization. Therefore, the Prince William Sound Regional Planning Team recommends that the State of Alaska implement a fisheries economic development program that will promote, guide and direct the utilization of the present and future production potential of Alaska salmon.

2. It is recommended that projects described in Chapter 7.0 be funded and implemented as soon as possible.

3. It is recommended that every means be explored to achieve full utilization of existing hatcheries and that the Main Bay and Gulkana hatcheries be expanded.

4. It is recommended that ADF&G develop management plans to allow for full utilization of hatchery stocks in terminal and special harvest areas.

5 It is recommended that ADF&G open districts based on wild stock build up and projected wild fish escapement data with the exception of returns to hatcheries in terminal or special harvest areas.

6. It is recommended that lakes and streams for recreational enhancement be selected to minimize commercial interceptions and gear conflicts.

7. It is recommended that sockeye salmon stocking and hatchery construction plans be developed for the Prince William Sound, Copper-Bering River Region.

8. It is recommended that the following lakes identified as hatchery reservoir sites should not be stocked:

   Stream 100 Borodkin Creek, unnamed lake, Boulder Bay
   Stream 114 Turner Creek, Turner Lake, Galena Bay
   Stream 231 unnamed creek and lakes, Cedar Bay
   Stream 285 Cascade River, unnamed lakes, Cascade Bay
   Stream 289 Derickson Creek, unnamed lake, Derickson Bay
   Stream 224-40-000 C&D unnamed stream and lakes, McClure Bay
   Stream 617 Princeton Creek, unnamed lake, Icy Bay

   Stocking may result in contamination of the potential hatchery water supply with pathogens and preclude the use of the lake as a hatchery water source.

9. It is recommended that future pink and chum salmon hatcheries located in the Northern District utilize only early run stocks.

   Use of early run stocks would prolong the harvest timing of the seine fishery in Prince William Sound and these fish would be the first pink and/or chum salmon harvested in the State and would be readily marketed.

10. It is recommended that hatchery sites in Eaglek Bay be developed to their maximum potential.

11. It is recommended that hatcheries placed in the Northwestern District utilize only middle to late-run stocks.

    This would allow early run king and chum salmon destined for the Esther Hatchery and sockeye salmon destined for the Coghill and Unakwik districts to reach the intended user group, drift gill net and sport fishermen.

12. It is recommended that a pink and chum hatchery constructed at Princeton Creek utilize early to middle-run stocks and that a terminal fishery be developed.

13. It is recommended that fisheries habitat be protected.

14. It is recommended that the high seas interception of salmon by foreign fishermen be eliminated.

Appendix 1. Regional Planning Team Charter.

THE REGIONAL PLANNING TEAMS ARE AN IMPORTANT PART OF THE SALMON ENHANCEMENT EFFORT IN THE STATE OF ALASKA. THE FOLLOWING STATEMENTS CONSTITUTE THEIR MISSION, STATUS, AND OPERATIONS AND CONFIRM ROLES AND TASKS THAT, AS A MATTER OF PRACTICE, HAVE BECOME RECOGNIZED AS APPROPRIATE.

MISSION STATEMENT

The mission of a regional planning team (RPT) is to plan for the long-term future of the salmon resource within its region. The team's primary responsibility is to initiate and continue an orderly process that examines the full potential of the region's salmon production capacity.

LEGAL REFERENCE

Pursuant to AS 16.10.375-470, the Commissioner of the Alaska Department of Fish and Game (ADF&G) has designated salmon production regions throughout the state. In each such region, the Commissioner is responsible for the development and amendment, as necessary, of a comprehensive salmon production plan.

The RPT, which consists of representatives from ADF&G and the appropriate Regional Aquaculture Association, develops and amends the plan for the Commissioner. The team has ex-officio members as considered necessary by the individual RPTs. The RPT is ultimately responsible to the Commissioner. Any staff funded by the ADF&G to assist the RPT with planning may be administratively monitored by the association but will be supervised by the RPT in planning matters.

The RPT is the only statutorily-created planning group with legally-mandated ADF&G and private sector participation.

State statute defines certain duties of the RPTs. They are:

1. Plan development and amendment.

2. Review of private nonprofit (PNP) hatchery permit applications and recommendations to the Commissioner.

3. Review and comment on proposed permit suspensions revocations by the Commissioner.

HISTORICAL PERSPECTIVE

The underlying premise of regional planning is to provide a means whereby private-sector user groups, represented through regional aquaculture associations, and the public sector, represented by ADF&G, may establish and maintain a cooperative, working relationship.

This relationship would facilitate and enforce the efforts being made in each region to contribute to the maintenance and enhancement of the salmon resource.

The major, initial role of the RPT is to develop a Comprehensive Salmon Plan. Comprehensive salmon planning has evolved since 1977 into three basic components: (1) Phase I Planning - a Comprehensive Plan; (2) Phase II Planning -- project specific planning; and (3) plan maintenance.

The RPT reviews PNP permit applications, as mandated by the statutes. The RPT review and comment on an application is based upon the objectives of the Comprehensive Plan. To conduct these reviews, the RPT must have current knowledge of private and public-sector proposals and operations. Public-sector hatcheries are to be included in the development of the Comprehensive Plan, pursuant to AS 16.10.375. The RPT reviews and comments on public-sector hatchery operations as well.

PLANNING, REVIEW, AND COMMENT PROCESS

Phase I Planning

The process begins with the development of a long-range Comprehensive Plan for salmon production in a region.

The Comprehensive Plan is a 20-year, strategic, regional plan that is generally consistent with the plan content outline that has been adopted by the Commissioner's Office. Since opportunity and need for salmon resource enhancement vary by region, variations within the outline categories may be necessary to address regional differences. While a 20-year time span was determined to be reasonable for long-term salmon development planning, amendments necessary to keep the plan current require shorter time frame planning. This is referred to as Phase II planning.

Phase II Planning

Phase II of the planning process occurs after the comprehensive plan is approved and addresses the plan's statutory update and amendment requirements. The Phase II plan develops detailed project descriptions and provides information for project implementation. The product of this effort may be a separate document or may be additional information or revisions incorporated into the comprehensive planning process through annual reports or plan updates.

Prior to Commissioner approval of the Comprehensive Plan, Phase II: Northern Southeast (NSPII) the future role of the RPT had not been defined. Chapter 9 of the NSPII addresses this matter:

> "...since the beginning of the process, it has been recognized that the plan must not be considered fixed or static but, rather, constantly evolving; that, therefore, the RPT would have a continuing role in aquaculture planning. This continuing planning effort must relate actual events to the plan and make the plan responsive to new knowledge and ideas and changing conditions."

The Commissioner, in approving NSPII, sanctioned the process used to develop that document as a guide for the plan amendment process. Chapters 9 and 10 of the NSPII provide one format to accomplish the amendments and to respond to plan maintenance needs.

Plan Maintenance

The RPT will meet at least once a year to update the Comprehensive Plan. These updates may include identification of new projects, and assessment of progress of ongoing projects toward achievement of the goals and objectives of the Comprehensive Plan. Some vehicles that provide the RPT with necessary information to accomplish the update include PNP Annual Reports and FRED and PNP Basic and Annual Management Plans.

Update of the annual report should be a process involving both the RPT and the implementing agencies. The RPT will seek the best biological advice available from those agencies and formulate recommendations. The updates will be submitted to the Commissioner as an annual report. The Commissioner or his representative will consider the report recommendations.

Review and Comment

To execute legally mandated review and comment responsibilities and to arrive at recommendations for permit approval, revocation, or suspension, the RPTs require criteria that can be applied equitable to all permit applications and ongoing operations. The Commissioner and the RPTs have arrived at a general consensus that the review, comment, and evaluation criteria, designated and elaborated on in Chapter 9, pp. 76-86, NSPII, will "...be consistent with the language and charge provided in AS 16.10.400 (a), (f), (g)...," and will serve as a model to conduct reviews and make recommendations. RPT participation will not be limited solely to these criteria.

Appendix 1. Regional Planning Team Charter, (cont'd).

BASIC OPERATIONAL DUTIES

The Regional Planning Team (RPT) will:

1. Develop a Comprehensive Salmon Plan for the region it represents and submit the draft document to the Commissioner of the Alaska Department of Fish and Game (ADF&G) for review and approval.

2. Develop and submit for ADF&G Commissioner review and approval, a Phase II planning process or document to serve as a vehicle for the implementation and amendment of the Comprehensive Plan.

3. Establish and implement a maintenance program that is at least inclusive of items #6 and #14 below.

4. Review private nonprofit (PNP) hatchery permit applications and make recommendations to the Commissioner.

5. Review and comment to the Commissioner on PNP permit suspensions or revocations proposed by the Commissioner.

6. Review and comment on both PNP and ADF&G Annual Hatchery Management Plans, Annual Reports, and, at Commissioner's discretion, proposed permit alterations. This review could provide information for conducting performance analysis and evaluation for plan amendment purposes.

7. Apply regional criteria modeled in Chapter 9, pp. 76-86, Comprehensive Plan, Phase II, Northern Southeast Alaska to all review, comment, performance evaluation, and analysis activities.

8. Meet at least once annually, but as many times as necessary to discuss:

   A. Ongoing, enhancement and rehabilitation projects.
   B. New projects being considered for implementation.
   C. New opportunities which may be investigated as potential projects.

9. From the meeting or meetings addressed in paragraph #8, the RPT will prepare an annual report or plan update which will address the following items in relation to the Comprehensive Plan:

   A. Summarize the basic conditions of the Comprehensive Plan.

B. Present events and trends of the immediate, past five years with comparisons and contrasts to basic conditions.

C. Present major events of the immediate past season with comparisons and contrasts to basic conditions.

D. Project events for the coming five years and relate them to immediate goals and objectives of the Plan.

E. Summarize conditions at the end of the year with reference to all goals and objectives of the Comprehensive Plan, current year's accomplishments, and relevant RPT commentary.

10. Provide the general public an opportunity to review and comment on current Phase II projects and to suggest new projects.

11. Consider and incorporate, where appropriate, the public comments on suggested revisions to the Phase I and Phase II Plans.

12. Annually transmit to the Commissioner and draft report, resulting from the above considerations, for review and approval.

13. Incorporate the Commissioner-approved annual report into the Phase II planning process.

14. Make periodic recommendations to the Commissioner concerning potential changes in the Charter and perform such other tasks as are deemed advisable and desirable by the Commissioner.

CONCLUSIONS

The RPT is the instrument of active cooperation between the regional aquaculture associations and the ADF&G and its various divisions. To accomplish that cooperation, regular exchange of information and discussion of objectives are necessary. A regular meeting schedule is important to maintain the relationship. The work of the RPT should support the best interest of the resource and be based on the best professional fisheries information. It should also recognize the interests of the salmon users. To this end, regular participation from the users should be solicited, and those groups should be advised concerning the decisions and recommendations of the RPT. This dialogue is a key element of the regional planning process.

THEREFORE, REGIONAL PLANNING TEAMS ARE, BY MEANS OF THIS DOCUMENT, CHARTERED TO PERFORM THE BASIC OPERATIONAL DUTIES WITHIN THE GENERAL PLANNING FRAMEWORK OUTLINED ABOVE AND TO REGULARLY REPORT THEIR PROGRESS TO THE COMMISSIONER OF THE ALASKA DEPARTMENT OF FISH AND GAME.

GLOSSARY

ADF&G -- Acronym for Alaska Department of Fish and Game

Annual Report -- Summary of results of plan update.

Commissioner -- Principal executive officer of the Alaska Depart ment plan or other RPT products by the Commissioner.

Commissioner approval -- Formal acceptance of a salmon development plan or other RPT products by the Commissioner.

Comprehensive Plan, Phase II, Northern Southeast Alaska -- Document produced by Northern Southeast Regional Planning Team and approved by the Commissioner on December 6, 1982.

Comprehensive Salmon Production Plan -- A statutory-mandated, strategic plan, spanning 20 years, for perpetuation and increase of salmon resources on a regional basis.

Criteria -- Accepted measures or rules for evaluation of program and project proposals and operations.

Five-year action plan -- The section of Phase II which recommends projects for implementation within the next five years (Chapter 10 of NSPII).

NSPII -- Acronym for Comprehensive Plan, Phase II, Northern Southeast Alaska.

PNP -- Acronym for private nonprofit.

Phase II Plan -- An analytical document or process that addresses salmon production development by geographic unit, project, and site and makes recommendations concerning both long and short-range opportunities (usually 20 and 5-year time frames).

Plan amendment -- Analyzing and evaluating a planning document with the option of changing the plan.

Plan content outline -- A document that defines topics and gives guidance and shape to comprehensive salmon plans.

Plan development -- Composing, drafting, revising, and finalizing a planning document.

Plan maintenance -- Process through which the RPT reviews and comments on existing plans to preserve, continue, and expedite planned salmon production.

Plan, The -- Comprehensive Salmon Plan.

Plan update -- The process and results of RPT review and changes of a plan document.

Appendix 1. Regional Planning Team Charter, (cont'd).

Private nonprofit -- Legal and/or operational status of a private sector organization without a profit motive.

Private nonprofit hatchery permit application -- A request presented by a private nonprofit corporation to the Department of Fish and Game for a permit to operate a private nonprofit hatchery.

Private sector -- That group active in salmon resource development which is not employed by government.

Production -- Perpetuation or increase of the salmon resource through maintenance, rehabilitation or enhancement programs and techniques. The Salmon Production Plan addresses stock perpetuation and increase through appropriate balance and integration of program and techniques.

Project -- A unit of work having a beginning, middle, and end that functions according to defined performance criteria.

Public sector -- That group active in salmon resource development that is employed by government.

RPT -- Acronym for Regional Planning Team.

Regional Aquaculture Association -- A statutory-based, nonprofit corporation comprised of representatives of fisheries user groups and organized for the purpose of producing salmon.

Regional Planning Team -- A statutory-mandated planning group, comprised of Department of Fish and Game staff and Regional Aquaculture Association representatives, designated to develop the Comprehensive Salmon Plan.

Review and comment process -- A collection of accepted procedures to solicit and generate examination and remarks.

Revised plan -- A document resulting from incorporation of Commissioner-approved material into a plan.

Uniform procedures -- Those practices that have been accepted by planning participants as appropriate for conducting or accomplishing a task.

APPROVE:

_____ _____

Date

Appendix 2. Selected Alaska Regulations governing PNP hatcheries, regional planning teams, regional plans and hatchery plans.

CHAPTER 40. PRIVATE NONPROFIT SALMON HATCHERIES.

Article

ARTICLE 3. APPLICABILITY OF REGULATIONS

5 AAC 40.100. APPLICABILITY OF REGULATIONS. The provisions of 5 AAC 40.110--5 AAC 40.990 govern the permit application guidelines and procedures regarding the operation of permitted hatcheries. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375
AS 16.10.470

ARTICLE 4. PERMIT APPLICATION PROCEDURES

Section

5 AAC 40.110. AUTHORITY. The commissioner will review and take action on each application for a private nonprofit salmon hatchery. (Eff. / / , Register)

Appendix 2. Selected Alaska Regulations governing PNP hatcheries, regional planning teams, regional plans and hatchery plans, (cont'd).

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.400

5 AAC 40.120. PRE-APPLICATION ASSISTANCE. An applicant may request assistance in preparing an application or conducting related activities. The PNP coordinator, or the department area management biologist, will provide assistance to the extent practicable. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.400

5 AAC 40.130 MANAGEMENT FEASIBILITY ANALYSIS. (a) The department will assist an applicant by preparing a management feasibility analysis for each proposed hatchery site. The analysis will be completed before submittal of an application for a private nonprofit salmon hatchery permit. An analysis is based on information provided by the applicant to the PNP coordinator including

(1) the location of the facility;

(2) the species desired for hatchery production;

(3) the run timing, by species;

(4) the incubation and rearing levels desired during the first reproductive cycle, by species; and

(5) the incubation and rearing levels desired at full capacity, by species.

(b) Within 30 days after receipt by the PNP coordinator or the information described in (a) of this section, the department will complete a management feasibility analysis of the proposed hatchery. A management feasibility analysis includes, at a minimum, the following information:

(1) an estimate of potential contributions to the common property fishery;

(2) potential size and location of a special harvest area;

(3) special management considerations or the need for additional studies;

(4) potential broodstock sources;

(5) an assessment of production potentials for each species; and

(6) additional factors considered by the department to be relevant to the proposed hatchery operation. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.400

5 AAC 40.140. PERMIT APPLICATION. An application for a hatchery permit must be submitted to the PNP coordinator. The PNP coordinator will provide an application form upon request. The application must include a completed management feasibility analysis. The applicant shall provide, in the permit application, detailed statements of operational goals, objectives, and plans. (Eff. / / , Register)

Authority: As 16.05.020
AS 16.05.092
AS 16.10.400

5 AAC 40.150. APPLICATION FEE. An application must be accompanied by the fee required by AS 16.10.400 (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.400

5 AAC 40.160. ACCEPTANCE DETERMINATION. The PNP coordinator will review an application submitted for acceptance. If the PNP coordinator determines that the application is not acceptable, the PNP coordinator will request additional information in writing from the applicant. The review period described in 5 AAC 40.190, Schedule A, begins when the management feasibility analysis is completed and the application is accepted. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.400

5 AAC 40.170. REGIONAL PLANNING TEAM REVIEW. (a) The appropriate regional planning team, as established under 5 AAC 40.300, shall review each application to determine if the proposed hatchery is compatible with the appropriate regional comprehensive salmon plan. The regional planning team shall use the following application review criteria:

Appendix 2. Selected Alaska Regulations governing PNP hatcheries, regional planning teams, regional plans and hatchery plans, (cont'd).

(1) the contribution the proposed hatchery would make to the common property fishery;

(2) the provisions for protection of the naturally occurring stocks from any adverse effects which may originate from the proposed hatchery;

(3) the compatibility of the proposed hatchery with the goals and objectives of the comprehensive salmon plan for the region; and

(4) whether the proposed hatchery would make the best use of the site's potential to benefit the common property fishery.

(b) An applicant may review the regional planning team determination and comment on it by letter to the commissioner. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375
AS 16.10.400

5 AAC 40.180. ADDITIONAL INFORMATION. If, after an application has been accepted by the PNP coordinator, the department determines that information in the application is insufficient for the adequate evaluation of the proposed hatchery, the PNP coordinator will request additional information from the applicant. Time frames applicable to the department review in 5 AAC 40.190, Schedule A, are suspended until additional information is received and accepted by the PNP coordinator. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.400

5 AAC 40.190. REVIEW PROCEDURE SCHEDULE. The timing of the application review and approval process is described in Schedule A, set out below.

Note to Publisher: The material designated as "Schedule A," on the following page, should be printed immediately following the lead-in text in 5 AAC 40.190, above.

Appendix 2. Selected Alaska Regulations governing PNP hatcheries, regional planning teams, regional plans and hatchery plans, (cont'd).

HATCHERY PERMIT APPLICATION - REVIEW PROCEDURE SCHEDULE A

Applicant	Salmon Rehabilitation Enhancement Coordinator	Regional Planning Team Review	FRED technical staff review	Management & Regional Staff Review	Basic Management Plan (BMP)	Commissioner
Submits Application	Review for acceptance If incomplete returns to applicant for additional information and resubmittal 1	Reviews application to determine if proposal is consistent with the regional plan. Sends recommendation to the Commissioner	Reviews application submits comments or requests additional information 2,3	Reviews application and submits comments or requests additional information 2,3	BMP is drafted by area staff, applicant and PNP office	Schedules Public Hearing (AS 16.10.410 and 5 AAC 40.280)

TIME ——— Day 1 ——— Day 60

1. Processing of application will not proceed until all requested information has been received.
2. All requests for additional information during the review period will be directed to the coordinator.
3. Review time frames are suspended until additional information is received and accepted.

CONSISTENCY FINDING AND ISSUANCE OF PRIVATE NONPROFIT HATCHERY PERMIT (AS 16.10.400)

Completed Application (Permit application and Basic Management Plan)	Public Hearing Held (AS 16.10.410 and 5 AAC 40.280)	Basic Management Plan finalized after completion of hearing	Proposed Consistency Finding	A. Consistency Finding B. Issuance or denial of Private Nonprofit Hatchery Permit by Commissioner or ADF&G
Notice of Public Hearing	Public hearing process concludes 15 days after oral hearing			

TIME

Day 1	Day 25-40	Day 40-69	Day 69	Day 75

(Eff. / / , Register) Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375
AS 16.10.400

Appendix 2. Selected Alaska Regulations governing PNP hatcheries, regional planning teams, regional plans and hatchery plans, (cont'd).

5 AAC. 40.200. COMPLETENESS DETERMINATION. For the purpose of complying with the project consistency review of the Alaska Coastal Management Program, as outlined in 6 AAC 50.010--6 AAC 50.190, a completed application which has been accepted by the PNP coordinator and a draft basic management plan, prepared under 5 AAC 40.820, for the operation of the facility. (EFF. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.400

5 AAC 40.210. PUBLIC HEARING. (a) The department will conduct a public hearing on each completed permit application. The commissioner will give notice of public hearing at any time after acceptance op an application. The notice will be given at least 25 days before a public hearing, and the notice will, in the commissioner's discretion, be given before the completion of the draft basic management plan. The hearing will be held under the following sequential procedures:

(1) the commissioner will make an introductory statement;

(2) the applicant shall make a presentation of the proposed hatchery plans, describing its location, incubation plans, the capacity of the facility, the donor stock source, and other relevant facts that may be of interest to the department or the public;

(3) the department will present the draft of the basic management plan for the proposed facility, including a presentation on fish culture aspects, production considerations, and a presentation of the management section of the basic management plan by the local commercial fisheries and sport fisheries area management biologist; and

(4) the commissioner will open the floor for public testimony and questions on all aspects of the proposed facility.

(b) The department will respond in writing within 10 working days to any specific objections offered by a member of the public at the hearing.

(c) The department will accept written comments for 15 days after the hearing, and will respond in writing, within 10 working days after receipt, to any specific objections received within that time. The public hearing process concludes 15 days after the oral hearing is held. (Eff. / / , Register)

Appendix 2. Selected Alaska Regulations governing PNP hatcheries, regional planning teams, regional plans and hatchery plans, (cont'd).

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.410

5 AAC 40.220. REVIEW AND DETERMINATION. (a) The commissioner will review the following information, compiled by the PNP coordinator, before rendering a decision on an application:

(1) recommendations from the regional planning team;

(2) recommendations resulting from the department's review of the application; and

(3) the results of the public hearing regarding the proposed facility.

(b) The commissioner will render a decision on the completed application, and notify the applicant in writing, within 75 calendar days after an application is complete. The commissioner's decision will be based on the following considerations:

(1) The physical and environmental nature of the proposed location must be suitable for enhancing runs or for establishing new runs, and must have the potential to make a reasonable contribution to the common property fishery. The proposed hatchery returns may not unreasonable or adversely affect management of natural stocks. The returns for the traditional fishery time, area, gear type, or user group allocations.

(2) The operation of the proposed hatchery must make the best use of the site's potential, to benefit the common property fishery. In order to achieve optimum public benefit from the state's private nonprofit hatchery program and ensure that the proposed hatchery is in the best interests of the public, enhancement sites must be developed to their fullest potential, with consideration to appropriate species and technological use of the site.

(3) The proximity of the proposed hatchery to an area that will allow for a segregated harvest of hatchery stocks without adversely affecting natural stocks is an important factor. The harvest area of the proposed hatchery must be of sufficient size to allow harvest of hatchery returns, and may not otherwise limit harvests to a location where fish would not be expected to be of sufficient quality to satisfy the requirements of AS 16.10.450 regarding fish sold for human consumption.

Appendix 2. Selected Alaska Regulations governing PNP hatcheries, regional planning teams, regional plans and hatchery plans, (cont'd).

(4) The proposed hatchery must have available donor sources that are approvable under 5 AAC 41. Proposed donor sources for hatchery brood stock must be able to meet necessary first-cycle egg take levels under department removal schedules.

(5) The proposed hatchery must have a secured water source and delivery system that is adequate for the proposed levels of incubation and rearing. The security of the water source must be demonstrated through the appropriate water use permits, annual hydrographs, chemical analysis of the water source, and any provisions necessary for recycling and depuration.

(6) The proposed hatchery facility and water intake structures may not be located in streams or reaches of streams that have dynamic flooding characteristics or that have significant and rapid bedload transport that may endanger water intake galleries, weirs, the facility, or the reliability of the water source for the proposed hatchery.

(7) The proposed hatchery must allow for the maintenance of adequate instream flows below the hatchery or any hatchery-related facilities, such as water intake structures, to support natural stocks.

(8) The proposed hatchery plans and staffing plans must demonstrate a reasonable level of operational feasibility and an acceptable degree of potential success.

(c) If the application is approved, the commissioner will, as a condition of the permit, require the permit holder to provide for suitable fish passage facilities in order to accommodate acceptable upstream and downstream passage of fish, if passage facilities are determined by the department to be necessary.
(Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375
AS 16.10.400

5 AAC 40.230. RECONSIDERATION. An application for a private nonprofit salmon hatchery permit which has been denied by the commissioner will, in the commissioner's discretion, be reconsidered if the applicant provides new or additional information that may have altered the original decision.
(Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.400

Appendix 2. Selected Alaska Regulations governing PNP hatcheries, regional planning teams, regional plans and hatchery plans, (cont'd).

ARTICLE 5. REGIONAL COMPREHENSIVE PLANNING

Section

300. Regional planning teams in general
310. Regional planning team composition
320. Chairman of regional planning team
330. Quorum and voting
340. Regional planning ream responsibility
350. Public notice
360. Public involvement
370. Plan approval

5 AAC 40.300. REGIONAL PLANNING TEAMS IN GENERAL. The commissioner will establish regions and regional planning teams for the primary purpose of developing comprehensive salmon plans for various regions of the state. The provisions of 5 AAC 40.300--5 AAC 40.370 govern the structure and functions of each regional planning ream and the development of a comprehensive salmon plan for each region. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375

5 AAC 40.310. REGIONAL PLANNING TEAM COMPOSITION. (a) Each regional planning team consists of six members. Three are department personnel appointed by the commissioner, and three are appointed by the board of directors of the appropriate regional aquaculture association, qualified under AS 16.10.380.

(b) The commissioner will, in his or her discretion, request the involvement of representatives of federal and state agencies to assist a regional planning team if their contribution will aid in the development of the regional comprehensive plan. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375
AS 16.10.380

5 AAC 40.320. CHAIRMAN OF REGIONAL PLANNING TEAM. (a) Each regional planning team shall elect a chairman to serve at the pleasure of the team.

(b) The chairman or his delegate shall

(1) conduct regional planning team meetings, including recording of proceedings, and employing agreed-upon rules of order;

(2) set the agenda and meeting time and place for regional planning team meetings; and

(3) coordinate regional planning team staff in the accomplishment of tasks assigned to the chairman by the team, including

(A) providing the commissioner with team communications requiring commissioner review or approval;

(B) contacting members to determine who will be attending the next scheduled meeting; and

(C) preparing minutes of the previous meeting. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375

5 AAC 40.330. QUORUM AND VOTING. A regional planning team may not transact business without a simple majority of four members. Voting procedures may be established at the discretion of the membership. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375

5 AAC 40.340. REGIONAL PLANNING TEAM RESPONSIBILITY. Each regional planning team shall prepare a regional comprehensive salmon plan, for the appropriate region, to rehabilitate natural stocks and supplement natural production, with provisions for both public and private nonprofit hatcheries. Each regional planning team shall consider the needs of all user groups and ensure that the public has opportunity to participate in the development of the comprehensive salmon plan. Each regional comprehensive plan must define regional production goals by species, area, and time. (Eff. / / , Register)

Authority: AS 16.05.020
AS.16.05.092
AS 16.10.375

5 AAC 40.350. PUBLIC NOTICE. The chairman of the regional planning team, or his designee, shall give two weeks notice. in a newspaper of general circulation in the appropriate region, of a planning team meeting. The chairman shall also give notice to radio and television stations in the appropriate region, for broadcast as no-cost public service messages.
(Eff. / / , Register)

Appendix 2. Selected Alaska Regulations governing PNP hatcheries, regional planning teams, regional plans and hatchery plans, (cont'd).

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375

5 AAC 40.360. PUBLIC INVOLVEMENT. Each regional planning team shall encourage public participation during all stages of the development and review of regional comprehensive salmon plans. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375

5 AAC 40.370. PLAN APPROVAL. (a) A draft regional comprehensive salmon plan must be submitted to the PNP coordinator for department review and comment.

(b) The draft regional comprehensive salmon plan must be distributed for public review.

(c) The regional planning team shall respond to comments received as a result of these reviews, and may incorporate them in the final draft of the regional comprehensive salmon plan.

(d) The regional planning team shall submit a final draft of the regional comprehensive salmon plan to the commissioner for review and approval. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375

ARTICLE 8. GENERAL PROVISIONS

Section

800. Non-transferability of permits
810. Preference right
820. Basic management plans
830. Hatchery inspection
840. Annual management plans
850. Notice of permit alteration
860. Performance review
870. Reporting of mortality
880. Surplus salmon eggs
890. Information
990. Definitions

5 AAC 40.800. NON-TRANSFERABILITY OF PERMITS. A hatchery permit is not transferable. Another person wishing to obtain a permit to operate a hatchery at a location which is already a

currently permitted site, shall submit an application, which is subject to the same application review schedule as outlined in 5 AAC 40.110 -- 5 AAC 40.230. If the assets, or control, of a private nonprofit corporation that holds a hatchery are transferred to a degree considered substantial by the department, the corporation shall submit a new application for a hatchery permit. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.400

5 AAC 40.810. PREFERENCE RIGHT. (a) A preference right under AS 16.10.400 applies to a potential hatchery site, and does not constitute an approval of a permit.

(b) As part of the pre-application assistance described in 5 AAC 40.120, the PNP coordinator will inform the applicant whether a qualified regional association or an approved local nonprofit hatchery corporation has an established preference right to the identified site.

(c) The PNP coordinator will notify the appropriate qualified regional association, by certified letter, of an applicant's intent to apply for a hatchery site if that site has been identified as a potential hatchery site in the comprehensive plan for the region.

(d) Within three weeks after receiving the notification, the qualified regional association may respond, by certified letter, to the PNP coordinator to establish a preference right at that location.

(e) If the qualified regional association exercises a preference right for that site, the association may, within one year, submit an application for acceptance. If an application is not submitted and accepted within one year, the qualified regional association relinquishes its preference right to that location.

(f) A local nonprofit hatchery corporation is eligible to establish a preference right to a proposed site if the corporation receives approval from the qualified regional association. That preference right is identical to the one which can be established by a qualified regional association.

(g) A local nonprofit hatchery corporation seeking regional association approval shall send a notice by, certified letter, to the PNP coordinator at the same time that a certified letter requesting approval is sent to the qualified regional association.

Appendix 2. Selected Alaska Regulations governing PNP hatcheries, regional planning teams, regional plans and hatchery plans, (cont'd).

(h) All applicants for a permit, including local nonprofit corporations, local nonprofit hatchery corporation approved by the qualified regional association, and qualified regional associations, shall follow the application procedures outlined in 5 AAC 40.110--5 AAC 40.230. (Eff. / / , Register)

Authority: AS 16.05.020
As 16.05.092
AS 16.10.400

5 AAC 40.820. BASIC MANAGEMENT PLANS. (a) Each hatchery operator shall manage the hatchery and its salmon returns in accordance with a basic management plan approved by the commissioner. Before the public hearing, held under 5 AAC 40.210, on the proposed hatchery, the department, in conjunction with the applicant, will develop a draft basic management plan. Department staff will present the draft plan at the public hearing and will make copies available for public review and comment at the hearing.

(b) If, following the public hearing, the commissioner decides to issue a permit for the proposed hatchery, the department will finalize the basic management plan after all comments have been considered. The final basic management plan describes the conditions under which the permit will be implemented, and is an addendum to the permit. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.400
AS 16.10.410
AS 16.10.443

5 AAC 40.830. HATCHERY INSPECTION. The permit holder shall notify the PNP coordinator when construction of the hatchery has been completed and the facility is ready for operation. The facility must be inspected and approved by the department before the permit holder may start operations. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.400
As 16.10.460

5 AAC 40.840. ANNUAL MANAGEMENT PLANS. (a) Beginning with the first year of operation of the hatchery, and on an annual basis after that, the department will prepare, in conjunction with the permit holder, an annual management plan to guide and condition hatchery operations for the succeeding calendar year.

(b) The PNP coordinator will organize the appropriate department staff and the permit holder in preparing a draft annual management plan. The appropriate regional planning team and the Department of Commerce and Economic Development may also review the plan. This plan must organize and guide the hatchery's operations, for each calendar year, regarding production goals, broodstock development, and harvest management of hatchery returns. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375
AS 16.10.400
AS 16.10.443

5 AAC 40.850. NOTICE OF PERMIT ALTERATION. (a) A hatchery permit holder may propose alteration of the permit and basic management plan, based on accumulated experience and changing conditions. The permit holder shall request, on a form provided by the PNP coordinator, a permit or change in the basic management plan for the hatchery.

(b) Requests for permit alterations must be received by the PNP coordinator, on the prescribed form, no later that February 15 of the calendar year that the proposed alteration is to occur. The commissioner will, in his or her discretion, extend the deadline for submittal of a permit alteration request, on a case-by-case basis, if the request is justified by extraordinary circumstances or emergency.

(c) The regional planning team may, if the commissioner so requests, review and make a recommendation to the commissioner on the permit alteration request.

(d) In reviewing the request, the commissioner will, in his or her discretion, consider past management practices and fish culture procedures associated with the request, the past performance of the hatchery, the recommendation of the regional planning team, and any additional information deemed necessary. (eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.400

5 AAC 40.860. PERFORMANCE REVIEW. (a) Based upon a department internal review, the PNP coordinator will notify the commissioner if a hatchery operator's performance is inadequate, according to the conditions under which the permit was granted.

Appendix 2. Selected Alaska Regulations governing PNP hatcheries, regional planning teams, regional plans and hatchery plans, (cont'd).

(b) The commissioner will, in his or her discretion, consider a permit alteration, suspension, or revocation in accordance with AS 16.10.430. If the commissioner decides to consider a permit alteration, suspension, or revocation, the coordinator will notify the appropriate regional planning team. The regional planning team may make a written recommendation to the commissioner on the proposed alteration, suspension, or revocation. The regional planning team shall use the following performance standards in their review, evaluation, and recommendation to the commissioner, including whether

(1) survivals in the hatchery are more that the minimum standards described in (c) of this section for a period of greater that four years;

(2) the transport of broodstock from wild sources does not continue for longer than one cycle of the particular species without reevaluation of hatchery operations;

(3) the hatchery contributes to the common property fishery;

(4) the hatchery does not significantly impact wild stocks in a negative manner;

(5) the hatchery fulfills the production objectives described in the terms of the hatchery permit; and

(6) there are any mitigating circumstances which were beyond the control of the hatchery operator.

(c) Minimum hatchery survival standards are as follows:

	Survival for this stage	Cumulative Survival
For captured broodstock to egg take	70%	
Green egg to eyed egg	80%	80%
Eyed egg to emergent fry	85%	68%
Emergent to fed fry1/	90%	61%
Fed fry to fingerling2/	90%	55%
Fingerling to smolt	75%	41%

1/ Fry achieving up to 25% weight gain from swim-up.
2/ Fry achieving substantially more than 25% weight gain from swim-up.

(Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375
AS 16.10.430

Appendix 2. Selected Alaska Regulations governing PNP hatcheries, regional planning teams, regional plans and hatchery plans, (cont'd).

5 AAC 40.870. REPORTING OF MORTALITY. (a) If, in any of the hatchery operations during the year, and event occurs which results in fish or egg mortalities above the minimum hatchery survival standards defined in 5 AAC 40.860, the operator shall inform the PNP coordinator immediately and shall submit an incident report, which must include

(1) a description of the nature of the incident;

(2) the cause of the incident;

(3) the time of the incident;

(4) the effect on the stocks;

(5) corrective action taken and proposed measures to eradicate future problems; and

(6) an assessment of the general impact on the program.

(b) The operator shall complete and submit the mortality incident report to the PNP coordinator within 15 days after the incident occurs. (Eff. / / , Register)

Authority: As 16.05.020
AS 16.05.092
As 16.10.400

5 AAC 40.880. SURPLUS SALMON EGGS. (a) Salmon eggs are surplus if the following conditions are met:

(1) the hatchery operator no longer needs to return to the indigenous stocks in order to develop the broodstock for the hatchery; and

(2) broodstock needs for the hatchery, as identified in the annual management plan, must have been achieved through salmon returning to he facility.

(b) A proposed sale of surplus salmon eggs by a permit holder must be identified in the annual management plan for the facility.

(c) A permit holder shall obtain a permit alteration from the commissioner if the eggs taken for sale purposes are to be incubated at the facility before transferral to the recipient facility.

(d) The appropriate fish transport permit must be approved by the commissioner before any surplus salmon eggs are transferred from the facility to the recipient facility.
(Eff. / / , Register)

Appendix 2. Selected Alaska Regulations governing PNP hatcheries, regional planning teams, regional plans and hatchery plans, (cont'd).

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.450

5 AAC 40.890. INFORMATION. The department will exchange information with the Department of Commerce and Economic Development, including copies of annual reports required to be submitted under AS 16.10.470, in order to ensure consistency between reports submitted by the permit holder to both agencies. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.470

5 AAC 40.990. DEFINITIONS. In this chapter,

(1) "commissioner" means the commissioner of the Department of Fish and Game or his designee;

(2) "common property fishery" means any fishery in which the general public is allowed to harvest fish subject to state and federal law;

(3) "completed application" means a final application which has been accepted by the commissioner and which contains a draft basic management plan for the operation of the facility;

(4) "department" means the Alaska Department of Fish and Game;

(5) "enhancement" means a strategy designed to supplement allowable harvest of natural freshwater and anadromous species; enhancement activities are primarily designed to implement artificial or semi-artificial production systems or to increase the amount of productive natural habitat;

(6) "escapement" means all fish that escape the common property fishery and includes two categories of escapement:

(A) the number of brood stock or spawners required to perpetuate and achieve natural, semi-artificial, and artificial production objectives; and

(B) the number of hatchery-produced fish taken for the hatchery harvest requirement, to be used to pay for the hatchery's reasonable operating and capital costs, at current market prices for the species involved;

(7) "permit" means a private nonprofit salmon hatchery permit, issued by the commissioner, which has not been suspended or revoked;

Appendix 2. Selected Alaska Regulations governing PNP hatcheries, regional planning teams, regional plans and hatchery plans, (cont'd).

(8) "PNP coordinator" means the salmon rehabilitation and enhancement coordinator of the private nonprofit hatchery program within the Department of Fish and Game;

(9) "regional comprehensive salmon plan" is a document that integrates and assembles all relevant information regarding the development and protection of the salmon resource, for a specific long-range period of time, into a strategic plan for an established region of the state;

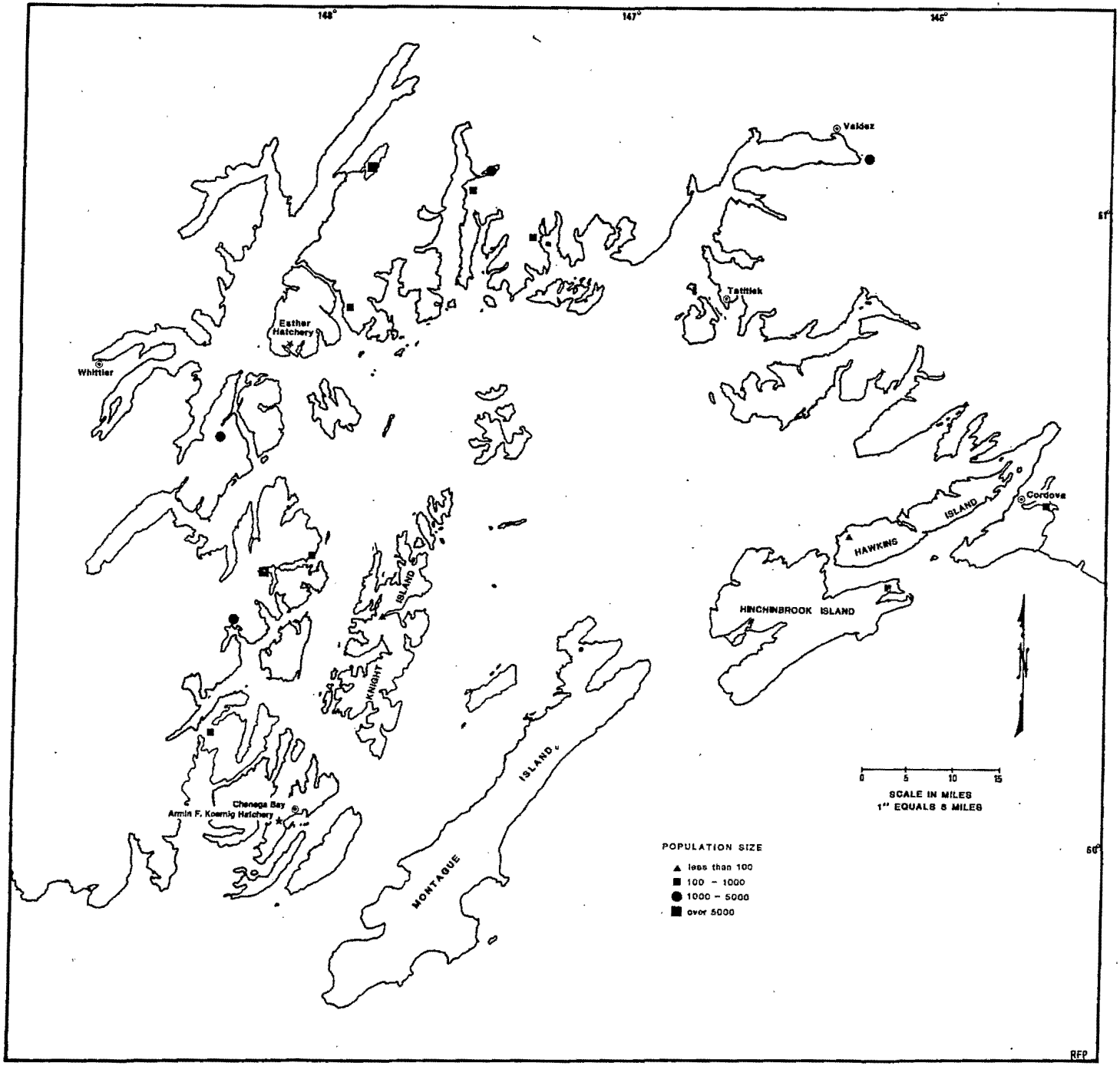
(10) "rehabilitation" means a strategy directed toward restoring debilitated natural stocks to optimum production levels; rehabilitation strategies consist of regulatory and nonregulatory activities; nonregulatory activities are directed at increasing the survival of debilitated brood stock and include removal of migration inhibitors, stream restoration, incubation and subsequent planting of eyed eggs, fry and fingerlings, lake fertilization and predator-competitor control;

(11) "salmon stock" means a population of salmon of a single species identified with a specific water system or portion of a water system, which share a common spawning period;

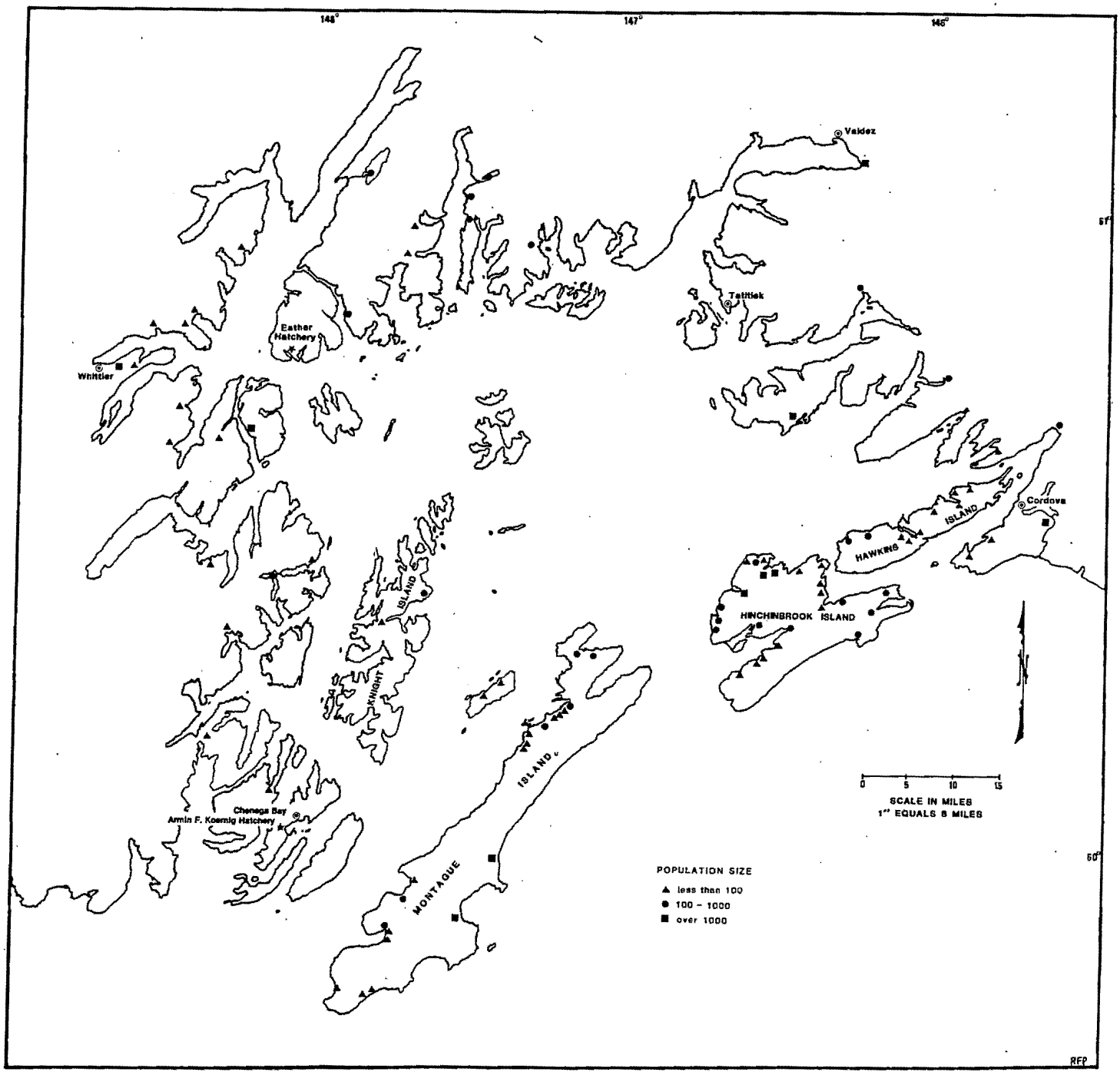
(12) "special harvest area" means an area designated by the commissioner or the Board of Fisheries where hatchery returns are to be harvested by the hatchery operators, and, in some situations by the common property fishery; and

(13) "terminal harvest area" means an area designated by the commissioner, Board of Fisheries regulation, or department emergency order where hatchery returns have achieved a reasonable degree of segregation from naturally occurring stocks and may be harvested by the common property fishery without adverse effects. (Eff. / / , Register)

Authority: AS 16.05.020
AS 16.05.092
AS 16.10.375
AS 16.10.475



Appendix 3. Sockeye salmon spawning and rearing areas within the drainages of the Prince William Sound Area. (prepared from unpublished data provided by ADF&G).



Appendix 4. Coho salmon spawning and rearing areas within the drainages of the Prince William Sound Area. (prepared from unpublished data provided by ADF&G).

Appendix 10. Reported commercial harvests of salmon in the Prince William Sound Area, 1889 through 1984 (cont'd).[1/]

Year	King	Sockeye	Coho	Pink	Chum
1981	404	251,222	4,383	20,524,470	1,878,716
1982	216	1,047,419	17,445	20,293,549	1,345,288
1983	1,048	92,111	10,496	14,038,796	1,041,309
1984[15/]	489	312,946	12,424	22,189,349	1,196,785
Average all years	1,927	209,291	40,117	4,111,433	384,062
Average 1960-1984	1,355	178,994	15,958	6,792,340	560,549

1/ Does not include the Copper River and Bering River districts. Includes harvests of hatchery stocks by commercial fishermen and harvests by hatcheries. Adapted from Pirtle (1976).
2/ Data for 1889 through 1927 are from Rich and Ball (1932). Data for 1889 through 1903 represent combined catches from Prince William Sound and Copper River.
3/ Data for 1890 through 1927 are from Rich and Ball (1932). Data for 1890 through 1902 represent combined catches from Prince William Sound and Copper River.
4/ Data for 1893 through 1927 are from Rich and Ball (1932). Data for 1889 through 1903 represent combined catches from Prince William Sound and Copper River.
5/ Data for 1896 through 1927 are from Rich and Ball (1932). Data for 1889 through 1903 represent combined catches from Prince William Sound and Copper River.
6/ Data for 1912 through 1927 are from Rich and Ball (1932).
7/ Data for 1928 through 1950 are from US Fish and Wildlife Service "Alaska Fishery and Fur Sea Industries."
8/ Data for 1928 through 1950 are estimated from the case pack data and a conversion factor of 3.5 king salmon per case.
9/ Data for 1928 through 1950 are estimated from the case pack data and a conversion factor of 12 sockeye salmon per case.
10/ Data for 1928 through 1950 are estimated from the case pack data and a conversion factor of 9 coho salmon per case.
11/ Data for 1928 through 1950 are estimated from the case pack data by Noerenberg (1954).
12/ Data for 1951 through 1959 are from Simpson (1960).
13/ Data for 1960 through 1973 are from ADF&G Commercial Fisheries Statistical leaflets.
14/ Data for 1974 through 1984 are from Randall et al. (1984) and (1985).
15/ Preliminary data.

Appendix 11. Reported harvests of commercial salmon catches by species and year, Copper River Area, 1889 through 1984.[1/]

Year	King	Sockeye	Coho	Pink	Chum
1889[2/]		242,790			
1890	5,491	411,190			
1891	6,185	710,740			
1892					
1893	8,674	792,690	72,000		
1894	8,494	710,000	17,000		
1895	10,248	507,630	142,937		
1896	1,407	714,595	31,862		
1897	2,044	371,487	25,605		
1898	1,850	417,171			
1899	4,682	527,122			
1900	3,462	748,310	88,175		
1901	6,558	781,438			
1902	2,500	800,044			
1903	4,600	814,345			
1904	5,014	501,630			
1905	20,000	320,000			
1906	2,165	265,378			
1907	869	263,557			
1908		466,414			
1909	3,067	316,688			
1910	974	221,993	18,149		
1911	1,358	407,559	33,660		
1912	6,181	456,390	36,238		
1913	2,307	404,914			
1914	3,043	570,959	42,192		
1915	7,334	818,729	12,098	16,076	
1916	14,259	569,531	118,267	31,578	67
1917	13,930	919,818	126,073	8,845	
1918	19,627	1,492,356	74,379	5,361	686
1919	13,266	1,328,643	53,468		
1920	22,997	854,624	73,924		
1921	11,466	570,291	377		
1922	10,075	505,775			
1923	10,339	625,875		462	
1924	15,862	790,835	41,889	186	23
1925	19,728	160,721	153,376	20	4
1926	21,338	211,341	177,781	85	
1927	35,598[3/]	341,291[3/]	410,350[3/]		
1928	42,144[4/]	584,319[5/]			
1929	43,866	918,065			
1930	23,181	805,999			
1931	35,268	804,497	109,319[4/]		
1932	29,403	828,920			
1933	14,073	645,540	96,263	272[6/]	
1934	10,407	975,916		2,686	
1935	2,352	111,579	79,722	153	

continued

Appendix 11. Reported harvests of commercial salmon catches by species and year, Copper River Area, 1889 through 1984.[1/]

Year	King	Sockeye	Coho	Pink	Chum
1936	6,939	862,789		255	
1937	11,538	1,024,416	45,535	1,802	
1938	7,614	767,721		1,785	500[7/]
1939	6,555	633,733	6,809	2,805	40
1940	3,876	435,993	266,892		
1941	9,225	432,941	700,086	9,503	200
1942	15,762	562,092	710,014	1,394	150
1943	14,670	700,439	186,380	918	
1944	7,638	769,552	294,619		
1945	18,063	823,805	349,580		390
1946	23,329	538,407	219,853		
1947	15,182	352,077	188,965		
1948	4,367	168,724	243,848		
1949	9,300	441,776	136,876		
1950	17,777	800,451	171,690	34	50
1951[8/]	17,439	451,943	154,418	101	48
1952	29,355	1,136,286	163,740	6,284	1,091
1953	12,198	563,708	29,866	166	46
1954	15,764	1,099,564	157,941	135	272
1955	20,438	636,005	158,208	149	12
1956	11,702	540,575	109,248	1,131	54
1957	8,151	541,637	58,705	1,841	1,224
1958	6,965	307,342	81,610	8,872	181
1959	9,833	299,782	132,259	940	67
1960[9/]	8,673	360,667	137,957	375	314
1961	7,621	528,223	133,987	1,639	106
1962	14,792	677,626	174,628	1,880	513
1963	10,871	375,029	202,621	1,487	85
1964	12,751	699,548	242,666	548	62
1965	15,390	818,277	70,786	803	331
1966	11,422	1,005,615	116,147	717	115
1967	9,853	508,327	160,532	573	218
1968	9,743	573,261	230,867	4,343	473
1969	14,040	696,836	77,405	847	244
1970	19,375	1,115,695	161,892	645	687
1971	16,486	616,801	208,915	1,762	5,287
1972	22,349	727,144	103,211	2,304	717
1973	19,948	332,816	132,272	8,964	10,713
1974[10/]	18,980	607,766	46,625	9,839	664
1975	19,644	335,687	53,502	236	807
1976	31,479	865,195	111,900	3,392	178
1977	22,089	619,140	131,356	23,185	335
1978	29,062	249,872	220,338	3,512	2,233
1979	17,678	80,528	194,885	1,295	107
1980	8,454	18,908	225,299	3,966	198
1981	20,178	477,662	310,154	23,952	1,799
1982	47,362	1,177,632	454,763	7,154	1,177

continued

Appendix 11. Reported harvests of commercial salmon catches by species and year, Copper River Area, 1889 through 1984.[1/]

Year	King	Sockeye	Coho	Pink	Chum
1983	50,022	633,010	234,243	7,345	2,217
1984[11/]	38,955	899,776	382,432	32,194	6,935
Average all years	14,134	605,289	156,643	4,657	946
Average 1960-1984	19,889	600,042	180,775	5,718	1,461

1/ Adapted from Pirtle (1976) and Randall et al. (1985).
2/ Data for 1889 through 1927 are from Rich and Ball (1932).
3/ Data from 1927 through 1950 include Bering River catch data. King salmon estimates for the years 1927 through 1945 are based on case pack data and a conversion factor of 3 king salmon per case. Coho salmon estimates for the years 1931 through 1950 are based on case pack data and a conversion factor of 8.5 coho salmon per case.
4/ Data from 1928 through 1950 are from US Fish and Wildlife Service, Bureau of Commercial Fisheries, annual management reports.
5/ Data for 1928 through 1955 are from Thompson (1954).
6/ Data for 1933 through 1950 are from US Fish and Wildlife, "Alaska Fishery and Fur Seal Industry." Estimated from case pack and a conversion factor of 17 pink salmon per case.
7/ Data for 1938 through 1950 are from US Fish and Wildlife, "Alaska Fishery and Fur Seal Industry." Estimated from case pack and a conversion factor of 10 chum salmon per case.
8/ Data for 1951 through 1959 are from Simpson (1960).
9/ Data for 1960 through 1973 are from ADF&G Commercial Fisheries Statistical leaflets.
10/ Data for 1974 through 1984 are from Randall et al. (1984) and (1985).
11/ Preliminary data.

Appendix 12. Approximate exvessel value of salmon harvested by purse seine, drift gill net and set gill net fishermen, Prince William Sound Region, 1960 through 1984.

	Purse Seine				Drift Gill Net						Set Gill Net	Grand Total
Year	General Districts	Coghill	Unakwik	Total	Copper River	Bering River	Coghill	Unakwik	Eshamy	Total	Eshamy	All Gear
1960	1,227.6	2/	3/	1,227.6	746.1	129.4	2/	3/	closed	875.5	closed	2,103.1
1961	1,192.3	no record	3/	1,192.3	997.2	154.4	259.9		3/ 5/	1,411.5	5/	2,603.8
1962	4,175.4	no record	no record	4,175.4	1,366.9	182.6	26.3 4/		5/	1,575.8	5/	5,751.2
1963	3,032.9	no record	no record	3,032.9	905.1	158.6	34.7 4/		closed	1,098.4	closed	4,131.3
1964	2,245.6	no record	no record	2,245.6	1,598.1	165.0	62.3 4/		closed	1,825.4	closed	4,071.0
1965	1,021.8	190.5 4/		1,212.3	1,399.6	89.3	239.2 4/		5/	1,728.1	5/	2,940.4
1966	1,357.5	67.5 4/		1,425.0	2,059.9	119.5	129.3 4/		5/	2,308.7	5/	3,733.7
1967	1,227.5	130.5 4/		1,358.0	1,271.7	103.3	126.1 4/		closed	1,501.1	closed	2,859.1
1968	1,156.2	133.9 4/		1,290.1	1,522.8	170.2	235.6 4/		closed	1-928.6	closed	3,218.7
1969	2,053.4	174.9 4/		2,228.3	1,588.4	81.5	334.3 4/		13.0	2,017.2	138.1	4,383.6
1970	1,472.0	74.5 4/		1,546.5	2,680.1	269.2	124.4 4/		7.7	3,081.4	56.2	4,684.1
1971	3,647.7	346.9 4/		3,993.6	1,882.1	261.2	184.1	11.8	closed	2,339.2	closed	6,332.8
1972	closed	closed	closed	0	2,041.0	147.3	368.7	28.8	71.9	2,657.7	127.0	2,784.7
1973	5,005.0	171.3	0	5,176.3	2,777.5	478.5	714.7	47.0	113.5	4,131.2	98.8	9,406.3
1974	closed	143.4	closed	143.4	2,953.0	172.7	745.8	63.3	523.4	4,458.2	167.2	4,768.8
1975	5,423.5	202.9	0	5,626.4	1,688.3	196.0	706.8	42.9	closed	2,634.0	closed	8,260.4
1976	5,816.8	237.7	14.5	6,069.0	5,757.1	459.5	708.1	50.5	closed	6,975.2	closed	13,044.2
1977	8,310.4	622.4	0	8,932.8	6,276.2	458.7	2,167.1	61.6	259.4	9,223.0	130.0	18,285.8
1978	4,930.6	16.6	94.4	5,192.6	5,274.5	1,207.9	2,370.4	96.2	closed	8,949.0	closed	14,141.6
1979	23,038.8	124.2	0	23,163.0	3,537.4	2,622.3	1,405.3	96.9	closed	7,661.9	closed	30,824.9
1980	21,004.2	220.4	14.2	21,238.8	2,503.4	1,010.5	1,118.5	18.8	8.6	4,658.8	15.7	25,913.3
1981	45,778.1	181.2	209.2	46,170.5	8,278.9	1,307.9	2,470.2	35.7	closed	12,092.7	closed	58,263.2
1982	18,725.4	1,484.0	77.4	20,286.8	13,543.1	1,929.2	6,269.4	278.7	closed	22,019.4	closed	42,306.2
1983	14,061.0	57.5	4.0	14,122.5	6,783.5	1,930.0	1,117.0	78.1	324.1	10,232.7	194.5	24,549.7
1984 6/	19,400.7	15.2	0	19,415.9	13,431.8	3,456.6	2,578.7	169.8	394.8	20,031.7	389.4	39,837.0

1/ Based on average weight and price data as provided by the Cordova Aquatic Marketing Assn. and described by Pirtle (1976) and Randall et al. (1984).

2/ Coghill District created in 1961.

3/ Unakwik District created in 1962.

4/ Coghill and Unakwik catches combined.

5/ Drift and set gill net catches combined.

6/ Preliminary data.

Appendix 13. Subsistence fishing permits issued and returned and reported subsistence harvests of salmon in the Upper Copper River drainage, 1960 through 1984.

Year	Perimits Issued			Dip Net						Fishwheel						Estimated Total[2/]
	Dip Net	Fish-wheel	Total	king	Sockeye	Coho	Other	Total Reported Catch	Estimated Total[2/]	King	Sockeye	Coho	Other	Total Reported Catch	Estimated Total[2/]	Dip Net and Fishwheel
1960	44	33	77	40	1,096	7	127	1,270	1,752	96	5,643	18	55	5,812	7,399	9,151
1961	307	82	389	29	1,748	108	355	2,240	3,090	356	13,336	442	240	14,374	18,299	21,389
1962	435	117	552	76	3,127	94	157	3,454	4,764	768	11,143	287	16	12,214	15,549	20,313
1963	361	140	501	130	1,994	85	21	2,230	3,344	334	12,061	473	102	12,970	15,780	19,124
1964	794	200	994	320	3,813	1	77	4,211	5,515	405	8,102	52	430	8,989	12,569	18,084
1965	982	143	1,125	316	6,899	0	332	7,547	10,127	328	5,861	52	632	6,873	8,388	18,515
1966	1,132	138	1,270	212	7,240	0	301	7,753	10,546	343	9,478	0	2	9,823	12,559	23,105
1967	1,166	154	1,320	214	5,932	0	56	6,202	9,999	205	8,525	0	138	8,868	9,628	19,627
1968	1,235	143	1,378	368	7,672	143	49	8,232	11,451	276	7,147	90	93	7,606	11,334	22,785
1969	1,415	167	1,582	486	18,054	127	12	18,679	21,993	233	9,550	97	10	9,890	12,591	34,584
1970	3,242	245	3,487	324	24,938	548	39	25,849	33,706	103	11,562	6	42	11,713	14,596	48,302
1971[3/]	4,168	374	4,542	1,091	28,115	339	50	29,595	37,088	272	9,370	24	2	9,668	13,599	50,687
1972[4/]	3,485	205	3,690	1,199	18,996	196	2	20,393	24,011	302	7,854	52	14	8,222	10,490	34,501
1973[5/]	3,840	305	4,145	1,226	16,407	10	14	17,657	18,895	639	10,943	41	56	11,679	12,845	31,740
1974[6/]	3,305	288	3,593	817	15,143	159	1	16,120	17,685	324	7,657	4	32	8,017	9,907	27,592
1975	2,452	350	2,802	943	7,694	0	13	8,650	9,217	762	5,626	0	20	6,408	8,184	17,401
1976	2,512	451	2,963	1,173	12,205	0	58	13,436	14,654	885	8,726	24	0	9,635	11,497	26,151
1977	3,526	540	4,066	1,475	22,755	425	42	24,697	28,423	738	13,594	29	90	14,451	16,785	45,208
1978	3,313	392	3,705	1,554	16,863	424	5	18,846	21,655	393	5,553	163	11	6,120	7,060	28,715
1979	2,730	470	3,200	1,536	12,069	670	20	14,295	16,939	979	11,530	82	75	12,666	20,646	37,585
1980	2,804	399	3,203	1,767	12,287	578	29	14,661	18,173	489	9,150	61	96	9,796	16,927	35,100
1981	3,555	523	4,078	1,410	26,763	683	16	28,872	37,352	503	26,245	166	10	26,924	31,335	68,687
1982	5,475	615	6,090	1,900	59,713	975	26	62,614	68,643	632	37,086	271	131	38,120	41,083	109,726
1983	6,911	630	7,541	4,255	66,620	1,281	101	72,257	79,392	1,166	34,375	409	21	35,971	39,342	118,734
1984	5,415	475	5,890	1,641	44,977	669	19	47,306	50,734	366	20,101	120	10	20,597	28,631	79,365
Avg.	2,584	303	2,887	980	17,725	301	77	19,083	22,366	476	12,409	119	93	13,096	16,281	38,647

1/ Adapted from Randall et al. (1985) and Roberson (personal communication).

2/ Reported catch expanded by ratio of number of permits issued to number of permits returned.

3/ Last use of dip net/fishwheel combination permits.

4/ First issuance of permits at Chitina.

5/ Last use of "black list."

6/ Permits issued at Chitina and Glennallen only.

Appendix 14. Subsistence fishing permits issued and returned and reported subsistence harvests of salmon on the Copper River Delta, 1960 through 1984.

Year	Permits Issued	Permits Returned				Reported Catch			
		Unused	Unsuccessful	Successful	Total	King	Sockeye	Coho	Total
1960	13	2/	2/	3/	2/	0	0	158	158
1961	14	2/	2/	3/	14	60	137	99	296
1962	14	2/	2/	3/	2/	44	135	3	182
1963	8	0	2	6	8	3	13	157	173
1964	5	2	0	0	3	14	0	0	14
1965	31	5	2	13	20	12	459	85	556
1966	45	10	2	19	31	47	175	0	222
1967	61	19	9	28	56	83	153	0	236
1968	17	8	1	6	15	11	36	0	47
1969	49	13	7	13	33	16	63	85	164
1970	32	3	1	23	27	66	179	0	245
1971	29	9	12	5	26	10	32	4	46
1972	104	5	0	75	80	149	569	53	771
1973	94	0	0	89	89	153	326	180	659
1974	9	2	2	1	5	5	4	2	11
1975	2	0	0	2	2	0	5	0	5
1976	27	0	0	14	14	1	10	0	11
1977	23	0	0	22	22	10	71	0	81
1978	34	19	0	9	28	37	18	12	67
1979	49	20	4	17	41	45	26	17	88
1980	39	17	6	12	35	19	27	17	63
1981	72	21	4	26	51	48	145	104	297
1982	108	42	3	45	90	60	634	106	802 4/
1983	87	41	4	27	73	79	107	57	254 5/
1984	118	47	14	43	104	68	324	135	549 6/
Avg. all years	43	11	3	20	35	42	146	51	240

1/ Adapted from Randall et al. (1985).
2/ No record.
3/ Unknown.
4/ Includes 1 pink and 1 chum salmon.
5/ Includes 11 pink salmon.
6/ Includes 22 pink salmon.

Appendix 15. Subsistence fishing permits issued and returned and reported subsistence harvests of salmon in the Prince William Sound Area, 1960 through 1984.[1/]

	Permits		Catch					
Year	Issued	Returned	King	Sockeye	Coho	Pink	Chum	Unknown[2/]
1960	50			139	505	1,292	75	150
1961	12		1	41	123	732	3	
1962	9				119	214	142	
1963	9		3		416	298	24	
1964	15			11		900		
1965	22	16				179	25	
1966	3	3		3	19	20	50	
1967	4	3			4	4		
1968	4	3			20	156		22
1969	7	3			16			
1970	1	1						
1971	3	2				46		
1972	0	0			289			
1973	19	16						
1974	3	1						
1975	2	0						
1976	0	0						
1977	4	4						
1978	3	2						
1979	15	2						
1980	26	15		7	6			
1981	12	8		3	29		2	
1982	35	27		84	4	31	24	
1983	26	21		22	36	9	79	
1984	8			10				13
Average	12	5	0	13	63	155	17	7

1/ Does not include harvests in the Copper River or Bering River districts. Adapted from Randall et al. (1985).
2/ Catches not reported by species.

Appendix 16. Estimates of sport fishing effort and sport harvests of salmon in the Prince William Sound, Copper-Bering River Region, 1977 through 1984.[1/]

Location	Year	Days Fished[2/]	King	Sockeye	Coho	Pink	Chum
Valdez Bay marine waters	1977	19,423	247	557	5,277	12,020	219
	1978	12,687	58	78	3,582	7,910	1,444
	1979	19,068	88	141	6,403	13,217	845
	1980	18,707	121	568	5,545	11,606	913
	1981	18,716	76	367	4,018	11,686	572
	1982	13,904	210	241	4,014	6,634	639
	1983	15,764	241	343	4,710	8,696	976
	1984	18,620	125	786	5,138	9,639	1,397
	Average	17,111	146	385	4,836	10,176	876
Passage Canal marine waters	1977[3/]						
	1978[3/]						
	1979	4,134	29	0	761[4/]	573	0
	1980	3,756	26	0	1,541[4/]	1,343	0
	1981	4,875	0	0	32[4/]	691	0
	1982	4,520	42	0	1,635[4/]	2,065	0
	1983	6,103	41	0	294[4/]	2,014	0
	1984	4,166	212	62	549[4/]	935	0
	Average	4,592	58	10	802	1,270	0
other marine areas[5/]	1977[3/]						
	1978[3/]						
	1979	10,737	215	1,210	2,833	2,836	573
	1980	8,854	121	861	2,282	2,919	34
	1981	10,078	248	562	1,134	1,534	324
	1982	12,402	147	1,603	2,484	2,903	440
	1983	14,196	314	1,397	2,916	3,284	262
	1984	17,884	37	1,110	1,535	2,306	324
	Average	12,359	180	1,124	2,197	2,630	326
Coghill Lake and vicinity	1977[3/]						
	1978[3/]						
	1979	1,273	0	629	0	654	64
	1980	1,371	0	1,524	0	276	52
	1981	1,734	0	572	0	637	11
	1982	1,621	0	1,520	0	723	63
	1983	809	0	781	0	168	21
	1984	786	0	249	12	112	12
	Average	1,266	0	879	2	428	37

continued

Appendix 16. Estimates of sport fishing effort and sport harvests of salmon in the Prince William Sound, Copper-Bering River Region, 1977 through 1984 (cont'd).[1/]

Location	Year	Days Fished[2/]	King	Sockeye	Coho	Pink	Chum
Eshamy Lake and vicinity[6/]	1977[3/]						
	1978	2,305	0	2,099	0	511	0
	1979	1,038	0	990	0	237	0
	1980	714	0	138	0	121	0
	1981	868	0	465	0	65	0
	1982	1,007	0	671	0	210	0
	1983	1,180	0	1,315	0	157	0
	1984	1,740	0	736	37	449	0
	Average	1,265	0	916	5	250	0
Shrode Lake and vicinity	1977	1,209	0	319	0	658	25
	1978	1,314	0	1,229	0	310	0
	1979	424	0	94	0	173	0
	1980	657	0	95	0	17	0
	1981	426	0	33	0	64	22
	1982	307	0	105	0	105	52
	1983	371	0	41	0	168	0
	1984[3/]						
	Average	673	0	274	0	214	14
other lakes in Prince William Sound	1977[3/]						
	1978[3/]						
	1979	1,698	0	0	0	0	0
	1980	1,100	0	0	0	0	0
	1981	769	0	0	0	0	0
	1982	717	0	94	52	1	0
	1983	3,710	0	453	619	42	0
	1984	2,191	0	773	125	175	12
	Average	1,698	0	220	133	36	2
other streams in Prince William Sound	1977[3/]						
	1978[3/]						
	1979	3,333	10	346	1,310	200	18
	1980	4,355	34	594	1,119	525	26
	1981	1,358	0	140	367	97	43
	1982	2,047	0	52	713	283	10
	1983	2,497	0	109	849	147	10
	1984	8,430	37	286	1,683	860	25
	Average	3,670	14	255	1,007	352	22

continued

Appendix 16. Estimates of sport fishing effort and sport harvests of salmon in the Prince William Sound, Copper-Bering River Region, 1977 through 1984 (cont'd).[1/]

Location	Year	Days Fished[2/]	King	Sockeye	Coho	Pink	Chum
Gulkana River	1977	4,165	421	1,180			
	1978	6,570	606	662			
	1979	17,323	2,440	545			
	1980	13,752	1,688	1,248			
	1981	14,430	1,469	1,447			
	1982	14,979	1,603	1,896			
	1983	16,911	2,224	1,921			
	1984	12,870	1,676	1,489			
	Average	12,625	1,516	1,299	0	0	0
other areas in Upper Copper River drainage	1977	22,130	111	2,482	269		
	1978	13,334	35	944	126		
	1979	18,895	508	1,054	412		
	1980	16,636	413	861	164		
	1981	15,297	248	76	0		
	1982	15,474	199	1,457	398		
	1983	11,687	355	698	84		
	1984	21,294	1,111	1,778	496		
	Average	16,843	373	1,169	244	0	0
Eyak River	1977	3,544		209	1,229		
	1978	2,003		127	704		
	1979	4,653		362	2,633		
	1980	6,954		69	4,822		
	1981	3,910		43	2,948		
	1982	4,043		0	2,096		
	1983	2,647		192	1,017		
	1984	3,731		75	1,284	12	
	Average	3,936	0	135	2,092	2	0
total all marine and freshwaters of the Prince William Sound Area	1977	20,632	247	876	5,277	12,678	244
	1978	16,306	58	3,406	3,582	8,731	1,444
	1979	41,705	342	3,410	11,307	17,890	1,500
	1980	39,514	302	3,780	10,487	16,807	1,025
	1981	38,824	324	2,139	5,551	14,774	972
	1982	36,525	399	4,286	8,898	12,924	1,204
	1983	44,630	596	4,439	9,388	14,676	1,269
	1984	53,817	411	4,002	9,079	14,476	1,770
	Average	36,494	335	3,292	7,946	14,120	1,179

continued

Appendix 16. Estimates of sport fishing effort and sport harvests of salmon in the Prince William Sound, Copper-Bering River Region, 1977 through 1984 (cont'd).[1/]

Location	Year	Days Fished[2/]	King	Sockeye	Coho	Pink	Chum
total all fresh-waters of the Copper River Area	1977	29,839	532	3,871	1,498	0	0
	1978	21,907	641	1,733	830	0	0
	1979	40,871	2,948	1,961	3,045	0	0
	1980	37,342	2,101	2,178	4,986	0	0
	1981	33,637	1,717	1,566	2,948	0	0
	1982	34,496	1,802	3,353	2,494	0	0
	1983	31,245	2,579	2,811	1,101	0	0
	1984	37,895	2,787	3,342	1,780	12	0
	Average	33,404	1,888	2,602	2,335	2	0
total all marine and freshwaters of the Prince William Sound and Copper River areas combined	1977	50,471	779	4,747	6,775	12,678	244
	1978	38,213	699	5,139	4,412	8,731	1,444
	1979	82,576	3,290	5,371	14,352	17,890	1,500
	1980	76,856	2,403	5,958	15,473	16,807	1,025
	1981	72,461	2,041	3,705	8,499	14,774	972
	1982	71,021	2,201	7,639	11,392	12,924	1,204
	1983	75,875	3,175	7,250	10,489	14,676	1,269
	1984	91,712	3,198	7,344	10,859	14,488	1,770
	Average	69,898	2,223	5,894	10,281	14,121	1,179

1/ Does not include watersheds or marine waters of the Copper River or Bering River districts. Adapted from Mills (1979, 1980, 1981a, 1981b, 1982, 1983, 1984 and 1985). With the exception of coho salmon harvested in Passage Canal, the majority of fish harvested are thought to be wild stocks.
2/ Days or parts thereof spent fishing for any species of fish.
3/ No estimates made.
4/ These harvests are, for the most part, attributed to smolt releases in Whittier streams.
5/ Does not include Eshamy Lagoon.
6/ Includes Eshamy Lagoon.

Appendix 19. Estimates of pink salmon escapement in index areas of individual fishing districts of Prince William Sound Area, 1960 through 1984.[1/]

Year	Eastern	Northern	Coghill	North-western	Eshamy	South-western	Montague	South-eastern	Total
1960	475,073	113,653	106,830	96,743	4,796	150,992	214,987	167,747	1,330,821
1961	706,790	123,900	330,910	117,270	32,820	101,170	289,290	496,830	2,198,980
1962	650,300	253,490	298,180	119,010	13,830	94,120	317,360	271,720	2,018,010
1963	378,050	77,760	144,920	209,310	11,980	37,780	78,750	417,190	1,355,740
1964	485,470	349,010	178,010	174,960	18,100	154,700	121,220	360,150	1,841,620
1965	258,680	54,970	70,410	117,350	9,340	53,380	77,000	255,930	897,060
1966	489,800	255,710	132,900	68,040	11,290	99,690	42,050	201,150	1,300,630
1967	321,520	167,300	242,750	301,330	13,740	96,010	23,800	300,270	1,466,720
1968	360,300	136,630	104,340	97,450	12,030	153,480	44,100	183,440	1,091,770
1969	328,960	147,880	114,520	150,230	12,280	120,230	63,470	218,060	1,155,630
1970	328,730	109,240	86,060	84,070	7,420	61,840	73,190	139,640	890,190
1971	529,820	161,540	526,950	87,580	7,800	96,280	337,540	373,900	2,121,410
1972	317,450	91,610	24,050	42,200	1,510	26,170	28,860	75,550	607,400
1973	264,850	44,840	561,200	2,310	5,390	60,640	106,340	184,340	1,229,910
1874	229,370	186,130	42,660	157,860	6,330	135,420	11,800	89,170	858,740
1975	570,830	44,270	570,950	9,220	5,720	72,140	110,950	234,210	1,618,290
1976	446,470	123,380	50,930	65,800	5,500	45,700	12,260	115,560	865,600
1977	465,970	62,150	338,750	87,920	32,080	193,980	196,970	315,510	1,693,330
1978	268,940	159,870	75,270	125,680	5,690	214,920	48,680	156,830	1,055,880
1979	782,420	223,580	66,230	174,890	12,860	251,850	323,490	1,091,970	2,927,290
1980	515,380	171,410	182,430	155,670	13,813	121,047	114,170	302,190	1,576,110
1981	768,000	259,850	444,700	144,180	21,409	172,341	506,140	594,890	2,911,510
1982	566,530	325,890	264,420	165,330	14,080	175,110	125,870	470,000	2,107,230
1983	540,480	180,040	311,200	209,810	9,280	173,240	247,260	634,890	2,306,200
1984	1,209,050	591,700	468,040	491,120	17,080	380,710	193,020	801,540	4,152,260
Avg.	490,369	176,632	229,504	138,213	12,247	129,718	148,343	338,107	1,663,133

1/ Does not include escapement data for the Copper River and Bering River districts. Adapted from Randall et al. (1984).

Appendix 18. Estimates of chum salmon escapement in index areas of individual fishing districts of Prince William Sound Area, 1960 through 1984.[1/]

Year	Eastern	Northern	Coghill	North-western	Eshamy	South-western	Montague	South-eastern	Total
1960	92,100	24,729	33,560	6,898	0	4,800	16,782	23,008	201,877
1961	117,950	50,420	60,700	10,240	20	4,730	34,380	59,910	338,350
1962	238,660	67,670	63,760	32,260	800	9,810	34,190	39,690	486,840
1963	148,090	68,390	77,160	37,090	0	5,330	15,070	20,030	371,160
1964	176,840	64,750	104,950	31,640	40	3,520	31,650	29,160	442,550
1965	69,180	20,980	22,020	17,670	20	1,820	17,500	46,480	195,670
1966	85,480	39,440	28,720	13,430	300	3,120	32,720	20,160	223,370
1967	97,420	50,930	10,560	4,730	0	2,360	11,060	10,700	187,760
1968	99,350	31,530	22,950	14,360	0	5,100	1,590	21,400	196,280
1969	81,140	9,770	37,700	5,690	0	2,170	1,710	26,310	164,490
1970	58,180	6,100	17,330	4,670	390	380	3,370	11,910	102,330
1971	79,930	16,190	15,450	19,120	120	1,090	25,620	9,260	166,780
1972	134,780	79,030	25,890	24,630	70	2,780	5,190	29,310	301,680
1973	267,210	143,420	78,810	10,980	170	960	2,930	42,110	546,590
1874	92,840	53,830	39,700	5,310	0	200	90	2,910	194,880
1975	28,220	7,820	7,100	310	440	140	0	2,760	46,790
1976	17,870	26,520	35,750	2,710	0	90	0	950	83,890
1977	53,200	36,360	41,640	0	0	4,480	560	8,370	144,610
1978	102,290	25,410	13,550	14,100	0	500	0	6,030	161,880
1979	57,450	17,040	13,150	5,510	0	80	0	4,450	97,680
1980	32,160	34,250	12,610	1,850	2	38	280	6,230	87,420
1981	92,240	39,740	30,740	16,850	13	757	0	21,890	202,230
1982	175,950	80,200	24,150	18,600	79	1,591	0	26,090	326,660
1983	145,670	91,770	62,800	33,050	100	3,600	0	22,900	359,890
1984	131,130	60,400	24,460	0	0	10	0	9,160	225,160
Avg.	107,013	45,868	36,208	13,268	103	2,378	9,388	20,047	234,273

1/ Does not include escapement data for the Copper River and Bering River districts. No chum salmon escapement data has been collected in the Unakwik District. Adapted from Randall et al. (1985).

Appendix 19. Reported commercial drift gill net and purse seine catches of salmon by species and gear type in the Unakwik District, 1971 through 1984.[1/]

Drift Gill Net Catches[2/]

Year	King	Sockeye	Coho	Pink	Chum
1971	0	1,508	0	14,318	1,837
1972	2	10,010	0	3,445	859
1973	1	8,858	0	119	91
1974	5	10,449	3	10,911	500
1975	4	11,449	0	84	70
1976	4	8,421	0	2,744	331
1977	3	7,912	2	257	141
1978	24	9,116	0	2,082	597
1979	11	9,250	9	2,359	289
1980	0	1,547	6	4,815	727
1981	0	2,445	0	4,488	1,369
1982	1	48,644	0	334	597
1983	8	13,275	0	1,517	1,423
1984[4/]	1	18,513	0	26,864	6,954
Avg.	5	11,528	1	5,310	1,128

Purse Seine Catches[3/]

1973	closed				
1974	closed				
1975	closed				
1976	0	7	0	8,526	225
1977	closed				
1978	3	268	5	55,115	5,025
1979	closed				
1980	0	6	0	9,113	355
1981	0	108	0	71,624	17,650
1982	0	2	4	88,837	517
1983	0	6	0	2,460	693
1984[4/]	0	0	0	0	0
Avg.	0	33	1	19,640	2,039

1/ Adapted from Randall et al. (1982, 1983, 1984 and 1985).
2/ Prior to 1971, drift gill net catch reports were combined with Coghill data.
3/ Prior to 1973, seine catch reports were combined with Coghill data.
4/ Preliminary data.

Appendix 20. Salmon escapement counts derived by tower, weir, aerial surveys and ground surveys in the Coghill District, 1960 through 1984.[1/]

Year	King	Sockeye[2/]	Coho[3/]	Pink[4/]	Chum[5/]
1960		129,000[3/]		106,832	33,560
1961		54,792		330,910	60,700
1962		26,866		298,180	63,760
1963		63,984	280	144,920	77,160
1964		22,200[3/]		178,070	104,950
1965		40,000		70,410	22,020
1966		80,000		132,900	28,720
1967		11,800[6/]		242,750	10,560
1968		11,800[3/]		104,340	22,950
1969		10,142[6/]		114,520	37,700
1970		9,658[6/]		86,060	17,330
1971		15,000[3/]		526,950	15,450
1972		16,392		24,050	25,890
1973		13,281		561,200	78,810
1974		22,333		42,660	39,700
1975		34,855		570,950	7,100
1976		9,056		50,930	35,750
1977		31,562		338,750	41,640
1978		42,284		75,270	13,550
1979		48,281		66,230	13,150
1980		142,253		182,430	12,610
1981		156,112[7/]		444,700	30,740
1982		180,314[7/]		264,420	24,150
1983		38,783[7/]		311,200	62,800
1984[8/]	21	63,622[7/]		468,040	24,460
Avg.	1	50,975	11	229,507	36,208

1/ Adapted from Pirtle (1976) and Randall et al. (1983, 1984 and 1985).
2/ Only an estimate for Coghill River. With the noted exceptions, counts were derived by counting tower from 1961 through 1973 and weir commencing in 1973.
3/ Aerial and/or ground survey estimate of entire Coghill River drainage.
4/ Aerial and/or ground survey estimates of spawners in 8 to 24 index streams throughout Port Wells.
5/ Aerial and/or ground survey estimates of spawners in 6 to 12 index streams throughout Port Wells.
6/ Unexpanded tower count.
7/ Includes jacks.
8/ Murray (personal communication, 1985).

Appendix 21. Reported commercial drift gill net and purse seine catches of salmon by species and gear type in the Coghill District, 1971 through 1984.[1/]

Drift Gill Net Catches[2/]

Year	King	Sockeye	Coho	Pink	Chum
1971	73	45,514	54	68,883	52,829
1972	67	134,628	296	5,961	18,503
1973	144	74,426	237	61,328	68,311
1974	156	95,610	103	98,149	51,428
1975	525	142,864	357	99,492	32,438
1976	102	54,334	72	53,219	89,140
1977	124	154,342	49	332,859	127,476
1978	469	193,899	64	49,527	100,679
1979	543	75,753	1,837	259,372	56,916
1980	196	54,679	1,028	357,967	66,221
1981	148	102,094	387	529,998	135,962
1982	89	925,757	169	182,758	246,694
1993	975	36,781	1,243	385,518	232,098
1984[4/]	396	95,956	567	897,496	264,878
Avg.	286	156,188	462	241,609	110,255

Purse Seine Catches[3/]

1973	40	2,856	18	68,918	16,403
1974	192	4,273	22	54,268	7,720
1975	246	4,985	30	145,155	2,561
1976	83	6,159	29	56,967	30,328
1977	40	16,436	50	230,215	37,102
1978	206	9,623	34	13,059	14,007
1979	692	3,047	55	38,560	5,709
1980		2,159		134,876	4,702
1981		1,746		19,306	22,941
1982	23	16,782	29	1,042,396	144,879
1983		234	5	38,889	8,329
1984[4/]		21		10,011	1,126
Avg.	127	5,693	23	154,385	24,651

1/ Adapted from Randall et al. (1982, 1983 and 1985).
2/ Prior to 1971, drift gill net catch reports were combined with Unakwik data.
3/ Prior to 1973, seine catch reports were combined with Unakwik data.
4/ Preliminary data.

Appendix 22. Reported commercial catches of salmon by species in the Eshamy District, 1904 through 1984.[1/]

Year	King	Sockeye	Coho	Pink	Chum
1904[2/]		55,000			
1905		98,750			
1906		55,500			
1907		17,500			
1908		117,000			
1909		135,750			
1910		68,750			
1911		7,500			
1912		16,250			
1913		55,000			
1914		50,000			
1915		25,000			
1916		17,000			
1917		100,000			
1918		103,750			
1919		45,000			
1920		20,500			
1921		60,500			
1922		97,050			
1923		116,000			
1924		2,500			
1925		5,000			
1926		10,500			
1927		15,500			
1928		no records			
1929		no records			
1930		no records			
1931[3/]	14	21,021	166	5,952	635
1932		27,727	7	10,573	93
1933		6,625		7,800	220
1934		7,394	2	7,143	
1935		45,474	545	21,296	3,490
1936		29,829	397	59,799	4,062
1937	1	20,582	6	45,544	
1938		42,476	10	97,708	573
1939		16,772		17,617	
1940		13,011		41,734	8,419
1941		18,673	744	30,284	878
1942		51,390[3/]			
1943		catch not separated			
1944		32,719	534	8,608	1,404
1945		19,743	902	21,371	19,527
1946		31,799	1,330	25,488	12,398
1947		77,703	657	32,144	7,007
1948		102,632	434	12,081	3,109
1949		23,556	1,070	40,698	14,112

continued

Appendix 22. Reported commercial catches of salmon by species in the Eshamy District, 1904 through 1984 (cont'd).[1/]

Year	King	Sockeye	Coho	Pink	Chum
1950		26,772	780	23,289	3,976
1951		78,360	1,580	62,790	9,552
1952		43,128	720	11,025	2,872
1953		15,828	1,070	52,815	9,152
1954		7,848	560	15,666	5,560
1955		12,919	595	26,857	4,806
1956		75,355	788	32,101	14,439
1957		33,665	738	22,672	12,183
1958		-closed-			
1959		-closed-			
1960[4/]		-closed-			
1961[5/]		55,133	1,334	113,326	22,918
1962		23,857	3,895	76,345	39,909
1963		-closed-			
1964		-closed-			
1965[6/]		15,456	71	550	649
1966		20,826	745	36,584	7,896
1967		-closed-			
1968		-closed-			
1969		61,768	211	25,460	8,136
1970		17,292	579	44,381	5,632
1971		-closed-			
1972		52,888	1,146	45,375	26,008
1973	69	16,439	149	21,501	27,546
1974	22	19,034	125	285,441	28,896
1975		-closed-			
1976		-closed-			
1977	31	26,805	51	87,779	12,562
1978		-closed-			
1979		-closed-			
1980		2,661	63	5,331	264
1981		-closed-			
1982		-closed-			
1983	2	2,052	22	355,099	6,183
1984[7/]	12	46,716	380	525,502	18,451
Average all years	2	31,348	277	29,083	4,241

1/ Adapted from Pirtle (1976).
2/ Data for 1904-1927 was interpreted from a graph (Rich and Ball, 1932). Data for king, coho, pink and chum salmon are not available. Eshamy District consisted of the area between Gunboat Creek and Point Nowell.

continued

Appendix 22. Reported commercial catches of salmon by species in the Eshamy District, 1904 through 1984 (cont'd).[1/]

3/ From 1931-1951, U.S. Bureau of Fisheries, Annual Reports. Number of salmon calculated from case pack on basis of 12 sockeye, 10 coho, 21 pinks and 8 chums per case. Eshamy District consisted of the area between Port Nellie Juan Light and Granite Bay Point.
4/ From 1960-1983, ADF&G Annual Management reports.
5/ Probably not all from Eshamy District.
6/ Catch since 1965 represents both set and drift gill nets.
7/ Preliminary data.

Appendix 23. Reported commercial gill net catches of salmon by species and gear type in the Eshamy District, 1967 through 1984.[1/]

Set Gill Net Catches

Year	King	Sockeye	Coho	Pink	Chum
1967		-closed-			
1968		-closed-			
1969	13	56,785	182	22,133	7,120
1970		15,309	515	38,637	4,682
1971		-closed-			
1972	33	37,771	520	25,013	10,345
1973	28	8,969	78	9,724	10,914
1974	4	6,394	11	68,300	5,408
1975		-closed-			
1976		-closed-			
1977	9	9,889	2	24,743	4,218
1978		-closed-			
1979		-closed-			
1980		2,000	38	2,371	134
1981		-closed-			
1982		-closed-			
1983					
1984[2/]	5	23,226	98	278,176	3,000
Average all years	5	8,908	80	26,061	2,546

Drift Gill Net Catches

1967		-closed-			
1968		-closed-			
1969	3	4,984	29	3,327	1,016
1970		1,911	60	5,689	949
1971		-closed-			
1972	49	15,117	626	20,362	15,663
1973	41	7,470	71	11,777	16,632
1974	18	12,640	114	217,141	23,488
1975		-closed-			
1976		-closed-			
1977	22	16,916	49	63,036	8,344
1978		-closed-			
1979		-closed-			
1980		661	25	2,960	130
1981		-closed-			
1982		-closed-			
1983	1	724	9	164,856	2,754
1984[2/]	7	23,490	282	247,326	15,451
Average all years	8	4,662	70	40,915	4,690

1/ From ADF&G annual management reports.
2/ Preliminary data.

Appendix 24. Weir and ground survey counts of salmon escapement in the Eshamy District, 1931, 1932 and 1950 through 1984.[1/]

Year	King	Sockeye	Coho	Pink	Chum
1931[2/]	16*	78,980*	4,741*	6,157*	
1932	41*	229,668*	6,372*	3,773*	
1950[3/]		30,364*	971*	421*	
1951		62,661*	1,518*	5,515*	
1952		42,859*	51*	119*	
1953		4,588*	185*	718*	
1954		1,437*	15*	418*	
1955		13,036*	1,505*	6,611*	717*
1956	2*	46,863*	177*	1,166*	14*
1957		51,308*	400*	4,031*	16*
1958		5,224*	27*	273*	3*
1959		6,908*	256*	674*	
1960[4/]		13,217*	132*	4,796	
1961		47,275*	436*	32,820	20
1962		9,390*	1,677*	13,830	800
1963		3,092*	232*	11,980	
1964		67,729*	1,565*	18,100	40
1965		108,963*	532*	9,340	20
1966		26,593*	194*	11,290	300
1967		10,821*	192*	13,740	
1968		68,048*	450*	12,030	
1969		61,196*	96*	12,280	
1970		11,460*	25*	7,420	390
1971[5/]		954*	97*	7,800	120
1972		28,683*	71*	1,510	70
1973		10,202*	205*	5,390	170
1974		633*		6,330	
1975		1,724*	41*	5,720	440
1976		19,367*	125*	5,500	
1977		11,746*	230	32,080	
1978		12,580*	20*	5,690	
1979		12,169*		12,860	
1980	5*	44,263*	128*	13,813	2
1981		23,408*	249*	21,409	13
1982	1*	6,782*	79*	14,080	79
1983		10,348*	58*	9,280	100
1984[6/]	2*	36,121*	881*	17,080	0
Average all years	2	32,991	647	9,082	90

1/ Adapted from Pirtle (1976).

continued

Appendix 24. Weir and ground survey counts of salmon escapement in the Eshamy District, 1931, 1932 and 1950 through 1984.[1/]

2/ 1931 was the first year that the Eshamy River weir was operated. 1931 and 1932 data from US Bureau of Commercial Fisheries, Alaska Fishery and Fur Seal Industries reports.
3/ From 1933 through 1949, no counts were made due to lack of funds. 1950 through 1959 data from US Bureau of Commercial Fisheries, Annual Management reports.
4/ 1960 to present data from ADF&G Annual Management reports.
5/ Count not accurate as weir was not fish tight at all times.
* Weir count, dates of operation varied annually. All other counts were from 3 to 5 pink salmon index streams and 2 chum salmon index stream (Pirtle, 1977).

Appendix 25. Reported commercial catches of salmon by species in the general seine districts, 1960 through 1984.[1/]

Year	King	Sockeye	Coho	Pink	Chum
1960	299	35,176	27,147	1,841,896	381,858
1961	406	478	9,651	2,174,873	199,071
1962	1,830	16,765	27,998	6,663,730	847,154
1963	2,293	43,339	48,641	5,292,689	937,635
1964	65	38,110	30,967	4,201,106	534,553
1965	880	48,909	44,723	2,069,642	107,761
1966	620	11,110	22,770	2,559,231	388,286
1967	3,245	21,118	39,787	2,393,596	192,475
1968	1,349	10,441	10,579	2,242,924	267,650
1969	2,766	23,990	12,422	4,757,351	256,935
1970	1,031	34,222	10,621	2,624,463	202,098
1971	3,104	18,042	28,533	6,805,689	415,368
1972	478	0	192	2	0
1973	2,151	22,223	995	1,905,012	617,488
1974	0	0	0	0	0
1975	1,744	29,842	5,753	4,208,074	65,410
1976	855	43,888	6,070	2,897,535	250,424
1977	450	104,863	691	3,861,972	395,329
1978	340	9,177	1,392	2,660,290	354,839
1979	769	61,990	4,942	15,114,847	263,500
1980	82	126,463	1,830	13,300,729	407,891
1981	252	147,719	3,375	19,993,579	1,745,987
1982	103	56,324	17,243	17,622,651	968,700
1983	439	38,542	9,706	12,711,549	789,808
1984[2/]	80	151,740	11,477	20,222,330	905,376
Average all years	1,025	43,779	15,100	6,325,030	459,824

1/ Includes harvests of wild, rehabilitated and enhanced stocks in the Eastern, Northern, Northwestern, Southwestern, Montague and Southeastern districts. This does not include seine catches in the Coghill and Unakwik districts. Minor troll harvests which occurred during 1974 through 1976 are included. Adapted from Randall et al. (1985).
2/ Preliminary data.

Appendix 26. King salmon peak index area escapement data, Copper River Area, 1971 through 1984[1/].

Area	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
East Fork Chistochina R.	512	348	476	137	71	289	132	137	810	575	120	1,260	575	577
Gulkana R.	269	1,200	623	1,317	741	777	1,090	921	1,380	718	(754)	1,656	931	2,189
Mendeltna R.	56	49	15	15	(38)	35	73	52	5	3	51	70	12	26
Kaina Ck.	81	89	172	55	(123)	37	91	125	279	247	191	200	166	382
St. Anne Ck.	4	25	(26)	32	(26)	15	10	24	16	8	19	35	87	89
Manker Ck.	30	4	17	29	19	6	15	20	16	35	23	49	141	264
Grayling Ck.	45	47	47	49	(48)	17	(48)	92	153	66	107	127	287	279
L. Tonsina R.	200	(129)	100	65	161	98	35	285	285	70	191	440	330	568
Indian R.	(20)	13	20	4	6	61	20	9	29	24	(20)	179	41	17
Total	1,217	1,904	1,496	1,703	1,233	1,335	1,514	1,665	2,973	1,746	1,476	4,016	2,570	4,391

1/ Adapted from Randall, et al. (1984 and 1985).
Brackets indicate an interpolated count.

Appendix 27. A summary of sockeye salmon escapement data, Copper River Area, 1970 through 1894.

Year	Index Area Counts: Delta[1]	Upper River[2]	Total	Estimated Total Upriver Run[3]	Reported Dip Net Catch	Reported Fishwheel Catch	Estimated Sport Catch	Estimated Spawning Escapement
1970	36,712	73,945	110,657	265,670[4]	24,938	11,562	1,800[5]	227,370
1971	45,270	70,232	115,502	449,124[4]	28,115	9,370	4,000[5]	407,639
1972	49,235	32,031	81,266	256,001[4]	18,996	7,854	2,000[5]	227,151
1973	26,801	64,345	91,146	253,156[4]	16,407	10,943	4,000[5]	221,806
1974	18,493	29,417	47,910	no estimate	15,143	7,657	2,000[5]	no estimate
1975	32,060	11,190	43,250	no estimate	7,694	5,626	4,000[5]	no estimate
1976	41,000	24,276	65,276	no estimate	12,205	8,726	3,000[5]	no estimate
1977	40,455	72,763	113,218	no estimate	22,755	13,594	3,662[7]	no estimate
1978	65,850	23,488	89,338	194,372[6]	16,863	5,553	1,606[7]	170,350
1979	80,700	29,523	110,223	248,709[6]	12,069	11,530	1,599[7]	223,511
1980	119,150	55,595	174,745	283,856[6]	12,287	9,150	2,109[7]	260,310
1981	82,850	76,820	159,670	534,263[6]	26,763	26,245	1,523[7]	479,732
1982	62,000	89,945	151,945	467,277[6]	59,713	37,086	3,353[7]	367,125
1983	67,545	77,410	144,955	545,724[6]	66,620	34,375	2,619[7]	442,110
1984	83,440	92,790	176,230	536,806[6]	44,977	20,101	3,267[7]	468,461
Average	56,771	54,918	111,689	366,814[8]	29,795[8]	16,706[8]	2,534[8]	317,779[8]

1/ Peak aerial survey counts in 7 index spawning areas.

2/ Peak aerial survey counts in 20 index spawning areas.

3/ The actual spawning escapement can be derived by subtracting estimates of Upper Copper River sport and subsistence harvests.

4/ Escapement estimates of sockeye salmon tagged at Miles Lake and recaptured at Woods Canyon.

5/ Estimates provided by Williams (personal communication).

6/ Escapement estimates based on sonar counters located at the outlet of Miles Lake. These counts are not segregated by species; however, the majority of the counts are believed to be sockeye salmon.

7/ Based on statewide harvest survey presented in Mills (1978, 1980, 1981a, 1981b, 1982, 1983, 1984 and 1985).

8/ Average based on data for 1970 through 1973 and 1978 through 1984.

Appendix 28. Sockeye salmon peak index area escapement data, Copper River Area, 1971 through 1984.1/

Index Area	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Copper River Delta														
Eyak L. McKinley	5,800	12,275	6,000	4,625	17,500	8,500	8,000	13,450	13,500	22,500	11,300	11,700	8,900	10,390
L. 39 Mile Ck.	1,200	5,050	1,800	2,000	8,000	6,000	15,000	18,000	25,000	27,500	10,000	9,500	12,000	11,200
Tokun L. Little	8,270	14,910	5,511	2,400	2,500	3,500	4,500	6,500	17,500	18,000	9,500	13,000	13,000	17,000
Martin L. Martin	20,000	2,000	8,000	1,468	1,200	8,500	4,201	6,600	6,500	17,000	8,500	7,000	6,500	9,000
L. Martin River	3,000	3,000	1,500	1,500	2,000	8,000	1,550	4,500	4,000	6,500	2,500	6,000	6,000	10,000
Martin L.	2,000	7,000	2,000	1,500	460	4,000	4,094	10,500	10,000	17,650	26,050	5,300	9,000	11,350
Martin River Sl.	5,000	5,000	1,990	5,000	400	2,500	3,100	6,300	4,200	10,000	15,000	9,500	11,000	14,500
Delta Total	45,270	49,235	26,801	18,493	32,060	41,000	40,445	65,850	80,700	119,150	82,850	62,000	66,400	83,440
Upper Copper River														
Salmon Ck.	(275)	0	200	400	0 P	300	(275)	50	450	1,500	250	850	1,550	1,350
Tonsina L.	500	250	300	200	250	900	(432)	4	775	650	1,725	1,700	2,850	975
Mahlo Ck.	12,400	1,525	4,500	500	314 G	600	5,200	300	450	1,000	1,800	3,300	2,400	4,300
St. Anne Ck.	25,100	1,900	7,400	2,100	449 G	1,700	7,000	1,150	730	5,000	4,700	8,800	9,700	10,300
Mendeltna Ck.	870	1,950	1,200	332	325	900	3,900	725	350	1,125	4,830	400	2,850	1,900
Keg Ck.	(810)	0	1,435	190	256	125	725	1,050	1,300	2,335	320	495	620	2,505
Dickey Ck.	170	73	2,500	10	25	0	650	75	13	250	20	410	135	105
Swede L.	9	400	350	15	6	10	750	80	155	400	450	1,400	550	2,400
Paxson L. outlet	3,400	2,700	4,300	1,000	550	2,800	3,800	2,500	1,900	3,800	1,500	3,800	3,300	4,100
Mud Ck. inlet	7,900	5,818	10,500	14,300	2,100	4,200	6,000	2,700	5,400	8,200	2,200	1,150	7,500	15,700
Mud Ck. & L.	600	850	500	300	400	1,100	650	150	460	740	810	1,900	470	270
Mud Ck.-Summit L.	3,250	1,675	5,700	2,700	1,200	1,900	5,900	800	2,600	3,075	3,400	17,400	5,700	9,600
Fish L.	700 P	4,500	6,300	800	2,800	900	8,000	2,650	1,700	3,175	8,800	22,560	5,500	10,950
Bad Crossing #1&#2	6	0	9,275	650	5	16	8,400	600	650	75	15,000	4,550	2,000	760
Fish Ck.	900	650	2,200	450	200	250	6,900	1,300	350	900	10,500	1,700	900	900
Mentasta L.	2,295	800	2,700	700	450	600	3,500	3,600	2,500	3,200	7,400	3,250	6,800	4,850
Suslota L.	4,550	4,830	3,400	400	0	100	300	1,200	1,000	1,700	300	1,800	5,600	700
Tanada L.	4,093	930	10	2,800	700	2,200	7,100	525	3,375	4,200	5,300	3,800	4,300	9,100
Long L.	2,000	3,000	150	750	1,100	2,450	877	1,425	3,100	2,650	1,325	1,700	5,600	1,360
Tana R.	(404)	180	1,425	520	60	25	(404)	504	465	2,130	290	1,100	2,485	3,665
Upper River Total	70,232	32,031	64,345	29,117	11,190	21,076	70,763	21,388	27,723	46,105	70,920	82,065	70,810	85,790

Appendix 28. Sockeye salmon peak index area escapement data, Copper River Area, 1971 through 1984.1/

1/ Adapted from Randall (1984) and Roberson (personal communication). These data represent the greatest or peak number of spawners that were observed in selected spawning areas. These area counts are used as an index of relative escapement magnitude in the numerous spawning areas of the Copper River Delta and Upper Copper River. Unless noted otherwise, data were obtained by aerial means.
Brackets indicate interpolated data.
P - indicates poor survey conditions.
G - indicates ground survey count.

Appendix 29. Coho salmon aerial survey data, Copper River Delta, 1964, 1965, 1968, 1969, 1971 and 1973 through 1984.[1/]

Index Area	1964	1965	1968	1969	1971	1973	1974	1975	1976	1977
Eyak L.	4,000	3,500	150	(416)	(2,070)	2,000	175	7,350	3,000	3,700
Hatchery Ck.	300	400	3	(93)	(600)	(237)	(523)	(579)	(148)	(573)
Power Ck.	(1,151)	(319)	(100)	(120)	(774)	(306)	(675)	(747)	(191)	(739)
Ibek Ck.	1,950	2,000	(327)	250	(2,179)	(1,065)	4,500	3,500	(540)	3,500
19 Mile Ck.	50	300	(33)	(44)	(218)	(107)	(267)	200	(54)	35
McKinley Ck.	(1,050)	(287)	(82)	(110)	(545)	(266)	15	(740)	(135)	(679)
Salmon Ck.	800	500	(90)	350	(599)	(293)	(733)	(814)	(149)	1,300
26-27 Mile Ck.	(280)	(76)	(22)	(29)	(145)	(71)	(178)	(197)	(36)	(181)
39 Mile Ck.	400	300	300	300	(1,380)	2,950	6,500	2,500	(342)	3,000
Goat Mt. Ck.	5,300	(497)	(142)	500	(944)	(461)	(1,155)	1,500	(234)	(1,177)
Pleasant Ck.	8,000	900	25	350	(745)	500	550	(100)	(185)	1,500
Tokun L.	200	200	450	150	(272)	150	125	(370)	(68)	(340)
Tokun R.	(945)	(258)	(74)	(99)	(490)	150	(333)	500	(122)	(611)
L. Martin L.	(1,575)	(430)	(123)	300	(817)	115	700	350	(203)	(1,019)
Martin R.	(2,695)	(735)	300 +	100	1,160	1,532	5,500	525	(347)	2,000
Martin L.	(1,085)	50	(85)	350	(563)	50	750	(765)	(140)	(701)
Ragged Pt.	(1,155)	(315)	(90)	(121)	2,000	(293)	(733)	(814)	(149)	(747)
Ragged Outlet	(840)	(229)	(66)	(88)	(436)	(213)	1,800	150	(108)	300
yMartin R. Sl.	14,000	1,400	1,500	1,000	15,000	1,425	1,600	8,000	1,500	7,300
Total	45,776	12,646	3,877	4,420	30,374	12,134	26,062	28,936	7,511	28,701

1/ Adapted from Pirtle (1976) and Randall, et al. (1984 and 1985). These data represent the greatest or peak number of spawners that were observed in selected spawning areas. It should be noted that counts were made as weather allowed and may or may not have been made during periods of peak abundance. Counts are used as an index of relative escapement magnitude in the numberous spawning areas of the Copper River Delta and Bering River Area.

Brackets indicate interpolated data. Factors such as inclement weather, high water levels and turbulence often precluded aerial surveys.

continued

Appendix 29. Coho salmon aerial survey data, Copper River Delta, 1964, 1965, 1968, 1969, 1971 and 1973 through 1984 (cont'd).1/

Index Area	1978	1979	1980	1981	1982	1983	1984
Eyak L.	(903)	6,000	9,200	2,750 +	7,000	14,600	6,500
Hatchery Ck.	(236)	(616)	(1,729)	2,500	125	1,000	1,750
Power Ck.	(304)	(795)	(2,230)	800	1,500	1,000	1,900
Ibek Ck.	1,575	850	12,110	10,000	1,100	4,200	9,700
19 Mile Ck.	95	500	100	1,500	250	125	125
McKinley Ck.	(238)	500	2,500	(1,344)	500	5,000	500
Salmon Ck.	(262)	(781)	2,000	1,700	4,650	6,500	950
26-27 Mile Ck.	(63)	(189)	(635)	250	50	0	350
39 Mile Ck.	4,500	600	7,100	1,900	2,000	6,500	8,000
Goat Mt. Ck.	(412)	(1,230)	800	500	50		600
Pleasant Ck.	(325)	(970)	500	(1,837)	400	350	1,100
Tokun L.	(119)	(355)	2,000	(672)	400	125	0
Tokun R.	(214)	(639)	2,200	800	2,000	225	200
L. Martin L.	(357)	(1,065)	1,500	6,000	150	1,125	300
Martin R.	150	460	12,855	4,000	7,500	3,100	4,000
Martin L.	(246)	250	4,500	(1,389)	9,000	6,100	4,800
Ragged Pt.	(262)	(781)	(2,619)	200	2,500	200	200
Ragged Outlet	(190)	(568)	(1,905)	1,000	50	325	120
Martin R. Sl.	1,700	14,500	22,000	10,900	1,350	9,700	15,500
Total	11,905	31,399	83,983	48,653	31,575	54,075	51,795

Appendix 30. Reported harvests of commercial salmon by species and year, Bering River District, 1896-1984.[1/]

Year	King	Sockeye	Coho	Pink	Chum
1896	400[2/]	23,980[2/]			
1897		39,269			
1898		39,383			
1899		27,072			
1900		106,167			
1901		no report			
1902		no report			
1903		no report			
1904		123,400			
1905	no report	no report			
1906	111	54,074			
1907	no report	no report			
1908	no report	no report			
1909	no report	no report			
1910	no report	no report			
1911	no report	no report			
1912	no report	41,023	8,000[2/]		
1913	no report	38,519			
1914	no report	10,202			
1915	4	105,614			
1916	7	141,278	51,938	14,492[2/]	
1917	321	163,357	78,412		
1918	139	173,021	80,218	772	3[2/]
1919	72	139,792	76,729		
1920	120	162,582	63,865		
1921	3	120,667			
1922	72	131,179			
1923	86	192,361	24,723	298	
1924	111	87,114	80,030		
1925	77	52,632	57,018	206	
1926	76	37,424	52,668	135	
1927	[3/]	[3/]	[4/]	[4/]	[4/]
1928					
1929					
1930					
1931					
1932					
1933	134[5/]	19,751[5/]			
1934	70	78,262			
1935					
1936	213	50,154			
1937	86	28,733			
1938					
1939					
1940					
1941					
1942					

continued

Appendix 30. Reported harvests of commercial salmon by species and year, Bering River District, 1896-1984.[1/]

Year	King	Sockeye	Coho	Pink	Chum
1943					
1944					
1945					
1946					
1947					
1948					
1949					
1950					
1951	34[6/]	3,591[7/]	46,306[6/]	5[6/]	1[6/]
1952	0		13,642		
1953	26	8,572			
1954	0	129	91,964	9	1
1955	125	34,121	70,100	50	2
1956	147	41,437[8/]	53,484	46	5
1957	71	29,142	27,441	27	22
1958	72	23,947	21,202	32	1
1959	77	27,384	58,560	6	
1960	63[9/]	32,890[9/]	70,065[9/]	126[9/]	6[9/]
1961	872	60,116	50,883	30	1
1962	246	72,230	55,502		2
1963	95	23,127	88,610	60	
1964	36	13,469	78,708		
1965	3	10,651	52,114		32
1966	36	24,949	49,818		1
1967	20	11,866	46,138	3	2
1968	10	26,136	67,134	199	
1969	44	38,093	4,033	1	
1970	26	23,539	79,264	1	1
1971	105	36,776	88,231	4	
1972	107	51,445	19,825	3	1
1973	285	15,426	65,348	2	5
1974	32[10/]	4,208[10/]	28,615[10/]	7[10/]	2[10/]
1975	162	21,637	24,162	0	0
1976	228	30,908	42,423	43	1
1977	127	14,445	47,218	192	221
1978	331	33,554	91,097	266	2,391
1979	385	139,015	114,046	6,895	23,094
1980	0	0	108,872	0	0
1981	200	55,585	82,626	9,882	8,307
1982	254	129,667	144,752	47	333
1983	610	179,273	117,669	851	4,615
1984	330[11/]	91,784[11/]	214,632[11/]	309[11/]	20,408[11/]
Average 1960-1984	184	45,632	73,271	901	2,971

1/ Adapted from Pirtle (1976).

continued

Appendix 30. Reported harvests of commercial salmon by species and year, Bering River District, 1896-1984.[1/]

2/ Data for 1896 through 1925 from Rich and Ball (1932).
3/ Data for 1927 through 1932, 1935, and 1938 through 1950 are included in the Copper River catch data.
4/ Data for 1927 through 1950 are included in the Copper River catch data.
5/ Data for 1933, 1934, 1936 and 1937 are from International North Pacific Fisheries Commission (1974).
6/ Data for 1951 through 1959 are from Simpson (1960).
7/ Data for 1951 through 1955 are from Thompson (1964).
8/ Data for 1956 through 1959 are from Simpson (1960).
9/ Data for 1960 through 1973 are from ADF&G Statistical leaflets.
10/ Data for 1974 through 1984 are from Randall et al. (1984) and (1985).
11/ Preliminary data.

Appendix 31. Sockeye and coho salmon aerial escapement survey data, Bering River Area, 1961 through 1984.[1/]

Index Area	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
sockeye salmon												
Bering L.		200	15	400	280	3,180	2,500	9,400	47,000	20,000	21,675	20,000
Dick Ck.	7,164[2/]	16,000	4,500	2,800	4,100	3,000	4,350	19,000	15,000	13,500	30,000	16,000
Shephard Ck.	200		450	3,400	3,500	turbid	turbid	5,000	6,000	6,000	10,200	6,000
Kushataka L.	1,000	2,100	1,580	800	345	1,730	turbid	turbid	turbid	turbid		
Total	8,364	18,300	6,545	7,400	8,225	7,910	6,850	33,400	68,000	39,500	61,875	42,000
coho salmon												
Katalla R.											17,000	
Bering L.											500	
Dick Ck.											1,600	
Shepard Ck.												
Gandil R.												
Nichawak R.												
Total											19,100	

Index Area	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
sockeye salmon												
Bering L.	23,000	20,580	4,000	40,000	8,000	7,000	13,500	12,000	20,000	7,300	26,500	18,000
Dick Ck.	9,600	6,600	1,971	2,000	1,500	6,300	11,000	11,000	20,000	9,500	4,000	11,000
Shephard Ck.	3,000	15,000	150	5,500	glacial	6,000	silt	7,800	9,000	10,500	9,500	13,000
Kushataka L.	1,625	75	75	2,500	glacial	3,500	2,500	1,000	5,500	1,350	1,200	800
Total	37,225	42,255	6,196	50,000	9,500	22,800	27,000	31,800	54,500	28,650	41,200	42,800

Appendix 31. Sockeye and coho salmon aerial survey escapement data, Bering River Area, 1961 through 1984.[1/]

coho salmon												
Katalla R.	1,200	4,200	2,500	200	5,000 +	3,200		8,000	3,000	11,500	4,800	7,000
Bering L.	52	1,000	50		165		1,000	700	0	8,000	4,000	6,500
Dick Ck.	650	60	1,200		500			1,625	0	5,500	7,100	5,500
Shepard Ck.								0	600	muddy	muddy	muddy
Gandil R.								600		muddy	muddy	muddy
Nichawak R.								250		5,000	800	1,000
Total	1,902	5,260	3,750	200	5,665	3,200	1,000	11,175	3,600	30,000	16,700	20,000

1/ These data represent the greatest or peak number of spawners that were observed in selected spawning areas. It should be noted that counts were made as weather allowed and may or may not have been made during periods of peak abundance. Counts are used as an index of relative escapement magnitude in the numerous spawning areas of the Copper River Delta and Bering River Area. Adpated from Pirtle (1976) and Randall et al. (1984) and (1985).

2/ Includes Bering Lake.

Appendix 32. Completed fish habitat improvement projects in the Prince William Sound, Copper-Bering River Region, 1962 through 1984.

District	Stream	Name	Year	Work Accomplished	New Habitat Created[1/]	Estimates of Additional Harvestable Adults				Initial Cost	
						Sockeye[2/]	Coho[3/]	Pink[4/]	Chum[5/]	USDA FS	ADF&G
Copper River		Tokun Lake	1984	Fertilization		145,000				$5,000	$40,000
		Mile 18	1971	Channel excavation							
			1984	Channel excavation							
	841-1	Boswell Bay Ck.	1981	Fishpass	83 acres	4,200				$89,720	
Eastern	2	Hartney Ck.	1968	Log removal						$200	$500
	11	Humpback Ck.	1967	Channelization						$300	$900
	20	Spring Ck.	1968	Channel improvement						$800	$700
	21	Rogue Ck.	1968	Rechanneling and log removal						$300	$500
			1971	Rechanneling						$800	$2,200
	37	Allen Ck.	1968	Rock weirs						$300	$300
	52	Control Ck.	1965	Falls blasted						$3,200	
			1974	Fishpass	16,800 sq.ft.			2,400*		$20,000	$15,000
	89	Fish Ck.	1968	Log removal						$300	$400
	93	Kirkwood Ck.	1968	Log removal	26,500 sq.ft.			3,700		$300	$300
	99	Lagoon Ck.	1968	Rechanneling						$2,800	$4,000
			1972	Rechanneling	44,000 sq.ft.			6,200	4,400	$3,200	$200
	106	Gladhough Ck.	1968	Channeling	3,100 sq.ft.			400		$300	$300
Northern	218	Billy's Hole	1963	Fishpass						$6,500	$3,900
			1981	Fishpass removal and blasting	83 acres	4,200				$23,000	
	241	Cannery Ck.	1967	Channel cleaning						$1,000	$1,000
			1968	Channel improvement						$200	$400
			1972	Log removal						$200	$500
	276	Black Bear Ck.	1978	Stream cleaning	4,700 sq.ft.			700	500	$3,300	
	277	Unnamed Ck.	1978	Stream cleaning	4,000 sq.ft.			600	400	$3,300	
	278	Comeback Ck.	1978	Stream cleaning	3,200 sq.ft.			400	300	$3,400	
	291	Low Ck.	1978	Stream cleaning	4,050 sq.ft.			600		$3,300	
Coghill	300	Red Ck.	1978	Fishpass	53 acres	2,600	400			$28,000	
					34,000 sq.ft.			4,800			
	304	Passing Ck.	1978	Stream cleaning	2,500 sq.ft.			400		$3,300	

continued

Appendix 32. Completed fish habitat improvement projects in the Prince William Sound, Copper-Bering River Region, 1962 through 1984.

District	Stream	Name	Year	Work Accomplished	New Habitat Created[1/]	Estimates of Additional Harvestable Adults				Initial Cost	
						Sockeye[2/]	Coho[3/]	Pink[4/]	Chum[5/]	USDA FS	ADF&G
	307	Village Ck.	1978	Stream cleaning	2,500 sq.ft.			400	300	$3,400	
	414	Harrison Lagoon	1972	Diversion						$1,500	
		Ck.	1973	Low flow structure						$1,400	
	417	Hobo Ck.	1978	Fishpass	264,000 sq.ft.			37,000		$31,000	
	430	Meacham Ck.	1968	Log removal						$250	$250
			1972	Log removal						$300	
	432	Swanson R.	1968	Log removal						$250	$250
Northwestern	435	Logging Camp	1978	Fishpass						$27,500	
		Ck.	1979	Pool structure and log removal						$1,680	
			1981	Fishpass removal							
	447	Squirrel Ck.	1973	Debris removal						$650	
	455	Paulson Ck.	1969	Channeling						$290	$290
			1970	Channeling						$900	$900
			1981	Fishpass	66,000 sq.ft.			9,200		$24,000	
	476	Shrode Ck.	1962	Wood control gate						$6,000	$4,000
			1964	Cement fishway						$20,000	$11,000
			1972	Concrete weir	257 acres	12,800				$5,000	$2,000
					164,700 sq.ft.			23,100*			
Eshamy	508	Solf Ck.	1968	Channel improvement	12,000 sq.ft.			1,700		$300	$350
Southwestern	604	Erb Ck.	1969	Channeling						$290	$290
	665	Bjorn Ck.	1968	Channel improvement						$300	$400
	677	Hayden Ck.	1968	Rechanneling	10,500 sq.ft.			1,500		$300	$300
	687	Sockeye Ck.	1982	Fishpass	55 acres	2,800	300			$45,000	
	688	Otter Lake	1982	Fishpasses and barrier modification	58 acres		400			$106,000	

continued

Appendix 32. Completed fish habitat improvement projects in the Prince William Sound, Copper-Bering River Region, 1962 through 1984.

District	Stream	Name	Year	Work Accomplished	New Habitat Created[1/]	Estimates of Additional Harvestable Adults				Initial Cost	
						Sockeye[2/]	Coho[3/]	Pink[4/]	Chum[5/]	USDA FS	ADF&G
	690	Solf Lake	1978	Channel diversion						$119,000	
			1980	Gabion installation							
			1981	Gabions at outlet	150 acres					$5,700	
Montague	707	MacLeod Ck.	1972	Channelization						$200	$1,300
	710	Hanning Ck.	1973	Debris removal						$750	$100
	738	Russel Ck.	1971	Log removal						$3,200	
			1972	Log removal						$50	
	744	Wilby Ck.	1967	Log and gravel revetment						$800	$1,200
			1968	Rock barrier removal						$200	$500
	745	Wild Ck.	1967	Log and gravel revetment						$800	$1,200
			1968	Channel stabilization						$500	$1,000
	749	Shad Ck.	1967	Log removal and channelization						$600	$630
			1968	Log removal and drop structure						$200	$500
	759	Rocky Ck.	1983	Fishpass	30 acres 87,100 sq.ft.	1,500	600	12,200		$108,000	
	770	Udall Ck.	1967	Log removal						$500	$200
	775	Pautzke Ck.	1967	Channel through berm						$500	$1,000
Southeastern	810	Garden Cove Ck.	1970	Channeling and log removal						$500	$1,450
	811	Etches Ck.	1969	Log removal						$2,500	$3,000
			1970	Debris removal						$750	$1,260
	812	Nuchek Ck.	1969	Rechanneling						$1,900	$5,000
			1970	Channeling and revetment						$1,000	$3,800

continued

Appendix 32. Completed fish habitat improvement projects in the Prince William Sound, Copper-Bering River Region, 1962 through 1984.

District	Stream	Name	Year	Work Accomplished	New Habitat Created[1/]	Estimates of Additional Harvestable Adults				Initial Cost	
						Sockeye[2/]	Coho[3/]	Pink[4/]	Chum[5/]	USDA FS	ADF&G
	815	Constantine Ck.	1967	Crib dam						$300	$1,700
			1968	Deflector and log removal						$2,000	$2,800
			1969	Deflector						$800	$2,200
			1970	Log removal and revetment						$1,000	$5,740
			1971	Dam repair and channeling	2 acres			12,200	9,000	$400	$600
	828	Cook Ck.	1968	Log removal						$300	$300
	831	Double Ck.	1968	Log removal						$300	
	847	Hawkins Ck.	1967	Log and gravel dam						$300	$700
			1968	Log removal						$350	$350
			1969	Stream grading	2 acres			12,000		$400	$400
	850	Canoe Ck.	1969	Stream widening						$450	$500
	852	Forest Service Trail Ck.	1980	Fishpass	83 acres 4,000 sq.ft.		800	 4,000		$56,920	
Total Costs										$790,500	*******
Estimate of total harvestable fish[6/]											
Copper River Area						149,200	0	0	0		
Prince William Sound Area						23,900	2,500	120,750	14,900		
Both areas combined						173,100	2,500	120,750	14,900		

1/ Some projects involve improvements which are difficult to quantify, and, therefore, no estimates of the amount of new habitat or harvestable adults have been made.

2/ Number of harvestable adults based on 50 fish per surface acre of lake.

3/ Number of harvestable adults varies from 5 to 10 fish per surface acre of lake surface.

4/ Number of harvestable adults based on 0.14 fish per sq.ft. of spawning area.

5/ Number of harvestable adults based on 0.10 fish per sq.ft. of spawning area.

6/ Number of pink salmon is the average of odd and even-year returns.

* Odd year fish will benefit.

Appendix 33. **OUTLINE FOR ANNUAL HATCHERY MANAGEMENT PLANS**

I. OPERATIONAL PLANS FOR 198_ [1/]

A. Egg Take Goals by Species (Divide into Donor and Hatchery Returns)

B. Egg Take, Transport and Carcass Disposal Plans

C. Incubation Plans

D. Rearing and Release Plans

II. DONOR STOCK MANAGEMENT (BY SPECIES) FOR 1980 [1/2/]

A. Discussion of Management Strategies That Could be Used to Increase Escapement to the Donor Stream as per Hatchery's Needs for Brood Stock

B. Escapement Requirements [3/]

C. Fish Collection Relative to Gear Type(s) Providing Escapement Requirements, Affects on Non-Target Species, Habitat and Other User Groups

III. HATCHERY RETURN MANAGEMENT (BY SPECIES)

A. Management in Common Property Fisheries

1. Probable or established migration route(s) (map) and timing.
2. Fisheries that returns may enter.
3. Possible exploitation in fisheries entered.
4. Special management strategies in those fisheries needed due to hatchery stock.

B. Special Harvest Area (S.H.A.) (For Private or Terminal Harvest Area for FRED Hatcheries)

1. Hatchery Harvest [1/] (Does not Apply to FRED)

a. Hatchery harvest likelihood: statement of quota and brood stock needs.
b. S.H.A. boundaries map and hatchery gear type considerations.
c. Strategies for separating hatchery harvest from brood stock.
d. Avoidance of non-target species in harvest and brood takes.
e. Strategies to provide best quality possible.
f. Other management concerns or strategies.

2. Common Property Fisheries (FRED & Private)

a. Commercial, sport and subsistence harvest likelihood on returns (by gear)

b. Strategies for separating commercial, sport and subsistence harvests from brood stock.
c. Management of S.H.A. non-target sport fisheries.
d. Other management concerns or strategies.

IV. MARKING STUDIES PLANNED FOR 198__ (BY SPECIES)

1/ Hatchery operator must supply the following.
2/ This section will be needed only when donor egg takes from wild stocks are used. Donors must have been approved under section "II-B" of the "Basic Management Plan" (original or approved modification of).
3/ Escapement schedule (sliding scale).

Appendix 34. **OUTLINE FOR BASIC HATCHERY MANAGEMENT PLANS**

I. INTRODUCTION

A. Production Statement

B. Goals

C. Objectives

II. HATCHERY OPERATIONAL CONSIDERATIONS

A. Facility Design

B. Fish Culture Considerations

C. Stock Separation and Release Plans

III. BROOD STOCK CONSIDERATIONS

A. Brood Stock Development Schedule

1. Adults required at full production
2. Projected wild adult donor stock takes

B. Wild Donor Source Selection

1. Specific criteria for the hatchery that wild donor sources should meet
2. Approved donor sources

IV. HARVEST MANAGEMENT CONSIDERATIONS (BY SPECIES)[1/]

A. Management in Common Property Fisheries

1. Fisheries that returns may enter - list by name and number
2. Possible exploitation in fisheries entered
3. Impact on existing management strategies
4. Designation of Terminal Harvest Area

B. Special Harvest Area (S.H.A.)[1/]

1. Hatchery harvest

a. S.H.A. boundaries (map) and hatchery gear type considerations
b. Non-target species avoidance considerations
c. Fish quality considerations

2. Common property harvest

   a. List approved common property gear that may take S.H.A. returns
   b. Commercial, sport and subsistence harvest considerations
   c. Management, S.H.A. non-target sport fisheries

V. SUMMARY OF RESEARCH/OPERATIONAL REQUIREMENTS

A. List of Studies Needed

1/ This section should be called Terminal Harvest Area (T.H.A.) for FRED hatcheries and should not include Section IV B.1.

Appendix 35. **ALASKA REGULATION GOVERNING THE ARMIN F. KOERNIG (PORT SAN JUAN) HATCHERY MANAGEMENT PLAN.**

CHAPTER 24.
PRINCE WILLIAM SOUND AREA

5 AAC 24.365 is added to Article 3 to read:

5 AAC 24.365. PORT SAN JUAN SALMON HATCHERY MANAGEMENT PLAN. The department, in conjunction with the hatchery operator, shall manage the Point Elrington and Port San Juan subdistricts to achieve the corporation escapement goal for the Port San Juan salmon hatchery. (Eff. / /85, Register)

Authority: AS 16.05.060
AS 16.05.251

Appendix 36. Anchorage and USA consumer price index (CPI) data and average ex vessel salmon prices in the Prince William Sound Region, 1960 through 1984

	CPI[2]		Ex vessel Prices[1]					
					Prince William Sound districts	Copper R. and Bering R. districts		
Year	Anchorage	USA	King	Sockeye	Coho	Coho	Pink	Chum
1960	91.8	89.2	.23	1.47 ea.	1.15 ea.	1.15 ea.	.48 ea.	.68 ea.
1961	92.8	89.9	.23	1.50 ea.	1.15 ea.	1.25 ea.	.48 ea.	.68 ea.
1962	92.5	91.1	.23	1.55 ea.	1.25 ea.	1.35 ea.	.52 ea.	.76 ea.
1963	93.2	92.2	.23	.24	.15	.15	.105	.0875
1964	93.9	93.3	.03	.27	.15	.15	.105	.0875
1965	94.2	94.9	.23	.27	.15	.15	.0984	.0794
1966	97.9	98.5	.23	.27	.16	.16	.1024	.0824
1967	100.0	100.0	.23	.28	.17	.17	.1048	.0838
1968	102.6	105.7	.23	.28	.19	.19	.1048	.0838
1969	107.3	111.6	.30	.30	.28	.28	.192	.1126
1970	111.5	118.1	.30	.30	.30	.30	.117	.0955
1971	114.4	122.4	.36	.32	.16	.225	.1203	.0983
1972	116.9	126.6	.40	.35	.16	.225	.1725	.13825
1973	123.8	136.6	.50	.7005	.16	.65	.3625	.36
1974	140.2	153.0	(.64)[3]	(.55)	no est.	no fishery	(.38)	(.40)
1975	157.4	164.6	(.67)	(.47)	no est.	(.56)	(.34)	(.30)
1976	167.9	173.3	(.80)	(.72)	no est.	(.70)	(.38)	(.41)
1977	177.3	184.5	1.40	.97	.37	.70	.3575	.3992
1978	193.9	200.9	1.39	1.23	.39	1.10	.3701	.4258
1979	211.4	225.4	1.62	1.40	.39	1.10	.3777	.53
1980	236.5	256.2	1.40	.85	.39	.95	.4229	.5
1981	253.7	280.7	1.65	1.40	.44	.95	.54	.5
1982	264.0	301.4	1.40	1.01/.80	.40	.86	.23	.38
1983	270.4	303.1	1.05/.25[4]	.95/.85	.30	.75	.24	.24
1984[5]	277.5	312.2	1.30/1.15	1.15/.90	.23	1.10	.23	.27

1/ The prices paid to the fishermen. Prices are expressed in dollars per pound unless noted otherwise.

2/ From Bureau of Labor Statistics of the US Dept. of Labor. Year 1967 is the base year. October or November indices utilized.

3/ Brackets indicate an estimate of the average price.

4/ Price to left of slash is tie price for fish harvested in the Copper River and Bering River district fish. Price to right of slash is the price for fish harvested in Prince William Sound.

5/ Approximate exvessel prices.

FOOTNOTE SOURCES

1/ Joint Federal-State Land Use Planning Commission for Alaska. 1974. Alaska Regional Profiles: Southcentral Region. University of Alaska, Arctic Environmental Information and Data Center.

2/ Data based on US Government census. Data provided by Linda, Leask, University of Alaska, Institute of Social and Economic Research.

3/ George Covel, USDA Forest Service, Cordova, personal communication, 1985.

4/ Dan Ketchum, Alaska Dept. of Natural Resources, Anchorage, 1986, personal communication.

5/ USDA Forest Service. 1983. Supplement to the draft environmental impact statement and draft forest plan and Nellie Juan-College Fiord wilderness study report. Admin. Doc. No. 116.

6/ Al Kimker, Alaska Dept. of Fish and Game, Homer, personal communication, 1985.

7/ Larson, D. 1980. 1979 Fisherman's Income Survey, Herring and Salmon Fisheries. Univ. of Alaska. Alaska Sea Grant Program. Rep. 80-5. Fairbanks. 20 pp.

8/ Alaska Dept. of Fish and Game. 1984. Commercial Finfish Regulations. Juneau. 118 pp.

9/ Adapted from Mills, M.J. 1985. Statewide Harvest Study - 1984 Data. Alaska Dept. of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1983-1984, Project F-9-16, 26 (SW-I-A). 88 pp.

10/ Mike McCurdy, Alaska Dept. of Fish and Game, Cordova, personal communication, 1985.

11/ Richard Randall, Alaska Dept. of Fish and Game, Cordova, personal communication, 1985.

12/ Paul McCollum, Valdez Fisheries Developement Assn., Valdez, personal communication, 1985.

13/ Bruce Suzumoto, Prince William Sound Aquaculture Corp., Cordova, personal communication, 1985.

14/ Tim McDaniel, Alaska Dept. of Fish and Game, Cordova, personal communication, 1985.

15/ Ken Roberson, Alaska Dept. of Fish and Game, Glennallen, personal communication, 1985.

16/ Jeff Koenings, Alaska Dept. of Fish and Game, Soldotna, personal communication, 1986.

17/ Adapted from Shepherd, B.G. 1984. The Biological Design Process Used in the Development of Federal Government Facilities During Phase I of the Salmon Enhancement Program. Canadian Tech. Rep. of Fish. and Aqua. Sci. No. 1275. 53 pp.

LITERATURE CITATION

Alaska Administrative Code. Private Nonprofit Salmon Hatcheries. 5 AAC 40.005--5 AAC 40.990.

Alaska Administrative Code. Port San Juan Salmon Hatchery Management Plan. 5 AAC 24.365.

Alaska Dept. of Fish and Game. FRED Directive No. 3. FRED Div. Juneau.

Alaska Dept. of Fish and Game. Regional Planning Team Charter. Juneau.

Alaska Dept. of Fish and Game. unpublished salmon distribution data. Div. of Comm. Fish. Cordova.

Alaska Dept. of Fish and Game. 1960-1973. Alaska Catch and Production, Commercial Fisheries Statistics. Statistical Leaflets. Div. of Comm. Fish. Juneau.

Alaska Dept. of Fish and Game. 1985. An Atlas to the Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes. Southcentral Region. Resource Management Region II. As revised March 29, 1985.

Blanchet, D. 1983. Chugach National Forest Environmental Atlas. USDA Forest Service, Alaska Region Rep. No. 124.

International North Pacific Fisheries Commission. 1974. Historical Catch Statistics for Salmon of the North Pacific. 2nd draft.

Joint Federal-State Land Use Planning Comm. for Alaska. 1974. Alaska Regional Profiles: Southcentral Region. Univ. of Alaska. Arctic Environmental Information and Data Center.

Larson, D. 1980. 1979 Fisherman's Income Survey, Herring and Salmon Fisheries. Univ. of Alaska. Alaska Sea Grant Program. Rep. 80-5. Fairbanks. 20 pp.

Mills, M.J. 1978 Alaska Statewide Sport Fish Harvest Studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1978-1979, Project F-9-11, 20 (SW-I-A). 122 pp.

Mills, M.J. 1980. Alaska Statewide Sport Fish Harvest Studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1979-1980, Project F-9-12, 21 (SW-I-A). 65 pp.

Mills, M.J. 1981a. Alaska Statewide Sport Fish Harvest Studies (1979). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22 (SW-I-A). 77 pp.

Mills, M.J. 1981b. Alaska Statewide Sport Fish Harvest Studies (1980). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22 (SW-I-A). 107 pp.

Mills, M.J. 1982. Alaska Statewide Sport Fish Harvest Studies (1981). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1981-1982, Project F-9-14, 23 (SW-I-A). 115 pp.

Mills, M.J. 1983. Alaska Statewide Sport Fish Harvest Studies (1982). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1982-1983, Project F-9-15, 24 (SW-I-A). 118 pp.

Mills, M.J. 1984. Alaska Statewide Sport Fish Harvest Studies (1983). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1983-1984, Project F-9-16, 25 (SW-I-A). 122 pp.

Mills, M.J. 1985. Statewide Harvest Study - 1984 Data. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1983-1984, Project F-9-16, 26 (SW-I-A). 88 pp.

Noerenberg, W.H. 1954. Prince William Sound Spawning Ground Survey, 1954. Univ. of Wash. Fisheries Research Institute. Circular No. 69.

Pirtle, R.B. 1977. Historical Pink and Chum Salmon Estimated Spawning Escapements from Prince William Sound, Alaska Streams, 1960-1975. Alaska Department of Fish and Game Technical Data Report No. 35. 332 pp.

Pirtle, R.B. 1976. Historical Catch, Escapement, and Related Commercial Fishery Statistics of Fish and Shell fish, Prince William Sound Area, Alaska. Alaska Department of Fish and Game Data Report No. 26. 92 pp.

Prince William Sound Regional Planning Team. 1983. Prince William Sound-Copper River Comprehensive Salmon Plan, Phase I - 20 Year Plan (1983-2002). 176 pp.

Randall, R., P. Fridgen, M. McCurdy and K. Roberson. 1982. Prince William Sound Area - Annual Finfish Management Report. Alaska Department of Fish and Game. Division of Commercial Fisheries. Cordova.

Randall, R., P. Fridgen, M. McCurdy and K. Roberson. 1983. Prince William Sound Area - Annual Finfish Management Report. Alaska Department of Fish and Game. Division of Commercial Fisheries. Cordova.

Randall, R., P. Fridgen, M. McCurdy and K. Roberson. 1984. Prince William Sound Area - Annual Finfish Management Report. Alaska Department of Fish and Game. Division of Commercial Fisheries. Cordova. 135 pp.

Randall, R., P. Fridgen, M. McCurdy J. Brady and K. Roberson. 1985. Prince William Sound Area - Annual Finfish Management Report. Alaska Department of Fish and Game. Division of Commercial Fisheries. Cordova. 151 pp.

Rich, W.H. and E.M. Ball. 1932. Statistical Review of the Fisheries, Part III: Prince William Sound, Copper River and Bering River. USDI Department of Commerce. Bureau of Commercial Fisheries. Bull. No. 7.

Simpson, R.R. 1960. Alaska Commercial Catch Statistics. Statistical Digest No. 50. US Fish and Wildlife Service. Bureau of Commercial Fisheries.

Thompson, S.H. 1964. The Red Salmon of the Copper River, Alaska. USDI Fish and Wildlife Service. Bureau of Commercial Fisheries. MR 64-12.

USDA Forest Service. 1983. Anadromous salmon habitat capability coefficients (memorandun).

USDI Fish and Wildlife Service. 1928-1950. Alaska Fishery and Fur Seal Industries.

PERSONAL COMMUNICATION

Covel, George, USDA Forest Service, Cordova, 1985.

Hepler, Kelly, Alaska Dept. of Fish and Game, Anchorage, 1985.

Ketchum, Dan, Alaska Dept. of Natural Resources, Anchorage, 1985.

Kimker, Al, Alaska Dept. of Fish and Game, Homer, 1985.

Koenings, Jeff, Alaska Dept. of Fish and Game, Soldotna, 1985 and 1986.

Maxwell, Carol, Alaska Dept. of Fish and Game, Cordova, 1985.

McCollum, Paul, Valdez Fisheries Developement Assn., Valdez, 1985.

McCurdy, Mike, Alaska Dept. of Fish and Game, Cordova, 1985.

McDaniel, Tim, Alaska Dept. of Fish and Game, Cordova, 1985.

Murray, Marnee, Alaska Dept. of Fish and Game, Cordova, 1985.

Pellissier, Rene, Prince William Sound Aquaculture Corp., Cordova, 1986.

Randall, Rich, Alaska Dept. of Fish and Game, Cordova, 1985.

Roberson, Ken, Alaska Dept. of Fish and Game, Glennallen, 1985.

Suzumoto, Bruce, Prince William Sound Aquaculture Corp., Cordova. 1985.