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Prince William Sound–Copper River Phase 3 Comprehensive Salmon Plan

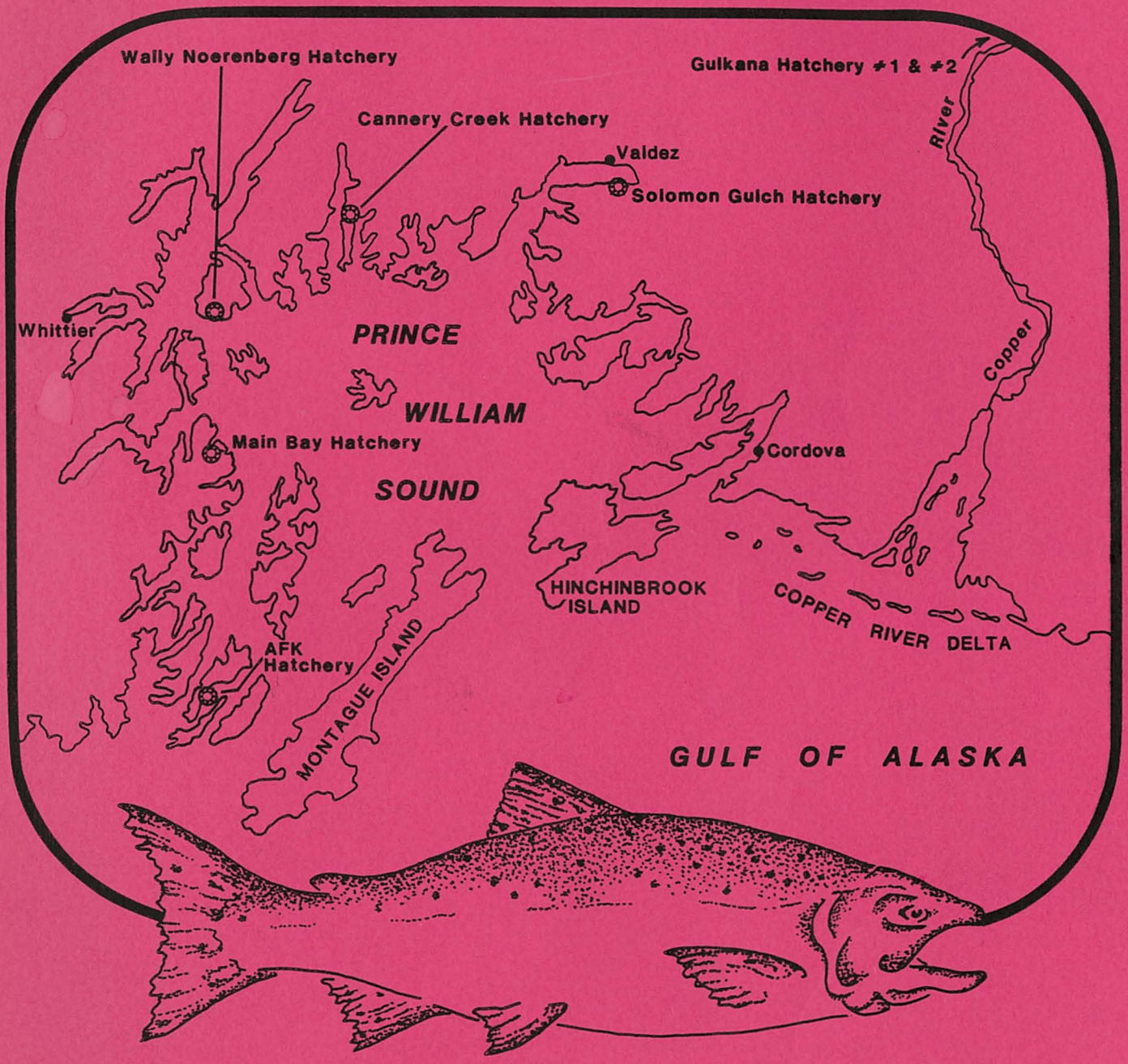
by

ADF&G Staff

October 1994

Alaska Department of Fish and Game **Division and Commercial Fisheries**

PRINCE WILLIAM SOUND - COPPER RIVER
PHASE 3
COMPREHENSIVE SALMON PLAN



PRINCE WILLIAM SOUND - COPPER RIVER
REGIONAL PLANNING TEAM

October, 1994

STATE OF ALASKA

WALTER J. HICKEL, GOVERNOR

DEPARTMENT OF FISH AND GAME

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October 3, 1994

Mr. Mark Willette
Chairman
Prince William Sound/Copper River
Regional Planning Team
P.O. Box 669
Cordova, AK 99574

Dear Mr. Willette:

This letter is to officially inform you and all members of the Prince William Sound/Copper River Regional Planning Team (PWS/CR RPT) of my approval of the PWS-CR Phase 3 Comprehensive Salmon Plan.

Prior to the submittal of the plan for my consideration, I have been informed that, in compliance with AS 16.10.375, the PWS/CR RPT distributed a public review draft in March 1994 to more than 120 individuals, organizations and agencies, and solicited public comments on proposed revisions through published notices in regional newspapers, public notices posted throughout the region, and a scheduled PWS/CR RPT meeting that occurred in Cordova in May 1994 to address comments and questions. The plan has also undergone complete technical reviews by staff from the Alaska Department of Fish and Game (i.e., Commercial Fisheries Management and Development, Sport Fish, Subsistence, and Habitat Divisions) and the U.S. Forest Service. I am confident that the PWS/CR RPT has been responsive to the comments and suggestions resulting from this thorough review process.

Based on the efforts of the PWS/CR RPT in preparing this plan and comments I have received on the quality of those efforts, I believe a viable and responsible document has been produced for the Prince William Sound/Copper River region that emphasizes using biology, land, engineering, financial, and public input to enhance its fisheries resources and equitably provide benefits to all user groups. Therefore, I offer my congratulations to you and all members of the team, and my appreciation for your cooperation with the department and myself in producing phase three of this comprehensive plan.

Sincerely,

Carl L. Rosier
Commissioner

cc: ADF&G Division Directors
PWS/CR RPT Members

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PHASE 3 COMPREHENSIVE SALMON PLAN

PREFACE

The Prince William Sound / Copper River Regional Planning Team (PWS/CR RPT) presents the Phase 3 Comprehensive Salmon Plan for Prince William Sound and the Copper River, including associated drainages. Prince William Sound (PWS) and the Copper River/Bering River systems constitute fishery management Area E.

This report and project recommendations update the Area E Phase 1 (PWS/CR RPT, 1983), and Phase 2 (PWS/CR RPT, 1986) plans. It is not the intent of this report to reiterate historic fisheries data. Rather, this report focuses on contemporary issues and actions recommended to achieve a healthy future salmon fishery. Issues which must be tackled including fisheries development, stability, diversification, marketing, management, research and funding, are discussed integrally with production objectives.

For information pertinent to the historic salmon fishery in Area E, you are referred to the PWS/CR Comprehensive Salmon plans, Phase 1 and Phase 2, Salmon Aquaculture Program (Prince William Sound Aquaculture Corporation [PWSAC], 1975), as well as Reports 1 and 2 (PWSAC ATF, 1990) prepared by the Enhanced Salmon Allocation Task Force (ATF) appointed by Prince William Sound Aquaculture Corporation (PWSAC), the regional aquaculture association.

While offering direction in the form of fishery goals and production objectives for Prince William Sound, the Phase 3 plan only reports on the status of the Copper River system, which may be the subject of future planning.

This report is presented as a guideline for salmon fisheries development and is subject to annual review and revision based on changing conditions in the fishery.

REGIONAL PLANNING TEAM MEMBERS

The PWS/CR RPT consists of six voting members, a non-voting Chairman and non-voting ex-officio members as designated by the Chair. Three team members are appointed by the ADF&G Commissioner, and three members are appointed by the Board of Directors of regional aquaculture association. The PWS/CR RPT members and chairman are:

James Brady	ADF&G Division of Commercial Fisheries Management and Development
Tim McDaniel	ADF&G Division of Commercial Fisheries Management and Development
Kelly Hepler	ADF&G Division of Sport Fish
John McMullen	Prince William Sound Aquaculture Corporation (President)
Armin Koernig	Prince William Sound Aquaculture Corporation (Board Director)

Emil Nelson	Prince William Sound Aquaculture Corporation (Board Director)
Mark Willette	ADF&G Division of Commercial Fisheries Management and Development, Chairman of the PWS/CR RPT

Alternate members are appointed to fill vacant or absent seats. Alternates for ADF&G and PWSAC are:

Wayne Donaldson	ADF&G Division of Commercial Fisheries Management and Development
Mark Willette	ADF&G Division of Commercial Fisheries Management and Development
Craig Whitmore	ADF&G Division of Sport Fish
Kathy Halgren	Prince William Sound Aquaculture Corporation (current)
Tom Kohler	Prince William Sound Aquaculture Corporation (1989 to 1993)
Bob VanBrocklin	Prince William Sound Aquaculture Corporation (1990 to 1993, deceased)

Ex-officio members include:

David Schmid	US Forest Service
Kate Wedemeyer	US Forest Service
Jody Seitz	ADF&G Subsistence Division
Dave Cobb	Valdez Fisheries Development Association

Staff:

Howard Ferren	Prince William Sound Aquaculture Corporation

The PWS / CR RPT would like to recognize Mr. Ken Florey, Regional Manager, Division of Commercial Fisheries Management and Development ADF&G, for his past participation on the RPT and his commitment to the regional comprehensive salmon planning process.

EXECUTIVE SUMMARY

The Prince William Sound / Copper River Regional Planning Team (PWS/CR RPT) has been charged with the task of developing a third generation comprehensive salmon plan for the Prince William Sound/Copper River region. Focused on optimum production and sustained yield, the RPT has adopted as the purpose for the Phase 3 Plan, to:

> **...achieve optimum production of wild and enhanced salmon stocks on a sustained yield basis through an integrated program of research, management, and application of salmon enhancement technology, for the benefit of all user groups.**

GOALS

The plan establishes three fishery goals which are founded in the regional allocation and management plans, as well as necessitated by the economic realities of the Area E fishery and enhancement program.

1. Increase fishing opportunities for salmon resource users.

2. Achieve equitable allocation of the harvestable surplus of wild and enhanced salmon, while minimizing changes to historic fishing patterns.

3. Achieve an economically self-sustaining fishery.

The goals must be achieved within a series of regulations, biological and financial constraints, and through adherence to those principles which guide hatchery operators and their government and industry partners.

FISHERIES MANAGEMENT OBJECTIVES

Prince William Sound salmon managers deal with mixed stock / mixed species fisheries where hatchery stocks often out number wild stocks. Consequently, stock identification programs are central to management success, which is gauged in terms of sustained yield of wild stocks.

The PWS fishery manager, while conducting the commercial harvest, must balance competing interests for: (1) wild stock escapement requirements, (2) hatchery cost recovery and brood stock needs, and (3) an orderly common property harvest of the highest possible quality. Paramount of these is the requirement to sustain the long term health and yield of the Sound's wild stocks of salmon.

OPTIMUM PRODUCTION

The concept of optimum production incorporates a blend of biological requirements for maximum sustained yield of wild stocks and the biological and economic requirements for optimum production of enhanced stocks.

The PWS/CR RPT recommends that five biological and economic criteria be employed to recognize optimum production as the hatchery program in Prince William Sound is further developed and fine tuned:

1) wildstock escapement goals must be achieved over the long term;

2) the proportion of hatchery salmon straying into wild-stock streams must remain below 2% of the wild-stock escapement over the long term;

3) the growth rates of juvenile salmon during the early marine period must be density independent over the long term;

4) the abundance of juvenile salmon predators must be independent of juvenile salmon abundance over the long term; and

5) the long-term average cost of hatchery operation, management, and evaluation must remain below 50% of the value of hatchery production.

PRODUCTION RECOMMENDATIONS

Guided by these criteria, the RPT recommends a refined and deliberate scope of production and release objectives which include:

1. broaden the run timing of the pink salmon return to better match production with harvest and processing capacity;

2. remote release some current, and any increases in Wally Noerenberg Hatchery chum salmon production, outside of the Esther Subdistrict to minimize increases in the exploitation rate on wild stocks returning to the Northwestern and Coghill districts;

3. shift emphasis in sockeye salmon production to an earlier run timing (Eyak stock) to minimize increases in the exploitation rate on wild stocks migrating through the Eshamy District;

4. remote release any increase in sockeye salmon production in the middle run timing (Coghill stock) to minimize increases in the exploitation rate on wild stocks migrating through the Eshamy District;

5. remote release early pink salmon production at the Solomon Gulch Hatchery outside of Port Valdez to improve product quality and reduce exploitation on wild stocks;

6. maintain current levels of coho and chinook production for sport fisheries.

These objectives are to be tempered within the framework of mixed stock fisheries management. The concept of "optimum production" describes a blend of natural and supplemental production, which cannot occur without an integrated management program. The PWS fishery manager, while conducting the commercial harvest, must

balance competing interests for: (1) wild stock escapement requirements, (2) hatchery cost recovery and brood stock needs, and (3) an orderly common property harvest of the highest possible quality. Paramount of these is the requirement to sustain the long term health and yield of the wild stocks of salmon.

Because the salmon enhancement program within the Prince William Sound - Copper/Bering rivers area is well advanced, the Phase 3 Plan attempts to identify the most promising enhancement opportunities which remain given the various guidelines and constraints that effect the program.

The current level of enhanced salmon production returning to hatchery facilities has added to the complexity of managing the wild salmon mixed stock fishery. Consequently the Phase 3 plan does not recommend significant increases in adult returns to these facilities. Rather, the plan points towards opportunities that may be provided in various remote release locations throughout the Prince William Sound. A remote release location may involve the same impacts and concerns as would the establishment of a hatchery facility at that location. Potential remote release locations were analyzed based upon a number of factors including management considerations as assessed by overlap in run timing with local wild stocks, and genetic effects which may result from straying. Management considerations were judged to be more favorable when run timing overlap with local wild stock production was minimal, thus minimizing potential for mixed stock interception problems. Genetic factors were judged most favorable when there was total isolation, (i.e. no chance of interbreeding) or when local brood stocks were selected.

The plan identifies the remote release locations that hold the most promise for future production, by minimizing the wild stock management and genetic concerns. Twenty three potential remote release sites were analyzed in the plan. Some of the sites that hold most promise include, North Montague Island, Barry Arm, Kings Bay, and Naked Island.

The production goals identified in the plan are summarized in the following table. These goals are intended to set the upper limit to enhanced production for Prince William Sound for the foreseeable future. The attainment of these goals will be greatly influenced by the accuracy of biological assumptions made in this plan, the amount of capital available in the future, and future market conditions. Biological assumptions will be tested by evaluation studies, which under developing policy, must precede the approval of new or expanding enhancement projects.

HABITAT PROTECTION, ENHANCEMENT AND WILD STOCK REHABILITATION

Hatchery production is the primary enhancement tool in Prince William Sound, but wild salmon stocks will continue to play an important role in future program development. ADF&G's statutory responsibility to protect wild stocks provides the basic groundwork on which all enhancement activities are built. Habitat enhancement and wild stock rehabilitation projects discussed in this plan will not result in significant increases in salmon production. However, coupled with effective management and evaluation programs, these activities are important for maintaining the health of wild stocks to achieve optimum sustained production.

PWS Enhanced Salmon Production Goals

(in millions of adult fish and green eggs)

Stock	Facility	Current permitted eggs \1	Current incubator space \2	Current + 10 yr eggs \3	Current adults \4	+ 10 yr projected adults
Early pink	VFDA	230.00	230.00	230.00	8.07	8.07
	WNH	0.00	0.00	252.00	0.00	12.00
	Total	230.00	230.00	482.00	8.07	20.07
Late pink	AFK	190.00	126.00	190.00	5.73	8.60
	WNH	211.00	188.00	211.00	8.94	10.00
	CCH	147.00	152.00	207.00	6.10	8.30
	Total	548.00	466.00	608.00	20.77	26.90
Early chum	WNH	111.00	111.00	302.00	1.98	5.40
	Total	111.00	111.00	302.00	1.98	5.40
Late chum	VFDA	18.00	18.00	36.00	0.19	0.40
	AFK	13.00	0.00	0.00	0.00	0.00
	CCH	5.00	0.00	0.00	0.00	0.00
	Total	36.00	18.00	36.00	0.19	0.40
Sockeye						
Eyak (early)	MBH	0.10	0.10	10.64	0.01	1.50
Coghill (middle)	MBH	5.10	5.10	7.97	0.72	1.12
Eshamy (late)	MBH	2.10	2.10	4.26	0.30	0.60
	Total	7.30	7.30	22.87	1.03	3.22
Coho	VFDA	2.00	2.00	2.00	0.11	0.11
	WNH	4.00	2.50	2.50	0.18	0.18
	Total	6.00	4.50	4.50	0.29	0.29
Chinook	VFDA	0.30	0.00	0.00	0.00	0.00
	WNH	4.00	1.00	1.00	0.03	0.03
	Total	4.30	1.00	1.00	0.03	0.03

(\comppln\prodgoal.wk1)

\1 Current green egg permits issued to PNP programs in PWS.
\2 Green egg incubation space currently available in existing facilities.
\3 Eggs required to be permitted within 10 years to meet production goals.
\4 Adult salmon which could be produced based on current incubation space and rearing assumptions.

Protection of marine and terrestrial habitats is vital to the health and productivity of both wild and hatchery fish. We must recognize optimum production is based on the quality of these habitats. Natural disasters and man caused pollution and habitat alteration must be anticipated with concern, action and mitigation if we are to maintain our salmon stocks.

SECTION 2 REPORT: COPPER / BERING RIVERS

The Copper River/Bering River information report, section 2 of the Phase 3 Plan, documents historic and current production levels, and user participation in the commercial, sport, subsistence and personal use fisheries.

Fisheries development is complex and guided within a framework of regulations, biological feasibility and economic feasibility. It is weaving together these and other issues into a framework of logic and simplicity that is difficult and necessary, inorder to comprehend the interrelationships of elements of this plan and the need to move forward with initiating its recommendations. The plan, at best, attempts to integrate these elements through its sequence of discussions, analysis of interrelationships, and recommendations.

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SECTION 1

PRINCE WILLIAM SOUND

REPORT AND RECOMMENDATIONS

SECTION 1

PRINCE WILLIAM SOUND

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PURPOSE

Achieve optimum production of wild and enhanced salmon stocks on a sustained yield basis through an integrated program of research, management, and application of salmon enhancement technology, for the benefit of all user groups.

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1.00 INTRODUCTION

1.10 FISHERIES DEVELOPMENT

The Senate Advisory Council of the Alaska State Legislature reiterated in 1987 that "Alaska's fisheries are the backbone of its renewable resource economy" (Senate Advisory Council Alaska State Legislature, 1987). This has been fundamental since Alaska fisheries beginnings in the late 1800's through territorial days, and was a major factor in establishing Alaska statehood.

The major thrust of Alaska's salmon fishery development has been to conserve wild stocks while enhancing production to provide stability to the industry and increased economic benefit. Policy driving this thrust is derived from Alaska's constitution which provides for fisheries utilization, development and conservation for the maximum benefit of the people.

Fisheries development encompasses social, cultural, recreational and commercial needs. Conservation of the resource has priority and underlies all development recommendations. The core of the PWS Phase 3 Comprehensive Plan is commercial development which, in the long run, is intended to fulfill other cultural and social needs.

> "Fishery development is clearly a part of economic development that is fostered by all governments. As such an activity, its goal is to increase the social benefits from the fisheries which, in the long term, must include their conservation." (Royce, 1987)

The State of Alaska re-emphasized the essence of wild stock conservation in SB 457 (State of Alaska 17th Legislature, 1992). This bill states "fish stocks in the state shall be managed consistent with sustained yield of wild fish stocks". However, the Legislature further recognized the integral role of hatcheries in the over-all fishery program by directing the Board of Fisheries to "consider the need of fish enhancement projects to obtain brood stock" in allocating enhanced fish stocks, and to "direct the department to provide a reasonable harvest of fish...to obtain funds for the enhancement project if the project is consistent with sustained yield of wild fish".

1.11 STABILITY

Stability in the fishery implies "a predictable biological and economic situation" (Senate Advisory Council Alaska State Legislature, 1987). The economic base of fisheries, however, is highly volatile and has generally operated in a 'boom and bust' environment. This lack of stability is generally debilitating to the industry and to those communities dependent upon it.

> "Dramatic fluctuations in resource availability, changing foreign exchange rates, and the lack of diversified markets, to name but a few examples, result in equally dramatic fluctuations in employment and income for industry participants and communities. As a result, there is no real economic stability for those involved and dependent upon the industry." (Fisheries Policy Task Force, 1983)

The basis for Alaska's salmon enhancement is to provide stability through more predictable production than that historically achieved in wild stock systems.
A predictable economic "situation" is another matter altogether. "Given the stress on many of our traditional fisheries, the developing gear conflicts, and changing market conditions, choices must be made in the management of our fisheries today that include economic considerations." (Fisheries Policy Task Force, 1983)

One "key to financial stability in Alaska's fishing industry is diversification" (Fisheries Policy Task Force, 1983).

1.12 DIVERSIFICATION

Diversification is a fundamental investment strategy which is intended to reduce risk. When employed in fisheries production, diversification in species, run timing and harvest opportunity reduces economic risk by offering multiple products at different times of the season, thereby expanding market possibilities.

1.13 MARKETING AND ECONOMICS

Recent declines in salmon value emphasize the need for expanding "markets" and "marketing" as additional key areas for successful fishery development. The economic down side of high, stable production cannot be corrected simply through species and run timing diversification. New markets must be pursued to achieve economic stability. Complacency, lack of policy, and unknown external controlling factors may be responsible for marketing inadequacies. It was emphasized early in Alaska's salmon fishery development program: "the importance of marketing relative to development, diversification and stabilization cannot be understated" (Fisheries Policy Task Force, 1983). This is still true today and an area which requires continued attention.

Alaska investment in marketing falls far short of competitor commitments. Alaska's $6 million commitment to marketing dims in comparison to Norway's $11 million or the $20 million combined figure of leading world producers (Alaska Seafood Marketing Institute, 1991).

Steps must be taken to integrate marketing with fishery planning and management of the resource to assure realization of fishery development.

1.14 MANAGEMENT

In keeping with the philosophy that integrating different sector goals and strategies will provide for successful fishery development, the State must also provide management strategies that coordinate these goals. Management strategies must address enhancing economic benefit and allocating opportunity to beneficiaries in addition to the state's mandated responsibility for conserving the salmon resource and managing for its utilization and development.

> "...it is readily apparent that the State must develop a plan for the management of its salmon resources that integrates the management goals of wild salmon stocks with the production of hatchery salmon in such a manner that will produce the

maximum economic benefits for the industry and the people of the State. This salmon management plan must therefore incorporate economic as well a biological goals and must include consideration of supply and demand impacts on market conditions." (Fisheries Policy Task Force, 1983)

Nearly a decade has lapsed since this course of integrated and coordinated fisheries development was recommended.

In Area E, salmon resource users, managers and enhancement programs have been successful in preparing fishery plans that incorporate production with allocation and management of the fishery. Conservation of the resource has been reemphasized. Planned economic benefit resulting from negotiated fishing opportunities has been approved by users. Strategies to manage the fishery to achieve gear group allocations while maintaining high fish product quality are being constantly refined. Efforts of the PWS Salmon Harvest Task Force, PWSAC Production Planning Committee and Allocation Task Force focus energies and commitment to achieve the full benefits of fisheries development. Coupled recently with new and reinvigorated marketing efforts, further strategies will unfold to provide guidelines to manage the fishery to fulfill the level of conservation, utilization and development envisioned in Alaska's Constitution.

1.15 IMPLEMENTATION

The Governor's Fishery Policy Task Force (1983) concluded that a "fisheries management policy which stated specific and measurable goals, both in terms of stock conservation and economic and social benefits, was necessary for the long term good of the state." Policy "should include a plan of implementation" (Senate Advisory Council Alaska State Legislature, 1987).

In Area E, Phase 1 and Phase 2 Comprehensive Salmon plans listed identifiable and quantifiable enhancement and fishery objectives. Implementation plans were developed resulting in today's achievements in production. These efforts have elevated Prince William Sound to one of the world's premier salmon aquaculture centers.

The next development step logically leads to reassessing and redefining goals and objectives for Area E. A plan of implementation must follow so the progress made to date in the PWS/CR salmon fishery can continue.

The state further needs to assume leadership in defining direction. "The fundamental problem may be that the State of Alaska has no concrete comprehensive long term policy to guide the conservation and development of the fisheries" (Senate Advisory Council Alaska State Legislature, 1987). It was subsequently noted that an assortment of state policies directly and indirectly affecting community fisheries development and the absence of a comprehensive management and development plan are obstacles to rational progress (Senate Advisory Council Alaska State Legislature, 1989).

The plan set forth under the title of the PWS/CR Comprehensive Salmon Plan, Phase 3 brings us a step closer to rational development of the Area E fisheries.

1.16 CURRENT INDUSTRY EVOLUTION

Alaska's historic dominance in worldwide salmon production has been affected by factors such as significant increases in enhanced salmon production in South America, increasing market share of farmed salmon and corresponding record setting harvests of wild and enhanced salmon in Alaska. The Alaska salmon industry is faced with the challenge of maturing from traditional corporate theory and practices governing industry management, production and processing techniques to more contemporary business tactics which involve vertical integration and value added production that have benefited our European and Asian competitors.

Professor James E. Lannan states "Future trends in salmon production are less likely to be determined by technical considerations than by marketing factors and a plethora of institutional concerns..." (Lannan, 1988).

Success of the Phase 3 plan is predicated on maturation of the industry and integrated coordination of industrial sectors: management, research, production, processing and marketing. The future, however, cannot be achieved without information and cost.

1.17 RESEARCH

The future of the Alaska salmon industry must be built on a foundation of knowledge. Research can provide the information needed to develop this knowledge. We have learned that under predictable environmental conditions production can be greatly increased and annually stabilized to support industry and user needs. Fish culture and fundamental, practical, biological research contributed to these advances in salmon aquaculture. It is imperative that research not stop at this level.

Research must encompass biological and ecological issues including: migratory research, stock identification and recovery programs; stock forecasting research; ocean condition research; habitat research; stock origin and genetic research; reproduction and life cycle research; early life history and stock interaction research. Efforts must also be furthered in product development, market and economic investigations.

We can also learn from others' experiences to provide focus to our research. However, knowledge we gain can lead us to infer and establish plans of action which "may conflict with existing conditions or result in incongruities between management realities and...theories" (Rutledge and McCarty, 1989). The PWS/CR RPT recognizes there are both biological and social/economic systems to plan and manage for.

Again, the PWS/CR RPT supports a wild stock conservation priority. We must be certain that in our efforts to meet user needs by developing the fishery that production and harvest strategies minimize impacts to wild stocks.

1.18 FUNDING

Finally, the Phase 3 Plan cannot progress without necessary financial support. As programs select and implement project recommendations, the integrated workings of research, product development, marketing and economic impact analysis must be put

into place. This will require coordination between agencies and organizations involved in both the activities and the essential funding.

As state revenues decline from depleted non-renewable resources, "...increases in both the value of fishery resources and fishery revenues, will insure that fisheries will play even greater roles in the state economy in the future. Meaningful levels of funding for fishery research and management activities are now more important than ever so that these resources can be used wisely and in the best economic interests of the residents of Alaska." (Kruse, 1988)

1.20 FEASIBILITY

Hatchery production of salmon in Prince William Sound is at the present time accomplished entirely by the non-profit (PNP) corporations which operate in an environment of biological, financial and political uncertainty.

If the PNP salmon enhancement program in Prince William Sound is to achieve long term biological and financial success, a number of prerequisites must be recognized and met.

1.21 REGULATORY ENVIRONMENT

The PNP program was created as a fisheries and social approach to resource and regional economic development, and is guided and controlled by state and federal statutes, regulations and policies which are becoming increasingly restrictive.

Ocean ranching involves the release of fry and smolts into public waters to rear together with wild salmon in nearshore and offshore environments. Hatchery production numbers and releases are strictly controlled. All returning wild and hatchery salmon are managed as common property in accordance with law and fisheries regulations. This program of common property resource enhancement for limited entry fisheries relies upon a positive political environment for its existence.

1.22 BIOLOGICAL CONSTRAINTS

Increases in enhanced salmon production in Prince William Sound are possible only if shown to be biologically feasible. Intensified research is being integrated into the enhancement program to detect impacts on wild stocks and ecosystem carrying capacities, and thereby will determine upper levels of hatchery production, by species.

New and required research will determine the feasibility of improving the enhancement program through species diversification and run timing selection of enhanced stocks, and the use of remote release locations to better utilize food supplies and decrease hatchery and wild stock interactions. Harvest studies are intended to document variations in ocean survival of enhanced fish released at various locations and also provide fisheries managers with added in-season information with which to achieve desired escapements of wild stocks. The ADF&G and the PNP's share funding responsibilities for hatchery related research, which is now a condition of permitting.

1.23 FINANCIAL NEEDS

PNP operators not only must maintain financial feasibility, but must provide net economic benefit to the entire salmon industry. Financial feasibility for a PNP corporation is achieved when revenues from the sale of its cost recovery fish equal program cost. Enhancement tax receipts, grants and other program receipts may also contribute to the financial stability of a PNP organization.

Inflation, lag time in realizing the results of changes in species composition, fluctuations in ocean survivals and value of marketed salmon are all variables which influence the financial feasibility of the PNP program. In addition, new demands for evaluation of wild and hatchery stock interactions and the impact of enhancement activities on the marine environment contribute to increases in the cost of the enhancement program.

Increases in the allocation of hatchery returns for cost recovery is not a preferred means of maintaining financial stability. That action results in loss of net benefit to fishermen along with their support of the program.

Financial feasibility may be possible in some years, but not in others due to fluctuations in run sizes and market prices. Therefore, financial strategies must be developed to effectively deal with the cyclic nature of the fisheries. Program costs must be held in check and cost recovery salmon must be utilized in a manner that achieves best possible price such as production of value added food products.

1.24 PNP HATCHERY OPERATOR'S ABILITIES AND RESPONSIBILITIES

In selecting hatchery sites, primary consideration must be given to the available fresh water quality, quantity and temperature regimes suitable for brood maturing, incubation and rearing of the chosen quantities and species of salmon to be produced.

Fry and smolt release sites at the hatchery or at remote locations must, among other conditions, be sufficiently productive to support the specie(s) and numbers of juveniles released.

Hatchery harvest areas and enhanced salmon run timing must be selected in such a way that fisheries on adult returns of wild and enhanced stocks can be managed to achieve wild stock escapement needs, regardless of run strength of wild and hatchery fish, and that brood stock and corporate cost recovery goals of the hatchery operator can be met.

It is important that Boards of directors of PNP corporations are cohesive, knowledgeable and common goal-oriented, and that they make informed decisions with long range validity.

The PNP hatchery operators must be proficient in fisheries biology and fish culture technology. They must exercise responsible financial management, maintain continued communications with the appropriate branches of government, the scientific community, user group constituents and industry participants and use good business practices to provide for internal corporate stability and cost-effective operations.

1.25 GOVERNMENT AND INDUSTRY PARTNERSHIP

Government, PNP's, fishermen and salmon processors are industry partners. The salmon enhancement program is dependent on the combination of policies, regulations and business decisions enacted by each of the partners. Given the biological uncertainty of salmon returns and the continuous price fluctuations in world salmon markets, our salmon fisheries and the PNP enhancement program will be at risk if the partners are unwilling or unable to provide regulatory and financial stability for all segments of the industry.

1.30 EXXON VALDEZ OIL SPILL

On March 24, 1989, the EXXON VALDEZ ran aground on Bligh Reef in eastern Prince William Sound, spilling 11 million gallons of Alaska North Slope crude oil into the marine waters. Wind driven currents and tides spread the oil over vast areas of Prince William Sound and other reaches of the North Gulf Coast while leaving masses of oil and residues on beaches, tidelands and the benthos.

Immediate impacts within the spill area were observed in bird and marine mammal mortality associated with oil contact. Oil contact and beach cleaning further resulted in impacts to intertidal and subtidal communities.

Natural Resource Damage Assessment studies conducted by the State and Federal governments have demonstrated egg mortality, fry deformities, and reduced growth in juvenile pink salmon in Prince William Sound. Oil contamination in intertidal salmon spawning beds caused direct egg mortality and fry deformities in 1989 and 1990. Up to 75% of the pink salmon in Prince William Sound spawn in intertidal habitats. As the years passed after the spill, egg mortality in oiled streams persisted due perhaps to genetic damages resulting from exposure of the parent generation. Reduced growth of juveniles in oiled areas in 1989 likely caused reduced fry-to-adult survival of both wild and hatchery salmon. Wild populations of pink salmon do not appear healthy and have likely declined as a result of the spill, although there is uncertainty as to the full extent and mechanisms of injury. Damage assessment studies focused primarily on pink salmon, but wild chum salmon that rear in oiled areas probably incurred similar damages.

1.31 OIL SPILL IMPACTS TO SALMON RESOURCE AND NEED FOR FURTHER RESEARCH

Faced with potentially broad scale and long term damage to the salmon resources in Prince William Sound, particularly to pink salmon, research must move forward quickly and thoroughly to determine the extent of damage as well as the mechanisms through which the ecosystem and damaged resources are affected. This information is needed to develop effective restoration programs for the salmon resources in PWS.

Recent EVOS Trustee Council funding of the SEA (Sound Ecosystem Assessment) integrated research program is an important step towards developing a better understanding of the extent of oil damage and the mechanisms which distribute impacts throughout the ecosystem.

1.32 REPLACEMENT OF LOST SERVICES (SALMON RESOURCES)

Driving the Phase 3 Plan is the need "to achieve optimum production of wild and enhanced salmon stocks on a sustained yield basis through an integrated program of research, management, and application of salmon enhancement technology, for the benefit of all user groups".

We have reviewed criteria prerequisite for successful fisheries development and highlighted the regulatory, biological, environmental, financial, technological and hatchery/government partnering necessary for feasibility of the salmon program. However, faced with possible ecosystem and genetic damage resulting from the 1989 oil spill, all the planning and program development that has to date been supported may not achieve the sustainable level of optimum production needed to provide viable benefits to the resource users without replacement of lost resources.

2.00 ALASKA ENHANCEMENT SYSTEM

Alaska was granted statehood January 3, 1959. Local control and conservation of state salmon resources were the principal driving forces behind this initiative. The Alaska Department of Fish and Game was created and took management control of the state's fishery resources in 1960, guided by policy mandates in the Constitution, and as directed under Title 16 of Alaska Statutes. Under these statutes, Sec. 16.05.020. Functions of the Commissioner, he shall... *"2) manage, protect, maintain, improve, and extend the fish, game and aquatic resources of the state in the interest of the economy and general well-being of the state."*

2.10 FRED DIVISION, ALASKA DEPARTMENT OF FISH AND GAME

The need to address depressed salmon stocks resulted in statutory and regulatory changes including the addition of the Fisheries Rehabilitation, Enhancement and Development (FRED) Division within the Department of Fish and Game (1971). F.R.E.D. is directed under Section 16.05.092. Duties of division of fisheries rehabilitation, enhancement and development... *"3) through rehabilitation, enhancement and development programs do all things necessary to insure perpetual and increasing production and use of the food resources of Alaska waters and continental shelf areas;".*

NOTE: Following a series of record salmon returns in the 1980's, the FRED Division was dissolved by Executive Order in 1993.

2.20 PRIVATE NONPROFIT HATCHERIES AND REGIONAL ASSOCIATIONS

Additional fisheries conservation and development measures include limited entry (1972), and the Nonprofit Hatcheries Act (State of Alaska, 1974). Section 1 ch 111 SLA 1974 provides:

> *"It is the intent of this act to authorize the private ownership of salmon hatcheries by qualified nonprofit corporations for the purpose of contributing, by artificial means, to the rehabilitation of the state's depleted and depressed salmon fishery. The program shall be operated without adversely affecting natural stocks of fish in the state and under a policy of management which allows reasonable segregation of returning hatchery-reared salmon from naturally occurring stocks."*

The Nonprofit Hatcheries Act allows for permits to be issued by the Commissioner of ADF&G to private non-profit (PNP) hatchery corporations for the operation of salmon hatcheries for the purpose of ocean ranching.

Regional Associations were developed as an instrument of the Nonprofit Hatcheries Act to assist region wide coordination between hatchery programs and salmon resource users. Under Title 16. Sec. 16.10.380. Regional associations., *"the commissioner shall assist and encourage the formation of qualified regional associations for the purpose of enhancing salmon production."* Criteria for such associations include that it be comprised of representatives of commercial fishermen and other interested user groups in the region, and that its board of directors include no less than one representative of each user group belonging to the association.

2.30 REGIONAL PLANNING TEAMS (RPT)

To plan the salmon enhancement objectives for specific fishery regions, regional planning teams were mandated. Sec. 16.10.375., *"...comprehensive (regional) salmon plans shall be developed by regional planning teams consisting of department personnel and representatives of the appropriate qualified regional associations..."*. Regional planning teams consist of six members: three ADF&G members appointed by the Commissioner of Fish and Game, usually representing the regional Commercial Fisheries, F.R.E.D. and Sport Fish Divisions of the Department, and three members appointed by the Board of Directors of the regional aquaculture association. The RPT elects a chairman as a seventh, but non-voting member, and ex-officio, non-voting members as may be recognized by their affiliations, such as representatives from the US Forest Service.

The RPT:

1. develops and recommends regional comprehensive salmon plans for approval by the Commissioner of ADF&G;

2. solicits public input and arranges for public review of the plans throughout the region;

3. reviews and comments on hatchery permit applications and other proposed enhancement and non-regulatory rehabilitation projects, and

4. reviews and comments on proposed hatchery permit suspensions and/or revocations.

2.40 PROJECT EVALUATION

The RPT develops regional production goals describing the fishery by species, area and time (**5 AAC 40.340**). PNP operators take direction from these regional goals in developing project specific production plans. PNP applications for hatchery permits, permit alteration requests (PAR), and fry transport permits (FTP) to implement such projects, are subject to RPT review and recommendation. Further application analysis is conducted by the Department. Final authority for permitting rests with the Commissioner. These steps are intended to assure a comprehensive approach to implementing programs tied to goals having a region wide perspective.

Keeping in mind various biological and management constraints, as well as regional fishery development goals, the RPT reviews and evaluates projects, basing their recommendations to the Commissioner on various criteria. Hatchery permit application review by the Regional Planning Team is subject to **5 AAC 40.170**, wherein review criteria are established. The RPT shall use the following criteria:

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.

In addition to statutory criteria, the PWS/CR RPT has developed additional criteria to evaluate project applications. These criteria are specifically intended to:

a) provide guidance to applicants in developing projects to assure that a clear and comprehensive understanding of project development and fishery development is reached; and,

b) that regional implications are investigated, understood and compatible with regional goals.

Many of these PWS/CR RPT specific evaluation criteria stem from 5 topic areas of concern including: production feasibility, allocation implications, management of the fishery, biological considerations, and resultant program benefits compared to program costs.

Specifically,

1. Production feasibility:
   - does the project require new technologies;
   - does the project change the existing facility (physical plant), or is it a new facility;
   - does it fully utilize the sites potential;
   - is expertise available to the program to develop a successful project;
   - will it be funded.

2. Allocation
   - is the project consistent with the regional allocation policy;

3. Management
   - can management still achieve wild stock escapement with this project in place;
   - is there a stock identification program and what are possible stock impacts;
   - can the project be managed for corporate escapement;
   - can the harvest be managed for quality.

4. Biological
   - will the project conform with State genetic policy;
   - what are possible impacts resulting from early marine life history;

- how will the project impact ecosystem carrying capacity.

5. Benefit/cost
   - will the project result in a benefit/cost ratio of 2.3:1 or greater;
   - what is the anticipated ex-vessel price of the production;
   - what are the fishery management costs;
   - what are the costs of harvesting the fish;
   - what are capital and operating costs of the program;
   - what are additional benefits derived such as "value" to sport and subsistence users.

Applicants are encouraged to use the PWS/CR RPT Project Criteria Checklist (APPENDIX 2) to develop this information which is discussed by the RPT as part of the internal review process. By developing such a base of comprehensive information, hatchery operators will have a better understanding of their role in regional fisheries development.

2.50 REGIONAL PLANS

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."*

Comprehensive plans have evolved into 3 basic components:

1. Phase 1: a comprehensive 20 year plan;

2. Phase 2: a 5 year plan focusing on specific project planning;

3. plan maintenance: an annual review of regional accomplishments and listing of new recommendations that may further the goals of the region.

3.00 PRINCE WILLIAM SOUND / COPPER RIVER ENHANCEMENT SYSTEM

Late in 1974, in the Prince William Sound and Copper-Bering rivers commercial fishery management area (Area E), an ad hoc committee of the local fishermen's organization, Cordova Aquatic Marketing Association (CAMA), incorporated Prince William Sound Aquaculture (PWSAC). As a non-profit corporation established under the Private Salmon Hatchery Act (1974), the corporation was to achieve higher and more stable levels of salmon production in the region through enhancement.

Representatives from the Prince William Sound Fish Processors Association, from city governments and village corporations in the region, and other user groups, were invited to sit as the Board of directors, enabling the corporation to attain "regional association" status. The Board consists of 45 members: 13 drift gill net permit holders, 13 seine permit holders, 1 set net permit holder, and representatives from communities, processors, user groups and native associations within the region.

Working with the F.R.E.D. Department of ADF&G, the corporation embarked on an enhancement program outlined in the corporation's original development prospectus, Salmon Culture Program (PWSAC, 1975). Along with extensive hatchery siting investigations and fisheries research, the first major capital project called for building the Port San Juan salmon hatchery, later to become the Armin F. Koernig Hatchery. This hatchery was proposed as a pink salmon hatchery, initially conceived to incubate 20 million eggs. A total of 5 hatcheries were envisioned to meet the needs of high, sustained production.

Initial capital to operate the regional corporation and fund projects was derived from local organization and community grants, a federal grant, and a self imposed assessment the fishermen volunteered from their gross salmon harvest revenues. Matching contributions were provided by processors. Shortly thereafter, the capital investment required for development was to come from loans established through the Department of Commerce and Economic Development (Fisheries Enhancement Loan Fund, Sec. 16.10.505). Security offered for these loans included a royalty assessment on the sale of salmon the fishermen voted to impose on their gross sales (Sec. 16.10.530). This was no longer a voluntary contribution, but a regulated assessment voted at 2% of the fair market value of the fish. The assessments were to be paid by processors from a withholding of fishermen's harvest sales, and given to the State, which later made payment to the regional association.

Regional planning teams were defined and activated to assure region wide comprehensive planning for enhancement. Consisting of representatives from the regional association and ADF&G Departments of Commercial Fisheries, F.R.E.D. and Sport Fish, RPTs are responsible for regional planning, proposed project review, and recommending to the commissioner, on appropriate course of action for project permitting. The planning team for Area E is chartered as the Prince William Sound / Copper River Regional Planning Team.

The specific mission of the PWS/CR RPT as stated in its revised charter (1990) 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.

In addition, it is the mission of the PWS/CR RPT to integrate production planning with allocation and management in order to facilitate achieving regional fishery objectives and goals." (APPENDIX 1)

The Phase 1 Comprehensive Plan for Area E was completed in 1982 and approved for implementation by the Commissioner in 1983. Subsequently, Phase 2 planning was initiated, culminating with the Commissioner's approval in 1986 of the Prince William Sound-Copper River Comprehensive Salmon Plan.

3.10 INITIAL PROGRAMS

Prior to Phase 1 investigations and listing of comprehensive planning production objectives, F.R.E.D. and PNP hatchery programs were active in PWS and the Copper River. F.R.E.D. had on line the Cannery Creek Hatchery with incubation capacity for 50 million pink salmon eggs; the Gulkana Hatchery, consisting of twenty stream side incubation boxes for 10.3 million sockeye eggs; and, the Main Bay Hatchery, operational in 1982 with a capacity for 95 million chum salmon eggs. Initial Main Bay brood consisted of 3 million pink salmon eggs transferred from AFK Hatchery.

During these early years of enhancement, PWSAC operated the Port San Juan Hatchery on Evans Island, later to be called the Armin F. Koernig (AFK) Hatchery. The AFK facility began operating in 1975. The facility was designed for incubating 150 million pink, and 13 million chum salmon eggs.

Valdez Fisheries Development Association (VFDA), under an educational permit, began as a stream side incubation project at Crooked Creek. VFDA's Solomon Gulch Hatchery was brought on line in the early 1980's. This facility was designed to incubate 50 million pink, 18 million chum, and 1 million coho salmon eggs. Nerka, Inc., operated a small (300,000 egg) hatchery on Perry Island.

The Phase 1 Plan sought to provide a comprehensive outlook to the scope and direction of regional enhancement by identifying gaps in salmon fishery knowledge and user needs, and then attempting to comprehensively implement projects to fill those needs.

3.20 PHASE 1 COMPREHENSIVE PLAN

Approved by the commissioner of the Alaska Department of Fish and Game in 1983, the Phase 1 plan assessed then existing harvests of wild stocks against user demand identified through harvest records, economic projections and user surveys. The harvest gaps identified between actual harvest and user demand provided the focus for enhancement recommendations.

In addition, clearly identified were knowledge gaps which would be important to fill to gain a better understanding for managing the fishery in the presence of wild stocks and

large returns of hatchery salmon. Specific recommendations to fill the knowledge gaps included:

- forecasting improvements;
- in-season run assessment;
- test fishing;
- stock identification programs;
- improved escapement enumeration;
- optimum escapement research; and,
- carrying capacity investigations.

Processing capacity was highlighted as potentially insufficient to deal with existing production due to unreliability of participating floating processors, and fluctuating wild stocks. A greater harvesting capacity requirement was also recognized as necessary, should hatchery salmon increase to projected levels.

To fill the harvest gaps determined between wild and existing hatchery production, and user needs identified in the Phase 1 Plan, enhancement objectives were recommended including:

1. expansion of chum rearing capacity at Main Bay Hatchery (ADF&G), thereby increasing short term rearing from 25 million to 86 million chum fry, which could potentially increase fry to adult survival from 0.7% to 2.0%;

2. construction of fish handling and short term rearing facilities at the Cannery Creek Hatchery (ADF&G), which could improve efficiency at the site and thereby increase egg take by 30 million, resulting in 80 million total;

3. expansion of the Gulkana Hatchery (ADF&G) to better utilize the spring water available for incubation;

4. construction of the Esther Island Hatchery (now the Wally Noerenberg Hatchery) (PWSAC), designed to incubate 50 million early chum, 50 million late chum, 200 million late pink, 1 million coho, and 1 million chinook salmon eggs;

5. rehabilitation and enhancement programs including lake stocking, lake enhancement, stream stocking, fish pass installations, and stream improvement (ADF&G, PWSAC and the US Forest Service).

3.30 PHASE 2 COMPREHENSIVE PLAN

The Phase 2 Comprehensive Plan was approved by the commissioner in 1986 as a 5 year plan outlining project specific recommendations. Whereas the Phase 1 Plan tackled the broader question of existing resource availability, and user demand, while listing specific production objectives, the Phase 2 Plan focused on specific projects

planned to fulfill production recommendations by the year 2002. Overall goals of the Phase 2 Plan included:

1. initiate actions toward achieving the 20 year goals and objectives set forth in the Phase 1 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 harvesting and marketability through selection of stocks of favorable run timing; and
   d) maximize or optimize the production of salmon based on the capabilities of the area.

These overall goals translated into fishery objectives that were intended to increase net harvestable fish available to user groups. Specific projects recommended to result in these harvest increases included:

1. complete Esther Hatchery construction and brood stock development resulting in 7.5 million pinks, 2.2 million chums 33,000 coho and 107,000 king salmon annually;

2. increase the capacity of the Solomon Gulch Hatchery resulting in a total production of 4.5 million pinks, 336,900 chums, 22,900 coho and 7,600 king salmon annually;

3. increase Main Bay Hatchery production which would result in 1.1 million pinks and 1.6 million chum salmon annually;

4. increase Cannery Creek Hatchery capacity resulting in 4.9 million pink salmon annually;

5. expand Gulkana Hatchery resulting in 290,000 sockeye annually (Copper River system).

Recommendations further included new pink/chum hatchery siting and construction, sockeye hatchery construction, stream and lake stocking, fishpass construction and maintenance, and evaluation/research programs.

3.40 ACCOMPLISHMENTS TO DATE

Since the inception and implementation of the fisheries rehabilitation, enhancement and development program in Alaska, salmon enhancement has achieved tremendous milestones. Examples found in Prince William Sound and the Copper River include the most productive salmon hatchery program in North America (Prince William Sound

Aquaculture Corporation), the largest salmon hatchery in the world (Wally Noerenberg Hatchery), and the most successful sockeye program in the world (Gulkana and Main Bay Hatcheries). These accomplishments are due to commitment by the State of Alaska to support salmon enhancement through legislation and loan funds, and the undaunted commitment of fishermen, hatchery program managers and Alaska Department of Fish and Game managers to design and develop a program of foresight and commercial proportions.

Salmon production in Area E has measurably grown. Where the historic annual harvest of pink salmon averaged 5 million fish in PWS, the current harvest is estimated at 40 million fish, approximately 90% of hatchery origin. In addition, projects are on-line expanding chum, sockeye, coho and chinook salmon.

3.50 ENHANCED SALMON PRODUCTION

The present day production of enhanced salmon reflects to a great measure the objectives listed in the Phase 2 Plan, although certain strategies have emerged which warrant listing.

1. The Esther Island Hatchery (Wally Noerenberg Hatchery) is presently at full production capacity, but expansion plans to utilize the water resource of the site will increase the production. In addition, the Esther II site, originally conceived as a sockeye facility, now produces pink salmon in temporary shelters. At present capacity, WNH will produce adult salmon numbering approximately 10 million late pinks, 1.2 million early chums, 220,000 cohos and 17,000 chinook salmon.

2. Solomon Gulch Hatchery, operated by Valdez Fisheries Development Association, is presently expanding its pink and chum production. Coho production has led to development of significant sport fish increases. VFDA has also led development of commercially significant remote releases of pink salmon. Expansion of remote release locations has been proposed, recommended by the RPT, and permitted by the Commissioner. Total production includes approximately 7 million early pink salmon, 100,000 coho salmon and 30,000 late chum salmon.

3. The Main Bay Hatchery program has been redirected. Originally slated for chum and pink salmon production, the facility now produces sockeye salmon only. The facility claims the title of the largest sockeye hatchery in the world. In 1991, PWSAC took over operations of the facility from the state on terms of a 20 year operating lease.

   Presently producing approximately 5 million sockeye smolts, facility expansion in progress will result in an increased capacity to nearly 10 million smolts. Further expansion is planned which will increase the final program capacity to 20 million sockeye smolts of 3 stocks: early, middle and late run timing, resulting in a projected return of 4 million adult sockeye. Present level of production is estimated at 800,000 adults.

4. Cannery Creek Hatchery, previously state operated, is now operated by Prince William Sound Aquaculture Corporation under a 20 year lease with the State of Alaska (1988). Expansion plans have been prepared to take full advantage of the location's water resource, thereby increasing late pink production at the facility beyond that suggested in the Phase 2 Plan. Estimated adult production is 6 million late pink salmon.

5. The Gulkana Hatchery (I and II), consisting of two spring or stream-side incubator box sites, produces sockeye for the Gulkana-Copper River system. Although the facilities belong to ADF&G, the program is operated and funded by Prince William Sound Aquaculture Corporation under terms of a contract similar to those for Cannery Creek and Main Bay Hatcheries.

   Present plans would implement a fry/smolt feeding program intended to increase the survival of sockeye released into the Copper River system. Current estimated adult production is 220,000 sockeye salmon. Although a small chinook program was initiated at the Gulkana II site, the Department of Fish and Game has since discontinued that program.

6. The AFK facility is under reconstruction. As a result, green egg capacity will increase from 128 million to 190 million so that water resources and facility space is fully and efficiently utilized. Adult production of late pink salmon will increase to more than 6 million.

7. Subsistence opportunities have expanded due to returning numbers of salmon now available for harvest throughout Prince William Sound and the Copper River area. VFDA has also implemented a common property fishery (CPF) coho release program in Boulder Bay accessible to subsistence users from Tatitlek. Chinook salmon are also being released (beginning 1994) at Chenega as common property and are accessible to subsistence users.

8. Sport opportunities have expanded as evidenced by increased sport harvests on returning hatchery salmon at various hatchery locations, and through an expanded remote release program delivering coho salmon to Whittier and Cordova, and chinook salmon to Cordova, Whittier and Valdez. These remote release projects are funded and conducted by PWSAC to fulfill the regional associations goal to benefit all users.

Aside from production increases outlined in Phase 2, and modifications to production strategies, substantial accomplishments have taken place at the level of allocation and management planning.

3.60 INTEGRATED FISHERIES DEVELOPMENT

Concurrent with research, development and production successes, users, managers and producers of the enhanced salmon industry have taken steps towards integrated

fisheries development. The vision promoted in Prince William Sound and the Copper River area foretold that fisheries development could only be achieved with an understanding of and commitment to allocating the enhanced resource while managing the fishery based on the state's wild stock priority.

Major strides during 1989-1991 were made towards realizing this vision including adoption of regional allocation and management plans. These steps have provided a model to other regions seeking to achieve growth, stability, balance and equity in their salmon fisheries while promoting conservation of wild stocks.

As the PWS salmon fishery matures, integrating allocation and management guidelines with production objectives and strategies, has contributed to a more comprehensive approach to regional planning and enhancement.

3.70 ALLOCATION POLICY

In January, 1989, while meeting in Cordova, the Alaska Board of Fisheries charged the regional association (PWSAC) to develop an enhanced salmon allocation and management plan. Issues surrounding production and allocation had reached such a tenor that the Board of Fisheries sought resolution to the numerous and highly charged proposals before it which dealt with enhanced salmon allocation. The Board of Fisheries took this position because PWSAC was responsible for the high level of enhanced salmon production, and the proposals dealt primarily with allocating hatchery salmon. It was therefore seen as the responsibility of the regional association to work with its Board of Directors and users of the resource to negotiate an allocation agreement between user groups, an agreement which could then be presented to the Board of Fisheries for action.

Production and allocation seemed inextricably tied to fisheries development. After ten months of negotiations and research, an allocation policy was agreed to by the users and adopted by the PWSAC Board of Directors (APPENDIX 3). The policy called for long term planning and production to achieve a balance in harvest opportunity and value between the commercial gear groups.

3.80 MANAGEMENT PLAN

To achieve the balanced opportunity stipulated by the allocation policy required a management plan. This would support that fish produced with the intention of contributing to specific beneficial uses, would be managed for that result. The regional planning team revised its charter to undertake such a mission (APPENDIX 1), adopted the allocation policy, and upon approval of the commissioner of Alaska Department of Fish and Game, the PWS/CR RPT initiated a public process to develop a management plan. This plan would integrate the enhanced production with allocations to provide salmon fishery managers the regulatory framework to manage for allocation.

Five months of negotiations resulted in the "PWS Management and Salmon Enhancement Allocation Plan" (APPENDIX 4). This plan was adopted in its entirety by the Board of Fisheries in January, 1991, setting the stage for integrated fisheries

development. Now, with a management plan to guide managing for enhanced salmon allocations, many of the outstanding and critical issues in the fishery could be resolved.

3.90 PHASE 3 PLANNING

Many of the objectives outlined within the Phase 1 and 2 plans have been completed. In addition, many aspects of the fishery have changed since the plans were approved. The RPT charter acknowledges that:

> *"...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."*

Recent events, new information, and changing conditions lead the PWS/CR RPT to categorize and initiate Phase 3 planning. Factors which encouraged this effort include:

1. successful achievement of many of the Phase 1-2 salmon enhancement objectives;

2. development of a regional allocation policy for enhanced salmon;

3. adoption of the allocation policy by the PWS/CR RPT;

4. public process formulation of the "PWS Management and Salmon Enhancement Allocation Plan" by the RPT and its introduction to and approval by the Alaska Board of Fisheries;

5. market trends which severely jeopardize fishery economics;

6. growing concerns over enhanced salmon production (marine system carrying capacity; market limitations; genetic implications; user group needs; complexities of the fishery and resultant challenges to manage for conserving wild stocks); and

7. need to define new regional goals and re-assess production objectives.

4.00 OPTIMUM PRODUCTION

The concept of optimum production for the purposes of this salmon plan incorporates a blend of biological requirements for maximum sustained yield of wild stocks and the biological and economic requirements for optimum production of enhanced stocks.

The concept of maximum sustained yield (MSY) of wild salmon has its roots in a set of theories used by fishery managers called stock-recruitment relationships, which link the number of adult spawners to the subsequent recruitment, or number of progeny produced that survive to spawn. These theories predict that at low stock size, recruitment will increase in proportion to stock size. At high stock size, they predict that recruitment will decline or level off, FIGURE 1. Maximum sustainable yield is the point at which the stock-recruitment curve is the greatest distance above the replacement line. Maximum sustained yield is defined in the state's escapement goal policy as "the greatest average annual yield from a stock", which in practice "is approached when a constant level of escapement is maintained on an annual basis regardless of run strength."

The stock-recruitment relationship for wild salmon populations is often best described by a relationship like that shown in Figure 1. The descending limb of the curve at high stock size is due to a process called compensatory mortality. Compensatory mortality occurs when mortality rates increase with increasing abundance. As an example, compensatory mortality for pink and chum salmon may occur during either the egg or early marine life stages. When large numbers of eggs are deposited in the gravel low dissolved oxygen or a build-up of metabolites may result in egg mortality. Similarly, a large fry outmigration may result in competition for a limited food resource leading to reduced growth and increased mortality, because slower growing individuals are vulnerable to predators for a longer period of time. In sockeye salmon, compensatory mortality may occur during lake residency. Large numbers of fry at this life stage may overgraze zooplankton stocks in the lake causing a collapse of the prey resource.

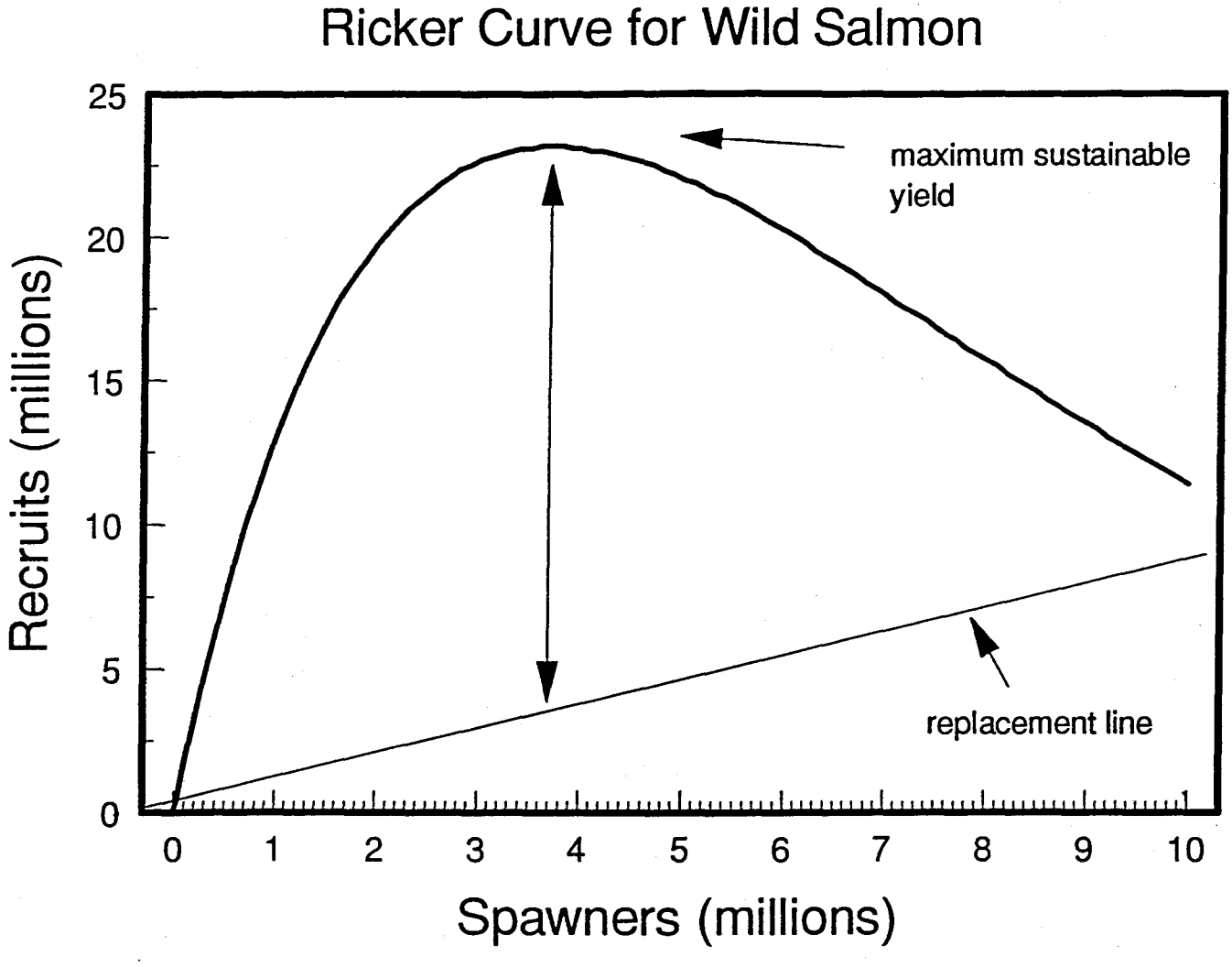
In a hatchery, the number of spawners is dependent upon the egg capacity of the facility which is based upon incubator space and the water supply. Compensatory mortality obviously will not occur during the egg stage in a properly managed hatchery. However, during the early marine life stage, compensatory mortality may occur when large numbers of fry compete for a limited food resource. If so, marine survival rates will decline (mortality will increase) as fry release numbers are increased.

4.10 RECOGNIZING OPTIMUM PRODUCTION

Recognizing the optimum level of hatchery production that can be sustained without depleting wild stocks or reducing the financial feasibility of hatchery operations is a difficult problem. Construction of stock-recruitment models for hatchery and wild salmon is a straightforward and workable method. However, the stock-recruitment model approach is not desirable, because the proper level for optimum production cannot be recognized until it is exceeded for several years. An alternative method involves monitoring several biological and economic indicators that may signal when optimum production is approached.

FIGURE 1

Example of a Ricker stock-recruitment curve for wild salmon.



The PWS/CR RPT recommends that five biological and economic criteria be employed to recognize optimum production as the hatchery program in Prince William Sound is developed:

1) wildstock escapement goals must be achieved over the long term;

2) the proportion of hatchery salmon straying into wild-stock streams must remain below 2% of the wild-stock escapement over the long term;

3) the growth rates of juvenile salmon during the early marine period must be density independent over the long term;

4) the abundance of juvenile salmon predators must be independent of juvenile salmon abundance over the long term; and

5) the long-term average cost of hatchery operation, management, and evaluation must remain below 50% of the value of hatchery production.

The PWS/CR RPT recognizes that more information is needed to refine several of these decision criteria. The SEA (Sound Ecosystem Assessment) research program may help provide much of the needed information. Given our present state of knowledge, these criteria are viewed as a reasonable starting point for recognizing the optimum level of enhanced salmon production in Prince William Sound. Prerequisite to this concept however, is the sustainability of maximum numbers of wild stock salmon, which is dependent on quality habitat including terrestrial habitat for high quality fresh water run-off into wild stock spawning beds, high quality intertidal and nearshore environments for fry rearing, and a healthy marine environment for adult growth and survival.

4.20 ACHIEVE WILDSTOCK ESCAPEMENT GOALS

The complexity of fishery management is significantly increased when managers seek to achieve stock-specific exploitation rates and several stocks are harvested together in a mixed-stock fishery. Generally, the fishery is managed for the more abundant or valuable stock. Long-term yield from the weaker stock may be reduced under these conditions, because escapement goals are not consistently achieved. Management of wild chum stocks in Prince William Sound is an example of this problem, because the fishery is generally managed for pink salmon escapement. As the hatchery program developed in Prince William Sound, fishery managers were faced with a mixed-stock fishery composed of several stocks of hatchery and wild salmon. By the late 1980's, hatchery stocks were more abundant than wild stocks, but managers were required by state law to manage for the weaker wild stock. As a result, the cost of management has increased, because managers must have inseason stock composition data to achieve wild-stock escapement. The acceptable margin of error has also declined, because wild stocks can be quickly overharvested when the wild run is very weak. If the required level of precision is not achieved and wild-stock escapement goals are not met, the long-term yield from wild stocks will decline.

In this context, optimum production is achieved at a level of hatchery production that can be managed without overexploitation of wild stocks. In Prince William Sound, wild-stock

salmon are managed to achieve wild-stock escapement goals (section **5.20 Wild Stock Escapements**). Any long-term reduction in wild-stock escapement below the escapement goal is considered an unacceptable depletion of wild stocks. Because the ability of fishery managers to achieve wild-stock escapement is a function of management precision, the level of optimum production may be a function of the cost of increased management precision and the quality of the tools managers use. Further study of the migratory patterns of wild and hatchery salmon is needed to identify places and times where hatchery salmon can be harvested without overexploiting wild salmon.

4.30 MAINTAIN STRAYING RATES BELOW THRESHOLD

Straying of hatchery-reared salmon into wild-stock streams may reduce wild-stock productivity, because genetic variability among wild stocks is reduced. Since the late 1980's, hatchery salmon have greatly outnumbered wild salmon in Prince William Sound. Under these conditions, even relatively low straying rates of enhanced stocks may cause reduced genetic variability among affected wild stocks, because the straying rate as a proportion of wild-stock escapement is relatively high. At the present time, the straying rate of hatchery salmon in wild-stock streams is not known. A monitoring program should be implemented to periodically estimate the rate of hatchery-salmon straying into wild-stock streams, and to better define genetic stock boundaries in PWS. If it is determined that the rate of straying is significantly greater than the acceptable threshold of 2%, the PWS/CR RPT will determine whether and to what extent the hatchery program in Prince William Sound should be modified to reduce the rate of straying. The PWS/CR RPT recognizes that the present estimate of the acceptable threshold of hatchery-salmon straying is not well supported. Further research is needed to improve our confidence in the estimate of acceptable hatchery-salmon straying rates. This work must include studies to determine the effect of interbreeding of wild and hatchery salmon on the productivity of wild salmon. Hatchery operational strategies that may minimize straying or the effect of hatchery-salmon straying should also be examined.

4.40 DENSITY INDEPENDENT GROWTH

The growth rate of juvenile salmon is directly related to survival to adult, because slower-growing individuals are vulnerable to predators for a longer time. Competition for food or suitable rearing habitats may reduce juvenile salmon growth and thus survival. Competition for food may occur among several species of juvenile fishes including salmon, herring, sandlance, capelin, walleye pollock, sablefish, gray cod, and others. The carrying capacity of Prince William Sound for juvenile salmon and other fishes is likely a function of food abundance and composition, the degree of diet and habitat overlap among species, and the relative abundance of various juvenile fish species. These parameters likely vary both within and between years.

Determining reasonable decision criteria regarding the occurrence of density-dependent growth among juvenile salmon is a difficult problem. If growth (and survival) is density dependent among hatchery salmon, release strategies may be modified to offset the effect. Also, economic analyses can determine the net benefit of releasing larger numbers of fish. However, if hatchery and wild salmon occupy the same marine nursery habitats, releases of hatchery salmon may reduce the survival and thus long-term yield of wild salmon. At the present time, insufficient data is available to determine the level of

acceptable density-dependent growth among wild salmon. Studies directed at detecting density-dependent growth must be conducted over several years, because environmental factors that affect growth vary interannually and over decadal time scales. However, the PWS/CR RPT recognizes that the carrying capacity of the marine ecosystem for juvenile salmon is limited. As new information becomes available, the PWS/CR RPT will establish more definitive decision criteria regarding marine carrying capacity.

Experimental manipulation of hatchery releases is likely to provide the data needed to detect density-dependent growth. Juvenile salmon should be released in large and small groups at different locations and times. Growth rates of juveniles in each group can be estimated from recovery of tagged fish. The magnitude of density-dependent growth could then be estimated from bioenergetic and statistical techniques that account for variations in ocean temperature and zooplankton abundance.

4.50 DENSITY INDEPENDENT PREDATOR ABUNDANCE

The predation rate on juvenile salmon is directly related to the abundance of predators. Two processes related to enhanced salmon production may lead to increased predator abundance. First, predator behavior may be affected by enhanced salmon production leading to an aggregation of predators along the migratory pathway of juvenile salmon. Second, the reproductive success of predators may be increased, because juvenile salmon provide a significant proportion of the predator's annual energy demand. This concept is based on the following two assumptions: (1) predator mortality is density independent at present levels of predator abundance, and (2) predator offspring recruit back to Prince William Sound. If these assumptions are valid, increased energy intake among predators may lead to increased somatic growth, development of larger gonads, production of more offspring, and increased predator abundance. The effect of enhanced salmon production on predator behavior can be evaluated by monitoring changes in the abundance and distribution of juvenile salmon predators during the salmon outmigration. The effect of enhanced salmon production on reproductive success can be evaluated by estimating the proportion of the predator's annual energy budget derived from juvenile salmon.

Determining reasonable decision criteria regarding the occurrence of density-dependent predation is a difficult problem. If predation on hatchery salmon is density dependent, release strategies may be modified to offset the effect. However, if predator responses to enhanced salmon affect wild salmon, releases of hatchery salmon may reduce the survival and long-term yield of wild salmon. The PWS/CR RPT recognizes that enhanced salmon production may affect predator abundance in Prince William Sound. However, insufficient information is available at the present time to determine if predator population size has responded to enhanced salmon production. Identification of important predator species and their population units is a necessary first step toward addressing this issue. As new information becomes available, the PWS/CR RPT will establish more definitive decision criteria regarding density-dependent predation.

4.60 ECONOMIC BENEFITS OF SALMON ENHANCEMENT PROGRAM

A self-sustaining salmon enhancement program must make a substantial contribution to common property fisheries and also generate sufficient revenue to provide for the cost of production, management, and evaluation. This decision criteria does not refer to the allocation of hatchery salmon between the common property fisheries and hatchery operators. The goal of the hatchery operators in PWS is to provide 70% of their production to the CPF. An assessment of the benefits of enhanced salmon production must include costs associated with managing mixed stocks of wild and hatchery fish, because management precision must be increased to achieve wild-stock escapement. Similarly, costs associated with evaluation programs must be part of the equation, because the effect of enhanced salmon production on wild salmon must be determined and quantified to insure sustained yield of wild salmon. The PWS/CR RPT recognizes that funding for management and evaluation programs will likely come from a variety of sources. Calculation of the value of enhanced salmon production must include ex-vessel value, and non-commercial and secondary economic benefits to communities in the region. The cost and value of the salmon enhancement program will be calculated as a ten-year moving average, because the cost and value of hatchery salmon production varies considerably from year to year. In the future, the PWS/CR RPT will determine how to calculate the costs and values of the hatchery program and will establish a more definitive decision criteria regarding economic benefits.

5.00 MANAGEMENT OF PRINCE WILLIAM SOUND FISHERIES

5.10 MANAGEMENT OBJECTIVES

The concept of "optimum production" describes a blend of natural and supplemental production, which cannot occur without an integrated management program. Prince William Sound salmon managers are faced with a mixed stock, mixed species fishery where hatchery stocks can vastly outnumber wild stocks. The relative strengths of the hatchery and wild stock components varies each season, consequently stock identification programs are central to management success. The PWS fishery manager, while conducting the commercial harvest, must balance competing interests for: (1) wild stock escapement requirements, (2) hatchery cost recovery and brood stock needs, and (3) an orderly common property harvest of the highest possible quality. Paramount of these is the requirement to sustain the long term health and yield of the Sound's wild stocks of salmon.

5.20 WILD STOCK ESCAPEMENTS

The Alaska State Constitution requires that the fish resources of the state be managed on a sustained yield basis. The state legislature recently added to this charge, placing the highest priority on the conservation of wild stocks of salmon. The principal method of insuring the health of wild stock systems is to manage the intercepting fisheries to provide the biological escapement required for long term sustained yield. Wild stocks returning to the northern areas of the Sound are especially at risk as they are repeatedly subjected to intense fishing pressure as they pass by hatchery areas along their migratory route to their natal streams.

Pink and Chum Salmon: The Sound's natural production over the past 30 years has contributed an average harvestable surplus to the common property fisheries of 5 to 7 million pink salmon and 500,000 to 600,000 chum salmon, with considerable annual variation.

There are over 1000 documented anadromous streams in the Sound that are distributed throughout nine management districts. Managers monitor the number of fish that escape the fishery and enter these streams by aerial surveys conducted while the runs are in progress. Weekly aerial surveys are flown on 209 streams that provide managers with a comparative index of the magnitude and the timing of the spawning migration. These streams were selected to be representative of the other streams based on the timing of the runs, and other physical characteristics. Weekly spawner counts, called escapement indices, are compared to historical data, dating back to 1960.

The weekly indices are summed through the season and corrected for stream life to yield a final escapement index count for the season. Because it is not possible to manage for individual streams, pink salmon systems are managed in aggregate, and the escapement goals are established accordingly (TABLES 1, 2, 3).

Prior to the introduction of large-scale hatchery enhancement, which began in 1978, the commercial seine fishery was traditionally managed on a weekly fishing schedule of 5 days per week. The fishing season typically started in mid-July and ran through early or

mid-August depending upon run strength. Frequently, fishing was opened to all districts in the Sound. Districts were selectively opened or closed, based on escapement trends, in order to meet desired escapement goals. The Eastern and Northern Districts have the earliest natural returns of both chum and pink salmon, and are typically the first districts to open. These districts also have some of the latest pink and chum stocks, and consequently may remain open the longest of any of the other districts.

TABLE 1

Aerial escapement goals for PWS odd cycle pink salmon by district.

District	Point Goal	Escapement Range
Eastern	422,000	380,000-465,000
Northern/Unakwik	128,000	115,000-141,000
Coghill	178,000	160,000-196,000
Northwestern	83,000	75,000-92,000
Eshamy	5,700	5,000-6,200
Southwestern	116,000	105,000-128,000
Montague	162,000	146,000-179,000
Southeastern	333,000	300,000-366,000
Total	1,427,700	

TABLE 2

Aerial escapement goals for PWS even cycle pink salmon by district.

District	Point Goal	Escapement Range
Eastern	474,000	427,000-521,000
Northern/Unakwik	213,000	192,000-235,000
Coghill	143,000	129,000-158,000
Northwestern	135,000	122,000-149,000
Eshamy	8,200	7,000-9,000
Southwestern	144,000	130,000-159,000
Montague	70,000	63,000-77,000
Southeastern	239,000	215,000-263,000
Total	1,426,200	

TABLE 3

Aerial escapement goals for chum salmon by district.

District	Point Goal	Escapement Range
Eastern	98,500	87,200-109,000
Northern/Unakwik	33,000	29,400-36,750
Coghill	33,500	29,600-37,050
Northwestern	21,500	19,000-23,700
Eshamy	0	0-0
Southwestern	3,500	3,400-4,250
Montague	12,500	11,400-14,250
Southeastern	22,500	20,000-25,000
Total	225,000	

Sockeye Salmon: There are at least a dozen sockeye systems in PWS of which the two most actively managed are the Coghill and Eshamy Lake systems. The department operates weirs on both systems to monitor annual escapements. The Coghill and Eshamy districts have commercial fisheries directed at the returns to these respective lake systems. The Coghill sockeye return occurs in June and early July, and therefore provides for the first commercial fishing opportunities in PWS. The Eshamy Lake sockeye return occurs through July and August, and therefore overlaps with the timing of the Sound's pink and chum salmon returns. The Unakwik District also has a directed fishery on sockeye returns to Miners and Cowpen lakes. This fishery is less actively managed with weekly fishing periods and escapements which are monitored by aerial surveys.

5.30 HATCHERY COST RECOVERY AND BROOD STOCK

The operation of private nonprofit hatcheries brings with it the obligation to provide the hatchery operator with a certain portion of the hatchery run for recovery of operational costs and brood stock to sustain production. Cost recovery harvests and brood stock collection take place within a designated area termed the special harvest area (SHA). SHA's are generally located immediately in front of the hatchery facility where potential for wild stock interception is thought to be minimized to the greatest degree possible. SHA's are opened by the department for the hatchery operator to harvest fish, often on a seven day per week basis through the duration of the return.

Daily cost recovery harvests and sex ratios are monitored at the hatcheries and provide managers with a good run assessment tool throughout the return. Cost recovery requirements and brood stock needs are determined in advance of the season and published in the annual facility management plan (AMP) drafted for each facility. Cost recovery requirements are combined for the PWSAC facilities, while a separate cost recovery goal is established for the non-association Valdez Fisheries Development Association Solomon Gulch Hatchery.

Based upon run performance in the SHA, interception of hatchery return by the common property fishery is increased or decreased to meet the desired goal. Management strategies are developed each year based upon the specific cost recovery and brood stock requirements, the forecast returns of wild and hatchery fish, and other factors as appropriate. These management strategies are formalized annually for each facility in the AMP, which is developed jointly between the hatchery operators and ADF&G. These plans receive public review through the PWS/CR RPT and at the Salmon Harvest Task Force.

5.40 MIXTURE OF HATCHERY AND WILD SALMON

When the first hatchery returns arrived in PWS, fishery management became significantly more complex. Fisheries managers and the hatchery operators developed early strategies to protect the natural stocks, provide for the selective common property fishery harvest of hatchery fish, and allow for cost recovery harvests at the hatcheries. The general approach entailed managing the waters of the major fishing districts of the Sound where wild and hatchery stocks are mixed, for achievement of wild stock escapement. Thus the fishing time permitted in the general waters of the Sound is based strictly upon the wild stock strength and performance. If any surplus of hatchery fish remains, it is then harvested in a terminal area where further interception of wild stocks is minimized. Tagging studies have shown that harvesting in terminal areas does not eliminate wild stock interception, but may reduce it significantly.

A terminal hatchery subdistrict has now been established at each hatchery facility in PWS for this purpose. These areas provide a location where hatchery salmon can be taken by the common property fishermen with minimal interception of wild salmon. A summary of the terminal hatchery subdistricts by facility is provided below.

Hatchery Facility	Location	Terminal Hatchery Subdistrict
Armin F. Koernig (AFK)	Southwestern District	Port San Juan Subdistrict
Wally Noerenberg (WHN)	Coghill District	Esther Subdistrict
Cannery Creek	Northern District	specified by E.O.
Main Bay	Eshamy District	Main Bay Subdistrict
Solomon Gulch	Eastern District	Valdez Narrows Subdistrict

The hatchery subdistricts are also used with other subdistricts or areas as required to provide protection to hatchery returns when so directed in regulatory management plans adopted by the Board of Fisheries. These subdistricts and areas can be closed during years of strong wild stock returns to protect hatchery returns and assist the hatchery operator to meet cost recovery and brood stock goals. An example of this is the regulatory management plan for the AFK Hatchery (5AAC 24.365) which directs the department to "manage the Port San Juan and Port Elrington subdistricts to achieve the corporate escapement goal for the AFK Hatchery". Other examples include the Solomon Gulch Hatchery Management Plan (5AAC 24.366) and the Wally Noerenberg (Esther Island) Hatchery Management Plan (5AAC 24.368).

5.50 MIXED STOCK MANAGEMENT

Managing fisheries composed of mixed wild stocks or mixed wild and hatchery stocks can lead to over-exploitation of weak stocks. The western corridors of the Sound generate the most concern to management of the Sound's natural production due to mixed-stock interactions with hatchery returns. The Coghill Lake sockeye return shares run timing with the chum salmon return to the WHN hatchery. Production scale returns of chums to the WHN hatchery cannot be harvested without significant interception of Coghill Lake sockeye salmon, even if commercial harvests are confined to the Esther Subdistrict. With a depressed Coghill stock, this level of interception may be too high to provide minimum escapements. Mixed stock concerns extend to the Eshamy District where wild Coghill sockeye salmon migrate through the Crafton Island Subdistrict at the same time that early timing sockeye salmon are being harvested in the district. Confining the commercial fleet to terminal locations, while biologically justified, leads to congested fisheries with gear conflicts and allocation concerns. Further, the value of the harvest suffers due to decline in quality of the catch. Alternative management strategies which may put the fleet in the outer waters for limited time periods cannot be adequately evaluated without better knowledge of stock composition in the catch.

Modernization of the seine fleet and a shift in fishing patterns to the capes and entrance areas of the Sound had resulted in a shift towards concentrated fishing effort in the Southwestern District. The straights and passes in this portion of the Sound constitute the chief entrance area for both hatchery and wild fish returning to the Sound. Salmon stocks in this area are highly concentrated and indistinguishably mixed. When wild stock returns of pink salmon are weak, fishing must be restricted in this area to prevent over exploitation of wild stocks. During such years, fisheries are therefore dominated by terminal harvests which restrict the fleet in congested areas and increases competition within and between gear groups.

5.60 QUALITY ISSUES

With worldwide and state salmon production at high levels, prices have fallen along with demand for all but the highest quality salmon. Flesh quality of the catch declines when salmon are allowed to mill in terminal areas, particularly late in the return. Consequently terminal areas must be fished aggressively to minimize this quality decline.

To maximize the quality (and the economic yield) of their catch, fishermen and processors demand that as much of the harvest as possible be taken in the mixed stock entrance areas rather than terminal subdistricts in front of the hatcheries. In an effort to promote this, enlarged closures have been established in the interior bays of the Sound to offer wild stock systems more protection. However, fleet concentrations at the Sound's entrance areas in the Southwestern District, can result in very high exploitation rates on wild stocks. Consequently fishery managers risk over exploitation of wild stocks when conducting harvest in these areas.

5.70 MIXED STOCK FISHERIES AND PROTECTION OF WILD STOCKS

Stocks in the northwestern corner of the Sound, are particularly vulnerable to over exploitation because they must transit the Southwestern District, and migrate through the

interception fisheries in front of the AFK, Main Bay and WHN hatcheries before reaching their spawning streams. Preliminary results from a run reconstruction model have shown that the cumulative exploitation rate on wild stocks of pink salmon returning to the Coghill District may be as high as 89% in some years. Results from coded-wire tag and scale pattern analyses indicate that the exploitation rates on wild Coghill Lake sockeye salmon were 59% in 1992 and 79% in 1993.

Due to the time required for wild stock fish to migrate from the Southwestern District to spawning streams inside the Sound, aerial assessment alone is insufficient to manage for growing demands of the fishery. To take advantage of harvest opportunities which may occur at the entrances before wild stock escapement trends inside of the Sound are evident, stock composition studies are required. Within season stock composition information can provide managers with an estimate of the interception rate and magnitude of the wild-stock returns. This provides managers a basis to assess risk of a Southwestern District opening by evaluating its potential impact on wild stock escapement rates.

The coded wire tag (CWT) project in PWS currently is the only study that can differentiate hatchery and wild stock pink salmon in the commercial catches in the Southwestern District. This project is labor intensive, costly and statistically limited in its application to the fisheries, however the information it provides is sorely needed. Improved stock identification technologies need to be developed to provide more refined results to the demanding and rapidly changing fisheries of PWS.
The stock composition data from the CWT program is used in conjunction with aerial survey data on escapements, hatchery run entry data, and commercial catch data to form the basis for management decisions. It gives managers feedback on various management scenarios, such as the corridor approach attempted in the 1992 season. Only with inseason stock identification can managers hope to open specific passages or mixed stock areas outside of the terminal hatchery subdistrict which might otherwise have been left closed for protection of wild stocks. It should be pointed out that good stock composition information does not guarantee that managers will be able to provide more fishing time in the Southwestern District or the general waters of the Sound. Rather it provides managers with a basis for evaluating the potential impact to wild stocks that an opening in the mixed stock areas may generate.

The impact of large scale hatchery returns on the PWS wild stocks could be devastating if knowledge of the interactions between hatchery and wild fish is not gained and applied to production planning and fisheries management. Wild stock returns to the northwestern areas of the Sound are currently put at risk by high exploitation rate hatchery harvests which may occur along their migratory route. Quantitative studies are needed to evaluate this risk and apply management strategies to insure that wild-stock production in the Sound is not compromised.

6.00 PRODUCTION RECOMMENDATIONS

As the reader reviews this chapter it is important to recognize that there are numerous biological, environmental, economic and social conditions that affect development of a workable salmon enhancement plan designed to optimize salmon production in Prince William Sound. Few of these conditions are static or accurately predictable so a certain amount of conservatism is called for in developing plans for increased production. It serves no useful purpose to produce more salmon than are marketable or can be harvested as a quality product. Most importantly, the Department of Fish and Game has a statutory obligation to manage for and protect wild salmon stocks. This mandate forms the basic premise which guides the management of existing supplemental production and largely defines criteria for redistributing current production and developing new increments of diversified production.

6.10 GOALS

1. Increase fishing opportunities for salmon resource users.

Increased fishing opportunities is the measure by which most fishery users will rate the success of the Phase III plan. These opportunities can be created by increasing existing runs, diversifying species, broadening run timing, and providing fishery resources at locations which are more accessible by users.

Increasing existing runs through enhancement can result in increased harvests. If wild runs are maintained at healthy levels, then optimum utilization of hatchery returns is more likely achievable.

Species diversification benefits the commercial fisheries by smoothing out the highs and lows of a fishery dominated by a single species such as pink salmon in PWS. The two year life cycle of pink salmon results in large variations in run size since the return each year consists of a single year class. In contrast, the adults of other species of salmon return as different year classes over a period of several years which reduces the scale of annual variation in returns. King, coho and sockeye are also the most highly prized species for home use and for recreational fishing. Diversification thus enhances fishing opportunities for all users.

Congestion in fisheries will be reduced as hatchery returns are diversified and spread out over time and area. Remote releases will play a key role in spreading out the commercial fleet and will also benefit sport and subsistence users. Releases where road side access is available provides opportunities to many users restricted from more remote fisheries accessible only by boat or airplane.

2. Achieve equitable allocation of the harvestable surplus of wild and enhanced salmon, while minimizing impacts to historic and traditional fisheries on wildstocks.

The harvestable surplus consists of all salmon in excess of wildstock escapement and hatchery brood stock requirements. For hatchery production to continue, a portion of the

surplus must be allocated to cost recovery fisheries. The excess is intended to be allocated equitably to the user groups.

Although salmon production in PWS is harvested by multiple user groups in mixed stock fisheries and at hatchery and community release sites, the intention is to minimize impacts to historic and traditional fisheries on wildstocks as much as possible. In addition, the value of the commercial salmon catch is intended to be divided approximately 49-50-1 between seine, drift gillnet and set gillnet users to maintain the historic economic balance between these commercial gear groups. (See PWS allocation policy.)

3. Achieve an economically self-sustaining fishery.

The fishery should be productive enough to generate capital sufficient to fund the management, research, enforcement and enhancement efforts needed to maintain that production. Capital can be generated directly through taxes such as income taxes, fish landing taxes and enhancement assessments, or through cost recovery programs which generate a majority portion of the funding for hatchery operations.

Additional capital is indirectly accrued through excise taxes on sporting equipment which translates into Dingel-Johnson funding for sport fish programs. The economic activity induced by commercial and sport fisheries generates large amounts of tax money for the General Fund of the State of Alaska. A portion of this money is budgeted by the State to maintain staff and officers for management, research and enforcement. The General Fund is also the source for state grants and loans to the PNP hatcheries.

At the present time, the General Fund of the state is heavily dependent on oil based revenues. Funding for salmon resource management and development in PWS can be described as subsidized since a portion of the capital originates from the oil industry. Enhancement, coupled with sound management and associated research and enforcement, should develop a fishery resource of sufficient value to be economically self-sustaining.

6.20 THE CHALLENGE

To meet the Phase 3 fishery goals, a combination of enhancement projects is recommended to increase, diversify and redistribute supplemental production. The PWS/CR RPT also recommends sequencing production increments to address anticipated changes in market conditions. For instance, as an abundance of late pink salmon is anticipated based on existing or near-term future hatchery production, regional enhancement goals focus on diversification of harvest opportunities by stabilizing late run pink production and developing additional production of early run pink and chum salmon and sockeye salmon.

Based on the philosophical tenet: fisheries development is economic development, the PWS/CR RPT believes it is essential that hatchery production increases supporting continued fishery development must result in positive net economic benefits to intended user groups. The goal is sustained salmon production at levels which can be effectively managed, provide for an economically viable fishing industry and support the continued

growth and development of the communities which rely on the salmon fishery as a principal basis for their economies.

Comprehensive planning for additional production must consider market demand and product development as well as the biological implications of increasing hatchery production. In drafting this comprehensive production plan the RPT used a ten year window as the development period for optimizing production and implementing fishery diversification strategies. The purpose of pacing production increases is to allow the fish processing industry to improve infrastructure and develop new markets and product lines. Also, additional time may be required to conduct applied research projects that will provide information to fishery managers for more effective management of fisheries targeting on larger enhanced returns. Hopefully, these steps will result in positive net economic benefits to the industry.

Defining future production goals required the RPT to review present regional salmon production capacities and take into account planned and approved projects for increased production. The RPT then identified and assessed opportunities in the region for the redistribution of hatchery production by using remote releases of hatchery fish and maximizing natural production by identifying rehabilitation opportunities. This information, coupled with a knowledge of user needs, allocation issues, genetic and management constraints, provided the basis for developing the regional salmon production recommendations.

Our knowledge limitations predicate production increases be described at present by an upper limit. The upper limit of production is based upon our current understanding of biological aspects of salmon culture, fisheries management, and achieving maximum sustained yield of wild stocks. The limit is also based on existing hatchery water supplies, limits of economically feasible production, production and release opportunities to reduce fleet congestion, and projected allocation parity between user groups. The upper limit is an attainable goal if all conditions are met.

6.30 PRODUCTION GOALS AND OBJECTIVES

The following production goals are guidelines to direct salmon enhancement in Prince William Sound. The 10 year projections for adult returns should be considered as the upper limit of enhanced production for the foreseeable future (TABLE 4).

The goals are by no means indicative of what the future will be but rather a listing of species specific production targets that could be attained if certain conditions allow. The attainment of these goals will be greatly influenced by the accuracy of biological assumptions, the availability of sufficient information to assess those assumptions, the amount of capital available for investment, the availability of expanded or new salmon markets, and environmental and political conditions. A project review checklist has been developed to evaluate the feasibility of new projects. The project checklist considers fishery management issues, genetic guidelines and stock interactions. Criteria for evaluating potential remote release projects has also been established.

Increases in pink salmon and early run chum salmon production are largely dependent upon the development of a large scale remote release program to distribute adult returns

TABLE 4

PWS Enhanced Salmon Production Goals
(in millions of adult fish and green eggs)

Stock	Facility	Current permitted eggs \1	Current incubator space \2	Current + 10 yr eggs \3	Current adults \4	+ 10 yr projected adults
Early pink	VFDA	230.00	230.00	230.00	8.07	8.07
	WNH	0.00	0.00	252.00	0.00	12.00
	Total	230.00	230.00	482.00	8.07	20.07
Late pink	AFK	190.00	126.00	190.00	5.73	8.60
	WNH	211.00	188.00	211.00	8.94	10.00
	CCH	147.00	152.00	207.00	6.10	8.30
	Total	548.00	466.00	608.00	20.77	26.90
Early chum	WNH	111.00	111.00	302.00	1.98	5.40
	Total	111.00	111.00	302.00	1.98	5.40
Late chum	VFDA	18.00	18.00	36.00	0.19	0.40
	AFK	13.00	0.00	0.00	0.00	0.00
	CCH	5.00	0.00	0.00	0.00	0.00
	Total	36.00	0.00	36.00	0.19	0.40
Sockeye						
Eyak (early)	MBH	0.10	0.10	10.64	0.01	1.50
Coghill (middle)	MBH	5.10	5.10	7.97	0.72	1.12
Eshamy (late)	MBH	2.10	2.10	4.26	0.30	0.60
	Total	7.30	7.30	22.87	1.03	3.22
Coho	VFDA	2.00	2.00	2.00	0.11	0.11
	WNH	4.00	2.50	2.50	0.18	0.18
	Total	6.00	4.50	4.50	0.29	0.29
Chinook	VFDA	0.30	0.00	0.00	0.00	0.00
	WNH	4.00	1.00	1.00	0.03	0.03
	Total	4.30	1.00	1.00	0.03	0.03

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\1 Current green egg permits issued to PNP programs in PWS.
\2 Green egg incubation space currently available in existing facilities.
\3 Eggs required to be permitted within 10 years to meet production goals.
\4 Adult salmon which could be produced based on current incubation space and rearing assumptions.

away from hatchery terminal harvest areas, and reduction in interception of wild stocks in mixed stock fisheries.

The current sockeye program at Main Bay is based on production of Coghill and Eshamy stocks with remote releases of F_1 generation fish at each respective lake system. In the future the Main Bay program will emphasize Eyak stock sockeye production and remote releasing Coghill and Eshamy stocks.

Production of coho and chinook salmon will remain stable at present levels of green egg production projected to result annually in returns of approximately 300,000 coho and 32,000 chinook.

Salmon production recommendations are summarized (TABLE 4) by listing current projected adult returns, projected adult returns in 10 years based on potential permitted green egg capacities at hatcheries, current permitted green egg capacities, and potential future green egg capacities (10 years) based on possible permitting, capital expenditures and facility development.

These production goals and the associated remote release programs are intended to achieve the following objectives:

1. Broaden the run timing of the pink salmon return to better match production with harvest and processing capacity.

2. Remote release some current, and any increases in Wally Noerenberg Hatchery chum salmon production, outside of the Esther Subdistrict to minimize increases in the exploitation rate on wild stocks returning to the Northwestern and Coghill districts.

3. Shift emphasis in sockeye salmon production to an earlier run timing (Eyak stock) to minimize increases in the exploitation rate on wild stocks migrating through the Eshamy District.

4. Remote release any increase in sockeye salmon production in the middle run timing (Coghill) stock to minimize increases in the exploitation rate on wild stocks migrating through the Eshamy District.

5. Remote release early pink salmon production at the Solomon Gulch Hatchery outside of Port Valdez to improve product quality and reduce exploitation on wild stocks.

6. Maintain current levels of coho and chinook production for sport fisheries.

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7.00 REMOTE RELEASE RECOMMENDATIONS

Remote releasing increments of production is recommended to fulfill fishery objectives such as increasing opportunity in area and decreasing congestion in hatchery terminal harvest areas. Based on more than 18 months of investigation and site selection, the RPT recommends the remote release locations and selected stocks for release listed in TABLE 5.

Remote release recommendations are preliminary and require scrutiny of genetic and management concerns which may be raised for each site and stock recommended. Pertinent remote release site discussions and guidelines are provided in APPENDIX 5, PWS/CR RPT Remote Release Site Report.

The RPT also recommends that a drift gillnet district be established in Kings Bay. The purpose for this recommendation is to provide a remote release site for Main Bay Hatchery sockeye and Wally Noerenberg Hatchery early chum salmon with the intent of reducing the exploitation rate on wild stocks migrating through the Eshamy District and Esther Subdistrict.

The RPT evaluated sockeye production and release options in greater detail than the generalized concept of salmon stocks and release locations listed in TABLE 5. This was done to guide development of the Main Bay Hatchery sockeye program. The Main Bay Hatchery, originally designed as a pink and chum facility, was later considered for its potential as a sockeye hatchery. Discussions beginning in 1986 to refocus the facility resulted in preliminary plans to convert the hatchery and eventually produce 20 million sockeye smolts of three run time stocks. Based on an assumed "age 1" sockeye smolt survival of 20%, 4 million adult sockeye salmon could eventually return annually to the hatchery and remote release locations in PWS.

The sockeye program is important to diversification of the fisheries, rehabilitating depleted sockeye systems at Eshamy Lake and Coghill Lake, expanding fishing opportunity in time and area, and addressing user group allocations. However, with increasing production and the potential for remote releasing sockeye smolts at several locations, the PWS/CR RPT expanded evaluations for marine and lake release sites for each sockeye stock (Eyak, Coghill and Eshamy). Summaries are presented both for potential marine release locations and lake release sites. See TABLES 6 and 7. Not all sites presented are recommended as candidate release sites, and sites that are, may not be recommended for all three sockeye stocks.

Regarding pink and chum recommendations, emphasis is placed on production and releases which target production objectives. Early pink salmon production will broaden the timing of the pink salmon return better matching harvest with available processing capacity. Releasing early pink salmon in underutilized areas will further increase fishing opportunity. Sites have been identified for pink and chum releases that will result in an increase of terminal fishing areas as well as create fisheries that can be conducted while minimizing potential increased exploitation on migrating wild stocks.

Detailed evaluations of sites, stocks, and genetic and management implications due to releases are to be undertaken by PNP operators and Department of Fish and Game

TABLE 5

REMOTE RELEASE SITE SUMMARY

RPT RECOMMENDATIONS

(REFER TO MAP 1)

Sites	No Release	Early Pink	Late Pink	Early Chum	Late Chum	Coho	Sockeye	Comments (See key)*
1. Nelson Bay				X			X	A,C
2. Simpson Bay	X							
3. Landlocked Bay	X							
4. Boulder Bay		X		X				A
5. Eaglek Bay		X						A,B
6. Naked Island		X	X	X	X		X	B,C,D
7. Perry Island	X							
8. Granite Bay						X		
9. Cochrane Bay	X							
10. McClure Bay	X							
11. Kings Bay		X		X			X	B,D
12. Herring Bay	X							
13. Drier Bay	X							
14. Bay of Isles	X							
15. Snug Harbor	X							
16. Whale Bay	X							
17. Port Bainbridge	X							
18. Montague Island				X			X	C
19. Zaikof/Rocky Bays				X				C
20. Port Etches	X							
21. Unakwik					X		X	C,D
22. Island (Esther) Bay							X	
23. Barry Arm							X	C,D

(prodpln4\rptremot.wk1)

*Key

A...Develop local brood stock

B...Develop early pink stock

C...Test release for survival evaluation

D...Gather more site information for evaluation

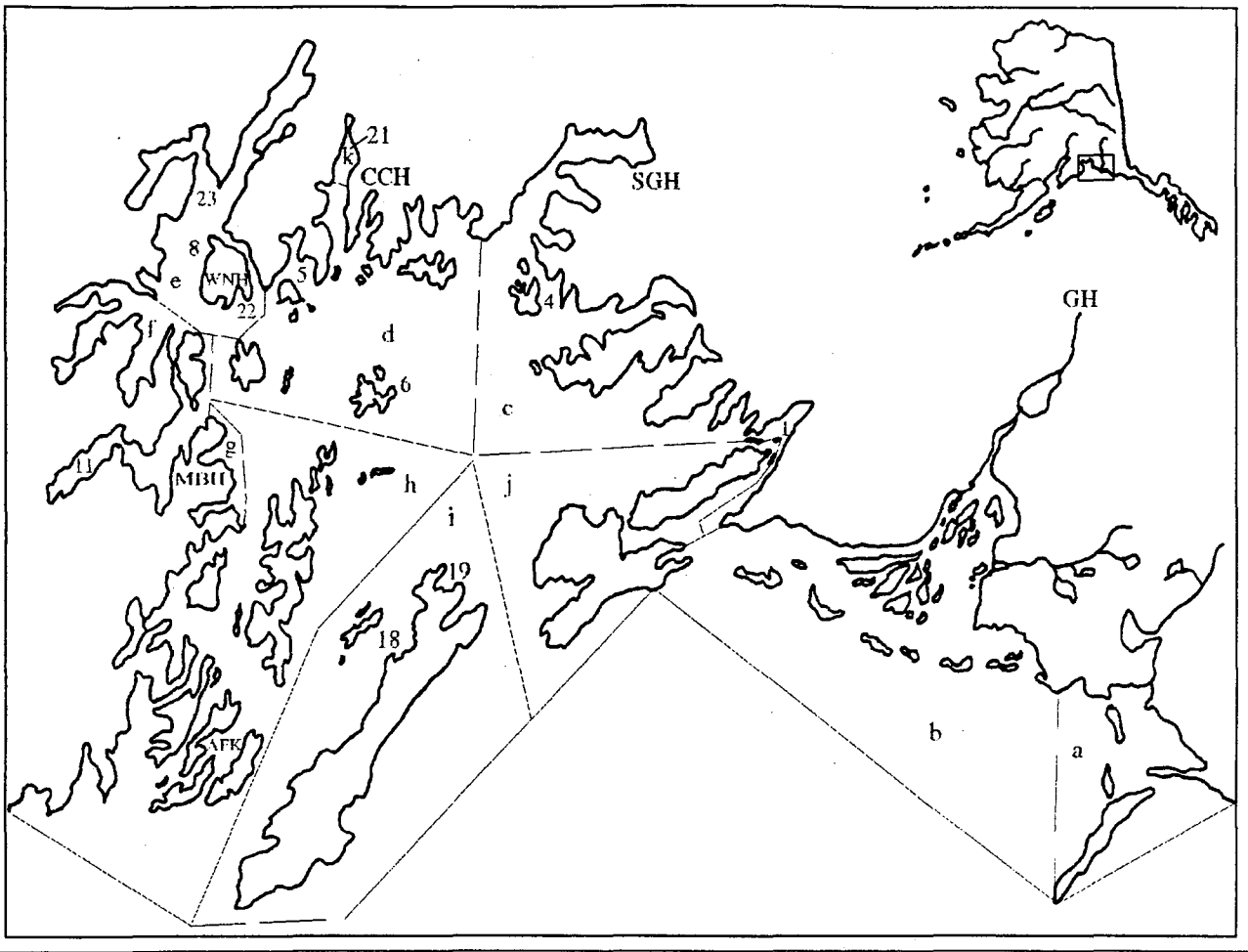
Format

= recommended location and stock

= not recommended

MAP 1

Prince William Sound
Fishing Districts, Hatchery Locations and
RPT Recommended Sites for Remote Releasing Salmon



Major Fishing Districts		Hatcheries by District	Recommended Release Locations by District
a	Bering R.	----------	----------
b	Copper R.	GH (Gulkana)	----------
c	Eastern	SGH (Solomon G.)	1: Nelson Bay 4: Boulder Bay
d	Northern	CCH (Cannery Cr.)	5: Eaglek Bay 6: Naked Island
e	Coghill	WNH (Noerenberg)	8: Granite Bay 22: Ester Bay 23: Barry Arm
f	Northwestern	----------	11: Kings Bay
g	Eshamy	MBH (Main Bay)	----------
h	Southwestern	AFK (Koernig)	----------
i	Montague	----------	18: Montague Is. 19: Zaikof/Rocky
j	Southeastern	----------	----------
k	Unakwik	----------	21: Unakwik

TABLE 6
SOCKEYE SALMON RELEASE OPTIONS: MARINE SITES

	MARINE SITES																											
Release criteria	Barry Arm			Kings Bay			Stockdale/ Chalmers			Rocky/ Zaikof			Coghill R. outlet			Eshamy Lagoon			Naked Is.			Nelson Bay			Eaglek		
Hat. stk run time 1/	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L
Wild stk present	N2/	?	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y
Run curve overlap	N	?	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y
Fishable area	*see map			*see map			*see map			*see map			*see map			*see map			8/			*see map			*see map		
Enforceability	*see map			*see map			*see map			*see map			*see map			*see map			8/			*see map			*see map		
Other management considerations	N	Y	Y	N	?5/	Y3/	N	?5/	Y	?5/	?5/	Y	Y	Y	Y	Y	Y	Y	N	?9/	?9/	N	?11/	Y	N	Y	Y
Adequate imprinting water supply	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y10/	Y10/	Y10/	Y	Y	Y	Y	Y	Y
Recommendation "worth pursuing"	Y	Y	Y	Y	Y	Y3/	Y	Y	N4/	Y	Y	N	N	Y6/	N	N	N	Y/7	Y	Y	Y	Y	?	N	Y	N	N

NOTES:

Code: N = no; Y = yes.

1/ E = early (Eyak) run; M = middle (Coghill) run; L = late (Eshamy) run.

2/ Since no wild stock are present in the vicinity at this time, a large area of the Coghill District could be open to fishing (not restricted to Barry Arm); release locations could also differ for early stock.

3/ Concerns focused on Eshamy Lake escapement while managing for mixed stock fishery of wild and migrating hatchery Eshamy stock to remote location.

4/ Stockdale/Chalmers is not recommended as a release site because small stocks of wild fish are present. However, if Kings Bay or Barry Arm are not acceptable for Eshamy releases, this area could provide an alternative.

5/ Requires test fishing to determine presence of migrating stocks.

6/ Interim releases recommended only.

7/ Interim releases recommended only.

8/ Definition of fishable area and enforceability will require further investigation.

9/ Requires test fishing to determine presence of migrating stocks.

10/ Needs evaluation.

11/ Site and local stocks require further investigation.

TABLE 7
SOCKEYE SALMON RELEASE OPTIONS: LAKE SITES

Release criteria	LAKE SITES																														
	Pass Lake Esther Pass Lk. Davis Lake Shoestring Lk			Solf Lake			North Nellie Juan lakes			Point Nellie Juan lakes			Louis Lake			Turner Lake Millard Lake Silver Lake			Eshamy Lake			Ewan Lake			Cedar Lake		
	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L			
Hat. stk run time 1/	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L			
Wild stk present	N	Y	Y	N	N	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y			
Run curve overlap	N	Y	Y	N	N	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y			
Other management considerations	N	Y	Y	N	N	Y	N	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y			
Recommendation "worth pursuing"	Y	N	N	Y	Y	N	Y	N\2	N	Y	Y\3	Y\3	Y	Y	N	Y	N	N	N\4	N\4	N\4	Y	N	N	Y	N	N			

Code: N = no; Y = yes.

1/ E = early (Eyak) run; M = middle (Coghill) run; L = late (Eshamy) run.

2/ For small sport fish release and harvest only.

3/ Releases may go unharvested if Eshamy/Crafton Is. Subdistricts are closed due to weak wild stock escapement.

4/ Releases will not be conducted here due to genetic considerations.

NOTES:
a. Lake releases could be continuous stocking programs, or periodic based on need to release Main Bay sockeye fry which exceed rearing capacity.
b. Terminal fishery area and enforceability are not described in that adults returning from lake stocking are intended to be caught in interception fisheries.
c. Stream catalog numbers: Pass (#329), Esther Pass (#345), Davis (#311), Shoestring (#344), Solf (#690), Nellie Juan (#481), Point Nellie Juan (#500), Louis (#689), Turner (#114), Millard (#115), Silver (#116), Eshamy (#516), Ewan (#603), Cedar (#213)
d. See ADF&G return data (Carpenter, 1991) on lakes which have been previously stocked.

personnel to better assess feasibility of such release projects. Site test fishing for wild stocks, coded wire tag and recovery programs, and straying and genetic sampling studies are among investigations which may be required preliminary to conducting remote releases and during the remote release project. Coordination between PNP operators and the Department is essential to developing the fishery toward the goals of the Phase 3 Plan.

PNP operators will be required to select from RPT recommended sites for any salmon stock they may wish to release, or identify new stocks for brood development to suit a specific location. In the event the Department receives a release proposal for a site not presently listed by the PWS/CR RPT, the site/stock will undergo the same vigorous preliminary evaluation as those presently recommended, and if necessary, detailed evaluations will be required.

8.00 HABITAT PROTECTION, ENHANCEMENT AND WILD STOCK REHABILITATION

Prerequisite to achieving optimum production of wild and enhanced salmon on a sustained yield basis is high quality habitat in which incubation, rearing and adult maturation occurs. Reaching the production goal set for optimum enhanced salmon production is fundamentally based on achieving maximum and sustained yield of wild stocks. It is imperative that habitat be protected to maintain basic environmental conditions needed to support healthy and productive wild stocks. In addition, habitat can be enriched through enhancement to increase the quality of localized conditions, and expanded in area to provide more productive habitat. Damaged habitat attributable to natural events and man caused degradation can be improved through rehabilitation activities designed to result in improved opportunity for wild stock production.

The preservation of marine habitat is vital to sustained wild stock production. Protection of habitat, enhancement of habitat, and mitigation of damaged habitat is fundamental and prerequisite to achieving goals and objectives of the Phase 3 plan.

8.10 WILD STOCK PRODUCTION

The history of the Prince William Sound salmon fishery portrays highly variable wild stock production. Evidence indicates wild stock variability is related to environmental conditions and escapement. Recent scientific findings relating sea surface temperature and plankton productivity to salmon production is providing a new insight into functioning of the wild stock system. In addition, the spawning environment and environment of the early life stages of salmon are important factors limiting production of wild salmon. Natural spawning bed area limitations due to small stream systems in PWS, impassible barriers to river and lake systems, tectonic activity uplifting previous spawning grounds, logging practises that damage stream beds, erosion, and deep penetrating freezes that kill eggs, alevins and fry, are among factors detrimental to strong and sustained wild stock production. Pollution resulting from human activities such as the EXXON VALDEZ oil spill can directly damage fish as well as habitat supporting fish production.

Rehabilitating wild stocks that are depressed, enhancing habitat to increase the capacity of the environment to yield higher numbers of wild stocks, and mitigating degraded habitat are important aspects of the program to sustain wild stock production and increase salmon harvest opportunity.

8.20 CAPACITY UTILIZATION

To utilize fully the environmental capacity is one clear objective of wild stock rehabilitation and habitat enhancement contributing to the goal of optimum sustainable production. It is unlikely that wild stock in PWS can produce the numbers of salmon that the hatchery system can. However, while wild stock rehabilitation may not substantially boost regional salmon production, it will improve utilization of habitat, help maintain the diversity and productivity of wild stocks, and may result in local increases in salmon production.

8.30 OBJECTIVES

Wild stock rehabilitation and habitat enhancement objectives include:

1. Fully utilize salmon habitat.
2. Restore the capacity of the habitat to support salmon.
3. Mitigate damage to habitat caused by natural disaster and man (earthquakes, oil spills, logging activity).
4. Maintain genetic diversity.
5. Create new spawning and rearing habitat, and enhance existing habitat.

While adopting these objectives, it is essential to recognize that:

a. Wild stock rehabilitation is intended to restore and maintain wild stock production.

b. Fish produced through habitat rehabilitation projects will be subjected to natural fluctuations in population due to environmental conditions.

c. Wild stock rehabilitation is not intended to solve mixed stock management problems and allow expanded fishing area.

d. The effects of rehabilitation production on allocations will be minimal, but additional harvest opportunities will be created.

e. It is very unlikely that the results of such programs will substantially increase production or result in management that is less restrictive. The cost/benefits of undertaking such programs will not likely be as advantageous as hatchery production in terms of commercial harvest value. However, in terms of user days, angler days, and other human considerations, the benefits may be considerable.

8.40 AGENCY PARTICIPATION

Primary participants in wild stock rehabilitation and habitat enhancement include the USDA Forest Service (Cordova and Glacier Ranger Districts), the Alaska Department of Fish and Game, and Prince William Sound Aquaculture Corporation. The Forest Service continues to play the largest role in these programs.

The Forest Service manages approximately 5.9 million acres of land in the Prince William Sound and Copper-Bering rivers region that make up the Chugach National Forest. The Chugach National Forest has the Federal responsibility to provide a sustained flow of renewable resources (outdoor recreation, forage, wood, water, wilderness, wildlife and fish), in a combination that best meets the needs of society now and in the future.

Recognizing the valuable fisheries resources within the Chugach, the Forest Service has emphasized and actively developed habitat improvement and restoration programs. These programs are aimed at maintaining or restoring wild stock fish habitat capability

for the benefit of all users. Project benefits are typically displayed in numbers or pounds of fish for commercial harvesters, opportunity to fish (angler days or user days) for recreational users, or the values associated with preserving the genetic integrity of a specific stock of fish.

The Forest's fisheries habitat improvement programs are closely coordinated with the Alaska Department of Fish and Game. Several habitat improvement projects are joint efforts between the Forest Service and ADF&G. The cooperative relationship between the organizations has developed through a common vision and mutual goals to rehabilitate wild stock and enhance habitat.

The ADF&G rehabilitation efforts are currently focused on salmon restoration projects related to the Exxon Valdez oil spill. Funding is being sought to:

- identify appropriate fisheries enhancement techniques for specific salmon stocks potentially impacted by the oil spill;
- enhancement of pink and chum stocks not impacted by the oil spill as a means to replace damaged stocks.

In addition, the ADF&G is working cooperatively with Forest Service and PWSAC personnel towards rehabilitating Coghill Lake sockeye.

Projects that typify wild stock rehabilitation and habitat enhancement include: spawning bed improvement or development, fish pass construction, deployment of stream-side incubation boxes, lake stocking, stream stocking, rearing pond development, placement of instream brush or cover structures, lake fertilization and stream bank stabilization. Projects may also include the taking of eggs from wild stocks for hatchery incubation and later release as fry or smolts into wild stock systems.

PWSAC's more recent role in rehabilitation has been the stocking of F_1 generation Eshamy and Coghill sockeye smolts at respective stream-lake systems. These projects are intended to improve adult returns thereby achieving needed adult escapement for natural spawning and improved production of those depressed wild stocks.

The Coghill Lake sockeye rehabilitation project is exemplary of the inter-agency commitment to rehabilitating wild stocks and warrants a brief discussion.

> The low sockeye returns to Coghill Lake in recent years appears to be due to low abundance of zooplankton that juvenile sockeye salmon depend on during lake residence (Edmundson, et al. 1992). The low number and small size of smolts outmigrating from the lake suggests that lake carrying capacity has declined in recent years. The decline of the zooplankton populations appears to be due to overgrazing by large fry populations in the mid 1980's.
>
> The Coghill Lake rehabilitation program includes four components: lake fertilization, escapement monitoring, juvenile stocking, and limnological/smolt production monitoring. The lake fertilization component is designed to boost primary and secondary production in the lake to provide greater food resources for juvenile salmon. If successful, the fertilization program will increase the

carrying capacity of the lake to historical levels. The escapement monitoring and juvenile stocking programs will be conducted jointly to insure that sockeye escapements and subsequent fry populations in the lake are increased gradually as lake carrying capacity increases. The limnological/smolt production monitoring programs will document changes in sockeye fry food abundance, fry growth rate, and smolt biomass. An empirical relationship between zooplankton biomass and smolt biomass in Alaskan lakes will be used to estimate lake carrying capacity (Koenings and Kyle, 1993). Changes in fry growth and smolt biomass will be used to evaluate the performance of the model.

The juvenile stocking program is intended to increase the rate of recovery of the sockeye salmon population. The juvenile stocking program will initially involve annual releases of 800,000 age 1 smolts at the outlet of the lake. Smolts releases at the lake outlet will be F_1 generation fish, e.g. progeny of wild spawners taken from the lake two years earlier. The purpose of the smolt stocking program is to insure that adequate numbers of spawners are available in future years. The smolt stocking program will be terminated after 1996 to minimize genetic changes in the Coghill Lake sockeye stock. Further juvenile stocking may continue after 1996 if low escapement results in fry populations that do not fully utilize the available rearing habitat. Under these conditions, fry or pre-smolt may be stocked into the lake to boost fry populations and increase the rate of recovery. Fry or pre-smolt will be F_1 generation fish. If the rehabilitation program is successful, lake carrying capacity is restored to historical levels, and natural fry populations are fully utilizing available rearing habitat, no further supplementation will be conducted.

Both Phase 1 and Phase 2 comprehensive salmon plans for Prince William Sound and the Copper-Bering rivers identified many potential rehabilitation and enhancement projects and projects in progress. Since 1985 the Forest Service has been actively evaluating initial projects and implementing new projects based on improved technology and understanding of habitat characteristics (see TABLE 8).

Additional projects proposed for implementation between 1993-1997 are also identified (TABLE 9).

Thus wild stock rehabilitation and habitat enhancement are viewed as important programs in the Phase III Comprehensive Salmon Plan contributing to optimum sustained yield of wild stocks while maintaining their diversity and productivity.

TABLE 8
Completed fish habitat improvement projects in Prince William Sound, 1985-1993.
(\data\phase3\pwsrehab.wq1)

Project Type	District	Stream #	Name	Year	Work Accomplished	Habitat Created	Species Targeted	Additional Adults	Initial Costs USFS	Initial Costs ADF&G
Structural Improvements	Montague	782	Stump Lake	1991	Water control structure	50 acres	SS, PS CT, DV	Uncertain	$11,000	
	Northern	289	Derickson	1986	Fish pass	42,000 sq. ft.	PS	5,900	$140,000	
	Northwestern	455	Paulson Creek	1988	Fish pass removal and step pool construction	66,000 sq. ft.	PS	9,200	$11,000	
	Coghill	414	Harrison Creek	1991	Low flow structure	N/A	PS	5,000	$4,000	
Resident Sport Fish Improvements/ Enhancements	Northwestern	453	Suprise Cove lakes	1985-1987	Coho stocking (50,000 fry)	Terminal harvest sport fishery	SS	User days	$1,000	
	Northwestern	479	Culcross Lake	1984-1987	Coho stocking (80,000 fry)	Terminal harvest sport fishery	SS	User days	$3,000	
	Coghill	331	Granite Bay lakes	1988-1991	Trickle-dam construction and fry stocking (5,000 fry)	Resident sport fish opportunity	RT	User days	$3,000	
Spawning/ Rearing Habitat Enhancement	Coghill	431	Pigot Bay	1991	Spawning channel	35,000 sq. ft.	CS	3,500	$80,000	

continued

TABLE 8 (continuation)
Completed fish habitat improvement projects in Prince William Sound, 1985-1992.

Project Type	District	Stream #	Name	Year	Work Accomplished	Habitat Created	Species Targeted	Additional Adults	Initial Costs USFS	Initial Costs ADF&G
Completed Fisheries Inventories	All	All	All	1989-1992	Channel type stream classification	GIS data base	N/A	N/A	$80,000	
	Montague	700-775	Montague Is.	1991-1992	Fisheries habitat inventory	Habitat capability modeling	CS	N/A	$28,000	
	Montague	700-707 778-787	Montague Is.	1989-1992	MIS monitoring	Montague timber access road monitor	PS, CS, CT	N/A	$15,000	

Note:
SS = silver salmon
RS = red salmon
CS = chum salmon
KS = king salmon
CT = cutthroat trout
RT = rainbow trout
GR = grayling

\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 sockeye salmon based on 50 fish per surface acre of lake.
\3 Number of harvestable coho salmon varies from 5 to 10 fish per surface acre of lake surface.
\4 Number of harvestable pink salmon based on 0.14 fish per sq. ft. of spawning area.
\5 Number of harvestable chum salmon 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.

TABLE 9

Proposed fish habitat improvement projects in Prince William Sound, 1993-1997.

(\data\phase3\futrrehab.wq1)

Project Type	District	Stream #	Name	Year	Work Accomplished	Habitat Created 1\	Species Targeted	Additional Adults	Initial Costs USFS	Initial Costs ADF&G
Structural Improvements	Montague/ Southeastern		Rocky Bay Boswell Bay Canoe Pass \5	1993-1995	Repair, reconstruct and maintain 10 fishways	N/A	SS, PS RS	40,000 \2,3,4	$65,000	
Spawning/ Rearing Habitat Enhancement	Coghill		Pigot Bay	1993	Expand spawning channel	35,000 sq. ft.	CS	3,500	___	
	Montague		Montague Is.	1993-1995	Stream rehabilitation and riparian habitat improvement	N/A	SS, CS PS	Not estimated	___	
Monitor and Identify Habitat Mitigation/ Rehabilitation	Montague		N/A	1993	Monitor road construction and identify mitigation needed to enhance/rehabilitate habitat	N/A	Any	N/A	$15,000	
Wild Stock Rehabilitation	Montague		Port Chalmers Other sites	1993-1995	Monitor fry survivals and escapements; expand stocking	N/A	CS	300,000 lbs	$72,000	
	Coghill		Coghill Lake	1993-1996	Lake fertilization to improve habitat	3,000 acres	RS	200,000	$23,000	$166,000
Complete Fisheries Inventories	Southeastern		All	1993-1997	Inventory population status & propose recovery measures	N/A	CT	N/A	$36,000	
	All	All	All	1993-1994	Complete channel type stream classification	N/A	N/A	N/A	$30,000	

continued

TABLE 9 (continuation)
Proposed fish habitat improvement projects in Prince William Sound, 1993-1997.

Note: SS = silver salmon; RS = red salmon; CS = chum salmon; CT = cutthroat trout

\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 coho salmon varies from 5 to 10 fish per surface acre of lake surface.

\3 Number of harvestable pink salmon based on 0.14 fish per sq. ft. of spawning area.

\4 Number of harvestable sockeye salmon based on 50 fish per surface acre of lake.

\5 Additional fishways include Trail Creek, Control, Paulson Creek, Red Creek, Shrode Creek, N. Dickerson Creek, Otter Creek.

9.00 REFERENCES

Alaska Seafood Marketing Institute. Salmon 2000. Juneau, Alaska. 1991.

Edmundson, J.A., G.B. Kyle, and Mark Willette. 1992. "Limnological and fisheries Assessment of Coghill Lake relative to sockeye salmon (*Oncorhynchus nerka*) production and lake fertilization." Alaska Department of Fish and Game, FRED Report No. 118.

Fisheries Policy Task Force. "Report and Recommendations of the Alaska Fisheries Policy Task Force." State of Alaska, Juneau. 1983.

Koenings, J. and G. Kyle. 1993. "Collapsed populations and delayed recovery of zooplankton in response to heavy sockeye salmon foraging." Proceedings of the International Symposium on Biological Interactions of Enhanced and Wild Salmonids. June 1991. Nanaimo, B.C. (In Press)

Kruse, Gordon H. "An Overview of Alaska's Fisheries: Catch and Economic Importance of the Resources, Participants in the Fisheries, Revenues Generated, and Expenditures on Management". ADF&G. February 1988.

Lannan, James E. "Contemporary Trends in World Salmon Production and Management Policy". Salmon Production, Management, and Allocation. Ed. William J. McNeil. Oregon State University Press. 1988.

Prince William Sound Aquaculture Corporation. Salmon Culture Program. 1975.

Prince William Sound Aquaculture Corporation Allocation Task Force. Allocation of Enhanced Salmon: Introduction, Identification, and Analysis of Issues Concerning Hatchery Salmon Allocations. Report Number One, Briefing Papers. 1990.

Prince William Sound Aquaculture Corporation Allocation Task Force. Allocation Task Force Report on Enhanced Salmon. Report Number Two, Trends and Conditions. 1990.

Prince William Sound Regional Planning Team. Prince William Sound - Copper River Comprehensive Salmon Plan. Phase 1: 20 Year Plan (1983-2002). 1983.

Prince William Sound Regional Planning Team. Prince William Sound - Copper River Comprehensive Salmon Plan. Phase 2: 5 Year Plan (1986-1991). 1986.

Royce, William F. Fisheries Development. Academic Press, Inc. 1987.

Rutledge, W. P. and C. E. McCarty. "Fishery Managements' Realities Versus Fishery Genetics' Fantasies." Fisheries Management Controversies: Biology, Economics, and Politics. Abstracts of papers presented at the 119th Annual Meeting of the American Fisheries Society. 1989.

Senate Advisory Council, Alaska State Legislature. "The Alaska Board of Fisheries: Fisheries Management Alternatives". October 1987.

Senate Advisory Council, Alaska State Legislature. "Community Fisheries Development". 1989.

State of Alaska 17 Legislature, SB457. 1992.

10.00 APPENDICES

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APPENDIX 1

PRINCE WILLIAM SOUND / COPPER RIVER REGIONAL PLANNING TEAM

COMPREHENSIVE SALMON PLANNING
ALASKA DEPARTMENT OF FISH AND GAME

RPT CHARTER AS REVISED FOR PRINCE WILLIAM SOUND/COPPER RIVER REGIONAL PLANNING TEAM

REGIONAL PLANNING TEAMS ARE AN IMPORTANT PART OF THE SALMON ENHANCEMENT EFFORT IN THE STATE OF ALASKA. THE FOLLOWING STATEMENTS CONSTITUTE THE MISSION, STATUS, AND OPERATIONS AND CONFIRM ROLES AND TASKS THAT, AS A MATTER OF PRACTICE, HAVE BECOME RECOGNIZED AS APPROPRIATE FOR THE PWS/CR RPT.

MISSION STATEMENT

The mission of the PWS/CR RPT is to plan for the long-term future of the salmon resource within it's 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.

In addition, it is the mission of the PWS/CR RPT to integrate production planning with allocation and management in order to facilitate achieving regional fishery objectives and goals.

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 RPT's. The RPT is ultimately responsible to the Commissioner. Any staff funded by the ADF&G or association to assist the RPT with planning may be administratively monitored by the association but will be responsible to 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 RPT's. 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 or 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 desciptions 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 has 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 condition."

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 Managment 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 and fisheries data 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.

In addition to identifying and recommending enhancement opportunities, the PWS/CR RPT will recommend fisheries management plans that support production and harvest objectives to achieve enhanced salmon allocations specified in the adopted regional allocation policy.

Review and Comment

To execute legally mandated review and comment responsibilities and to arrive at recommendations for permit approval, revocation, or suspension, the RPT's require criteria that can be applied equitably to all permit applications and ongoing operations. The Commissioner and the RPTs have arrived at a general concensus 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 16.10.4000 (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.

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 through #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.
   D. The relationship of such projects to the goals and objectives of regional policy and regional plans.

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 for the coming five years and relate them to immediate goals and objectives of the Plan.

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 the 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.

THERFORE, THE PWS/CR REGIONAL PLANNING TEAM IS BY MEANS OF THIS DOCUMENT, CHARTERED TO PERFORM THE BASIC OPERATIONAL DUTIES WITHIN THE GENERAL PLANNING FRAMEWORK OUTLINED ABOVE AND TO REGULARLY REPORT ITS PROGRESS TO THE COMMISSIONER OF THE ALASKA DEPARTMENT OF FISH AND GAME.

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APPENDIX 2

PRINCE WILLIAM SOUND / COPPER RIVER RPT
PROJECT CRITERIA CHECK LIST
Version: 2/18/94

Checklist submission date:_____
Project begin date:_____

The PWS/CR RPT will review salmon enhancement projects proposed by any agency or entity. Proposals should address criteria listed within the check list. Salmon projects proposed for PWS/CR should describe project intent and describe how the project goal will be achieved. This screening is to provide Region-wide coordination of all enhancement efforts and is not intended to be a definitive technical analysis.

The Planning Team will ensure that project funding needs are identified when the actions of one agency/entity require funding on the part of another agency/entity. An example is the need to fund tag/recovery efforts within the fishery and at a hatchery.

GOAL:

Projects will be evaluated on their contribution to achieving objectives of the comprehensive regional plan. Objectives are established to facilitate achieving regional goals. Regional goals support developing and maintaining a comprehensive salmon fishery that addresses fish production, allocation, management, and net benefit. The integration of these four fishery elements is intended to provide the tools and process necessary to plan and implement strategies to fulfill user needs and expectations as outlined in the regional plan and regional allocation policy for enhanced salmon.

AN ACCEPTABLE PROJECT GENERALLY:

1. Addresses the objectives outlined within the regional allocation policy. These objectives provide for:
   * reduced congestion and or conflict in the fishery,
   * minimized impact on wild stocks,
   * promoting highest possible fish quality,
   * maximizing production,
   * minimizing impacts to historic and traditional fisheries,

* supporting subsistence, sport and personal use needs,
* encouraging and supporting research and,
* recognition of healthy competition in the fishery.

In addition, an acceptable project generally:

2. Brings non-producing and underutilized areas of PWS/CR Region into production.

3. Rehabilitates stocks which are depleted below the threshold of reproductive viability.

I. PROJECT APPLICANT _____

Address _____

_____

Phone _____

II. PROJECT DESCRIPTION _____

_____

_____

_____

_____

1. Project location _____

2. Project purpose
   - A. Perceived user need _____
   - B. Addresses a particular management issue _____
   - C. Efficient use of _____ hatchery _____
   - D. Stock is at reduced production level _____
   - E. Site specific habitat opportunity _____
   - F. Other _____

   _____

   _____

3. Number of eggs/fry _____

4. Release location _____

5. Harvest location _____

6. Project type
   - A. Hatchery
     - New _____
     - Expansion _____
     - Remote release _____
   - B. Wild stock rehabilitation _____
   - C. Habitat improvement _____

7. Describe any new facilities to be constructed, including water quantity requirements and minimum anticipated discharge from the water source._____

_____

_____

_____

_____

_____

8. Target species:

pink _____	chum _____
coho _____	sockeye_____
chinook_____	

9. Are evaluation mechanisms included in the proposal?

A. Hydroacoustic surveys _____
B. Smolt enumeration _____
C. Mark and recapture; coded wire tagging _____
D. Adult contribution, enumeration _____
E. Other _____

III. PROJECT FEASIBILITY

1. Are enhancement methods proven or experimental?_____

_____

Describe them:_____

_____

_____

_____

_____

2. What is the project's cost recovery requirement?_____

_____

_____

3. What is the project's brood stock requirement?_____

_____

_____

4. How will brood stock be acquired?_____

_____

_____

5. If it is necessary to culture new brood stock, how long will it take?_____

_____

_____

6. How will juveniles be imprinted at release site?_____
_____
_____

7. How will juveniles be transported if remote released?
_____
_____

8. Will the project require involvement or permits from agencies other than ADF&G?_____

What agency(s)?_____

9. If implemented, will the project result in a need to revise existing regulations?_____

Please explain:_____
_____
_____
_____
_____
_____
_____
_____

IV. LAND USE

1. Is project compatible with adjacent land use policies?
_____
_____
_____

2. The landholder is?_____

3. Can the project be implemented without interfering with existing uses of the area?_____
_____
_____

4. Will the project fully utilize the site potential?_____
_____

V. MANAGEMENT

1. Can enhanced fish be harvested while protecting natural stocks?_____

How?_____
_____

2. Will the project contribute to a fishery that is manageable in time and area for all users?_____

3. Can the project be managed for corporate brood and cost recovery escapement?_____

4. Can the harvest be managed to achieve high fish quality?_____

5. Where will cost recovery occur to support the project?

_____

_____

VI. BIOLOGY

1. Will water utilized by the project reduce habitat for local fish stocks?_____

_____

2. Does the project conform with state genetic policy?

_____

_____

_____

3. Will the proposed project cause disease transmission to local fish stocks?_____

4. What are possible impacts of fry/smolt on marine and aquatic ecosystems?_____

_____

_____

5. How will returning adults impact marine, aquatic and terrestrial ecosystems?_____

_____

_____

_____

6. What is the run timing of the broodstock?_____

_____

7. How will run timing be maintained from one generation to another, i.e. egg take schedule?_____

_____

_____

_____

_____

_____

VII. ALLOCATION

1. Is the project consistent with the allocation policy?
_____

2. What user groups will benefit?_____
_____

3. What is the magnitude of the benefit to each user group?_____
_____

4. Is there a loss of harvest opportunity to existing users?_____

5. If so, what mitigation options are proposed?_____
_____
_____

6. Have the most probable harvest scenarios for fish produced by this project been considered?_____

   Please describe them:_____
   _____
   _____
   _____
   _____

7. Is there publicly owned space to create or expand recreational harvest support facilities?_____

   Please identify:_____
   _____

8. Can the project be implemented without conflicting with an existing commercial, recreational or subsistence fishery?_____

   Please explain:_____
   _____
   _____
   _____

VIII. COST

1. What is the cost of the project?
   Start-up_____
   Annual_____

2. How do you intend to fund implementation?_____

3. How do you intend to fund operational costs?_____

4. Will the project result in costs to other entities?____

Who?_____

5. Is the project financially feasible?_____

IX. COST/BENEFIT

1. Of the adult salmon returning to the project, what percentage will be contributed to the CPF (common property fishery)?_____

2. What ex-vessel price are you using to calculate your cost recovery?_____

3. How is the ex-vessel price expected to respond to the production?_____

4. What marketing strategies do you propose for the new production?_____

5. How is the quality of the proposed production expected to effect ex-vessel prices?_____

6. What are the fishery management costs associated with conducting an orderly fishery? _____

7. What are the hatchery harvest costs?_____

8. What are the costs associated with marking and evaluation studies?_____

9. What are the capital and operating costs of the program?_____

10. Other economic information:_____

APPENDIX 3

REGIONAL ALLOCATION POLICY

A. INTRODUCTION

This policy is production oriented. It will be used to guide the future for Area E enhanced salmon production. This policy does not prescribe any actions to provide immediate short term resolution to user concerns about, or perceptions of, enhanced salmon allocations or fishing opportunity.

B. POLICY INTENT

It is the intent of the allocation policy to state a clear position on the allocation of Area E enhanced* salmon. In so doing, the policy provides goals which give future direction to developing and implementing enhancement programs.

Flexibility is crucial. Variables within the natural environment, market place and political and regulatory arenas may affect the ability to implement and manage to achieve specific goals. Long term fishery trends which suggest deviations from the policy will be assessed and may trigger planning and production responses. It is emphasized that all allocation adjustments will be achieved at the planning and production phases and will not lead to in-season fishery adjustments.

> * ***Enhanced*** **salmon has replaced** ***hatchery*** **salmon within the policy recommendations. Due to user response supporting salmon rehabilitation projects in addition to hatchery production, the ATF definition of equating enhanced salmon to hatchey salmon is no longer valid. Enhanced salmon is now to be defined as: Salmon resulting from hatchery production and rehabilitation projects.**

C. POLICY OBJECTIVES

REDUCE CONGESTION IN THE FISHERY. With increased opportunity and reasonable diversification, harvesters will have more options over area and time to conduct fishing activities, thereby reducing congestion, interference and conflict.

MINIMIZE IMPACT ON WILD STOCKS. It is vital to the fishery to maintain the genetic integrity and viability of the wild stocks. ADF&G is recognized and supported for its mandated authority to manage for wild stock escapement. PWSAC will encourage protection of the fishery by minimizing aquaculture's impact on wildstocks, and will continue to interact with agencies, etc., and the holders of real property for the purpose of protecting the natural environment.

PROMOTE HIGHEST POSSIBLE FISH QUALITY. Management strategies and fishery plan implementation will be integrated to provide opportunities to harvest the highest possible quality fish. It is recognized there is responsibility in fishery planning and fishery management to protect and develop the resource. There is also concurrent

responsibility to assure access to the resource and to every reasonable degree assure that the resource is not diminished in quality due to management strategies or planning.

MAXIMIZE PRODUCTION. Enhancement opportunities will be identified and implemented to achieve policy goal. In addition, planning and management will pursue a course of fisheries development to increase the enhanced production of the region and expand the fisheries opportunity. In so doing, there will be proportional increases between the users in compliance with policy. The intended recipient of proposed production will be clearly designated.

MINIMIZE IMPACT TO HISTORIC AND TRADITIONAL FISHERIES. PWSAC will promote and reasonably plan enhancement activities that pose minimal disruption to historic and traditional fisheries on wildstocks that have existed since statehood.

DEVELOP AND SUPPORT IMPLEMENTATION OF STRATEGIES TO ACHIEVE POLICY GOAL. PWSAC will encourage an integration of allocation, production and management planning to maximize the positive benefits of any implementation schemes. Planning will be promoted to identify, develop and implement strategies to assure policy compliance and fisheries development. Diversification and expansion of fishing opportunity will be developed through strategies including, but not limited to, remote releases, species diversification and run timing selection. Policy goals and intents will be achieved through application of ongoing and future enhancement activities. PWSAC will encourage cooperation of the Alaska Department of Fish and Game and the Regional Planning Team (RPT) to assure policy compliance, and as necessary, increase management and enforcement functions and solicit user input.

SUPPORT SUBSISTENCE, SPORT AND PERSONAL USE NEEDS. PWSAC will continue to respond to subsistence and personal use needs as well as recreational opportunities within the enhanced salmon fisheries. PWSAC will provide information concerning the enhancement efforts in Area E and the significant financial contributions to the program made by the commercial fleet.

ENCOURAGE AND SUPPORT RESEARCH. Continued development of the fishery, preservation of wild stocks, the success of proposed projects and the protection of habitat rest on a foundation of knowledge and understanding. To acquire the tools critical to manage for local and region-wide enhancement, PWSAC will support research.

RECOGNIZE HEALTHY COMPETITION. Part of the mystique of fishing is the opportunity to compete, succeed, or fail in the enterprise. Healthy competition will be maintained to continue the flavor and spirit vital to a productive fishery and sustained life style.

D. ALLOCATION POLICY

It is the policy of PWSAC to equitably allocate enhanced salmon resources in Area E among all users through long-term planning, production and dedication of financial and human resources.

Subsistence, sport and personal use needs will continue to be addressed within planning and production strategies.

Pertaining to commercial fisheries, enhanced salmon allocations will be based upon the long-term historic economic balance that existed since statehood and prior to significant hatchery returns, as determined by ADF&G ex-vessel value records.

This balance will be utilized in planning and production as a long term approximate projection goal anticipated to achieve equitable value in returning salmon to drift gillnetters, seiners and set gillnetters; excluding brood stock and cost recovery salmon.

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APPENDIX 4

PRINCE WILLIAM SOUND MANAGEMENT AND SALMON ENHANCEMENT ALLOCATION PLAN

Enhanced production of pink salmon contributes as much as 90 percent of the commercial catch in Prince William Sound. Hatchery production for other salmon species may dramatically increase in the near future with the result being these species may be dominated by enhanced returns as well. The success of the salmon enhancement program has not been without costs. Historic fisheries have been altered to avoid the overharvest of wild stocks of salmon while attempting to catch large hatchery returns. Conflicts have developed between gear groups by having to fish together in small, crowded terminal harvest areas. Enhancement planning has also suffered due to lack of a management plan that will define a framework for future allocations of enhanced salmon.

The board recognizes the need to adopt an allocation plan giving clear direction to fishery managers and enhancement planners that will:

Minimize effects on wild stocks.

Minimize effects to historic and traditional fisheries while maintaining historic harvest value percentages.

Promote the highest possible quality fish.

Reduce congestion in the fisheries.

Maintain the diversity of uses of the salmon resources in Prince William Sound including subsistence, personal use and sport fisheries.

With these objectives in mind, it is the intent of the Board of Fisheries to allocate the natural and enhanced salmon stocks in Prince William Sound in such a manner as to maintain the longterm historic balance between competing commercial users that existed since statehood and prior to any significant production from enhancement programs. It is also the board's intent to maintain to the maximum extent possible the historic fishing areas and gear types and not allow development of new gear types in nontraditional areas.

To guide future production planning in Prince William Sound, the board endorses the allocation policy adopted by the Prince William Sound Aquaculture Corporation in May 1990 and directs both the department and private nonprofit hatchery operators to plan their enhancement production using the policy as a guideline.

By implementation of this plan, the board recognizes and preserves pink salmon as the primary species of importance to the purse seine gear type in Prince William Sound. It is the intent of this plan to provide an opportunity for development of enhanced returns of early timing chum, sockeye and chinook salmon to the gill net districts of Prince William Sound for the explicit benefit of the gill net gear users. It is also the intent of this plan to provide an opportunity for development of coho salmon returns after August 25 for the gill net fleet. The board recognizes that enhanced species returning to the gill net districts during the primary seine fishery in western Prince William Sound between July 18 and September 1 will be subjected to considerable seine interception and can not be explicitly targeted to the gill net fleet.

The board recognizes that wild stock management has the highest priority in determining fishery openings in the general waters of Prince William Sound.

The board recognizes the importance of flexible management and intends that the commercial fisheries of Prince William Sound be managed to protect wild stocks, maximize utilization of hatchery stocks and promote fish quality.

The Southwestern District is recognized as containing a mixture of wild and enhanced stocks, many of which are destined for other areas of Prince William Sound. The department will manage the general waters of this district based upon its assessment of the prevailing wild stock management concerns. Before July 18, the Southwestern District will be used as a migratory corridor to permit stocks moving through these waters to reach the gill net fisheries in the Eshamy and Coghill Districts.

The Perry Island Subdistrict is recognized as containing a mixture of wild and enhanced stocks, many of which are destined for other areas in Prince William Sound. The department will manage the general waters of this subdistrict based upon its assessment of the prevailing wild stock management concerns. Seines may be operated in the Perry Island Subdistrict on or after July 21 during emergency order fishing periods based upon the strength of the wild salmon stocks.

(#91-125 FB, 2/11/91)

5 AAC 24.370 PRINCE WILLIAM SOUND MANAGEMENT AND SALMON ENHANCEMENT ALLOCATION PLAN. The department shall manage the Prince William Sound commercial salmon fisheries as follows:

(1) The Eastern Northern (except Perry Island Subdistrict), Southeastern, Northwestern, and Montague Districts shall be managed by emergency order for the purse seine fishery with season openings and closures based on the strength of wild and enhanced stocks.

(2) Southwestern District:

(A) Before July 18, the Southwestern District is closed to salmon fishing;

(B) on or after July 18, purse seine may be operated in during periods established by emergency order based upon the strength of the wild pink salmon stocks.

(3) Perry Island Subdistrict:

(A) Before July 21, the Perry Island Subdistrict is closed to salmon fishing;

(B) on or after July 21, purse seines may be operated during periods established by emergency order based upon the strength of the wild pink salmon stocks;

(C) when the Esther Subdistrict is closed to achieve corporate escapement goals and brood stock needs of the Wally Noerenberg Hatchery, the Perry Island Subdistrict shall be closed.

(4) The Eshamy District gill net fisheries shall be managed by emergency order based on the surplus of wild and enhanced stocks returning to the district.

(5) Coghill District:

(A) Drift gill nets may be operated throughout the district during periods established by emergency order;

(B) beginning on July 21, purse seines may be operated throughout the district during periods established by emergency order;

(C) beginning on August 25, purse seines may be operated only in Lake and Quillian Bays during periods established by emergency order;

(D) beginning on September 5, purse seines may be operated only in Lake and Quillian Bays during periods established be emergency order and only if the harvestable surplus in the area in predominantly pink salmon.

(6) The Prince William Sound Salmon Allocation Policy (#91-125 FB, 2/11/91) is adopted by reference and shall be used by the department to guide salmon management in Prince William Sound. (Eff. 4/30/91, Register 118)

Authority: AS 16.05.251

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APPENDIX 5

NOTICE: Appendix 5 includes only introductory and text portions of the Remote Release Site Report. Appendices identified in the table of contents for this report are not included but can be located in the original and full text report of the PWS/CR RPT Remote Release Site Report available through the PWS/CR RPT at P.O. Box 1110, Cordova, AK. 99574.

HATCHERY SALMON

REMOTE RELEASE SITE

EVALUATIONS AND RECOMMENDATIONS

MAY, 1993

PREFACE

It is the responsibility of the Prince William Sound / Copper River Regional Planning Team (PWS/CR RPT) to prepare a regional comprehensive salmon plan to rehabilitate natural stocks and supplement natural production with hatchery salmon. The regional plan must define regional production goals by species, area, and time.

Beginning in the late months of 1989, the PWS/CR RPT began discussing the need for a Phase 3 Comprehensive Salmon Plan to address new conditions in the Area E salmon fishery. During the months that followed, the PWS/CR RPT prepared the general framework for Phase 3 planning and identified contents for the plan. Allocations and fishery management guidelines were to be incorporated. Fishery objectives, strategies, and recommended projects were also to be incorporated so the plan would comprehensively integrate production with allocations and management of the fishery. The result would be a plan setting forth the necessary steps to develop the fishery toward stability both in production and economy while meeting needs of the user.

Remote releasing salmon is one strategy for developing the fishery. Remote releases will result in diversification of harvest in area, species and time. As a further result of remote releases, the number of terminal harvest areas could be increased, easing congestion and conflict in the fishery. Also, protection from wild stock over-exploitation would be increased by allowing the fishery to continue in release terminal areas, sites where wild stocks would not be intercepted, during years of low wild stock abundance.

This report examines remote release site planning and site evaluation. Remote release recommendations resulting from this investigation will be incorporated in the Phase 3 Comprehensive Salmon Plan for Area E.

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1.00 INTRODUCTION

1.10 BACKGROUND

Enhanced salmon contribute greatly to the diversity and value of the PWS/CR salmon fishery. Enhanced salmon production has increased fishing opportunity for all users including commercial, subsistence, sport and personal use groups.

Five species of Pacific salmon are incubated and reared by the Prince William Sound / Copper River hatchery system. Primarily released at the hatchery site of rearing, salmon are also being released in increasing numbers at locations distant from the hatchery. Such **remote releases** contribute to diversifying the common property fishery by achieving adult returns at imprint sites or "terminal areas". The effect is to provide fishermen opportunities to access salmon at locations more conducive to successful fishing.

Successful fishing and fishing opportunities can be measured by different attributes according to the user and gear application. For instance, sport fishing opportunities can be improved by achieving adult salmon returns to areas accessible to day fishing excursions in recreational craft or to land based access points near communities or road systems. In the PWS/CR region, examples can be found in the remote releases of coho and chinook salmon at Fleming Spit in Cordova, coho and chinook releases adjacent to Whittier, and the pink, chinook and coho returns to Valdez.

Commercial fishing opportunities can also be improved by remote releasing salmon such as the release of pink salmon at Boulder Bay. Remote releases encourage fleet separation by providing more productive fishable area. Such remote releases can be designed as total harvest operations in order that the commercial fleet access the returning adult salmon throughout the entire run.

Remote release terminal fisheries may be subject to periodic closures during the course of enhanced returns. In addition, some fisheries restrictions may occur at terminal areas designated for hatchery cost recovery or brood stock needs. In other instances, remote releases could be designed strictly for brood stock or cost recovery which would enable commercial fishermen to access salmon at hatchery terminal sites or interception areas unhampered by the need to manage the area for brood or cost recovery.

As the PWS/CR salmon fishery continues to grow, increasingly complex issues arise such as congestion on the fishing grounds, allocation of enhanced fish between user groups, improving fish quality and increasing enhanced fish production. Users, fisheries management authorities and the regional aquaculture association are attempting to resolve these issues in concert with regional planning.

Hatchery salmon remote releases are considered as possible development projects to achieve an overall balanced fishery. In general, remote releases will provide increased terminal fishing opportunities for all user groups. The impacts such programs may have to wild stocks and fisheries management must be investigated to assure steps taken to implement such projects support conservation of the wild stock resource. In this regard, remote release site planning is not only essential for continued

conservation and utilization of fishery resources but also for development of the PWS/CR salmon fishery.

Remote release planning will not promote fisheries in mixed stock areas in Prince William Sound. Remote release planning is rather a process to identify terminal fishery areas within which intensive fisheries can exert a high exploitation rate on an enhanced stock with minimal impact to surrounding wild stocks. During years of large wild stock returns, remote released fish may be intercepted at entrances or the general waters of the Sound. However, when wild stocks are weak and offer little or no harvestable surplus, then the remote release stocks are intended to be harvested in terminal areas.

This report examines remote release planning including:

- fishing district descriptions (APPENDIX 4.10);
- computer modeling for remote releases and assessing possible fishery implications;
- identification of possible remote release sites;
- site evaluations based on identified criteria.

The analysis assumes that pink, chum and sockeye are the primary species to be remote released. The sockeye salmon remote release program is recommended as a mechanism to rehabilitate Eshamy and Coghill lakes wild stock sockeye which have been depressed in recent years. Sockeye remote releases can also be employed as mechanisms to distribute the gillnet fleet, thereby reducing congestion in the Eshamy and Coghill fishing districts, while simultaneously addressing allocations. Sites and stocks for sockeye releases are discussed.

1.20 REMOTE RELEASE: DEFINITION AND OBJECTIVES

The PWS/CR Regional Planning Team (PWS/CR RPT) defines "remote release" as the release of salmon fry or smolt at sites distant from the hatchery of incubation and rearing. The purposes of such releases include the following fishery objectives:

1. protect wild stocks during years of low abundance;
2. rehabilitate depressed wild stocks;
3. increase the number of fishable areas and thereby fishing opportunities;
4. improve the financial viability of the commercial fishery;
5. provide mechanisms for implementing the regional allocation policy;
6. improve the quality of fish in the catch by allowing harvest without intermittent closures.

1.30 EVALUATION CRITERIA

In planning for remote releases, sites are identified which meet fishery objectives listed above. In addition, selected remote release site criteria provide both objective measures and descriptive characteristics by which to evaluate sites for their appropriateness. Biological, genetic, management, harvest, and pre-existing use variables are considered.

Specific criteria identified for assessment of remote release sites within this report include:

1. existing hatchery stock run timing: (TABLE 1)

2. wild stock abundance: the adjusted stream totals (AST) for each index stream in the release management area as averaged between the years 1966-1987, ADF&G records; additional measures include the number of anadromous streams in the area.

3. run curve overlap: the overlap of run curves described by time and abundance of fish, between hatchery stock and local wild stock, indicating possible impact to local wild stock through stock mixing or fishery activity.

4. fishable area: the measure of the proposed remote release site surface area allocated for managing the release as a terminal fishery: (TABLE 2)

5. enforceability: the linear delineation of the imaginary boundary line(s) defining the proposed terminal area. (TABLE 3)

6. other management considerations: management for other stocks in vicinity but not within proposed release area such as migrating stocks or stocks spawning in nearby waters.

7. multiple use: Consumptive and non-consumptive use patterns within proposed release area. This issue includes uses of the proposed release location by man other than for salmon enhancement, and may include mariculture, in-water logging facilities and operations, or kayaking.

1.40 SITE PLANNING RECOMMENDATIONS

In this document, specific remote release sites are evaluated by the RPT for potential use as enhancement projects. The RPT makes recommendations for each site to facilitate development of proposals for remote releases. Aquaculture programs are encouraged when submitting proposals for remote releasing salmon, that focus is given to sites and stocks recommended. Should a site or program be proposed which is not among those recommended, the site will be evaluated against the same criteria provided in this report and utilized by the PWS/CR RPT in their planning process.

TABLE 1

MIGRATORY RUNTIMING OF SALMON STOCKS
FOR PRINCE WILLIAM SOUND HATCHERY FACILITIES

Hatchery	Specie	Parent Stock	Run Time \1	# Days	Peak (50%)	Early/Late
VFDA	Pink					
	Even	Jack Bay	6/20-8/6	48	7/10	E
	Odd	Siwash Crk.	6/14-8/1	49	7/4	E
	Chum	Crooked Crk. & Spring Crk.	7/20-8/30	42	8/5	L
	Coho	Corbin Crk.	8/4-9/23	51	8/31	L
AFK	Pink					
	Even	Duck River	7/19-9/5	48	8/14	L
	Odd	Ewan River	7/19-9/4	47	8/11	L
CCH	Pink					
	Even	Cannery Crk.	7/24-8/30	37	8/11	L
	Odd	Cannery Crk.	7/23-9/7	46	8/7	L
WNH	Pink					
	Even	AFK	7/20-9/6	48	8/16	L
	Odd	AFK	7/20-9/6	48	8/16	L
	Chum	Wells River & Bear Trap Crk.	6/17-7/26	40	6/26	E
	Coho	Power Creek Mile 18 Crk.	8/4-9/23	51	8/31	L
	Chinook	Willow Crk. & Deshka River	6/17-7/26	40	6/26	E
MBY	Sockeye					
	Eyak	Eyak River	Spawn 6/15-7/1	?	?	E
	Coghill	Coghill	6/1-7/31	61	6/25	M
	Eshamy	Eshamy	6/10-9/9	92	8/9	L
GULK 1	Sockeye					
		Indigenous	Spawn 8/1-11/10	?	late Sept.	?
GULK 2	Sockeye	E. Fork Gulk R. near Gulk 2	Early July to mid August	?	7/25-7/30	?
	Chinook	Confluence Pax & mid Fk Gulk	mid July to mid August	?	7/30-8/1	?

Notes:

\1 Run time is the date interval between which adult fish return to the terminal harvest area.

- Standard run times for pinks and chums are established as that period during which 95% of the total run returns to the hatchery special harvest area.
- Standard early pink run curve 6/15-7/20 (35 days).
- Standard late pink run curve 7/20-9/6 (48 days).
- Standard early chum run curve 6/14-7/26 (42 days).

TABLE 2

FISHABLE AREA		
District	Proposed Site	Fishable Area (Sq. miles)
Eastern	Nelson Bay	17.3
	Simpson Bay	8.8
	Landlocked Bay	4.2
	Boulder Bay	4.2
Northern	Eaglek Bay	11.4
	Naked Is.	62.0
	Perry Is.	
	South Bay 1	1.7
	South Bay 2	1.0
	East Twin	1.0
	West Twin	1.5
Unakwik	Unakwik Bay	14.8
Coghill	Granite Bay	1.4
	Esther Bay	1.4
	Barry Arm	36.5
Northwestern	Cochrane Bay	18.1
	McClure Bay	2.7
	Kings Bay	19.5
Southwestern	Herring Bay	8.4
	Drier Bay	6.8
	Bay of Isles	5.0
	Snug Harbor	2.9
	Whale Bay	9.1
	Port Bainbridge	7.2
Montague	Chalmers-Stockdale	35.2
	Zaikof Bay	9.1
Southeastern	Port Etches	13.9

TABLE 3

ENFORCEMENT

District	Proposed Site	Enforcement Lines: Primary Terminal Lines(s) #	Primary Terminal Lines(s) distance \1	Seconday Protected Areas #	Seconday Protected Areas distance \1	Gear-type
Eastern	Nelson Bay	4	4.992	2	1.001	Seine
	Simpson Bay	1	1.829	2	0.652	Seine
	Landlocked Bay	1	2.257	2	0.804	Seine
	Boulder Bay	1	2.901	2	0.603	Seine
Northern	Eaglek Bay	3	7.386	1	0.247	Seine
	Naked Is.	4	36.609	2	0.681	Seine
	Perry Is. South Bay 1	1	2.290	1	0.420	Seine
	Perry Is. South Bay 2	2	3.060	1	0.420	Seine
	W. Twin Bay	1	0.723	1	0.356	Seine
	E. Twin Bay	1	0.525	1	0.266	Seine
Unakwik	Unakwik Bay	1	1.720	0	-----	Drift/seine
Coghill	Granite Bay	1	1.811	0	-----	Drift/seine
	Esther Bay	3	0.728	0	-----	Drift/seine
	Barry Arm	1	3.031	1	1.675	Drift/seine
Northwestern	Cochrane Bay	1	4.517	6	6.460	Seine
	McClure Bay	1	0.944	2	0.406	Seine
	Kings Bay	1	2.866	4	3.253	Seine
Southwestern	Knight Is. Herring Bay	1	2.141	3	1.084	Seine
	Knight Is. Drier Bay	1	1.701	4	1.479	Seine
	Knight Is. Bay of Isles	1	1.492	1	0.279	Seine
	Knight Is. Snug Harbor	1	2.575	1	0.356	Seine
	Whale Bay	1	1.554	0		
	Port Bainbridge (inner)	1	2.190	1	0.269	Seine
Montague	Chalmers-Stockdale	2	8.120	0	-----	Seine
	Zaikof Bay	1	3.738	2	5.332	Seine
Southeastern	Port Etches	1	4.524	5	4.035	Seine

NOTE: \1 Distance given in miles or decimal miles.

Prior to formalizing a remote release proposal for project implementation, the proposal will further undergo ADF&G agency review and a public review and comment period.

When evaluating remote release site proposals, additional management and genetic concerns may be identified which will need to be addressed. Guidelines for these areas include the following.

1.41 MANAGEMENT

Harvest management is a very important consideration in the planning and selection of remote release sites. One of the key factors in evaluating the effects of a remote release program on harvest management is the timing of adult returns of the introduced stock compared to that for the wild stocks in the surrounding area. To sustain healthy populations, wild stock systems are harvested at a rate, based on the magnitude of their return, which assures the biological spawning requirement is achieved. If the natural return is weak, the harvest rate in the general fishery must be correspondingly low to meet this requirement. When an introduced stock returns to a remote release site, there are no escapement requirements and therefore 100% of the return can be harvested. When natural and introduced stocks occur together in a fishery, harvest management must balance the competing interests of managing for wild stock escapement and under utilizing the introduced stock, vs fully utilizing the introduced stock and compromising the wild stock escapement.

Remote release sites have been selected in areas that are thought to be barren of wild stocks during the run timing of the introduced stock. Therefore, the introduced stock is expected to be completely harvested with no undue concern for achieving wild stock escapement. However, with over 1,100 documented anadromous streams in Prince William Sound, there are few, if any areas that are truly barren of natural production. Therefore, from the standpoint of harvest management, remote release stocking programs should be planned so that the introduced stocks have a timing of return that minimizes overlap with the timing of the natural stocks in the surrounding area. When temporally isolated, differential harvest rates can be applied to the wild and remote release stock components.

1.42 GENETICS

Proposed remote releases of salmon must not compromise the genetic integrity of the wild stocks. Therefore, in evaluating remote release programs, priority should be given to those sites or projects that:

1. are barren of wild stocks of the same species;
2. use local stocks as brood; or,
3. result in adult returns (run timing curves) which do not overlap those of local stocks.

In addition to management and genetic guidelines, specific topic areas are recommended for evaluation such as early life history and cost/effects (see below).

1.43 EVALUATION STUDIES

The RPT recognizes that studies will be necessary to evaluate the effect of remote release programs on wild stocks. The set of studies that is needed will likely differ depending on the characteristics of specific remote release sites. The following types of studies may be necessary to evaluate specific remote release programs.

1. Interception rate on wild stocks

   Migrating wild stocks may be intercepted at some remote release sites. A test fishing program should be conducted for at least one year before hatchery stocks are released to estimate the rate of interception. Test fishing should occur at the proposed remote release site throughout the return timing of the proposed hatchery stock.

2. Inventory of wild spawning stocks

   Additional data on the abundance and timing of wild spawning stocks may be needed to determine the suitability of some proposed remote release sites when existing databases are inadequate. Foot surveys of streams and aerial surveys will be used to obtain this data when necessary.

3. Straying of hatchery stocks into streams

   Remote released stocks may stray into wild stock streams along migration routes or at the release site. The rate of straying into selected wild streams may need to be estimated to assess whether straying rates are unacceptably high. The acceptable level of straying for each species must be determined. Recovery of coded-wire tagged or otolith marked individuals will be used to estimate the rate of straying. Weirs will likely be needed to assess the straying rate into sockeye systems; whereas, foot surveys will provide adequate data for most pink and chum systems.

4. Genetic changes in wild stocks

   Interbreeding of wild and hatchery stocks may cause genetic changes in wild stocks leading to decreased productivity. Programs may be needed for selected systems to assess whether genetic changes are occurring in wild salmon stocks. Samples of various tissues will be periodically collected from spawners for electrophoretic analysis. Several years of sampling may be needed to document genetic changes in wild stocks.

5. Migration of hatchery stocks and effect on catch composition

   Hatchery stocks returning to some remote release sites may migrate through existing fisheries. In the absence of stock identification data, these interceptions may affect the ADF&G's ability to manage existing fisheries using catch-per-unit of effort (CPUE) as a measure of run strength. In these cases, coded-wire

tag or otolith marking programs will be needed to estimate the effect on hatchery stock interceptions on catches in existing fisheries. When these interceptions are found to be significant, ongoing stock identification programs will be needed to enable the ADF&G to manage existing fisheries.

6. Interactions between wild and hatchery stock juveniles

Wild and hatchery stock juveniles may compete for food resources at some release sites. If so, the growth and survival of both stocks may be reduced, because slow-growing individuals are vulnerable to predators for a longer time. Competition for food is more likely to occur among chum salmon that feed on limited epibenthic prey resources in shallow intertidal habitats. In these cases, recovery of coded-wire tagged juveniles may be needed to document changes in growth rate as the number of hatchery fish released increases over time.

2.00 REMOTE RELEASE FISHERY MODEL

2.10 HATCHERY STOCK/WILD STOCK MATRIX

To assist the RPT in it's evaluation of salmon stocks for remote release, a matrix was developed to generalize comparisons between the possible timing combinations for hatchery and wild stocks. Three run timings were categorized for both stocks: early run (corresponding to VFDA pinks, although earlier run wild stocks exist in PWS), middle run and late run (corresponding to AFK pinks) stocks. Note that complete separation of stocks is difficult to achieve (refer to FIGURE 1). These run designations established the cells for the matrix (FIGURE 2). For the purpose of matrix modeling, run timing for early, middle and late stocks are specified as normalized timing curves with specific curve peak mean dates (TABLE 4).

Generalized recommendations can be made on the wild and hatchery stock combinations from the perspective of Management as previously discussed in 1.41 and Genetics as discussed in 1.42. Additional advantages and disadvantages derived from the matrix are outlined below.

The concerns identified within each cell of the matrix were prepared according to cell designation: early-early, early-middle, early-late, middle-early, etc. For cells designated by the "absence" of wild stocks, based both on management and genetic concerns, the concept is recommended.

Early hatchery - early wild:

Management: not acceptable.
Genetics: acceptable.

Advantages:
1. strong desire among the fishing fleet to increase fishing opportunity by enhancing the early portion of the CPF.
2. provided a resident stock is used for the enhanced brood stock, natural stocks in the area would not be at risk from the stand point of genetics.

Disadvantages:
1. to preserve natural production, waters at and near the remote release site would be managed for wild stock escapement. In years of wild stock failure, the CPF may have to forego harvest of all or most of the enhanced stock in order to achieve minimum wild stock escapements.
2. if the minimum escapement needs are achieved by enhanced stock strays into wild stock streams, other local salmon stocks may still suffer shortfalls due to over exploitation.
3. limited availability of stocks and stocking areas to fill the early-early scenario.

Middle hatchery - early wild:

Management: not acceptable.
Genetics: not acceptable.

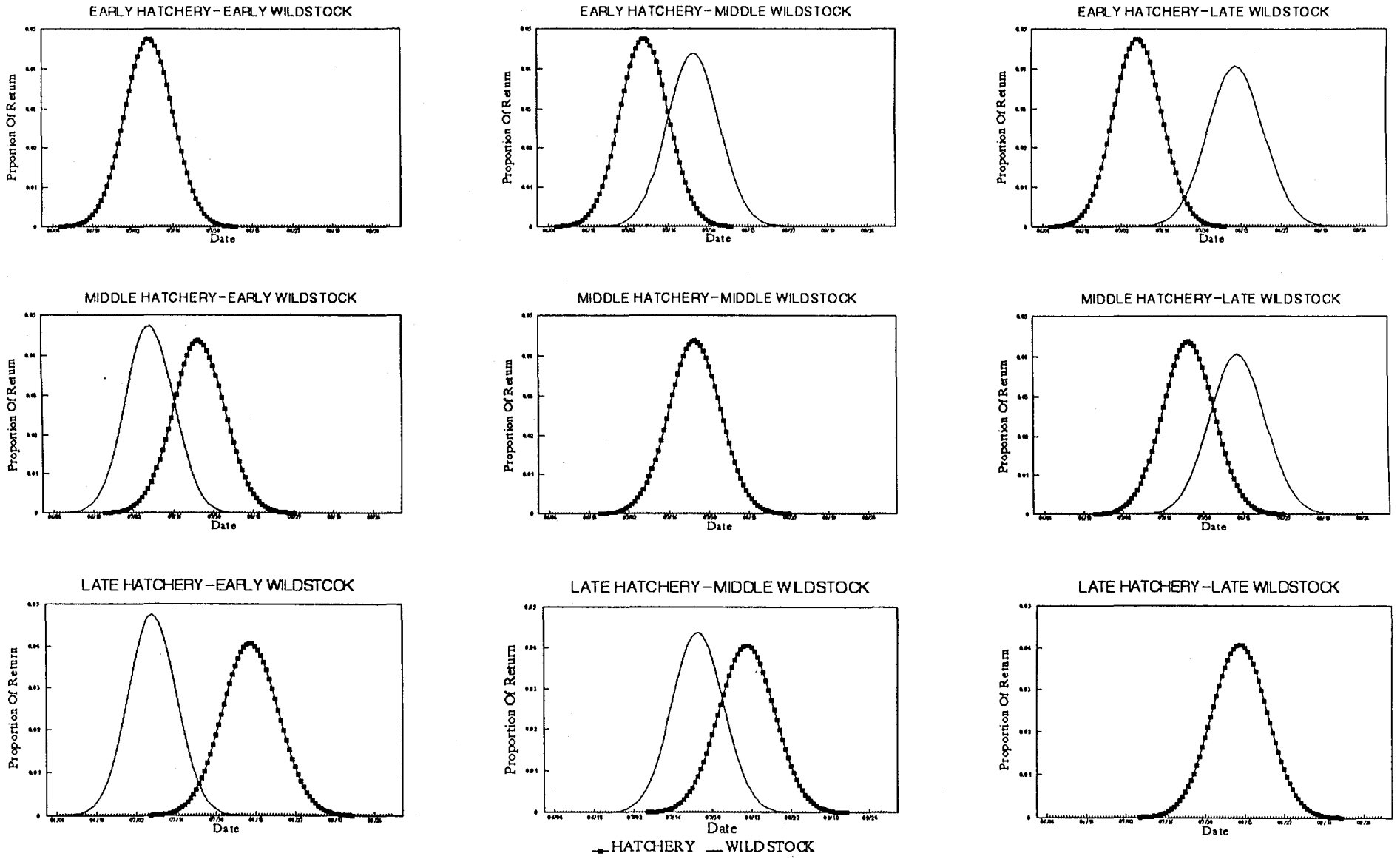
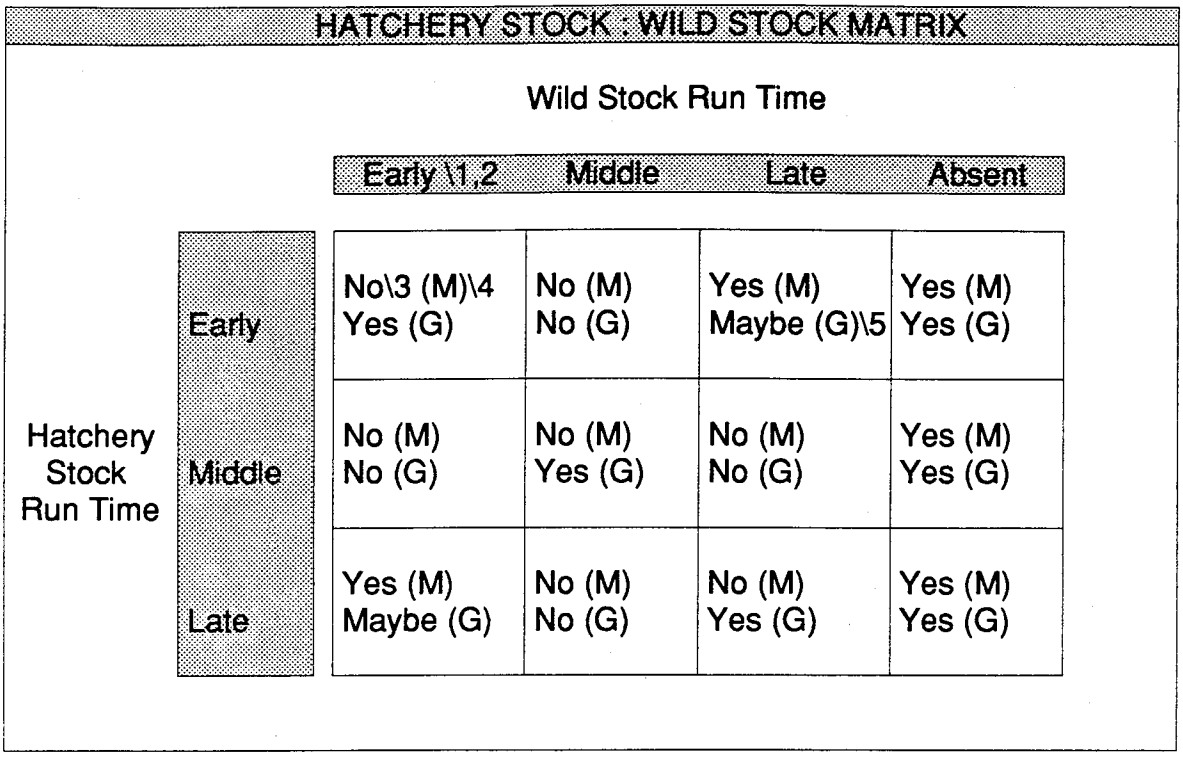


Figure 1: Relative run timing of hatchery and wild stock for various remote release scenarios. Run curves are described in terms of daily proportion of total return.

FIGURE 2



Notes:

\1 "Early, middle, late" refer to salmon stock run timing. "Absent" indicates non-existence of resident wild stocks of same species.

\2 "Early" = VFDA pink timing; "late" = AFK pink timing; "middle" refers to a stock timing with a mean date of migration halfway between early and late run time means.

\3 "Yes, no" and "maybe" indicate whether or not project would be acceptable.

\4 "(M)" symbolizes "management"; "(G)" symbolizes "genetic".

\5 "Maybe" indicates minimal or no overlap of run; issue would be site and stock specific.

Note:

Specific management and genetic concerns are listed under matrix discussion within text.

TABLE 4

RUN CURVE PEAK MEAN DATES				
	Calendar date	SD \1	Julian date	SD \1
Generic wild stock				
Early	07/07	8.41	189.70	8.41
Middle	07/24	9.11	206.88	9.11
Late	08/11	9.82	224.25	9.82
Generic hatchery stock				
Early	07/07	8.41	189.70	8.41
Middle \2	07/24	9.11	206.88	9.11
Late	08/11	9.82	224.25	9.82

Note:
\1 SD = standard deviation
\2 Assigned dates for comparative purposes only. A mid time run hatchery stock is not presently available.

Advantages:
1. better information on wild stock performance would be available before the hatchery fish arrive.
2. fills a production void.

Disadvantages:
1. although it may be possible to harvest most of the hatchery fish late in the run and thus reduce chance of hatchery fish straying into streams, the quality of these fish would be poor.
2. there are limited numbers of opportunities for this scenario in PWS.
3. could lead to over-exploitation of local wild stocks.
4. due to possible straying of the introduced stock, genetic integrity of local natural stocks would be put at risk.

Late hatchery - early wild:

Management: acceptable.
Genetics: may or may not be acceptable (site and stock specific).

Advantages:
1. can have maximum exploitation on hatchery fish thus minimizing straying into streams and over-exploitation of wild stocks;
2. minimal genetic problems due to time separation of returning stocks.

Disadvantages:
1. few opportunities for this scenario in PWS.
2. increased volume of salmon during peak of fishery would compound present processing/marketing problems.
3. increased production during the peak of the run causing greater problems for mixed stock fishery management in western PWS.
4. if there is any potential for inter-breeding of wild and hatchery stocks, natural stocks could be put at genetic risk.

Early hatchery - middle wild:

Management: not acceptable.
Genetics: not acceptable.

Advantages:
1. stronger market for early run fish.
2. desire to expand fishermen's opportunity early in season.
3. minimal impacts on non-local wild stocks because there will be no interception.
4. can allow high exploitation rate on first portion of hatchery return,

Disadvantages:
1. may have to forego portion of hatchery stock harvest until wild stock escapement achieved, resulting in hatchery fish of seriously deteriorated quality.
2. management must shift from hatchery release harvest to a wild stock management priority during the later portion of the return to prevent over exploitation of wild stocks.

3. not compatible with state genetic policy due to over-lapping run time of wild and hatchery stocks. Reduced exploitation rate on later part of hatchery run may exacerbate problem of hatchery fish straying into streams.

Middle hatchery - middle wild:

Management: not acceptable.
Genetics: acceptable.

Advantages:
1. expanded availability of areas and brood stocks.
2. fills production void from late July to early August.
3. provided a resident stock is used for the enhanced brood stock, natural stocks in the area would not be at risk from the stand point of genetics.

Disadvantages:
1. need to develop middle run brood will require remote egg takes.
2. in years of wild stock failure, common property fishery (CPF) will have to forego all or most of the enhanced stock in order to achieve wild stock escapement, unless enhanced fish stray into local streams.
3. mirrors wild stock timing and therefore may complicate wild stock management in the general waters of PWS due to increased desire to fish in mixed stock areas.
4. in years of weak wild stocks, if enhanced salmon stray into wild stock streams to satisfy minimum escapement needs, other salmon stocks may still be over-exploited.

Late hatchery - middle wild:

(**Note**: similar to middle - early scenario, except:...)

Management: not acceptable.
Genetics: not acceptable.

Advantages:
1. more opportunities for implementing scenario than for middle-early scenario.

Disadvantages:
1. increased production during the peak of the run in PWS could create greater problems for processing/marketing.
2. increased production during peak of run will increase complexity of managing the mixed stock fishery in western PWS.

Early hatchery - late wild:

Management: acceptable.
Genetics: may or may not be acceptable (site and stock specific).

Advantages:
1. strong market for early run fish.
2. desire for increased fishing opportunity early in season.
3. minimal impacts on non-local wild stocks because there will be no interception.
4. can allow high exploitation rate on first portion of hatchery return.

Disadvantages:
1. management must shift from hatchery release harvest to a wild stock management priority during the later portion of the return.
2. if there is any potential for inter-breeding of wild and hatchery stocks, natural stocks could be put at genetic risk.

Middle hatchery - late wild:

Management: not acceptable.
Genetics: not acceptable.

Advantages:
1. stronger market for early (middle) run fish.
2. desire to expand fishermen's opportunity early in season.
3. can allow high exploitation rate on first portion of hatchery return,

Disadvantages:
1. may have to forego portion of hatchery stock harvest until wild stock escapement achieved, resulting in hatchery fish of seriously deteriorated quality.
2. management must shift from hatchery release harvest to a wild stock management priority during the later portion of the return to prevent over exploitation of wild stocks.
3. increased impact on non-resident wild stocks due to increased interception in mixed stock fisheries at entrances to the Sound.
4. not compatible with state genetic policy due to over-lapping run time of wild and hatchery stocks. Reduced exploitation rate on later part of hatchery run may exacerbate problem of hatchery fish straying into streams.

Late hatchery - late wild:

Management: not acceptable.
Genetics: acceptable.

Advantages:
1. strays will not jeopardize wild stock genetic integrity.
2. high availability of areas and brood stocks.
3. provided a resident stock is used for the enhanced brood stock, natural stocks in the area would not be at risk from the stand point of genetics.

Disadvantages:
1. in years of wild stock failure, CPF will have to forego all or most of the enhanced stock in order to achieve wild stock escapement, unless fish stray into streams.

2. if hatchery salmon stray into streams to fulfill wild stock escapement, other returning wild stocks may still be over exploited.
3. may be disadvantageous to add to large volume of existing late fish.
4. mirrors wild stock timing and therefore may complicate wild stock management in the general waters of PWS due to lack of stock identification.

Early, middle, late hatchery - wild stock absent:

Management: acceptable.
Genetics: acceptable.

Advantages:
1. no conflict with wild stock management.

Disadvantages:
1. no genetic concerns.

2.20 COMPUTER MODEL FOR EVALUATING FISHERY IMPACTS

To further aid the study and evaluation of sites proposed for remote releases of salmon, a computer model was developed. This model allowed the RPT to superimpose not only generic stock runs, but also imaginary hatchery releases of salmon fry into specific locations of known wild stock species and abundance. The resultant adult production and estimated commercial fishery exploitation of the returning adults established parameters for modeling impact to local wild stocks.

To evaluate release scenarios and associated fishery management and genetic concerns, exploitation rates were assigned hatchery and wild stocks. This enabled determining whether commercial harvesting activity would be reasonable based on resultant wild stock escapement and/or residual (unharvested) hatchery fish necessitated to allow adequate stream escapement. The late scenario is prevalent when superimposing an earlier (early or middle) hatchery stock onto a later run (middle or late) wild stock.

The reverse of this release strategy superimposes a late (middle or late) hatchery run on an earlier (early or middle) wild stock and necessitates first allowing for stream escapement. By so doing, the CPF would have to forgo the earlier segment of the hatchery run. When stream escapement is assured, the earlier segment could then be harvested along with the recent segment of the run, however, the quality of this earlier segment would likely be sacrificed.

To evaluate impact to the local wild stock, two questions are asked.

1. If the exploitation rate on the hatchery salmon is 100%, what proportion of the wild stock run will be caught?

2. If we limit the wild stock catch to 70%, what proportion of the returning hatchery stock may the common property fishery be required to forego during harvest?

Table 5 aids this discussion by highlighting the percentage of the wild stock escapement goal achieved with 95% exploitation on stocks when hatchery fish are present. The early-late scenarios provide the greatest separation and allow for adequate (100%) escapement. Scenarios early-early, middle-middle and late-late indicate the virtual absence of escapement. However, should a local brood stock be developed for release, straying could possibly fulfill escapement needs. Therefore, these scenarios are generally acceptable, meeting both management and genetic criteria.

In order to determine what percentage of the hatchery run would result as unharvested (residual) to achieve wild stock escapement, a scenario was run assuming a 2.5 million adult hatchery stock return to the site of release (TABLE 6). Early-late/late-early scenarios are more likely to result in higher exploitation of the hatchery stock. Early-early, middle-middle and late-late scenarios would result in high percentages of residual hatchery stock, but again, should local brood stock be developed for the hatchery release, straying could alleviate wild stock stream escapement pressures.

The following are generic model conclusions:

1. The early hatchery-late wild stock and late hatchery-early wild stock scenarios can be managed to achieve 100% of the wild stock escapement goals and nearly complete harvest of hatchery fish.

2. The match-match scenarios would result in almost no wild stock escapement and a 30% unharvested surplus of hatchery fish. However, the model does not account for straying of hatchery fish into streams which is acceptable if a local brood stock is used. Management and genetic problems may be significantly reduced if the magnitude of straying is large.

3. For all other scenarios, wild stock escapement goals and complete harvest of hatchery fish cannot be achieved. If the fishery is managed to increase escapement, the unharvested surplus of hatchery fish is increased causing a decline in quality.

In addition:

1. The model is very sensitive to what percentage of hatchery stock is left, i.e., the tails of the distribution.

2. Further information is needed on genetic acceptability of VFDA (early) and AFK (late) stocks in the early-late and late-early scenarios if suitable sites can be found. These remote release sites would likely be outside the region of origin of these stocks.

3. More information is needed about the magnitude of straying to properly evaluate the match-match scenarios.

2.30 SITE SPECIFIC MODEL CONCLUSIONS

Twenty sites[1] were selected for evaluation for their potential as remote release sites for hatchery salmon. Subjecting the sites to the same rigorous evaluation

TABLE 5

PERCENTAGE OF WILD STOCK ESCAPEMENT GOAL ACHIEVED
WITH 95% EXPLOITATION ON STOCKS WHEN HATCHERY FISH ARE PRESENT \1, \2

GENERIC MATRIX MODEL

		Wild		
		Early	Middle	Late
Hatchery	Early	0.04%	22.69%	100.00%
	Middle	5.05%	0.04%	16.47%
	Late	100.00%	4.18%	0.04%

Notes:
\1 Assume 100% of hatchery stock is harvested.
\2 Assume no exploitation on wild stocks after hatchery stock is completely exploited.

TABLE 6

PERCENTAGE OF HATCHERY STOCK UNHARVESTED IF FISHERY
MANAGED FOR 70% EXPLOITATION ON WILD STOCKS

GENERIC MATRIX MODEL

		Wild		
		Early	Middle	Late
Hatchery	Early	30.00%	7.36%	0.15%
	Middle	7.25%	30.00%	9.18%
	Late	0.23%	8.37%	30.00%

methodology as applied to the generic scenarios resulted in the following conclusion. (See results, TABLE 7)

> All of the currently proposed remote release sites have middle to late wild stock run timing. Fishery management problems at these sites were evaluated for the even and odd year broodlines separately assuming that early VFDA brood stock was used. The results from this exercise indicated that the wild stock escapement goal could not be achieved if the fishery were managed to achieve complete harvest of the hatchery stock. Conversely, if the fishery were managed to achieve wild stock escapement, there would be an unharvested surplus of hatchery fish. For the even year broodline, wild stock escapement goals could be achieved at Eaglek Bay, Drier Bay, NW Box (Stockdale Harbor, Montague Island), and Zaikof/Rocky Bays with less than a 1% unharvested surplus of hatchery fish. For the odd broodline, wild stock escapement goals could be achieved at Drier Bay and Snug Harbor with less than a 1% unharvested surplus of hatchery fish.

\1 At the time of final report preparation, additional sites were identified which are not reflected in Table 7.

TABLE 7

REMOTE RELEASE SITE WILD STOCK ESCAPEMENT AND HATCHERY STOCK HARVEST MODELING COMPARISIONS

Site	Year Group	% Wild Stock Escapement \1	% Hatchery Stock Unharvested \2
Nelson Bay	Odd	32.86	09.97
	Even	27.31	07.35
Simpson Bay	Odd	17.54	20.74
	Even	26.90	11.09
Landlocked Bay	Odd	37.57	09.77
	Even	68.95	04.43
Eaglek	Odd	20.17	08.52
	Even	42.35	00.88
Cochrane Bay	Odd	14.19	06.28
	Even	30.48	05.30
McClure Bay	Odd	09.89	02.41
	Even	43.81	05.30
Kings Bay/ Nellie Juan	Odd	13.07	05.30
	Even	56.28	02.41
Drier Bay	Odd	00.04	00.09
	Even	02.05	00.90
Snug Harbor	Odd	74.07	00.20
	Even	24.54	08.52
Whale Bay	Odd	25.39	04.43
	Even	08.25	11.09
NW Box/ Montague Is.	Odd	28.82	02.41
	Even	58.25	00.28
Zaikof/Rocky Bays	Odd	37.96	01.92
	Even	47.07	00.38

Notes:
\1 Assuming 100% of the hatchery return is harvested.
\2 Assuming 70% exploitation on wild stocks.

3.00 SITE SPECIFIC ANALYSIS AND RECOMMENDATIONS

Each site proposed for remote releasing salmon was reviewed and evaluated. Site specific abundance, management, and genetic considerations, coupled with the generic model conclusions, provided the basis for concerns identified and site recommendations listed. Refer to Appendices 4.20.01 to 4.20.22 for site descriptions, maps, data and figures.

General recommendations were also determined which should become elements of any plan or program to release hatchery salmon. These include:

1. initial releases conducted on trial basis to determine straying;
2. test fishing conducted prior to release to determine interceptions;
3. allocation consequences must be considered if interceptions exist;
4. any release site can be reconsidered if a salmon stock is identified, such as a very early pink stock, that would reduce or eliminate concerns expressed in this document.

Table 8 summarizes concerns and recommendations of the committee. While this table generalizes the concept of salmon stocks, release locations, and recommendations, the RPT evaluated sockeye production and release options in greater detail to guide development of the Main Bay Hatchery sockeye program. The sockeye program is important to diversification of the fisheries, rehabilitating depleted sockeye systems at Eshamy Lake and Coghill Lake, expanding fishing opportunity in time and area, and addressing user group allocations. With expanding sockeye production and the potential for remote releasing sockeye fry and smolts at several locations, the PWS/CR RPT evaluated possible marine and lake release sites for each sockeye stock (Eyak, Coghill and Eshamy).

Tables 9 and 10 summarize sockeye marine and lake release site evaluations and recommendations. Not all sites presented are recommended as candidate release sites, and sites that are, may not be recommended for all three sockeye stocks. These tables and recommendations should be used in conjunction with recommendations listed under 3.10 to gain a complete perspective of RPT remote release recommendations for Prince William Sound.

3.10 RECOMMENDATIONS

NOTE: Nelson Bay was the first site evaluated. The Nelson Bay discussion provides greater detail, much of which is transferable to the remaining sites. Therefore, where early stock (VFDA) is referenced under Nelson Bay, or late (AFK), in the site evaluations to follow, only early or late will be stated without reference to AFK or VFDA unless otherwise described. In addition, the Nelson Bay site is described in complete text form whereas discussion for the remaining sites is listed as incomplete sentences, only highlighting concerns without fully describing them.

Please refer to the generic matrix and model results for benefit of review.

TABLE 8

REMOTE RELEASE SITE SUMMARY

RPT RECOMMENDATIONS

Sites	No Release	Early Pink	Late Pink	Early Chum	Late Chum	Coho	Sockeye	Comments (See key)*
1. Nelson Bay				X			X	A,C
2. Simpson Bay	X							
3. Landlocked Bay	X							
4. Boulder Bay		X		X				A
5. Eaglek Bay		X						A,B
6. Naked Island		X	X	X	X		X	B,C,D
7. Perry Island	X							
8. Granite Bay						X		
9. Cochrane Bay	X							
10. McClure Bay	X							
11. Kings Bay		X		X			X	B,D
12. Herring Bay	X							
13. Drier Bay	X							
14. Bay of Isles	X							
15. Snug Harbor	X							
16. Whale Bay	X							
17. Port Bainbridge	X							
18. Montague Island				X			X	C
19. Zaikof/Rocky Bays				X				C
20. Port Etches	X							
21. Unakwik					X		X	C,D
22. Island (Esther) Bay							X	
23. Barry Arm							X	C,D

(prodpln4\rptremot.wk1)

*Key

A...Develop local brood stock

B...Develop early pink stock

C...Test release for survival evaluation

D...Gather more site information for evaluation

Format

= recommended location and stock

= not recommended

TABLE 9
SOCKEYE SALMON RELEASE OPTIONS: MARINE SITES

Release criteria	Barry Arm			Kings Bay			Stockdale/ Chalmers			Rocky/ Zaikof			Coghill R. outlet			Eshamy Lagoon			Naked Is.			Nelson Bay			Eaglek		
	MARINE SITES																										
Hat. stk run time 1/	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L
Wild stk present	N2/	?	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y
Run curve overlap	N	?	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y
Fishable area	*see map			*see map			*see map			*see map			*see map			*see map			8/			*see map			*see map		
Enforceability	*see map			*see map			*see map			*see map			*see map			*see map			8/			*see map			*see map		
Other management considerations	N	Y	Y	N	?5/	Y3/	N	?5/	Y	?5/	?5/	Y	Y	Y	Y	Y	Y	Y	N	?9/	?9/	N	?11/	Y	N	Y	Y
Adequate imprinting water supply	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y10/	Y10/	Y10/	Y	Y	Y	Y	Y	Y
Recommendation "worth pursuing"	Y	Y	Y	Y	Y	Y3/	Y	Y	N4/	Y	Y	N	N	Y6/	N	N	N	Y/7	Y	Y	Y	Y	?	N	Y	N	N

NOTES:

Code: N = no; Y = yes.

1/ E = early (Eyak) run; M = middle (Coghill) run; L = late (Eshamy) run.

2/ Since no wild stock are present in the vicinity at this time, a large area of the Coghill District could be open to fishing (not restricted to Barry Arm); release locations could also differ for early stock.

3/ Concerns focused on Eshamy Lake escapement while managing for mixed stock fishery of wild and migrating hatchery Eshamy stock to remote location.

4/ Stockdale/Chalmers is not recommended as a release site because small stocks of wild fish are present. However, if Kings Bay or Barry Arm are not acceptable for Eshamy releases, this area could provide an alternative.

5/ Requires test fishing to determine presence of migrating stocks.

6/ Interim releases recommended only.

7/ Interim releases recommended only.

8/ Definition of fishable area and enforceability will require further investigation.

9/ Requires test fishing to determine presence of migrating stocks.

10/ Needs evaluation.

11/ Site and local stocks require further investigation.

TABLE 10
SOCKEYE SALMON RELEASE OPTIONS: LAKE SITES

	LAKE SITES																														
Release criteria	Pass Lake Esther Pass Lk. Davis Lake Shoestring Lk			Solf Lake			North Nellie Juan lakes			Point Nellie Juan lakes			Louis Lake			Turner Lake Millard Lake Silver Lake			Eshamy Lake			Ewan Lake			Cedar Lake					
Hat. stk run time 1/	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L			
Wild stk present	N	Y	Y	N	N	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y			
Run curve overlap	N	Y	Y	N	N	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y			
Other management considerations	N	Y	Y	N	N	Y	N	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y			
Recommendation "worth pursuing"	Y	N	N	Y	Y	N	Y	N\2	N	Y	Y\3	Y\3	Y	Y	N	Y	N	N	N\4	N\4	N\4	Y	N	N	Y	N	N			

Code: N = no; Y = yes.

1/ E = early (Eyak) run; M = middle (Coghill) run; L = late (Eshamy) run.

2/ For small sport fish release and harvest only.

3/ Releases may go unharvested if Eshamy/Crafton Is. Subdistricts are closed due to weak wild stock escapement.

4/ Releases will not be conducted here due to genetic considerations.

NOTES:
a. Lake releases could be continuous stocking programs, or periodic based on need to release Main Bay sockeye fry which exceed rearing capacity.
b. Terminal fishery area and enforceability are not described in that adults returning from lake stocking are intended to be caught in interception fisheries.
c. Stream catalog numbers: Pass (#329), Esther Pass (#345), Davis (#311), Shoestring (#344), Solf (#690), Nellie Juan (#481), Point Nellie Juan (#500), Louis (#689), Turner (#114), Millard (#115), Silver (#116), Eshamy (#516), Ewan (#603), Cedar (#213)
d. See ADF&G return data (Carpenter, 1991) on lakes which have been previously stocked.

1. NELSON BAY

Local Nelson Bay stocks of pinks and chums are considered middle to late run timing. Management of late (AFK) pinks remote released at this location would require a low exploitation rate or delayed harvest during the early and middle segments of the run until adequate local stock escapement is achieved. This would result in reduced quality and possible straying of hatchery fish into wild stock areas which could result in genetic transfer. Thus from the standpoint of genetics, wild stock management, and quality, this is not a recommended option.

Releasing an early pink stock (VFDA), would permit a partial harvest of hatchery fish prior to arrival of local wild stocks. This would result in high quality at the initial phase of harvesting. However, as local stocks move into the area, harvesting would be restricted to assure wild stock escapement. The remaining hatchery fish would potentially go unharvested resulting in diminished quality. After wild stock escapement was assured, any remaining hatchery stock may have deteriorated to such low quality as to make harvesting unrealistic. In addition, milling hatchery fish would have greater opportunity to stray which could potentially result in wild stock / hatchery stock genetic transfer. Consequently, this option is not recommended.

A preferable condition would be to cultivate an earlier brood stock which would exhibit no over-lap in its run timing with the local wild stock. During this early part of the season, the area is considered barren of salmon, and therefore both management and genetic concerns would be minimized.

Another alternative would be to develop a local stock for a hatchery release, thereby reducing genetic concerns. However, local wild stocks of similar run timing would potentially be subjected to high harvest pressure which would put wild stock escapement at risk. The release must therefore be managed to assure escapement of wild stocks in the vicinity, consequently a portion of the hatchery return would go unharvested. Further, the operational aspects of annual remote egg takes would reduce the cost/effectiveness of such a program. Such a program would generally not be recommended.

For Nelson Bay, **recommended options include utilization of existing early chum at the Wally Noerenberg Hatchery (if determined to be genetically acceptable) or develop a local early chum for brood such as the Koppen Creek stock.** Local chum brood development is preferred. WNH early chums could be released as a small test release program. Adhering to such recommendations would reduce management and genetic concerns. An early harvest of chums would provide for high quality, although the later part of the run may go unharvested to protect local stocks as they move into the area. Chum populations are sparse, pinks predominate, yet Nelson Bay is a more preferred estuarine habitat for chum rearing and may provide an excellent opportunity for a successful program. Sockeye salmon should also be investigated for possible release in Nelson Bay.

2. SIMPSON BAY

- local stock middle to late run timing;
- great overlap of existing broods and local stocks;
- resulting in genetic and management concerns;

- management complexities if local brood used;
- small fishable area;
- very successful local stock production;
- recommend to delete from list of sites.

3. LANDLOCKED BAY

- increased interception of Fidalgo stocks at Bidarka Pt.;
- middle to late run local stocks;
- existing brood would overlap local run timing;
- Lagoon Creek is very productive;
- recommend to delete from list of sites.

4. BOULDER BAY

- middle to late local stocks (Valdez, Fidalgo);
- no significant immediately local production;
- no immediate local chums;
- early Galena & Whalen Bay chums may require local annual egg-takes;
- area is isolated with little probability of interceptions;
- current program is workable by management;
- recommend delay action to consider program expansion for early pinks until Phase 3 production issues are addressed;
- recommend early chum if genetic concerns addressed.
- recommend local broodstock because it is a match-match scenario.

5. EAGLEK BAY

- local middle to late wild stock;
- highly productive wild stocks present;
- early releases would present genetic questions if existing stock were used;
- need to identify earlier stock for brood;
- change terminal line to include Cascade Bay;
- recommend to find earliest pink/chum brood stock possible: existing options poor to bad; early pink broodstock does not need to be local if there is no overlap with the local late run stock.
- WNH early chums are not recommend for release at this location because there is too much overlap with the local stocks.

6. NAKED ISLAND

- small local population present;
- uncertain if interceptions would result;
- straying may occur due to limited water source;
- early, middle or late stock releases would be considered;
- recommend early pinks, middle pinks or existing late production; any broodstock is acceptable;
- recommend test chum release to determine survival and straying;
- recommend test fishing to ascertain interceptions;
- recommend pursuing sockeye releases.

7. PERRY ISLAND

- no data available on local wild stock;

- area highly congested with migrating stocks including Main Bay and Coghill sockeye, Esther pinks/chums and VFDA pinks;
- area is managed for Esther Hatchery cost recovery and brood harvest;
- existing brood run timing overlaps with wild stock in vicinity;
- recommend to delete from list of sites.

8. GRANITE BAY

- no local stock data;
- an early stock release would greatly compound Coghill Lake management;
- need to coordinate development with state marine parks system;
- recommend as coho release site.

9. COCHRANE BAY

- highly productive wild stock area;
- middle to late local stock run timing;
- overlapping early or late hatchery stock;
- already high pressure on wild stocks due to hatchery fish harvests;
- Coghill interceptions;
- recommend to delete from list of sites.

10. MCCLURE BAY

- early local wild stock chum present;
- middle to late wild stocks;
- productive wild stock area;
- small fishable area;
- early or late releases would raise genetic and management concerns;
- need to coordinate with recreational users of the area to minimize user conflicts;
- recommend to delete from list.

11. KINGS BAY/NELLIE JUAN

- restrict terminal area to within 148^{o} 38' longitude;
- local stock data lacking;
- recommend better quantitative site information regarding local stocks;
- for early pinks, the brood stock does not need to be local if there is no overlap with the local late run stock.
- need to coordinate with recreational users of the area to minimize user conflicts.

12. HERRING BAY
13. BAY OF ISLES
14. DRIER BAY
15. SNUG HARBOR

- under current management plan area is closed prior to July 18;
- Herring Bay: middle to late run stocks present; preferable pink rearing habitat; early stock release potential;
- Drier Bay: middle timing local stock although data minimal; site has no potential;
- Bay of Isles: may have potential for early chums;

- Snug Harbor: major interception site and healthy local production; site has no potential;
- recommend delete all 4 sites from consideration due to present management plan for district.

16. WHALE BAY

- middle run local stocks;
- very healthy local production;
- recommend to delete from list.

17. PORT BAINBRIDGE

- lacking data on local stocks;
- presumed local stock run timing is middle to late;
- early stock release may be considered;
- present management regulations close district before July 18;
- recommend to delete from list.

18. MONTAGUE ISLAND: PORT CHALMERS-STOCKDALE HARBOR

- highly productive local pink stocks
- chums have not recovered since 1964 earthquake;
- late run local stocks;
- early pink genetic concerns;
- early chums would reduce management and genetic concerns;
- recommend early chum for release; release site localized to Port Chalmers;
- recommend sockeye for release.

19. ZAIKOF/ROCKY BAYS

- similar comments as Chalmers-Stockdale;
- Rocky Bay has small terminal area;
- late chum introduction would impact local pinks due to harvest pressure;
- recommend Zaikof Bay as possible site for early chum release.

20. PORT ETCHES

- highly productive natural stocks of mid to late run timing;
- recommend to delete from list of sites.

21. UNAKWIK DISTRICT

- may offer opportunities for sockeye rehabilitation or, late chum releases;
- allocation question should first be resolved;
- recommend evaluate potential for late chums.

22. ISLAND (ESTHER) BAY

- barren location;
- recommend as possible secondary release site for Coghill sockeye after Coghill Lake system is rehabilitated.

23. BARRY ARM

- test fish location for wild stocks;
- consider weiring off Coghill River to prevent Eyak stock from entering lake system if necessary;
- recommend as possible site for releasing F-1 generation Coghill stock sockeye or early run time Eyak stock sockeye;
- need to coordinate with recreational users of the area to minimize user conflicts.

SECTION 2

COPPER-BERING RIVERS AREA

INFORMATION REPORT

SECTION 2

COPPER AND BERING RIVERS AREA

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COPPER-BERING RIVER AREA

1.00 INTRODUCTION

The Copper-Bering River Area includes the marine waters and drainages from Cape Suckling on the main land to Hook Point on Hinchinbrook Island. This area is the largest planning unit within the Prince William Sound Region and contains approximately 24,000 sq. miles of land, lakes and rivers and 1,400 sq. miles of estuary and marine waters (Figure 1). The Copper and Bering Rivers are located in the area. The Copper River is the largest glacial-meltwater stream in Alaska, and drains a portion of the interior of Alaska as well as the Yukon Territory. The drainage has a small coastal component. Approximately 85 percent of the drainage is in the interior. The Canadian portion is glacial-bound.

Numerous communities are located within or immediately adjacent to the area, including: Cordova, Glennallen, Copper Center, Tonsina, Gulkana, Gakona, Mentasta Lake, Chistochina, Slana, Chitina, Copperville, Tazlina, Paxson, McCarthy, Kenny Lake, Mendeltna, Eureka and Sourdough (Figure 1). The population of the area in 1990 was 4,980 people.

Most communities are accessible by road. Cordova is only accessible by aircraft and the Alaska Marine Highway System (ferry). Construction of the Copper River Highway linking Cordova to the Richardson and/or Edgerton highways has been proposed by Governor Hickel.

Most of the area is federal, state and native land. The federal land managers include: U.S. Dept. of Agriculture, Forest Service (Chugach National Forest); U.S. Dept. of Interior, National Park Service (Wrangell-St. Elias National Park); U.S. Dept. of Interior, Bureau of Land Management. Native land owners include Ahtna Regional Corp., Chugach Regional Corp., Chitina Village Corp., Tatitlek Village Corp., and the Eyak Village Corp. (Figure 2). The Ahtna Regional Corporation is comprised of the following villages: Cantwell, Chistochina, Gakona, Gulkana, Kluti-Kaah (Copper Center), Mentasta and Tazlina.

Five species of salmon spawn in the area, and these in descending order of abundance are sockeye, coho, chinook, pink and chum salmon.

Sockeye salmon spawn throughout the Copper River drainage and are commonly categorized into two components: the upriver run and Delta run. The upriver component is comprised of more than 105 individual stocks that spawn upstream of river mile 30. The enhanced run is comprised of two stocks incubated at the Gulkana I and II hatcheries. Fry have been released in four lakes in the Upper Copper River drainage. The Delta run is comprised of approximately 30 stocks which spawn in the coastal lakes and streams.

Chinook salmon also spawn in the Upper Copper River drainage, and approximately 40 spawning stocks have been identified. Chinook eggs have also been incubated at the Gulkana II Hatchery and fry have been released in two locations. However, the chinook program has been discontinued.

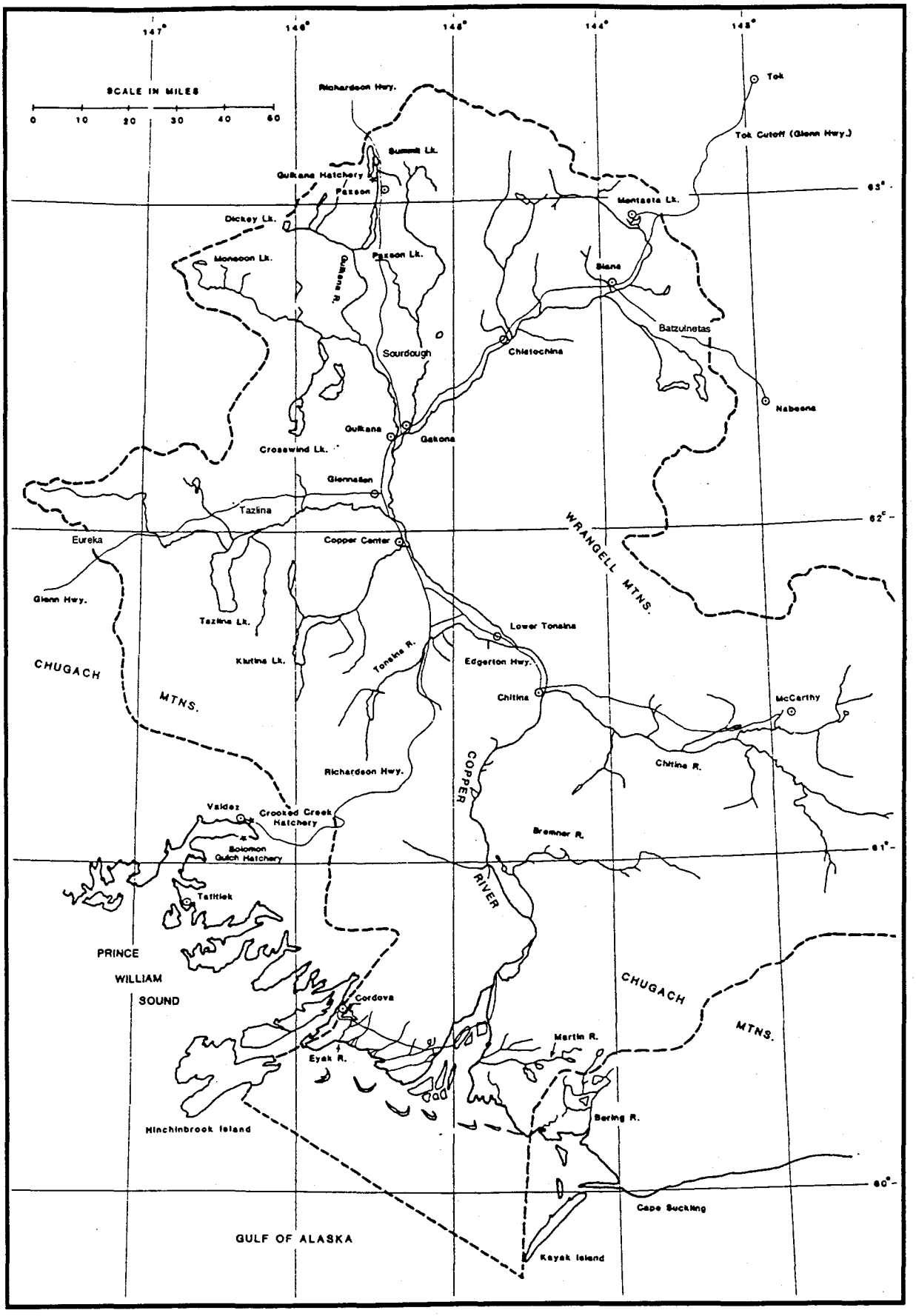

Figure 1. Copper-Bering rivers planning area.

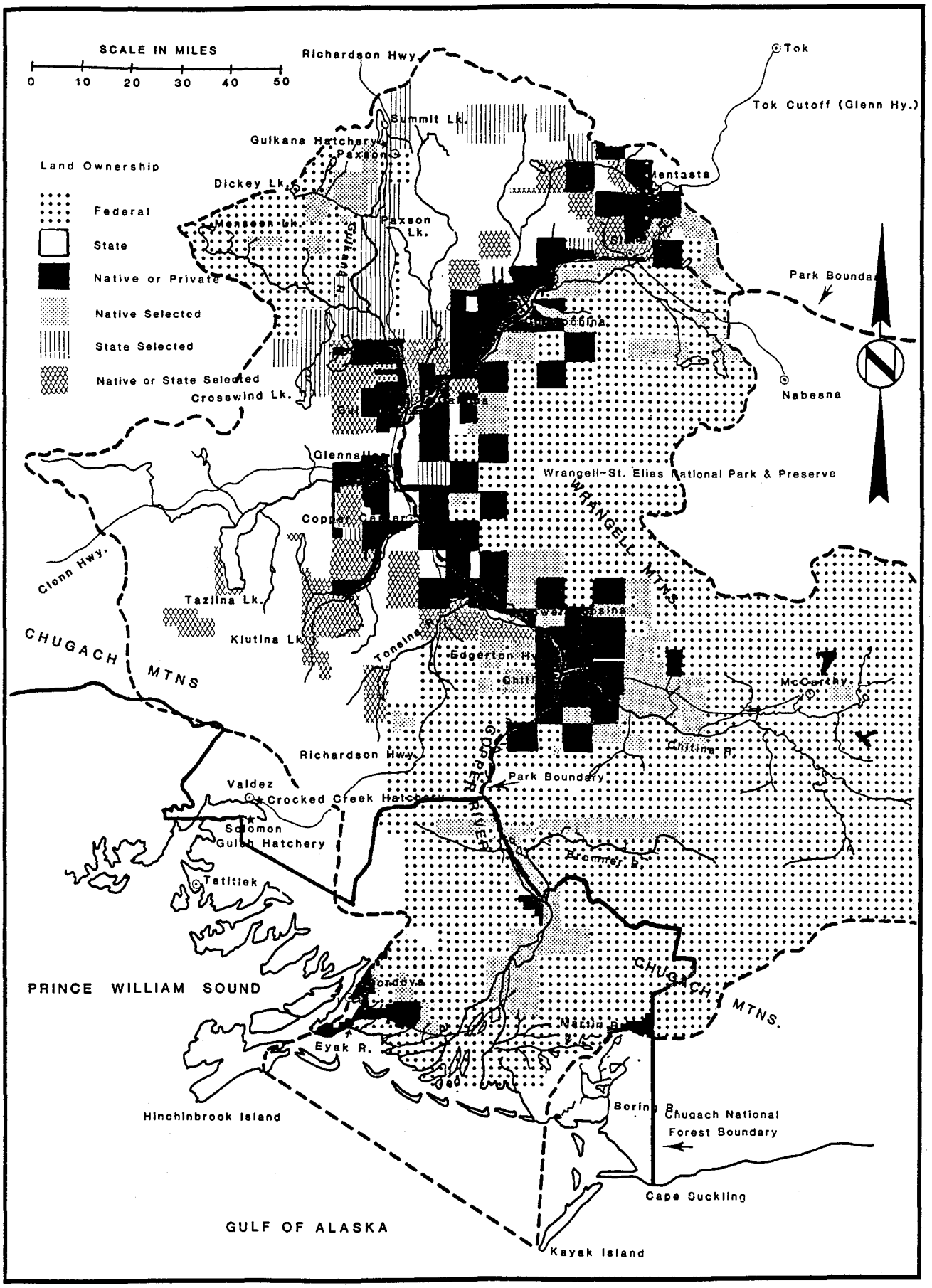

Figure 2. Major land ownership patterns in the Copper-Bering rivers area. Adapted from PWS-CR Comprehensive Salmon Plan, Phase 2. 1986.

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

Pink and chum salmon are confined to the Delta. Pink salmon have been observed in seven drainages and chum salmon in four drainages.

The majority of the catches made by the region's commercial drift gill net fishermen, subsistence and sport fishermen occur in the Copper-Bering River Area. All personal use catches occur in the Upper Copper River.

Numerous fisheries issues and concerns may lead to major changes in the existing fisheries or limit fisheries development, including:

a) subsistence statutes, regulations and litigation;
b) over harvesting of wild stocks;
c) steelhead could be easily eradicated;
d) genetic concerns;
e) marine mammal protection statutes and policies;
f) interception of nonindigenous stocks in the commercial fishery;
g) increasing subsistence, personal use and sport fishing effort;
h) decline of quality fishing on the Gulkana River;
i) Copper River highway(s) construction and increased access to Delta streams;
j) trespassing on native lands; and,
k) timber harvesting and coal development.

2.00 DRIFT GILL NET FISHERY

Drift gill net fishing is allowed in the estuary between Controller Bay and Hinchinbrook Island; these waters are divided into the Copper River and Bering River districts (Figure 3). The commercial salmon fishery began in 1889 (Tables 1 and 2). The State of Alaska Commercial Fisheries Entry Commission (CFEC) currently restricts the number of permit holders to 541 fishermen. The number of permit holders has been regulated by CFEC since 1974. Numerous fishermen hold more than one type of permit, e.g. drift gill net, seine and perhaps set gill net, and participate in more than one commercial fishery within the Region or state.

Few data are available on the number of crew members taking part in the fishery. Estimates derived in 1979 suggest that the average drift gill net boat has a crew of 1.3 fishermen, including the permit holder (Larsen, 1979).

Since 1960, the average commercial catch in the Copper and Bering River Districts has been 699,584 sockeye salmon, 21,792 chinook salmon, 285,957 coho salmon, 7,401 pink salmon and 6,089 chum salmon (Tables 1 & 2). Since 1960, drift gill net fishermen have earned approximately 81.4% of their income in these fishery management districts (Table 3).

The chinook, sockeye and coho salmon fisheries are managed to achieve optimum escapement. Efforts have been made to reduce the commercial catch of chinook

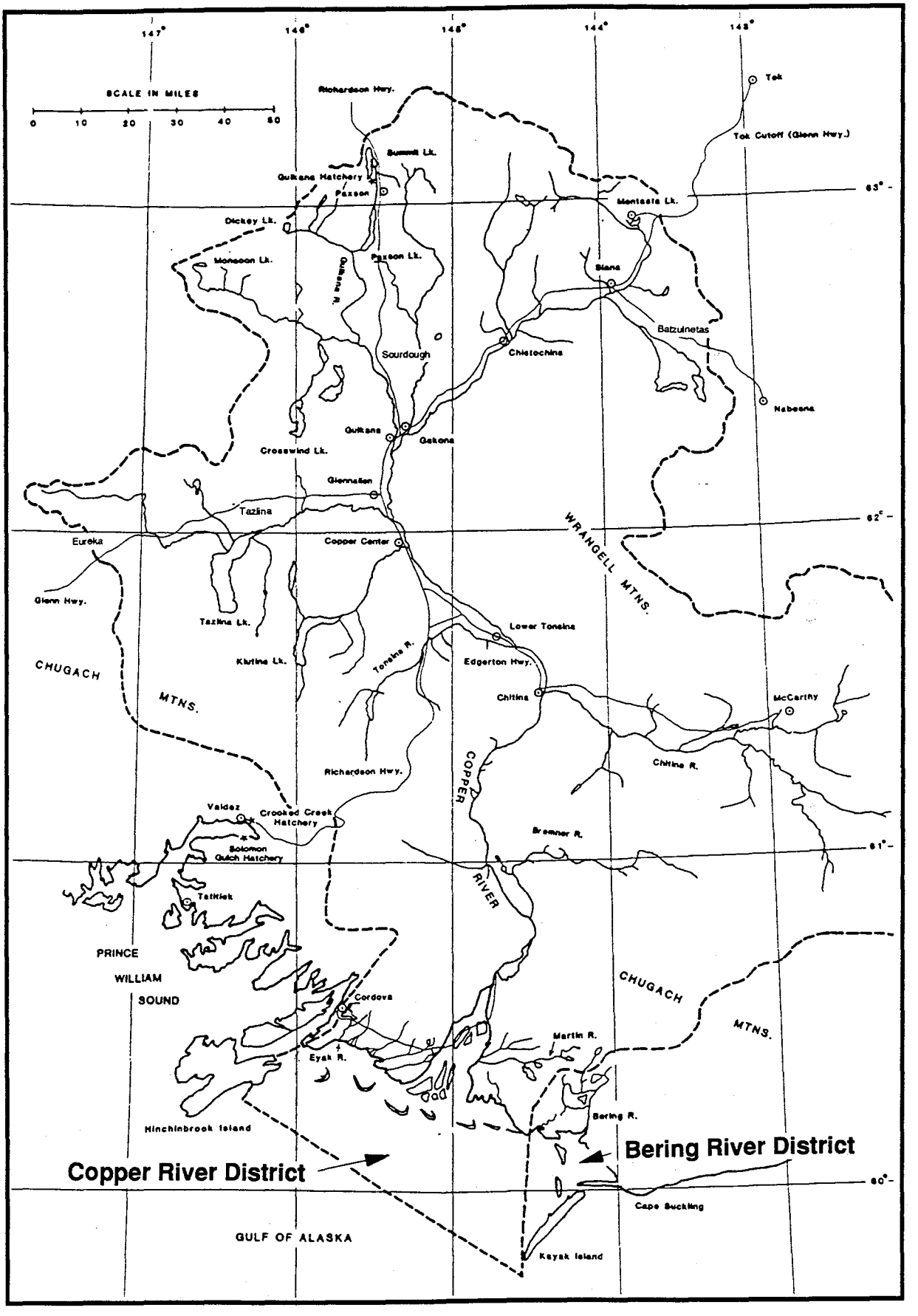

Figure 3. Commercial fishing districts of the Copper-Bering rivers area.

Table 1. C Commercial salmon catches by species and year, Copper River District, 1889-1993. \1

Year	Chinook	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			

continued

Table 1. Commercial salmon catches by species and year, Copper River District, 1889-1993 (cont'd). \1

Year	Chinook	Sockeye	Coho	Pink	Chum
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	
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

continued

Table 1. Commercial salmon catches by species and year, Copper River District, 1889-1993 (cont'd). \1

Year	Chinook	Sockeye	Coho	Pink	Chum
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	335,384	53,802	236	807
1976	31,483	865,254	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
1983	50,022	633,010	234,243	7,345	2,217
1984	38,955	899,776	382,432	32,194	6,935
1985	42,333	931,132	587,990	19,061	5,966
1986	40,670	780,808	295,980	3,016	17,614
1987	41,001	1,180,782	111,599	31,635	14,796
1988	30,741	576,950	315,568	2,775	11,022
1989	30,863	1,025,923	194,454	25,877	5,845
1990	21,702	844,778	246,797	1,596	7,545
1991	34,787	1,206,811	385,086	1,246	20,220
1992	39,810	970,938	291,627	1,664	5,807
1993	29,727	1,398,234	281,469	9,597	13,002
Average all years----	15,924	638,640	172,906	5,537	2,706
Average 1960-1993	23,790	703,446	212,655	7,042	4,069

1/ Adapted from Pirtle (1976). (\copper\coptab1.wq1)

2/ Data for 1889 through 1927 are from Rich and Ball (1932).

3/ Data from 1927 through 1950 include Bering River catch data. Chinook salmon estimates for the years 1927 through 1945 are based on case pack data and a correction factor of 3 chinook salmon per case. Coho salmon estimates for the years 1931 through 1950 are based on case pack data and a correction 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 1988 are from Randall et al. (1984) and (1985) and Brady et al. (1990).

Table 2. Commercial salmon catches by species and year, Bering River District, 1896-1993. \1

Year	Chinook		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										

continued

Table 2. Commercial salmon catches by species and year, Bering River District, 1896-1993. \1

Year	Chinook		Sockeye		Coho		Pink		Chum	
1936	213		50,154							
1937	86		28,733							
1938										
1939										
1940										
1941										
1942										
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	

continued

Table 2. Commercial salmon catches by species and year, Bering River District, 1896-1993. \1

Year	Chinook	Sockeye	Coho	Pink	Chum
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	91,784	214,632	309	20,408
1985	215	26,561	419,276	214	9,642
1986	128	19,038	115,809	15	243
1987	34	16,926	15,864	54	7
1988	19	7,152	86,539	23	181
1989	30	9,225	26,952	7	2
1990	14	8,332	40,952	2	1
1991	28	19,181	110,951	4	195
1992	21	19,721	125,616	4	1
1993	130	33,951	115,833	82	22
Average 1960-1993	154	38,261	84,988	644	2,404

1/ Adapted from Pirtle (1976). f:\copper\coptab2.wq1)
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 Anonymous (1974b).
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 1991 are from Randall et al. (1984) and (1985) and Brady et al. (1990).

Table 3. Total earnings (thousands) in the Copper and Bering River Districts compared to the total drift gill net earnings for Area E (PWS, Copper River, Bering River), 1960-1993.

Year	Copper River Dist.		Bering River Dist.		Copper-Bering R. Dist. Total		Copper-Bering R. Dist. Percent	Total Drift Gill Net	
1960	$746.1	\1	$129.4	\1	$875.5	\1	100.0%	$875.5	\1
1961	$997.2	\1	$154.4	\1	$1,151.6	\1	81.6%	$1,411.5	\1
1962	$1,366.9	\1	$182.6	\1	$1,549.5	\1	98.3%	$1,575.8	\1
1963	$905.1	\1	$158.6	\1	$1,063.7	\1	96.8%	$1,098.4	\1
1964	$1,598.1	\1	$165.0	\1	$1,763.1	\1	96.6%	$1,825.4	\1
1965	$1,399.6	\1	$89.3	\1	$1,488.9	\1	86.2%	$1,728.1	\1
1966	$2,059.9	\1	$119.5	\1	$2,179.4	\1	94.4%	$2,308.7	\1
1967	$1,271.7	\1	$103.3	\1	$1,375.0	\1	91.6%	$1,501.1	\1
1968	$1,522.8	\1	$170.2	\1	$1,693.0	\1	87.8%	$1,928.6	\1
1969	$1,588.4	\1	$81.5	\1	$1,669.9	\1	82.8%	$2,017.2	\1
1970	$2,680.1	\1	$269.2	\1	$2,949.3	\1	95.7%	$3,081.4	\1
1971	$1,882.1	\1	$261.2	\1	$2,143.3	\1	91.6%	$2,339.2	\1
1972	$2,041.0	\1	$147.3	\1	$2,188.3	\1	82.3%	$2,657.7	\1
1973	$2,777.5	\1	$478.5	\1	$3,256.0	\1	78.8%	$4,131.2	\1
1974	$2,953.0	\1	$172.7	\1	$3,125.7	\1	70.1%	$4,458.2	\1
1975	$1,688.3	\1	$196.0	\1	$1,884.3	\1	71.5%	$2,634.0	\1
1976	$5,757.1	\1	$459.5	\1	$6,216.6	\1	89.1%	$6,975.2	\1
1977	$6,276.2	\1	$458.7	\1	$6,734.9	\1	65.5%	$10,277.3	\2
1978	$5,274.5	\1	$1,207.9	\1	$6,482.4	\1	72.8%	$8,909.8	\2
1979	$3,537.4	\1	$2,622.3	\1	$6,159.7	\1	77.5%	$7,950.8	\2
1980	$2,503.4	\1	$1,010.5	\1	$3,595.7	\2	74.6%	$4,818.3	\2
1981	$8,278.9	\1	$1,307.9	\1	$8,912.2	\2	77.7%	$11,469.3	\2
1982	$13,543.1	\1	$1,929.2	\1	$14,381.4	\2	64.2%	$22,388.6	\2
1983	$6,783.5	\1	$1,930.0	\1	$8,427.2	\2	86.5%	$9,746.2	\2
1984	$13,431.8	\1	$3,456.6	\1	$14,499.4	\2	80.3%	$18,055.9	\2
1985				\1	$19,314.7	\2	80.3%	$24,051.0	\2
1986					$12,275.1	\2	71.4%	$17,181.0	\2
1987					$19,108.2	\2	70.5%	$27,104.8	\2
1988	$22,245.1	\3	$2,120.3	\3	$24,365.4	\3	68.3%	$35,655.8	\3
1989	$18,801.3	\3	$280.9	\3	$19,082.2	\3	80.1%	$23,810.5	\3
1990	$14,519.6	\3	$491.1	\3	$15,010.7	\3	65.4%	$22,964.8	\3
1991	$13,046.0	\3	$832.6	\3	$13,878.6	\3	79.4%	$17,484.9	\3
1992	$19,329.2	\3	$1,382.4	\3	$20,711.6	\3	77.2%	$26,812.3	\3
1993	$13,226.8	\3	$963.2	\3	$14,190.0	\3	75.2%	$18,857.8	\3
					Average		81.2%		

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/ CFEC final data.
3/ ADF&G ex-vessel value data.

(copper\coptab3.wq1)

salmon through mesh size restrictions and adjustments in early-season fishing time. Pink and chum salmon are also caught incidentally in the sockeye salmon fishery, and no efforts have been made to manage the fishery for these species.

In-season sockeye salmon management has been based on catch data and escapement estimates derived by sonar counters at Miles Lake and aerial surveys of Delta spawning areas (Table 4). Miles Lake is on the mainstream of the Copper River and is upstream of the Delta spawning areas. Weekly and seasonal escapement goals have been established. The seasonal goal for the Upper Copper River is based on the Copper River subsistence and personal use salmon fisheries management plans (Appendices 1 and 2).

Coho salmon management is based on catch data and aerial escapement counts of Delta spawning areas (Table 5). Sonar counts are not utilized for coho salmon management. The majority of coho salmon spawn below the sonar counters, and the counters are removed prior to the coho salmon migration.

Management of both the sockeye and coho salmon fisheries is difficult because of the apparent mixed nature of stocks in the fishery and the reduced water clarity of the estuary and numerous drainages in which salmon spawn.

3.00 SUBSISTENCE AND PERSONAL USE FISHERIES

Since 1960, 99 percent of the reported subsistence harvests within the Prince William Sound, Copper-Bering River Region have occurred in the Copper River. All personal use salmon harvests take place in the Upper Copper River.

Subsistence fishing regulations have been in flux since 1984. The State of Alaska, in 1984, made its first attempt to bring subsistence fishing regulations into compliance with the subsistence provisions of the Alaska National Interest Lands Conservation Act (ANILCA). This Act dictates that "rural" residents have "priority use" of the fish and wildlife resources of Alaska for subsistence purposes.

The Alaska Board of Fisheries in 1984 defined the boundaries of rural residency within the region and created a new class of fishermen for the Copper River, the personal use fishermen. As a result of the Board action, only residents of the Upper Copper River basin were qualified to obtain subsistence permits for the Upper Copper River fishery. The personal use category was created to provide a mechanism for non-local fishermen to harvest salmon in the Upper Copper River.

"Priority use" means that when decisions are made concerning catch limits and seasons, subsistence users are given priority over commercial, personal use or sport users.

The Board of Fisheries at the same time modified the Copper River Subsistence Salmon Management Plan and adopted the Copper River Personal Use Salmon Fishery Management Plan. Excerpts from current management plans are presented (Appendices 1 and 2).

Table 4. Copper River and Bering River area sockeye escapement estimates, 1971-1993. *

Year	Copper River Delta total	Upper Copper River	Copper River District total	Bering River area total	Copper/Bering total
1971	45,270 \1	449,124 \2	\3	no estimate	\4
1972	49,235 \1	256,001 \2		no estimate	
1973	26,801 \1	253,156 \2		no estimate	
1974	18,493 \1	no estimate		42,255	
1975	32,060 \1	no estimate		6,496	
1976	41,000 \1	no estimate		50,000	
1977	40,455 \1	no estimate		9,500	
1978	65,850 \1	194,372 \5		22,800	
1979	80,700 \1	248,709 \5		27,000	
1980	119,150 \1	283,856 \5		31,800	
6/1981	141,550	535,263 \5	676,813	no estimate	
1982	104,820	467,306 \5	572,126	no estimate	
1983	108,350	545,724 \5	654,074	no estimate	
1984	183,143	536,806 \5	719,949	48,500	768,449
1985	146,043	436,313 \5	582,356	24,300	606,656
1986	75,295	509,275 \5	584,570	18,975	603,545
1987	60,698	483,478 \5	544,176	26,525	570,701
1988	52,315	488,398 \5	541,713	13,330	555,043
1989	51,700	607,869 \5	659,569	23,300	682,869
1990	73,345	581,859 \5	655,204	19,741	674,945
1991	90,500	579,412 \5	669,912	32,220	702,132
1992	76,827	601,952	678,779	55,895	734,674
1993	57,720	833,389	891,109	27,725	918,834

(copper\table4.wq1)

Note: 1/ Peak aerial survey counts in 7 index spawning areas.
2/ Escapement estimates of sockeye salmon tagged at Miles Lake and recaptured at Woods Canyon.
3/ Information not available.
4/ Information not available.
5/ Upriver escapement estimates from Miles Lake sonar counts.
6/ The escapement figures listed for the years 1981-1992 are based on peak aerial estimates, sonar, and weir counts from a majority of the known salmon spawning areas in the Copper and Bering Rivers. These indices are not intended to provide a true estimate of total escapement for the coastal stocks, but a comparable index based upon the best data currently available. An effort has been made to standardize the estimate across years, however, in years prior to 1984, different methodology was used and discrepancies may be found when cross referencing to the primary data.
* From ADF&G Annual Finfish Management Reports: 1982, 1992.

Table 5. Copper River Delta and Bering River area coho escapement estimates, 1971-1993. \1

Year	Copper River Delta total	Bering River area total	Copper/Bering total
\2 1971	30,435	19,100	49,535
1972	no estimate	no estimate	no estimate
1973	12,067	1,902	13,969
1974	26,680	5,260	31,940
1975	29,559	3,750	33,309
1976	7,528	200	7,728
1977	29,176	5,665	34,841
1978	11,991	3,200	15,191
1979	21,374	1,000	22,374
1980	88,334	11,175	99,509
\3 1981	43,300	3,600	46,900
1982	40,325	30,000	70,325
1983	60,050	16,700	76,750
1984	64,525	20,000	84,525
1985	106,410	80,500	186,910
1986	25,790	9,420	35,210
1987	26,465	5,585	32,050
1988	27,620	11,415	39,035
1989	41,366	15,835	57,201
1990	42,386	24,800	67,186
1991	64,356	31,300	95,656
1992	44,563	16,300	60,863
1993	33,450	30,050	63,500

(copper\table5.wq1)

Note: 1/ From ADF&G Annual Finfish Management Reports: 1982, 1993.

2/ During the years 1971-1980, aerial estimates were interpolated for many individual streams. These numbers are reflected in the totals for each given year. In addition, some streams were not surveyed due to weather, high water or turbulence. Surveys were made as weather allowed and may not have been made during periods of peak abundance.

3/ The escapement figures listed for the years 1981-1992 are based on peak aerial estimates and weir counts from a majority of the known salmon spawning areas in the Copper and Bering River delta. These indices are not intended to provide a true estimate of total escapement for the coastal stocks, but a comparable index based upon the best data currently available. An effort has been made to standardize the estimate across years, however counts were obtained only as environmental conditions allowed and may not necessarily correspond to periods of peak abundance. Missing counts are generally a result of bad weather, high water, turbulence or other factors that prevented surveys for that given year.

4/ No counts in Eyak Lake and Ibek Creek due to silty water conditions. Index of

The Alaska Supreme Court ruled in 1989 that a state law limiting subsistence hunting and fishing activities to rural residents unconstitutionally discriminates against city residents. The Board of Fisheries actions which limited subsistence fishing to residents of the Upper Copper River basin were therefore void. The fishery is now open to all Alaskan residents. The state's attempts to align subsistence regulations with ANILCA have subsequently been stymied.

As a result of the conflict between the Alaska Constitution and ANILCA, the federal government took over game management on federal lands in Alaska in July 1990. Navigable rivers including the Copper River and its tributaries are considered to be state lands, and, therefore, are still under state management.

The state is currently attempting to regain control of fish and game management from the federal government. Governor Hickel's Subsistence Task Force is attempting to redefine qualified subsistence users and meet the requirements of the federal law. A state constitutional amendment may ultimately be required to resolve the issue.

Subsistence permits differ from personal use permits in the type of allowable gear, areas open to fishing, the amount of scheduled fishing time, household bag limits, maximum harvest levels and permit fee.

Subsistence fishermen may, depending on location, utilize fish-wheels, dip nets, gill nets or spears. Personal use fishermen are currently limited to dip nets.

Subsistence fishing is generally allowed in the Glennallen Subdistrict from June 1 through September 30, the Batzulnetas area during times specified by emergency order, and the Copper River District during commercial fishing periods (Figure 4). Personal use fishing is allowed in the Chitina Subdistrict June 1 through September 30 during periods established by emergency order.

The household possession limit for subsistence varies according to gear type and family size, and ranges from 15 to 500 salmon. Dip net and gill net fishermen are limited to 5 chinook salmon.

The household possession limit for personal use is basically 15 salmon for a household of 1 person, and 30 salmon for a household of 2 or more persons. No more than 5 chinook salmon may be taken per household. If the personal use harvest is less than 45,000 salmon at the end of the fifth week of the season, then the possession limit for a household of 1 is increased to 20 salmon, the possession limit for a household of 2 is increased to 40 salmon, and an additional 15 salmon may be taken for each additional family member. The household possession limit for chinook salmon does not increase.

There is no weekly or seasonal maximum harvest level for subsistence. Personal use harvests are regulated by weekly and seasonal maximum harvest levels or limits. The seasonal limit is 60,000 salmon, not including any salmon taken after August 31.

Subsistence permits are free; whereas, personal use permits have a fee of $10. This fee was created by legislative action and is supported by the Dip Net Fisherman's

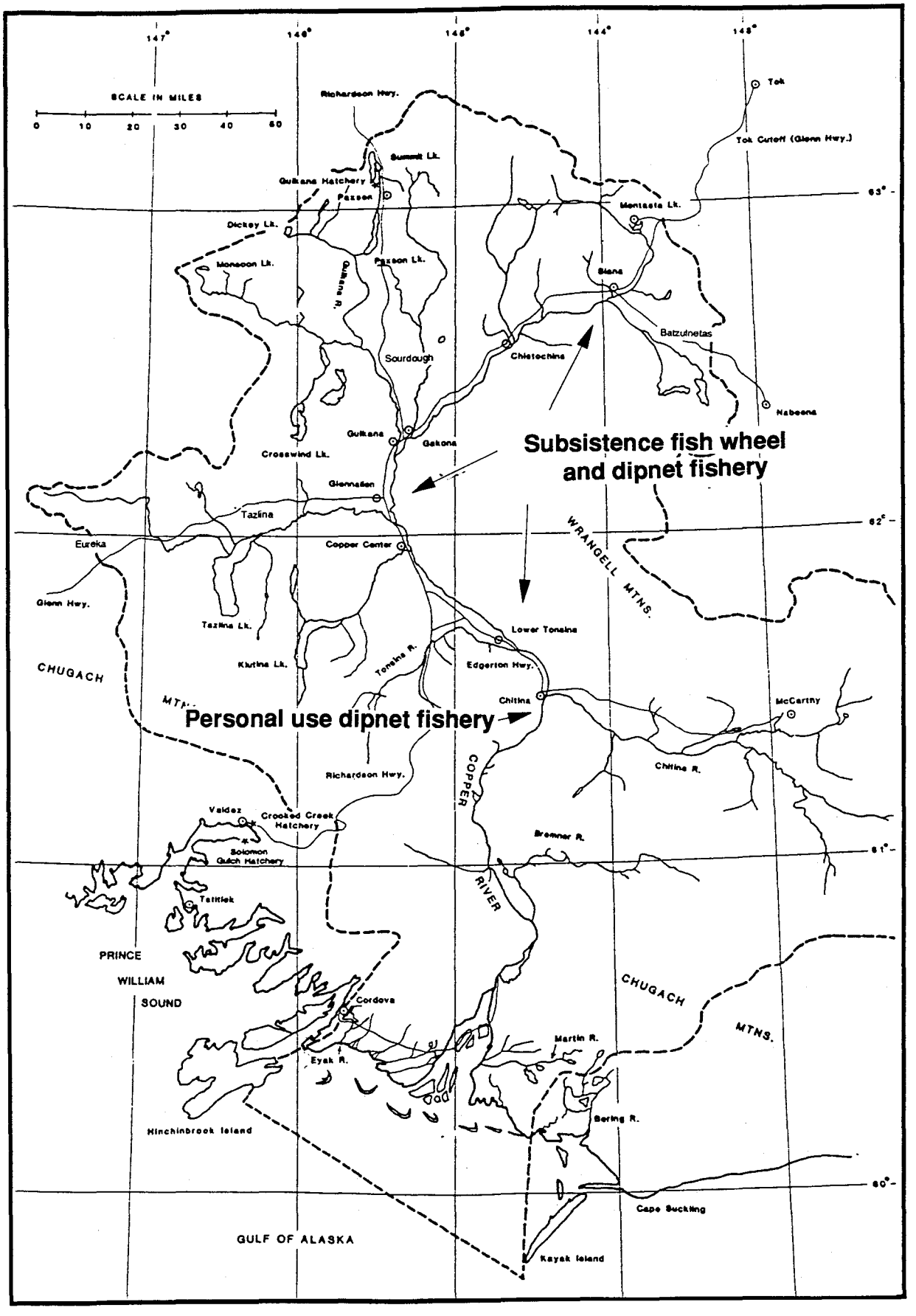

Figure 4. Subsistence and personal use fishing locations in the Copper-Bering rivers area.

Association. Proceeds are used to compensate the Chitina Village Corporation for the access across their lands and for garbage collection.

During the past 5 years, subsistence fishermen were issued an average of 119 dip net permits, 349 fishwheel permits and 92 gill net permits (Tables 6 and 7). It is estimated that the dip net, fishwheel and gill net fishermen harvested an average of 2,196, 22,942, and 460 salmon, respectively.

An unknown number of fish are taken annually by commercial gill net fishermen for home use. Commercial fishermen are not required to sell fish that they catch, nor is there a mechanism to report or record the number of salmon taken for home use. During preparation of the Phase I Comprehensive Salmon Plan, a questionnaire was distributed amongst the fishermen and one of the questions was: "How many of the following species did you take home for personal use during the 1981 commercial season?" The weighted average answer for all drift gill net respondents for all of Area E was 3.1 chinook salmon, 14.2 sockeye salmon, 0.4 pink salmon, 0.4 chum salmon, and 7.8 coho salmon. It is not possible to calculate the proportion of these fish that were harvested in the Copper-Bering River Area. These data suggest that in 1981, drift gill net fishermen caught, but did not sell, a total of 1,677 chinook salmon, 7,682 sockeye salmon, 216 pink salmon, 216 chum salmon, and 4,220 coho salmon.

During the past 5 years, an average of 4,975 dip net personal use and 63 fish-wheel personal use permits were issued. Fish-wheel permits were not issued after 1990. Dip net fishermen caught an average of 55,897 salmon and fish-wheel fishermen caught an average of 1,095 salmon.

4.00 SPORT FISHERY

The sport fishery has been managed by regulated methods and bag limits. The Copper River flows through two sport fisheries management areas. That portion of the Copper River upstream from a line crossing the Copper River between the mouth of Haley Creek and mouth of Canyon Creek in Wood's Canyon is in the Upper Copper/Upper Susitna Management area (Figure 5). That portion of the Copper River downstream of the described line is included in the Prince William Sound Management area. The majority of sport fishing occurs in the Upper Copper River area adjacent to the Richardson and Glenn Highway systems and along the Copper River Delta adjacent to the Copper River Highway. There is little sport fishing effort directed at that portion of the Copper River drainage downstream of Haley Creek and upstream of Miles Lake.

These management areas provide a unique blend of resident, anadromous, and stocked fishery resources. This discussion will be limited to anadromous salmon. The statewide harvest survey findings initiated in 1977 provide the best source of harvest and effort information for both management areas. Effort information includes estimates of the number of angler-days directed at salmon and non-salmon species.

In the Upper Copper River drainage, upstream of Haley Creek, salmon harvests are limited to chinook, sockeye and coho. The harvest of coho salmon is negligible as low numbers of fish migrate into the area after the majority of the sport fishing effort has occurred. The average chinook and sockeye salmon sport harvest during 1977 through

Table 6. Subsistence/personal use fishing permits issued and the reported harvest of salmon in the Upper Copper River drainage, 1960 through 1993.\1

Year		Permits Issued Dip Net	Permits Issued Fish-wheel	Permits Issued Total	Reported Catch All Species Dip Net	Reported Catch All Species Fish-wheel	Reported Catch All Species Total	Report Catch by Species King	Report Catch by Species Sockeye	Report Catch by Species Coho	Estimated Total \2
1960		44	33	77	1,179	5,660	6,839	136	6,739	25	8,803
1961		307	82	389	1,777	12,419	14,196	388	15,472	550	18,206
1962		435	117	552	3,203	11,101	14,304	848	14,543	381	18,486
1963		361	140	501	2,124	12,395	14,519	464	14,055	558	18,287
1964		794	200	994	4,133	7,749	11,882	725	11,915	103	16,340
1965		982	143	1,125	7,215	5,813	13,028	664	12,760	52	16,818
1966		1,132	138	1,270	7,452	9,188	16,640	555	16,718	0	21,896
1967		1,166	154	1,320	6,146	8,360	14,506	419	14,457	0	19,007
1968		1,235	143	1,378	8,040	6,071	14,111	644	14,819	233	20,283
1969		1,415	167	1,582	18,054	6,220	24,274	719	27,604	224	29,266
1970		3,242	245	3,487	22,700	9,886	32,586	427	36,500	554	42,757
1971 \3		4,168	374	4,542	28,115	9,370	37,485	1,363	37,517	363	48,449
1972 \4		3,485	205	3,690	18,996	7,854	26,850	1,501	26,850	248	32,468
1973 \5		3,840	305	4,145	16,407	10,943	27,350	1,846	27,350	51	29,428
1974 \6		3,305	288	3,593	15,143	7,657	22,800	1,141	22,800	163	26,001
1975		2,452	350	2,802	7,694	5,626	13,320	1,705	13,320	0	15,357
1976		2,512	451	2,963	12,130	8,321	20,451	2,017	20,451	17	23,623
1977		3,526	540	4,066	22,612	12,751	35,363	2,171	35,363	454	41,815
1978		3,313	392	3,705	12,569	6,638	19,207	2,050	19,207	633	22,029
1979		2,730	470	3,200	11,887	10,251	22,138	2,372	22,138	705	30,963
1980		2,804	399	3,203	14,650	9,805	24,455	2,256	21,437	639	35,081
1981		3,555	523	4,078	28,872	26,924	55,796	1,913	53,008	849	68,746
1982	\7	5,475	615	6,090	62,614	38,120	100,734	2,532	96,799	1,246	110,006
1983		6,911	630	7,541	72,257	35,971	108,228	5,421	100,995	1,690	118,734
1984	s	104	458	562	1,288	20,374	21,662	415	20,999	237	23,093
	p	5,311	17	5,328	46,018	223	46,241	1,592	44,079	552	49,940
	s&p	5,415	475	5,890	47,306	20,597	67,903	2,007	65,078	789	73,033
1985		4,153	533	4,686	29,856	22,877	52,733	1,673	50,488	544	64,200
1986	s \8	39	366	405	645	25,136	25,781	622	24,890	264	28,423
	p	3,966	65	4,031	41,641	1,054	42,695	2,294	39,794	521	44,047
	s&p	4,005	431	4,436	42,286	26,190	68,476	2,916	64,684	785	72,470
1987	s 8/	59	372	431	1,148	21,821	22,969	541	22,286	100	35,035
	p	4,186	73	4,259	42,301	470	42,771	2,739	39,614	398	46,115
	s&p	4,245	445	4,690	43,449	22,291	65,740	3,280	61,900	498	81,150
1988	s	70	339	409	1,860	18,955	20,815	672	19,761	245	30,514
	p	4,205	46	4,251	40,492	1,238	41,730	2,723	38,533	450	45,921
	s&p	4,275	385	4,660	42,352	20,193	62,545	3,395	58,294	695	76,435

continued

Table 6. Subsistence/personal use fishing permits issued and the reported harvest of salmon in the Upper Copper River drainage, 1960 through 1993 (cont'd). \1

Year		Permits Issued: Dip Net	Permits Issued: Fish-wheel	Permits Issued: Total	Reported Catch All Species: Dip Net	Reported Catch All Species: Fish-wheel	Reported Catch All Species: Total	Report Catch by Species: King	Report Catch by Species: Sockeye	Report Catch by Species: Coho	Estimated Total \2
1989	s	78	308	386	2,235	25,377	27,612	744	26,716	65	29,317
	p	4,447	137	4,584	53,321	3,223	56,544	2,160	53,505	825	58,914
	s&p	4,525	445	4,970	55,556	28,600	84,156	2,904	80,221	890	88,231
1990	s	95	311	406	2,703	27,942	30,645	604	29,947	87	32,290
	p	5,631	58	5,689	67,241	747	67,988	2,594	63,793	1,446	70,478
	s&p	5,726	369	6,095	69,944	28,689	98,633	3,198	93,740	1,533	102,768
1991	s	293	418	711	5,347	30,255	35,602	1,206	34,139	215	43,621
	p	6,222	0	6,222	81,189	0	81,189	3,902	73,929	3,297	85,763
	s&p	6,515	418	6,933	86,536	30,255	116,791	5,108	108,068	3,512	129,384
1992	s	151	504	655	4,075	38,774	42,849	1,320	41,199	330	49,276
	p	6,387	0	6,387	89,244	0	89,244	3,316	84,450	1,478	92,457
	s&p	6,538	504	7,042	93,319	38,774	132,093	4,636	125,649	1,808	141,733
1993	s	14	759	773	252	48,033	48,285	1,441	54,135	79	64,003
	p	7,914	N/A	7,914	99,327	0	99,327	2,886	94,998	1,443	102,903
	s&p	7,928	759	8,687	99,579	48,033	147,612	4,327	149,133	1,522	166,906
Avg. 87-93	s	109	430	539	2,517	30,165	32,682	933	32,598	160	40,579
	p	5,570	45	5,615	67,588	811	68,399	2,903	64,117	1,334	71,793
	s&p	5,679	475	6,154	70,105	30,976	101,081	3,835	96,715	1,494	112,372

1/ Adapted from Brady et al. (1990) and Roberson (personal communication). Data for 1992 preliminary as of 2/93.
2/ Includes other salmon species.
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.
7/ Return requirement enforced.
8/ Subsistence dip net catch estimated.

s - subsistence
p - personal use
s&p - subsistence and personal use total

(copper\coptab4.wq1)

Table 7. Subsistence fishing permits issued and returned and reported subsistence harvest of salmon on the Copper River Delta, 1960-1993. \1

	Permits Issued		Permits Returned			Reported Catch				
Year	Issued	Unused	Unsuc-cessful	Suc-cessful	Total	King	Sockeye	Coho	Total	
1960	13	*	*	**	*	0	0	158	158	
1961	14	*	*	**	14	60	137	99	296	
1962	14	*	*	**	*	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	\2
1983	87	41	4	27	73	79	107	57	254	\3
1984	118	47	14	43	104	68	324	135	549	\4
1985	94	27	9	58	94	88	261	83	433	\5
1986	88	28	9	48	85	86	348	47	481	\6
1987	95	50	5	34	89	49	359	14	510	\7
1988	114	40	17	40	97	59	226	42	440	\8
1989	75	32	2	30	64	56	339	51	454	\9
1990	88	38	8	38	76	60	469	82	611	
1991	129	43	11	61	115	136	830	38	1,009	\10
1992	126	46	7	67	110	142	785	42	999	\11
1993	111	43	4	46	93	120	428	29	577	
Recent 5-year avg.						103	570	48	730	

* No record.
** Unknown.
1/ Adapted from Randall et al. (1985) and Brady et al. (1990).
2/ Includes 1 pink and 1 chum.
3/ Includes 11 pinks.
4/ Includes 22 pinks.
5/ Includes 1 chum.
6/ Includes 23 Dolly Varden.
7/ Includes 73 Dolly Varden, 6 whitefish and 9 cutthroat.
8/ Includes 4 chum, 87 Dolly Varden, 15 whitefish and 7 cutthroat.
9/ Includes 3 chum, 2 Dolly Varden and 3 whitefish.
10/ Includes 2 whitefish and 3 Dolly Varden.
11/ Includes 30 "other".

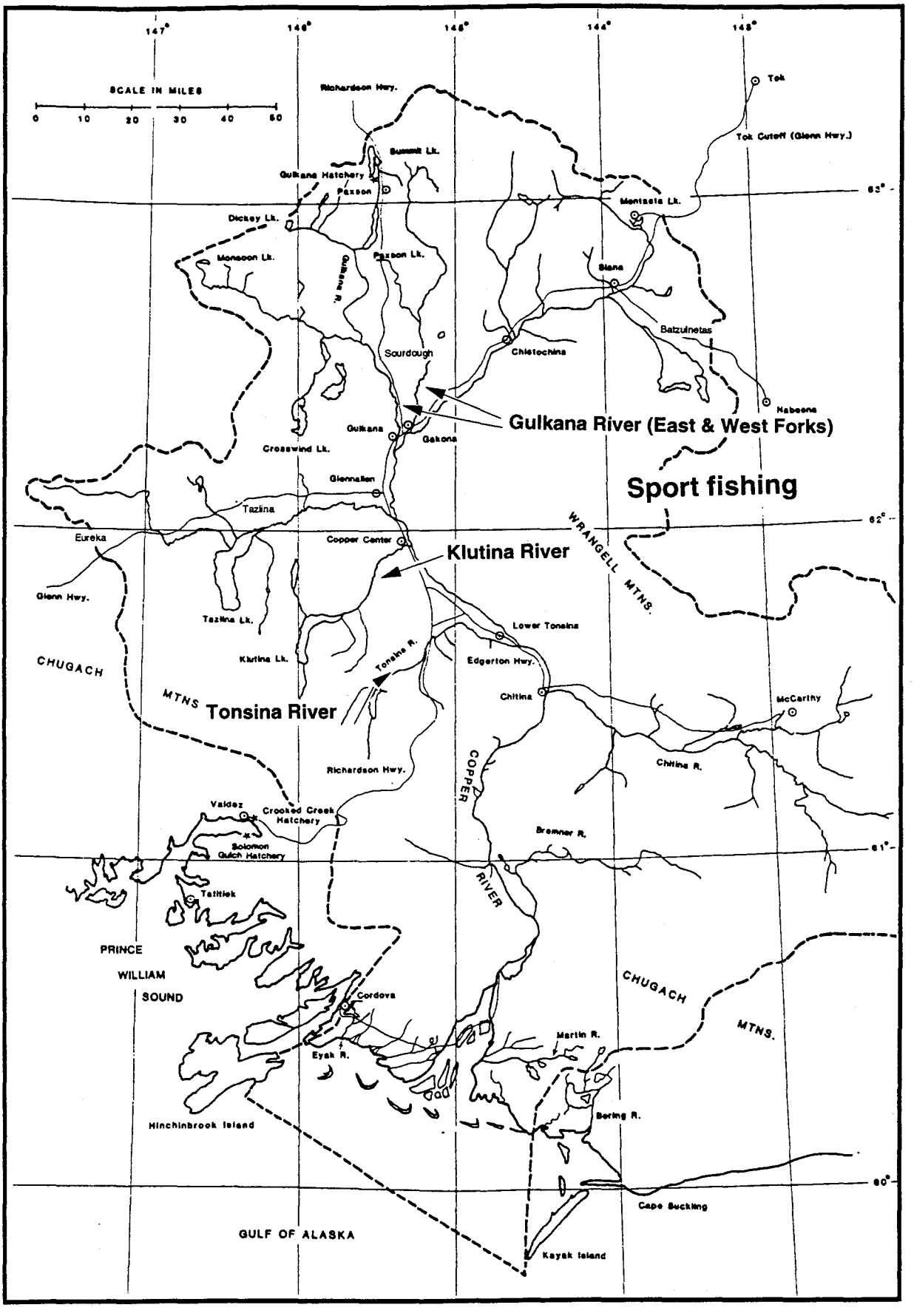

Figure 5. Major sport fishing areas in the Copper-Bering rivers area.

1990 was 2,073 and 3,172 fish, respectively (Table 8). Over 95% of this harvest for both species occurred from the Gulkana and Klutina Rivers. As a measure of sport harvest pressure throughout Prince William Sound and the Copper River, anglers have directed 47.8% of their efforts on the Upper Copper River (Table 9).

In the Copper River drainage, downstream of Haley Creek including the Copper River Delta, five species of salmon are harvested by recreational anglers. Freshwater fishing in this area has had a history of very limited participation through 1987 due principally to the fact that salmon fishing had either been closed or severely restricted in most road accessible freshwater sites. Coho, sockeye, chinook, pink and chum salmon harvests in this area during 1985-1989 averaged approximately 3,600, 400, less than 100, 500 and 100 fish respectively. The harvest estimate of coho salmon includes the harvest taken at Flemming Spit, a remote release site for both coho and chinook salmon. Beginning in 1992, it is anticipated that the harvest and effort directed toward chinook salmon will dramatically increase as a result of continuing the Flemming Spit chinook salmon release.

5.00 GULKANA HATCHERY COMPLEX

The hatchery complex presently consists of plywood and plastic incubation boxes situated near two spring tributaries of the Gulkana River and Paxson Lake (Figure 1). The current capacity of Gulkana I is 35.5 million sockeye salmon eggs. The eggtake goal for Gulkana II is 1.75 million sockeye salmon eggs. Egg-take and fry production data is available from 1973 (Tables 10-13). The complex is operated and funded by Prince William Sound Aquaculture Corporation (PWSAC), the regional aquaculture association, based on a long term operating contract for the Gulkana facility negotiated with the Alaska Department of Fish and Game in 1993.

The hatchery sites were selected because of various key factors, such as water temperature, water quantity and quality, ease of access, broodstock availability and proximity to major underutilized rearing areas. The total incubation potential for both sites is estimated to be 60 million eggs.

Sockeye salmon eggs at the Gulkana I facility have been collected from fish returning to the spring-fed stream at Gulkana I. Gulkana II sockeye salmon eggs have been collected from a stock that spawns in the East Fork of the Gulkana River above Paxon Lake. Chinook salmon eggs previously incubated at Gulkana II were collected from spawners in the East Fork of the Gulkana River below Paxon Lake. Fertilized eggs have been "seeded" on a bed of gravel or plastic substrate, 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.

Sockeye salmon fry have been released in an unfed condition in nearby lakes, including: Summit, Paxson, Crosswind, Harding, and Ten Mile lakes. Harding Lake is a land-locked lake near Fairbanks. Stocking at Harding and Ten Mile lakes has been discontinued. Paxon and Summit lakes are thought to be at or near the carrying capacity of fry, and, aside from brood stock maintenance releases at the site, further

Table 8. Estimates of sport fishing effort and harvests of anadromous salmon from the drainages and marine waters of Area E, 1977-1992.

Location	Year	Effort \1	No. of Fish \2				
			King	Sockeye	Coho	Pink	Chum
Valdez Arm (fresh	1977	19,423	247	527	5,277	12,020	219
and saltwater)	1978	12,687	58	78	3,582	7,910	1,444
	1979	19,068	88	141	6,402	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	16,035	241	343	4,710	8,696	976
	1984	23,053	125	786	5,138	9,639	1,397
	1985	51,652	unavail.	1,085	7,705	27,028	unavail.
	1986	31,472	unavail.	413	6,911	22,170	unavail.
	1987	48,029	unavail.	1,746	8,884	25,955	unavail.
	1988	51,744	unavail.	1,582	10,241	26,776	unavail.
	1989	49,122	unavail.	828	18,131	32,879	unavail.
	1990	71,250	220	1,630	18,630	46,730	1,258
	1991 \3	67,891	353	1,471	10,379	48,609	838
	1992 \3	60,442	317	2,153	17,580	28,587	804
	Averag	35,825	129	872	8,572	21,259	619
Near Whittier (boat	1977					1,292	
and shore)	1978					2,039	
	1979	4,134	29	0	761	1,590	0
	1980	3,756	26	0	1,541	1,768	0
	1981	4,875	0	0	32	935	0
	1982	4,520	42	0	1,635	2,014	0
	1983	6,103	41	0	294	2,065	0
	1984	4,166	212	62	549	691	0
	1985	7,789	unavail.	unavail.	1,389	1,343	unavail.
	1986	10,794	unavail.	unavail.	2,614	573	unavail.
	1987	9,725	unavail.	unavail.	2,137	0	unavail.
	1988	10,114	unavail.	unavail.	946	0	unavail.
	1989	7,153	unavail.	unavail.	719	918	unavail.
	1990	9,078	85	126	1,308	870	113
	1991 \3	12,697	47	360	1,907	1,440	205
	1992 \3	6,743	315	978	397	879	91
	Averag	7,261	57	109	1,159	1,078	29

continued

Table 8. Estimates of sport fishing effort and harvests of anadromous salmon from the drainages and marine waters of Area E, 1977-1992 (cont'd).

Location	Year	Effort \1	No. of Fish \2				
			King	Sockeye	Coho	Pink	Chum
Coghill Lake and	1977	5,482					
vicinity	1978	1,745		690			
	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
	1985	1,331	unavail.	554	unavail.	unavail.	unavail.
	1986	1,030	unavail.	657	unavail.	unavail.	unavail.
	1987	985	unavail.	417	unavail.	unavail.	unavail.
	1988	371	unavail.	146	unavail.	unavail.	unavail.
	1989	495	unavail.	344	unavail.	unavail.	unavail.
	1990	327	0	49	28	12	11
	1991 \4	(closed to fishing on Coghill Lake sockeye)					
	1992 \4	(closed to fishing on Coghill Lake sockeye)					
	Averag	1,210	0	626	3	215	20
Eshamy Lake and	1977						
vicnity	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	485	0	1,048	37	449	0
	1985	1,316	unavail.	836	unavail.	unavail.	unavail.
	1986	1,446	unavail.	688	unavail.	unavail.	unavail.
	1987	1,342	unavail.	634	unavail.	unavail.	unavail.
	1988	943	unavail.	637	unavail.	unavail.	unavail.
	1989	419	unavail.	352	unavail.	unavail.	unavail.
	1990	278	0	175	14	23	0
	1991 \3	869	0	152	7	63	0
	1992 \3	1013	0	460	32	9	0
	Averag	1,015	0	711	6	123	0

continued

Table 8. Estimates of sport fishing effort and harvests of anadromous salmon from the drainages and marine waters of Area E, 1977-1992 (cont'd).

Location	Year	Effort \1	No. of Fish \2				
			King	Sockeye	Coho	Pink	Chum
Copper River Delta	1977	3,544	0	209	1,229	0	0
	1978	2,003	0	127	704	0	0
	1979	4,653	0	362	2,633	0	0
	1980	6,954	0	69	4,822	0	0
	1981	3,910	0	43	2,948	0	0
	1982	4,043	0	0	2,096	0	0
	1983	6,609	21	630	2,318	0	84
	1984	8,196	0	112	2,718	149	0
	1985	1,869	0	130	727	55	0
	1986	8,423	11	321	3,776	412	15
	1987	10,451	0	507	3,254	641	10
	1988	6,848	9	600	5,693	364	236
	1989	17,069	0	353	4,710	627	64
	1990	3,720	0	272	1,778	0	0
	1991 \3	10,188	47	625	4,875	747	143
	1992 \3	15,220	109	2,630	4,492	420	38
	Averag	7,106	12	437	3,048	213	37
Total PWS and Copper River Delta (fresh and saltwater)	1977	48,369	247	6,512	8,829	25,425	244
	1978	35,046	58	4,575	9,125	16,300	1,444
	1979	46,594	342	3,772	13,964	17,972	1,500
	1980	46,468	302	3,849	15,309	16,807	1,025
	1981	42,734	324	2,182	8,499	14,774	972
	1982	40,568	399	4,286	10,994	12,923	1,204
	1983	47,614	596	5,124	10,405	14,696	1,269
	1984	57,548	411	4,077	10,363	14,488	1,770
	1985	72,662	0	2,908	11,633	32,670	0
	1986	64,280	0	4,878	16,098	25,272	0
	1987	81,221	0	4,889	16,680	31,382	0
	1988	84,971	0	4,763	19,262	31,470	0
	1989	95,295	0	3,939	25,631	37,994	0
	1990	105,739	418	3,562	26,639	49,146	1,945
	1991 \3	113,115	355	3,792	19,783	52,290	1,622
	1992 \3	113,443	983	8,358	25,259	32,011	964
	Averag	68,479	277	4,467	15,530	26,601	872

continued

Table 8. Estimates of sport fishing effort and harvests of anadromous salmon from the drainages and marine waters of Area E, 1977-1992 (cont'd).

Location	Year	Effort \1	No. of Fish \2 King	Sockeye	Coho	Pink	Chum
Upper Copper River	1977	51,485	532	3,662	269	0	0
Drainage	1978	44,566	641	1,606	126	0	0
	1979	57,266	2,948	1,599	412	0	0
	1980	50,518	2,101	2,109	164	0	0
	1981	53,499	1,717	1,523	0	0	0
	1982	54,953	1,802	3,343	393	0	0
	1983	51,276	2,579	2,619	84	0	0
	1984	51,954	2,787	3,267	496	0	0
	1985	48,569	1,939	4,752	410	0	0
	1986	51,563	3,663	4,129	202	0	0
	1987	52,324	2,301	4,876	330	0	0
	1988	45,867	1,562	3,038	291	0	0
	1989	52,096	2,356	4,509	18	0	0
	1990	50,635	2,302	3,569	0	0	0
	1991 \3	64,207	4,884	5,511	69	0	0
	1992 \3	72,052	4,412	4,560	113	0	0
	Averag	53,302	2,408	3,417	211	0	0
total all marine and	1977	99,854	779	10,174	9,098	25,425	244
freshwaters in Area E	1978	79,612	699	6,181	9,251	16,300	1,444
	1979	103,860	3,290	5,371	14,376	17,972	1,500
	1980	96,986	2,403	5,958	15,473	16,807	1,025
	1981	96,233	2,041	3,705	8,499	14,774	972
	1982	95,521	2,201	7,629	11,387	12,923	1,204
	1983	98,890	3,175	7,743	10,489	14,696	1,269
	1984	109,502	3,198	7,344	10,859	14,488	1,770
	1985	121,231	1,939	7,660	12,043	32,670	0
	1986	115,843	3,663	9,007	16,300	25,272	0
	1987	133,545	2,301	9,765	17,010	31,382	0
	1988	130,838	1,562	7,801	19,553	31,470	0
	1989	147,391	2,356	8,448	25,649	37,994	0
	1990	119,114	2,579	8,036	15,530	26,601	872
	1991 \3	177,322	4,772	9,303	19,852	52,290	1,622
	1992 \3	185,495	4,980	13,918	25,372	32,011	964
Average all years		119,452	2,621	8,003	15,046	25,192	805
Average last 5 years		152,032	3,250	9,501	21,191	36,073	692

1/ Days or portions of days spent fishing. (copper\coptab8.wq1)

2/ Estimated by mail questionnaire.

3/ Data compiled from ADF&G Fishery Data Series: Harvest, Catch, and Participation in Alaska Sport Fisheries, 1991, 1992.

4/ ADF&G Recreational Fishery Management Report, 1993.

Table 9. Sport fishing effort and harvests in the Upper Copper River drainage as a percentage of the total effort and harvests in Area E, 1977-1992. \1

			Salmon Harvested				
	Year	Effort \2	King	Sockeye	Coho	Pink	Chum
Upper Copper River Drainage	1977	51.6%	68.3%	36.0%	3.0%	0.0%	0.0%
	1978	56.0%	91.7%	26.0%	1.4%	0.0%	0.0%
	1979	55.1%	89.6%	29.8%	2.9%	0.0%	0.0%
	1980	52.1%	87.4%	35.4%	1.1%	0.0%	0.0%
	1981	55.6%	84.1%	41.1%	0.0%	0.0%	0.0%
	1982	57.5%	81.9%	43.8%	3.5%	0.0%	0.0%
	1983	51.9%	81.2%	33.8%	0.8%	0.0%	0.0%
	1984	47.4%	87.1%	44.5%	4.6%	0.0%	0.0%
	1985	40.1%	84.8%	62.0%	3.4%	0.0%	0.0%
	1986	44.5%	87.9%	45.8%	1.2%	0.0%	0.0%
	1987	39.2%	72.7%	49.9%	1.9%	0.0%	0.0%
	1988	35.1%	77.9%	38.9%	1.5%	0.0%	0.0%
	1989	35.3%	70.1%	53.4%	0.1%	0.0%	0.0%
	1990	45.0%	83.4%	44.3%	0.0%	0.0%	0.0%
	1991	36.2%	92.8%	59.2%	0.3%	0.0%	0.0%
	1992	38.8%	88.6%	32.8%	0.5%	0.0%	0.0%
	Avera	46.3%	83.1%	42.3%	1.6%	0.0%	0.0%

1/ Estimated by mail questionnaire. (copper\coptab8a.wq1)

2/ Days or portions of days spent fishing for salmon and nonsalmon species.

Table 10. Sockeye salmon egg take and fry production data, Gulkana I Hatchery, 1973-1993.

Year	Incubation Units and Substrates	Eggs Seeded	Fry Produced	Percent Survival	On Site Release	Transferred to Rearing		Units Lost to IHN	Loss \1 to IHNV	% Lost to IHNV
1973-74	1 (Gravel)	225,800	179,311	79.4%	79,691	99,620	TM			
1974-75	5 (Gravel)	1,266,552	886,556	70.0% \2	785,110	101,446	TM			
1975-76	5 (Gravel)	1,276,570	728,681	57.1%	627,081	101,600	TM			
1976-77	5 (Gravel)	1,288,142	627,170	48.7%	514,922	112,248	TM			
1977-78	5 (Gravel)	1,361,149	581,277	42.7% \3	477,219	104,058	TM			
1978-79	5 (Gravel)	1,320,472	1,040,563	78.8% \4	940,974	99,589	TM			
1979-80	10 (6 Gravel) (4 Intalox)	3,563,568	2,446,057	68.6% \5	1,105,397	1,340,660	SL			
1980-81	20 (18 Gravel) (2 Intalox)	6,228,897	5,249,173	84.3%	3,388,682	1,860,491	SL			
1981-82	24 (18 Gravel) (2 Intalox) (4 Experiment.)	9,166,596	8,033,217	87.6% \6	5,985,270	2,047,947	SL			
1982-83	24 (18 Gravel) (2 Intalox) (4 Experiment.)	10,931,889	9,782,684	89.5%	5,470,056	4,312,628	SL	1	428,705	3.92

continued

Table 10. Sockeye salmon egg take and fry production data, Gulkana I Hatchery, 1973-1993 (cont'd).

Year	Incubation Units and Substrates	Eggs Seeded	Fry Produced	Percent Survival	On Site Release	Transferred to Rearing		Units Lost to IHN	Loss 1/ to IHNV	% Lost to IHNV	
1983-84	41 (23 Gravel) (2 Intalox) (16 Experiment.)	13,033,894	10,904,209	83.7%	6,162,450	4,741,759	SL	1	322,049	2.47	
1984-85	58 (48 Gravel) (2 Intalox) (8 Experiment.)	26,771,104	19,019,944	71.0% \7	9,261,708	8,451,782 1,287,042	SL CW	2	873,016	3.26	\8
1985-86	60 (60 Gravel)	31,639,816	23,585,594	74.5%	8,586,509	14,999,085	SL	7	3,038,885	9.60	
1986-87	62 (60 Gravel) (2 Kitoi boxes)	28,694,258	22,397,733	78.1% \9	9,905,907	12,491,826	SL	6	2,399,643	8.36	
1987-88	65 (65 Gravel)	33,395,562	21,221,745	63.5%	6,204,322	503,375 2,487,396 12,026,642	HR CW SL	4	1,633,135	4.88	\10
1988-89	69 (all Gravel)	35,119,881	25,755,148	73.3% \11	10,105,238	515,046 3,130,373 12,004,491	HR CW SL	2	800,000	2.28	\12
1989-90	69 (All Gravel)	35,405,792	25,155,016	71.0% \13	13,298,695	505,305 4,906,005 6,369,811	HR CW SL	0	0	0	\14
1990-91	59 (All Gravel)	30,101,450	22,102,411	73.4%	10,522,819	5,469,759 6,109,833	CW SL	4	1,600,000	5.32	

continued

Table 10. Sockeye salmon egg take and fry production data, Gulkana I Hatchery, 1973-1993 (cont'd).

Year	Incubation Units and Substrates	Eggs Seeded	Fry Produced	Percent Survival	On Site Release	Transferred to Rearing		Units Lost to IHN	Loss 1/ to IHNV	% Lost to IHNV
1991-92	59 (All gravel) 23 (Intalox)	36,051,683	26,032,508	72.2%	10,563,621	8,420,351 7,048,536	CW SL	1	200,000	0.55
1992-93	----------	19,293,901	12,415,308	63.4%	5,257,169	4,496,590 2,661,549	CW SL	3	1,350,580	7.00
1993-94	----------	35,184,329								
Totals		361,321,305	238,144,305	65.9%						

1/ Based on an estimated 80% survival from egg to fry. (copper\copytab9)
2/ Unit 1 froze out due to insufficient water flow.
3/ Started Malachite Green 9/77.
4/ Change from rough to gentle eggtake methods.
5/ Unit 1A was disturbed by a bear.
6/ Started Betadine egg treatments, 9/81.
7/ A 10% correction factor was used due to undercounting by electronic fry counter.
8/ Malachite Green test.
9/ A 4% correction factor was used when fry numbers exceeded 400,000/day.
10/ One o and 3o /freezet., 50ppm Betadine. Poor winter water flow.
11/ Egg numbers were increased by 2.7% due to undercounting by electronic fry counter.
12/ Broken outlets caused loss of several units.
13/ No correction for fry or egg counting by electronic counters, total egg, total fry and survival percentages all minimum figures.
14/ Approx. 2.5 mil egg/fry loss to freezing during remote egg take.

TM = Tenmile Lake
SL = Summit Lake
CW = Crosswind Lake
HR = Harding Lake

Table 11. Sockeye salmon egg take and fry production data, Gulkana II Hatchery, 1987-1993.

Year	Incubation Units and Substrates	Eggs Seeded	Fry Produced	Percent Survival	On Site Release	Crosswind Lake	Transferred to Rearing	# of Units Lost to IHN	Est. Fry Loss to IHNV	% Fry Lost to IHNV	COMMENTS
1987-88	3 Poly Totes	309,822	185,631	59.9%	185,631		0	0			
1988-89	5 Poly Totes	1,073,296	765,447	71.3%	765,447		0	0			
1989-90	5 Poly Totes	1,016,434	828,613	81.5%	828,613		0	0			
1990-91	5 Poly Totes	1,311,931	765,902	58.4%	765,902		0	0			500,386 egg from Gulkana I stock
1991-92	5 Poly Totes	1,282,016	1,047,110	81.7%	1,047,110		0	0			Air purge installed
1992-93	5 Poly Totes 5 Kitoi Boxes	1,785,511	1,174,439	65.8%	609,061	565,378	1/				Chinook module changed to sockeye
1993-94	----------	1,786,531									
Totals		8,565,541	4,767,142	55.7%							

1/ All fry at Gulkana I and II received short term rearing in 1993 (4-6 weeks).

Table 12. Chinook salmon egg take and fry production data, Gulkana II Hatchery, 1987-1992.

Year	Incubation Units and Substrates	Eggs Seeded	Fry Produced	Percent Survival	On Site Release	Transferred to Rearing		# of Units Lost to IHN	Est. Fry Loss to IHNV	% Fry Lost to IHNV	COMMENTS
1987-88	3 Kitoi Boxes	13,431	1,388	10.3	0	1,388	PO				
1988-89	5 Kitoi Boxes	22,104	16,036	72.5	0	15,977	MS				
1989-90	5 Kitoi Boxes	60,236	0	0	0						All eggs lost due to freezing
1990-91	5 Kitoi Boxes	46,507	26,209	56.4	0	26,209	MS				
1991-92	5 Kitoi Boxes	92,198	65,290	70.8	14,659	30,448 20,183	MS PO				On site release due to holding tank overflow
1992-93	\1										
Totals		234,476	108,923	46.5%							

1/ The chinook program was discontinued in 1992.

(copper\coptab11)

PO = Paxson Lake Outlet
MS = Monsoon Lake

Table 13. Sockeye and chinook salmon fry releases and release locations, Gulkana I and II Hatcheries, 1973-1992.

Release Year	Chinook from G-II			Sockeye released from G-I						Sockeye Released from G-II		Total Sockeye Released (G-I,II)
	Monsoon Lake	Gulkana R. (E.Fork)	Total Released	Harding Lake	Ten Mile Lake	Crosswind Lake	Gulkana R. (G-I Site)	Summit Lake	Total Released	Gulkana R. (G-II Site)	Crosswind Lake	
1974					99,620		79,691		179,311			179,311
1975					101,446		785,110		886,556			886,556
1976					101,600		627,081		728,681			728,681
1977					112,248		514,922		627,170			627,170
1978					104,058		477,219		581,277			581,277
1979					99,589		940,974		1,040,563			1,040,563
1980					0		1,105,397	1,340,660	2,446,057			2,446,057
1981					0		3,388,682	1,860,491	5,249,173			5,249,173
1982					0		5,985,270	2,047,947	8,033,217			8,033,217
1983					0		5,470,056	4,312,628	9,782,684			9,782,684
1984					0		6,162,450	4,741,759	10,904,209			10,904,209
1985					0	1,287,042	9,261,708	8,451,782	19,000,532			19,000,532
1986					0		8,586,509	14,999,085	23,585,594			23,585,594
1987					0		9,905,907	12,491,826	22,397,733			22,397,733
1988	0	1,388	1,388	503,375	0	2,487,396	6,204,332	12,026,642	21,221,745	185,631		21,407,376
1989	15,977	0	15,977	515,046	0	3,130,373	10,105,238	12,004,491	25,755,148	765,447		26,520,595
1990	0	0	0	505,305	0	4,906,005	13,298,695	6,445,011	25,155,016	828,613		25,983,629
1991	26,209	0	26,209	0	0	5,469,759	10,522,819	6,109,833	22,102,411	765,902		22,868,313
1992	30,488	34,842	65,290	0	0	8,420,351	10,563,621	7,048,536	26,032,508	1,047,110		27,079,618
1993	0	0	0	0	0	4,496,590	5,257,169	2,661,549	12,415,308	609,061	565,378	13,589,747
Totals	72,674	36,230	108,864	1,523,726	618,561	30,197,516	109,242,850	96,542,240	238,124,893	4,201,764	565,378	242,892,035

Note: G-I = Gulkana I Hatchery
G-II = Gulkana II Hatchery
East Fork = Outlet of Paxson Lake
G-II chinook, 1989 there were 15,977 to Monsoon, w/59 kept as samples.

(copper\coptab12.wq1)

efforts will be directed towards the relatively underutilized waters of Crosswind Lake and lakes in the west fork of the Gulkana River.

The stream-side incubation box concept has proven successful at this location for incubating sockeye salmon, and the number of incubators has gradually been increased since 1973. It is estimated that the hatchery complex at its 1991 capacity will produce 190,600 adult sockeye salmon. Assuming a 60 percent commercial harvest rate, it is projected that drift gill net fishermen will catch approximately 114,400 sockeye salmon annually. Approximately 25,500 sockeye salmon will be required annually for brood purposes. Approximately 50,700 sockeye salmon will be available to harveste by subsistence, personal use and sport fishermen.

Following the 1991 egg take, a moratorium was placed on chinook salmon incubation pending a thorough review of the program. It is thought that the suitable riverine chinook salmon habitat is currently fully utilized by wild chinook salmon. It is unlikely the chinook program will ever be re-started.

Disease has not proven to be a major factor at this facility due in part to the modular nature of the egg box system and aquaculture practices. Although IHN virus outbreaks have occurred eight of the last nine years, the weighted average egg to emergent fry survival has been 74.1 percent.

6.00 WILD STOCK REHABILITATION AND HABITAT ENHANCEMENT

The need for and benefits of wild stock rehabilitation and habitat enhancement have been discussed (Phase 3 Comprehensive Salmon Plan, PWS section, chapter 7.00).

The USDA Forest Service administering the Chugach National Forest through the Cordova Ranger District has been the primary participant in salmon rehabilitation in the Copper River area. Completed rehabilitation projects identified in the Phase 2 Comprehensive Salmon Plan are listed in Table 14. The Forest Service has proposed a five year plan for habitat improvement and rehabilitation which emphasizes continuing commitment to salmon fishery development (Table 15).

7.00 ISSUES AND CONCERNS OF IMPORTANCE

7.10 SUBSISTENCE STATUTES, REGULATIONS AND LITIGATION

Current subsistence fishing statutes and regulations allow for unprecedented numbers of fish to be harvested. Aside from restrictions needed to assure wild fish escapement, there is virtually no cap or limit on the number of subsistence fishermen or their harvest. The fishery is now open to all residents and the only restrictions are season, household possession limit, and area restrictions. If subsistence harvests increase significantly, changes to the existing management plans will need to be made to ensure that wild fish escapement goals are met.

Interior natives brought suit in the US District Court (John v Alaska) asking that the court declare that the waterways in the Wrangell-St.Elias National Park were reserved by the creation of the park for park purposes; and, therefore, that they are park lands and under

Table 14
Completed fish habitat improvement projects in the Copper-Bering River Region, 1985-1992.

(data\phase3\crrehab.wq1)

Project Type	District	Stream #	Name	Year	Work Accomplished	Habitat Created	Species Targeted	Additional Adults	Initial Costs USFS
Structural Improvements	Copper R.		Mile 18 Creek	1991	Rearing pond development	2 acres	SS	200	$1,000
	Copper R.		Mile 18	1991-1992	Resident sport fish pond development	2 acres	SS	3,000	$4,000
Resident Sport Fish Improvements/ Enhancements	Copper R.		Crater Lake	1984-1991	Rainbow trout stocking (3,000 fry)	Fishing opportunity in barren lake	RT	User days	$1,000
	Copper R.		Pipeline Lakes	1988-1991	Arctic grayling stocking (70,000 fry, now discontinued)	Hike in sport fishing opportunity	GR	User days	$3,000
Spawning/ Rearing Habitat Enhancement	Copper R.	001	Alaganik Slough	1989-1992	Delta beaver pond fry access improvements	20 acres	SS	1,000	$20,000
	Copper R.		Sherman Ponds	1991-1992	Brush bundle cover structures	3 acres 20 structures	SS, DV	300ss ?dv	$8,500
	Copper R.		Sherman Creek	1992	Instream cover structures	5 structures	SS, DV	200ss ?dv	$3,000
	Copper R.		Mi. 18 Pond	1986-1988	Brush bundle cover structures	30 structures	SS	200	$4,500
	Copper R.		Mi. 24.75 Creek	1987	Rearing access channel development	3.5 acres	SS	800	$5,000

continued

Table 14
Completed fish habitat improvement projects in the Copper-Bering River Region, 1985-1992 (cont'd).

Project Type	District	Stream #	Name	Year	Work Accomplished	Habitat Created	Species Targeted	Additional Adults	Initial Costs USFS
Spawning/ Rearing Habitat Enhancement (continued)	Copper R.		Woodcutter Pond	1988-1989	Brush bundle cover structures	25 structures	SS	200	$6,500
	Copper R.		Mi. 25.25	1987	Spawning channel	22,500 sq. ft.	SS, RS	15,000ss ?rs	$22,000
	Copper R.	018L	Tokun Lake	1985	Lake fertilization	N/A	RS	?rs	$5,000
Completed Fisheries Inventories	All	All	All	1989-1992	Channel type stream classification	GIS data base	N/A	N/A	$80,000
	Copper R.		Mile 18 Creek	1991-1992	Fisheries habitat inventory	Habitat capability modeling	SS, CT	N/A	$8,000
	Copper-Bering		Bering River Martin River Katalla River	1988-1990	Fisheries habitat inventory	Bering River access road monitoring	RS, KS, CS PS, SS CT, DV	N/A	$20,000

Note:
SS = silver salmon
RS = red salmon
CS = chum salmon
KS = king salmon
CT = cutthroat trout
RT = rainbow trout
GR = grayling

\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 sockeye salmon based on 50 fish per surface acre of lake.
\3 Number of harvestable coho salmon varies from 5 to 10 fish per surface acre of lake surface.
\4 Number of harvestable pink salmon based on 0.14 fish per sq. ft. of spawning area.
\5 Number of harvestable chum salmon 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.

Table 15

Proposed fish habitat improvement projects in the Copper-Bering River Region, 1993-1997.

(\data\phase3\futrrecr.wq1)

Project Type	District	Stream #	Name	Year	Work Accomplished	Habitat Created\1	Species Targeted	Additional Adults\2,3	Initial Costs USFS
Structural Improvements	Copper River		Clear Creek	1993-1995	Investigate and build diversion structure	Reduce siltation in 3.5 miles of stream	SS, RS	3,000 angler days	$20,000
	Copper River		N/A	1993	Construct access to beaver ponds rearing habitat	20 acres	SS	Not estimated	$30,000
Spawning/ Rearing Habitat Enhancement	Copper River		Mile 25	1993-1994	Spawning and rearing habitat development	500 ft stream channel	SS	5,000	$45,000
	Copper River		Mile 25.25	1993-1995	Sediment traps and cover structures	1,500 sq ft spawing 200 sq ft cover	SS	15,000	$30,000
	Copper River		Sheridan Glacier area	1993-1995	Construct cover structures in newly colonized stream	20 structures	SS	5,000	$25,500
	Copper River		Mile 18	1993-1994	Rearing habitat & fish pond; revegetation, stocking & pier.	1.5 acres	SS	1,500\4 2,000\5	$28,000
	Copper River		Delta area	1993-1995	Create rearing habitat in Delta perched ponds	20 acres	SS	est. 10/ac	$40,000
	Copper River		Saddlebag Creek	1993-1995	Develop spawning channel\6	Not presently determined	SS, RS	10,000	$49,000
	Copper River		Hatchery Creek	1993-1997	Develop spawning channel; proj. uncertain. May build viewing platform with Eyak Corp.	Not presently determined	RS	20,000	$9,500 $2,000
Stock Analysis	Copper River		Mile 18	1993-1995	Coded wire tag fry/smolt & evaluate habitat productivity	N/A	SS, CT DV	N/A	$54,000

continued

Table 15
Proposed fish habitat improvement projects in the Copper-Bering River Region, 1993-1997 (cont'd).

Project Type	District	Stream #	Name	Year	Work Accomplished	Habitat Created	Species Targeted	Additional Adults	Initial Costs USFS
Stock Analysis	Copper River		Mile 24.75	1993-1994	Evaluate rearing pond & access channel habitat capability	N/A	SS	N/A	$6,000
	Copper River		Delta area	1993	Coho-cutthroat interactions	N/A	SS, CT	N/A	$30,000
Mitigation/ Rehabilitation	Bering River		N/A	1993	Identify and report on possible impacts from road construction	N/A	Any	N/A	$20,000
Complete Fisheries Inventories	Copper River		Delta area	1993-1994	Inventory population status & propose recovery measures	N/A	CT	N/A	\7
	Copper River		Delta area	1993-1997	Identify & inventory sport fish development opportunities	N/A	All	N/A	$30,000
Access	Copper River		McKinley Lake	1993-1995	Develop access: sport angling at Alaganik stream system \8	N/A	SS, RS	N/A	$30,000

Note: SS = silver salmon; RS = red salmon; CT = cutthroat trout; DV = Dolly Varden

\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 coho salmon varies from 5 to 10 fish per surface acre of lake surface.

\3 Number of harvestable sockeye salmon based on 50 fish per surface acre of lake.

\4 Anadromous salmon for sport and commercial harvest.

\5 Landlocked salmon for sport harvest.

\6 Project canceled.

\7 Program conducted jointly with PWS inventory; see PWS report for costs.

federal management. The plaintiffs perceive that the federal subsistence system will be more favorable to them than the state system. It is not clear what impact a ruling for the plaintiffs would have on management of the fishery.

7.11 OVER HARVESTING OF WILD STOCKS

Creation of a large run of sockeye salmon returning to the Gulkana Hatchery complex has raised fears of the over harvesting of wild stocks. These concerns have caused ADF&G to draft the Gulkana Hatchery Policy Paper in August, 1990 (Appendix 3). Excerpts from this paper are as follows.

> *It is the policy of the Department not to compromise its current level of wild stock management precision for increased harvests in the Copper River fisheries. Hatchery production at the current level or at an increased level must occur in conjunction with evaluation programs that ensure maintenance of wild stock escapements. The Department will manage the Copper River fisheries to achieve wild stock minimum escapement goals.*
>
> *At current production levels, wild stock productivity can be maintained as long as preseason planning assumptions (i.e., forecasts for hatchery and wild stocks and relative exploitation rates) are accurate. If survival of hatchery stocks differ from wild stocks, forecasts may not be accurate and escapements of upriver wild stocks may deviate for the desired goal. Achievement of upriver and delta stock escapements has become more difficult with the steady decline of delta escapements in recent years.*
>
> *Success in meeting wild stock management objectives is difficult to assess since information concerning the abundance and distribution of hatchery and wild stocks is just now becoming available. A more extensive assessment program needs to be designed and implemented to address these needs. This program must provide estimates of the hatchery returns by release site as well as detailed migratory timing information. Studies are also needed to differentiate delta and upriver components, and to more accurately estimate delta escapements.*
>
> *The drafters of this policy recommend that production for the Gulkana Hatchery complex not be increased above current permitted levels until an adequate evaluation program to address management concerns has been completed. Additionally, stock assessment programs must be continued to assure wild stock management is not compromised.*
>
> *The drafters of this policy feel that it is important for the State to recognize that fisheries enhancement programs place a burden on management of surrounding wild stocks and create new management complications. In calculating costs of enhancement projects (i.e., new hatchery facilities, lake stocking areas, remote release sites or stream side incubation facilities), funding of evaluation and increased management needs must be included as part of the project budget.*

7.12 STEELHEAD COULD BE EASILY ERADICATED

A small population of steelhead spawn in the Gulkana and Tazlina rivers. Steelhead are caught incidentally to other species, and it is feared that any targeted fishing pressure could eradicate these fish.

7.13 GENETIC CONCERNS

The selection of brood sources and fry release locations is limited by genetic concerns. The run timing of wild and hatchery fish must be considered when brood sources and fry release locations are selected. In fry release locations, there should be minimal overlap in run timing between wild stocks and hatchery stocks. The genetic integrity and productivity of the wild stocks must be maintained.

7.14 MARINE MAMMAL PROTECTION POLICIES

The National Marine Fisheries Service (NMFS) has management authority over the marine mammals of Alaska. Recent declines in the population of Stellar sea lions in western Alaskan waters caused NMFS to list the Stellar sea lion as "threatened." The historic data base regarding total number of Stellar sea lions is virtually limited to the past 31 years. It is unclear whether the observed decline is a natural cyclical phenomena or a man-induced decline. If populations continue to decline, NMFS may reclassify this species as "endangered." This may prohibit drift gill net fishermen from harassing, injuring and killing sea lions or, in the extreme case, may cause the gill net fisheries of Area E to be closed.

The Marine Mammals Protection Act may be revised in 1993, and, it has been proposed that the Act be revised so that NMFS regulates the incidental take of all species of marine mammals, in all areas and all fisheries.

7.15 INTERCEPTION OF NONINDIGENOUS SALMON STOCKS IN THE COMMERCIAL FISHERY

Tag recovery data indicate chinook and sockeye salmon harvested in the Copper and Bering commercial fishery are of nonlocal origin. The quantity of fish of nonlocal origin is minor.

7.16 INCREASING SUBSISTENCE, PERSONAL USE AND SPORT FISHING EFFORT

Alaska is currently one of the fastest growing states in the Union and the number of fishermen is anticipated to increase. Chinook salmon are presently considered to be fully utilized and recent catch rates for each user group cannot be maintained. Without enhancement, an increase in the harvest of any user group will cause either a decrease in wild spawners or a decrease in the harvests of other user groups.

7.17 DECLINE OF QUALITY FISHING ON THE GULKANA RIVER

The majority of sport catches of chinook and sockeye in the Upper Copper River drainage occur in the Gulkana River. The number of anglers and fishing guides has increased in recent years, and some local or long-time fishermen perceive that this has caused the quality of fishing on the Gulkana River to decline.

7.18 COPPER RIVER HIGHWAY(S) CONSTRUCTION AND INCREASED ACCESS TO THE DELTA

Construction of the Copper River Highway(s) to Cordova will provide sportfishing access to streams on the Delta. Coho salmon and perhaps sockeye salmon will sustain additional fishing pressure. Additional restrictions of existing fisheries may be required to ensure adequate escapement.

7.19 TRESPASSING ON NATIVE LANDS

Favored fishing streams such as the Copper, Klutina, and Gulkana rivers adjoin Ahtna Corporation and Chitina Village Corporation lands. These streams, being navigable, are state waters. Public access is limited and increasing numbers of fishermen in recent years have unwittingly or knowingly trespassed to fish. Construction of the Copper River Highway from Chitina has increased the exposure of Ahtna Corp. and Chitina Village Corp. lands to fisherman trespass.

7.20 TIMBER HARVESTING AND COAL DEVELOPMENT

Timber is currently being commercially harvested near Cordova, and coal development in the Bering River watershed has been proposed. Both activities, if improperly conducted, could compromise fisheries habitat and reduce wild salmon populations.

8.00 APPENDICES

APPENDIX 1

COPPER RIVER SUBSISTENCE SALMON FISHERIES MANAGEMENT PLAN.

5 AAC 01.647. COPPER RIVER SUBSISTENCE SALMON FISHERIES MANAGEMENT PLAN

[a] The purpose of this plan is to ensure that adequate escapement of salmon in the Copper River system occurs and that subsistence uses, as described under AS 16.05.251 and 5 AAC 99.010 are accommodated.

[b] The following are directives pertaining to the management of the Copper River System salmon:

[1] this policy governs only those salmon which pass the department sonar counters located at the Million Dollar Bridge;

[2] the department will manage the Copper River commercial salmon fishery to attain a total escapement into the Copper River of 516,000 salmon to ensure that an adequate escapement reaches the spawning ground and to provide for subsistence, personal use and sport fisheries;

[1] Salmon, other than chinook salmon, may be taken in the vicinity of former native village of Batzulnetas under the following conditions:

[1] unless modified by this subsection, 5 AAC 01.001 - 5AAC 01.040 and 5 AAC 01.600 - 5 AAC 01.645 apply to this fishery;

[2] salmon may be taken only under the authority of a Batzulnetas subsistence salmon fishing permit issued by the department; 1/ See the subsistence regulations for further detail regarding the open-water markers at Batzulnetas, methods and season.

APPENDIX 2

COPPER RIVER PERSONAL USE SALMON FISHERY MANAGEMENT PLAN.

5 AAC 77.590. COPPER RIVER PERSONAL USE SALMON FISHERY MANAGEMENT PLAN.

[a] The department shall manage the Copper River District commercial salmon fishery to attain a sonar count escapement of salmon based on the total of the following categories:

Spawning escapement	300,000	sockeye
	15,000	chinook
Subsistence harvest	35,000	salmon
Personal use harvest	60,000	salmon
Sport fishery	3,500	sockeye
	2,500	chinook
Hatchery brood	20,000	sockeye
Hatchery surplus	80,000	sockeye
TOTAL	516,000	

[b] The maximum harvest level for the Chitina Subdistrict personal use salmon fishery is 60,000 salmon, not including any salmon taken after August 31. The department shall manage the Chitina Subdistrict personal use salmon fishery to apportion the harvest as follows:

Week	Percent of Total Allowable Harvest
1	10
2	20
3	25
4	20
5	15

The remaining 10 percent of the total allowable harvest may be taken during the rest of the season. When more than 516,000 salmon pass the sonar counters, 25 percent of the excess are allocated to the personal use fishery and the remainder are added to the spawning escapement, to other user groups, and to hatchery brood stock.

[c] The opening of the Chitina Subdistrict personal use salmon fishing season may be delayed up to 10 days depending on the strength and timing of the sockeye salmon run.

APPENDIX 3

GULKANA HATCHERY POLICY PAPER

(NOTE by the PWS/CR RPT, 1994: The Gulkana Hatchery Policy Paper was prepared in 1990. Therefore, information contained within Appendix 3 may not be current, such as reference to chinook production at Gulkana Hatchery which no longer is permitted.)

By:

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Linda K. Brannian
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Division of Commercial Fisheries, Central Region
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[1] The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished Divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uniterpreted data. To accommodate needs for up-to-date information, reports in this series may contain preliminary data.

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INTRODUCTION

The Gulkana Hatchery Complex, consisting of two incubation facilities (Gulkana I and II), is located above Paxson Lake on the East Fork of the Gulkana River in the upper Copper River drainage (Figure 1). The Gulkana facilities are operating near their permitted sockeye salmon egg capacities of 35.5 million and 1.25 million eggs respectively. In addition, the Gulkana II facility is permitted to incubate 250,000 chinook eggs. Sockeye salmon fry from the Gulkana Hatchery Complex are released at four locations; (1) Gulkana I hatchery site, (2) Summit Lake, (3) Crosswind Lake, and (4) Gulkana II site. Chinook salmon fry are released into the East Fork Gulkana River or at Monsoon Lake.

AREAS OF CONCERN

Personal use, subsistence, and sport fisheries all benefit from the Gulkana Hatchery salmon returns, but the primary user is the commercial fishery in the Copper River District which accounts for 85% to 95% of the harvest of sockeye and chinook salmon in the Copper River system. In the Copper River District, hatchery fish are mixed with the wild stock returns to the Copper River system's "upriver" and "delta" spawning components. At the present permitted production level, potential mean annual adult returns would be approximately 250,000 sockeye and 2,500 chinook salmon. The recent ten year average annual commercial harvest in the Copper River fishery is approximately 650,000 sockeye and 34,000 chinook salmon. Thus, the hatchery component could increase the commercial harvest by 23% and represent nearly 20%, assuming a 60% exploitation rate. The contribution by hatchery chinook salmon would be less than 7% of the harvest.

Wild sockeye salmon returns to the Copper River district have been grouped into two major stocks based on geographic spawning areas: (1) an upriver and (2) a delta stock. Each stock is itself composed of many discrete spawning populations. Because the three stock components, hatchery, upriver, and delta, all return to spawn within the same time period, they are mixed in the commercial fishing district. This provides little opportunity, at present funding levels, for stock specific management. Therefore, all stocks are assumed to be exploited equally by the commercial fishery.

The delta stock consists of wild sockeye salmon populations which spawn in the coastal river systems south of the Chugach Mountains, east of Cordova and west of the Bering River. Spawning escapements to these systems are monitored by weekly aerial surveys of individual salmon spawning streams and lakes.

The escapement of upriver stocks past the commercial fishery is monitored at the Miles Lake Sonar Project, located approximately 30 miles above the commercial district. The commercial fishery is managed to achieve an escapement goal at Miles Lake partitioned over time based on historic run timing curves. The escapement goal at Miles Lake is based on three components; (1) wild stock spawning needs, (2) personal use, subsistence and sports fishery allocations, and (3) hatchery stock requirements. The hatchery component includes brood stock needed for future production as well as any hatchery returns which could not be

harvested by the commercial fishery without over exploiting wild stocks. The exploitation rate for all stocks is based on the forecasted run of wild stocks. If forecasts are accurate for wild and hatchery stocks, desired wild stock escapement levels will be met when the Miles Lake escapement goal is achieved. However if forecasts are incorrect, desired wild stock escapement levels may not be met even though the Miles Lake goal is achieved.

Sockeye salmon management is further complicated by stocks spawning in the Copper River delta systems. Since hatchery stocks augment the upriver escapement component, maximizing harvest of the upriver stock could result in over harvest of the delta stock. There is concern that the delta stocks can not sustain the same level of exploitation as the upriver run. Aerial survey estimates for 1986-1990 were 46% below the previous 10 year average (1976-1985) and 23% below the 20 year average (1966-1985). Under the current management strategy the escapement goal for the upriver run has been easily met which is not true for delta stocks.

Consistent evaluation of hatchery programs throughout the area, including the Gulkana facility, must be applied. Guidelines for evaluation and selection of proposed hatchery and remote release sites stress that overlap in run timing of hatchery and wild stocks be minimized. The purpose of this objective is to avoid mixed stock management problems which might jeopardize the integrity and productivity of wild stocks. Development of enhanced salmon returns must be accompanied by appropriate research programs to allow for harvest of total returns without determent to wild stocks.

Additional information and a more detailed explanation of specific areas of concern are presented in Appendix A. Due to these concerns, it is necessary to develop a policy of present and future salmon enhancement for the Gulkana Facility.

STATEMENT OF POLICY FOR THE GULKANA HATCHERY COMPLEX

It is the policy of the Department not to compromise its current level of wild stock management precision for increased harvests in the Copper River fisheries. Hatchery production at the current level or at an increased level must occur in conjunction with evaluation programs that ensure maintenance of wild stock escapements. The Department will manage the Copper River fisheries to achieve wild stock minimum escapement goals.

THE GULKANA HATCHERY POLICY'S IMPACT ON CURRENT PRODUCTION LEVELS

At current production levels, wild stock productivity can be maintained as long as preseason planning assumptions (i.e. forecasts for hatchery and wild stocks and relative exploitation rates) are accurate. If survival of hatchery stocks differ from wild stocks, forecasts may not be accurate and escapements of upriver wild stocks may deviate from the desired goal. Achievement of upriver and delta stock escapements has become more difficult with the steady decline of delta escapements in recent years.

Success in meeting wild stock management objectives is difficult to assess since information concerning the abundance and distribution of hatchery and wild stocks is just now becoming available. A more extensive assessment program needs to be designed and implemented to address these needs. This program must provide estimates of the hatchery returns by release site as well as detailed migratory timing information. Studies are also needed to differentiate delta and upriver components, and to more accurately estimate delta escapements. A list of programs, various combinations which would achieve these objectives, is provided in Appendix B of this document.

RECOMMENDATIONS

The drafters of this policy recommend that production for the Gulkana Hatchery complex not be increased above current permitted levels until an adequate evaluation program to address management concerns has been completed. Additionally, stock assessment programs must be continued to assure wild stock management is not compromised.

The drafters of this policy feel that it is important for the State to recognize that fisheries enhancement programs place a burden on management of surrounding wild stocks and create new management complications. In calculating costs of enhancement projects (i.e. new hatchery facilities, lake stocking areas, remote release sites, or stream side incubation facilities) funding of evaluation and increased management needs must be included as a part of the project budget.

GULKANA TASK FORCE SIGNATURES

James Brady — 9-10-90
James Brady — Date

Sam Sharr — 9-11-90
Sam Sharr — Date

Ken Roberson — 9/19/90
Ken Roberson — Date

Linda Brannian — 9/4/90
Linda Brannian — Date

Craig Whitmore — 9/17/90
Craig Whitmore — Date

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Larry Peltz — Date

APPENDIX A.
FISHERIES MANAGEMENT AND RESOURCE MONITORING OF COPPER RIVER BASIN SOCKEYE AND CHINOOK SALMON

INTRODUCTION

Sockeye salmon spawn throughout the Copper River basin and can be categorized into two stock groupings. One is an "upriver" run which includes sockeye salmon stocks which spawn in the Copper River watershed upstream of Miles Lake (River Mile (RM) 30). The other is a "delta" run consisting of all sockeye salmon stocks which spawn in the coastal lakes and streams of the Copper River delta and Bering River watersheds. The upriver run is composed of more than 100 individual sockeye salmon stocks. A portion of the upriver run consists of hatchery-reared sockeye salmon produced from Gulkana River stock eggs incubated at the Fisheries Rehabilitation Enhancement and Development (F.R.E.D.) Division Gulkana Hatchery Facility and released into Summit and Crosswind Lakes as well as at the hatchery. The delta run is composed of approximately 30 sockeye salmon stocks.

Chinook salmon spawn almost exclusively in the upriver tributaries of the Copper River. Forty chinook spawning stocks have been identified. Enhancement of the Gulkana River chinook stock also occurs at the Gulkana Hatchery Facility.

Sockeye and chinook salmon are harvested in a commercial fishery in the Copper River District in the Gulf of Alaska. Subsistence and personal use fishermen harvest sockeye and chinook salmon in the Copper River. Sport anglers harvest sockeye and chinook salmon in tributary streams of the Copper River.

Commercial Fishery

In 1988, 520 fishermen with drift gill net permits made deliveries during the Copper River salmon fishery (ADF&G 1990). The 1978-1988 average harvest has been 675,718 sockeye and 33,740 chinook salmon. An increasing proportion of the harvest is comprised of hatchery-reared sockeye salmon. The hatchery run will increase from 72,000 (1984-88 average) to an average 220,000 sockeye salmon for 1989-1992 (Table 1). The Copper River District sockeye fishery is managed to obtain a weekly escapement past a counting station below Miles Lake, Copper River (RM 30). Delta stock escapements are estimated from aerial surveys which must be done late in the fishery. This delay makes it difficult for managers to estimate delta run strength and react in a timely fashion.

The current management strategy continues to place top priority in obtaining wild stock escapement goals, past the counting station below Miles Lake and to this end has adjusted the weekly escapement schedule to account for the presence of hatchery stocks. This is accomplished by estimating the exploitation rate of wild upriver sockeye salmon stocks by fishery which would provide adequate wild stock

escapement and applying that same rate to the expected hatchery run. Surplus hatchery salmon are then added to weekly escapement objectives based on historic run timing of the Gulkana stock acquired from coded wire tag (CWT) return data.

To successfully achieve the escapement schedule, the following assumptions must be met:

1. Abundance forecast of upriver and hatchery stocks is accurate.

2. Forecast of run timing for upriver and hatchery stocks is accurate.

3. Annual upriver exploitation rate is the same for all stocks and allows adequate delta run escapement.

4. Juvenile and marine survival rates are equal for wild and hatchery stocks.

5. Proportion of wild and hatchery stocks is accurately assessed during the season.

If assumptions 1 through 4 are not fulfilled the importance of assumption 5 increases.

Most chinook salmon are caught during the first five to six weeks of the sockeye salmon fishery. When allowed, large mesh gill nets are used by many commercial fishermen early in the season to target chinook salmon. Chinook salmon management decisions are based on comparisons of reported catches to forecasted returns apportioned over time using historic catch curves. Chinook catches are managed through time closures or gill net mesh size restrictions. Fishery closures to protect chinook salmon are most effective during the first days of the fishery, prior to the arrival of large numbers of sockeye salmon. Gill net mesh size restrictions are generally not imposed until the second or third fishing period. Incidental chinook catches have increased, even with use of smaller meshed gill nets designed to target primarily on sockeye salmon. Following the first week, the fishery is managed for sockeye salmon.

Subsistence and Personal Use Fisheries

The largest personal use and subsistence fisheries occur in the upper Copper River at or above Wood Canyon (RM 95) where dip nets and fish wheels are used. The average number of personal use and subsistence permits issued during 1979-1988 was 4,273 for dip net and 477 for fish wheel. A 60,000 salmon guideline harvest apportioned among weekly periods, has been established for the Copper River personal use dip net and fish wheel fishery. The average catch for the personal use and subsistence fisheries in 1984-1988 has been 2,337 and 563 chinook and 40,505 and 21,985 sockeye salmon, respectively. The number of chinook and sockeye salmon harvested by the personal use fishery is controlled by limiting the allowable catch per permit. In recent years, an increased use of boats in the personal use dip net fishery has allowed participants to fish offshore and catch more chinook salmon.

Sport Fishery

Chinook and sockeye salmon are both targeted by sport fishermen in the Copper River Basin. During 1984-1988 fishing effort ranged from 28,000 angler days (1984 and 1986) to over 37,000 angler days (1987) for anadromous and resident fishes. The Gulkana and Klutina Rivers support the greatest amount of fishing effort directed at salmon in the Copper River Basin. In recent years these two systems have shown a trend of increasing use by individuals and guided parties. The Gulkana River chinook salmon annual harvest during 1984-1988 averaged 1,730 fish. During 1989, between June 16 and July 31, approximately 30,000 angler hours was expended on the Gulkana River, downstream of the West Fork, and 2,398 chinook salmon were caught of which 1,461 were kept and 937 released. The 1984-1988 average annual sockeye salmon harvest was approximately 2,500 fish. The directed sockeye salmon fishery has not shown an increase in effort and occurs from late June into September. The Klutina River chinook salmon annual harvest during 1984-1988 averaged 520 fish. During 1989 approximately 416 boat trips and 3,700 angler hours were expended on the Klutina River in the chinook salmon fishery. Approximately 1,587 chinook salmon were caught, 1,033 were kept, and 554 released. The 1984-1988 sockeye salmon annual harvest was approximately 1,000 fish. The sockeye salmon fishery has not shown an increase in effort. Approximately 1,400 sockeye salmon were taken in 1988.

Prior to the 1989 season, due to the increasing effort directed at chinook salmon within the Copper River Basin, spawning season closures and reduced bag and possession limits were implemented through the Board of Fisheries. It is not anticipated that further restrictions will be implemented although closures of specific systems can occur in response to conservation concerns (e.g. inadequate escapement). Harvest information is obtained through the State Wide Harvest Survey Questionnaire. In response to major changes of fishing effort during the season, creel surveys of specific systems may be conducted to verify results of the State Wide Harvest Survey or to gain specific fishery information not available from the survey.

EXISTING FISHERIES MONITORING AND RESEARCH PROJECTS

The Department monitors sockeye and chinook salmon resources in the Copper River Basin by collecting information on harvests and spawning populations. These data are obtained through programs which enumerate catches and escapements and describe the age, sex, size, and stock composition of runs.

Catch and Escapement Enumeration

Catches

Commercial Fisheries. Commercial period catches are obtained during the season from preliminary catch reports from processors. Daily catch and effort data by

district and statistical area are tabulated after the season from sales receipts (fish tickets) which must be provided to fishermen by processors at each sale. The price paid to fishermen, called ex-vessel value, is based on the price per pound and weight of the landing. Therefore, numbers of salmon landed is often estimated by dividing the landed weight by an estimated average weight of salmon by species. The average weight and its variance are not reported on fish tickets. Consequently the variance for the catch in numbers of salmon is unknown, but the difference between the actual and reported number of fish harvested is thought to be minor.

Subsistence and Personal Use Fisheries. Catches in these fisheries are estimated during and after the season from information recorded on permits returned to the Department. The precision and accuracy of catch estimates is a function of the accuracy of data from each returned permit and the percent of permits returned. In recent years the return rate has averaged 65% and 88% for the subsistence and personal use fisheries. In 1989, 94% of personal use permits were returned. It is assumed that a large portion of permits which are not returned are held by fishermen that did not catch salmon. The rate of return is, therefore, not directly proportional to the percent of catch reported and is estimated by a linear regression model.

Sport Fisheries. The State Wide Harvest Survey has been the method used to evaluate recreational fishery effort and harvest. Creel surveys do not occur on an annual basis and none are being conducted during 1990.

Escapements

Delta Wild Stock. Escapements of delta sockeye salmon runs are estimated from peak counts made during weekly aerial surveys of selected spawning sites and migratory corridors. Migratory timing curves (expected cumulative weekly proportions of total run) and mean annual escapements for major stocks are based on historic data (1972-present). These migratory timing curves and mean historic escapements are used to estimate the expected cumulative escapement each week of the season, effectively becoming escapement goals. These numbers are compared with aerial survey observations to determine whether escapement goals will be met.

Aerial counts are treated as relative indices of escapement for comparison between years and stocks since 1) survey conditions are variable and affect counting success, 2) the portion of the escapement actually visible from the air during a survey is unknown and, 3) stream life estimates are not available.

Upriver Wild Stock. Escapement of the upriver sockeye salmon run is estimated with hydroacoustic equipment located immediately downstream of Miles Lake, Copper River (RM 30). The river channel at the Miles Lake site is approximately 1,200 feet wide. The sonar counts fish as they pass through a 60 ft sonar beam emitted from transducers located on each shore. During typical conditions, strong mid-channel currents are thought to force most sockeye salmon to travel through the sonar beams. However, if water levels are low and mid channel currents lessen, sockeye salmon could travel farther offshore, beyond the range of the hydroacoustic equipment. Additionally, deployment of hydroacoustic equipment

during the first two weeks of the season is often not possible because of low water and ice bergs. During most years several days of significant fish passage occurs prior to equipment operation.

The hydroacoustic equipment used is unable to distinguish fish species, so the upriver escapement estimate is for all salmon combined. Again, strong currents and ice bergs prohibit systematic test fishing to obtain estimates of species composition. The hydroacoustic estimate is used as an estimate of sockeye salmon escapement from the commercial fishery. Estimating escapement of the much less numerous chinook salmon is not a goal of the project.

The migratory timing curve scaled to the escapement goal for the upriver sockeye run is used to determine expected weekly escapements. The abundance of discrete upriver spawning populations cannot be estimated during the season except for stock groups which share similar historic timing based on spaghetti tagging at Miles Lake (1970-1972) and Wood Canyon (1967-1972). However, it is assumed that use of the migratory timing curve will assure adequate escapement across all segments of the run. Aerial surveys are flown two or three times during the summer to assess the relative distribution of the upriver escapement to the various spawning sites.

Chinook salmon escapement is estimated from aerial surveys flown at the peak of spawning. Peak aerial survey counts are expanded to represent total escapement based on the relationship between aerial survey counts and mark-recapture population estimates from 1966-1968 and 1970-1971.

Upriver Hatchery Stock. The hatchery run is mixed with the wild delta and upriver runs and is included within the total escapement estimate of the upriver run at Miles Lake sonar. Escapement estimation must occur closer to the hatchery/release sites to adequately assess the total abundance of the hatchery run. Sockeye salmon from the Gulkana Incubation Facility are released at the Gulkana I and II hatchery sites, Summit, and Crosswind Lakes.

Escapement of hatchery sockeye salmon to Summit Lake which contains few wild sockeye salmon is estimated from aerial surveys and partial ground counts. Escapement of hatchery sockeye salmon to Paxson Lake tributaries, which are a mixture of wild and hatchery stocks (Gulkana site I and II releases), cannot be fully estimated. Aerial surveys will be used to estimate escapements into Crosswind Lake, which contain few wild sockeye salmon. The enhanced chinook salmon return to the Gulkana River from Monsoon Lake releases will also be counted by aerial surveys beginning in 1992.

Age, Sex, and Size Sampling

The objective in setting sample sizes for most age, sex, weight, and length (AWL) samples obtained from Copper River salmon fisheries is to simultaneously estimate the proportion of each age class in catch or escapement time-area strata within ± 5 percentage points of the true proportion 90% of the time. Samples are taken in the middle of each time-area stratum in stratified systematic designs or at the peak of abundance in unstratified designs. This objective is applicable for

commercial catch and delta wild stock escapement sampling.

Commercial Catches

AWL data for Copper River District commercial catches are estimated using a stratified systematic sampling design. In the sockeye salmon fishery, strata are weekly periods for the first six weeks of the season when catches are greatest and age composition changes are most rapid. The remainder of the fishery (July and August) is divided into two or three progressively longer time strata. Strata in the chinook salmon fishery are weekly periods during the portion of the run when 90% of the catches occur (May 15 - June 10). Sample size per stratum has averaged 590 sockeye and 545 chinook salmon (1985-1987).

Subsistence and Personal Use Catches

AWL data for sockeye salmon in subsistence and personal use catches are also estimated using a stratified systematic sampling design. Strata are weekly periods through the first five weeks of the season when catches are greatest and age composition changes are most rapid. One or two longer strata are sampled later in the season. Sample size per stratum has averaged 486 sockeye salmon (1985-1987). Chinook salmon are not sampled.

Escapements

Delta Wild Stock. Only major sockeye salmon escapements of the delta run are sampled. The logistics and expense of sampling numerous, isolated watersheds in this coastal area precludes multiple visits. Sockeye are sampled once at each selected spawning area at approximately the peak of abundance. Sample size per stratum has averaged 703 sockeye salmon (1985-1987).

Upriver Wild Stock. AWL data collected from the subsistence and personal use fishery are assumed to be representative of the sockeye salmon escapement to the upper Copper River. Daily sonar counts, shifted to account for travel time between Miles Lake and Chitina are stratified to match age composition strata in upriver catches.

Carcasses from the chinook salmon escapement to the Gulkana River are sampled for AWL data. Unfortunately, sample sizes are too small in most years to achieve desired levels of accuracy and precision. Grounds surveys are being expanded into other chinook salmon spawning tributaries to increase the number of samples collected. However, there is also concern that carcass samples may not represent all age classes present or provide accurate sex ratio estimates.

Upriver Hatchery Stock. The sockeye escapement of the Summit, Crosswind, and Paxson Lake (Gulkana I and II release) hatchery runs are not currently sampled for AWL data. The mixture of wild and enhanced stocks in the Paxson Lake system precludes obtaining a sample of pure hatchery fish.

Stock Identification Projects

Upriver Wild Stock Versus Delta Wild Stock

The contribution of the delta and upriver runs to the commercial catch of sockeye salmon in the Copper River District since 1982 has been estimated using scale patterns analysis (SPA). Linear discriminant models are constructed for each major age group in the fishery using scale measurements from escapement samples. These models generally have classification accuracies of 75% to 80%. Scale samples are collected in conjunction with the catch and escapement AWL sampling program described earlier. Analyses are completed after the season

An SPA project was developed after feasibility studies during 1980 and 1981 indicated that it was possible to separate upriver and delta stocks using SPA although it was not possible to discriminate among smaller stock groupings. The ratio of upriver to delta stocks in catches has varied from 47% to 25% among years. Spatial differences in the run composition of catches have not been detected during these studies, but temporal changes in the run have been documented. In general, the catch of upriver run sockeye salmon is larger during the first five or six weeks of the fishery (Figure 2). By late June the contributions of the two runs are approximately equal and remain so thereafter. The upriver run peaks in late May or early June, while the delta run peaks early to mid June. Timing differs by slightly over one week (Figure 3).

Wild Versus Hatchery Stocks

The contribution to the commercial catch of hatchery sockeye salmon released into Summit Lake has been estimated from coded wire tag (CWT) recoveries. A feasibility study was done in 1981 when approximately 1,500 smolt from Summit Lake were tagged and their adipose fins clipped. Approximately 20,000 smolt were tagged each year from 1982 through 1985. Unfortunately, total smolt migration from Summit Lake has never been estimated after an unsuccessful attempt. Catches from the Copper River commercial fishery have been scanned for tagged sockeye salmon since 1984. Currently 30% of the catch from each fishing period is scanned. Assuming a 10% survival rate from smolt to adult, there should have been 2,000 tagged sockeye salmon passing through the district annually from 1985 through 1988, of these about 1,200 should have been caught and 400 tags recovered. A recovery of this size would allow weekly estimates of hatchery run contributions to the commercial fishery to be made throughout most of the season.

However, only about 65 recoveries have been made in the commercial catch each year from 1985 to 1988. The reasons for this poor tag recovery have not been identified but could include 1) inadequate recovery procedures, 2) a high rate of tag loss (i.e. sockeye salmon with missing adipose fins but no CWT), or 3) a higher than estimated mortality rate for tagged sockeye salmon. It is unlikely that poor recovery procedures are to blame. CWT recovery samplers are all experienced and sockeye salmon are processed relatively slowly for the fresh/frozen market. Therefore, each sockeye salmon can be examined closely and sampling error is unlikely. Tag loss does not appear to be excessive, but there may be a high proportion of naturally missing adipose fins within wild

stocks. When this occurs in hatchery fish it can not be distinguished from tag loss or tag rejection. The average percent of sockeye salmon missing adipose fins without CWT estimated on the spawning grounds of Summit Late was 29% for 1985-1988. Average percent in samples from the commercial fishery for this same period was 83%. A higher than estimated mortality rate for tagged fish may be responsible for the poor recovery rates in 1985-1989. Each year capture, handling, and release techniques were improved. In addition, for 1986, the number of smolt tagged was increased to 50,000 to improve tag recovery in the 1989 commercial fishery. In 1989, 230 tags were recovered in the commercial fishery representing 40% of those with missing adipose fins. Budget cuts resulted in a cessation of tagging in 1987 and 1988. Tagging was resumed in 1989, and 50,000 smolt have been tagged annually. There appears to be a large number of sockeye salmon with natural missing adipose fins. In 1990, when few tagged sockeye salmon were expected to be present (3 and 6 year old fish) commercial catch samplers collected 269 heads from sockeye salmon with missing adipose fins (through statistical week 27). None of these heads contained tags.

In 1989, 12 million hatchery fry were released into Summit Lake; 50% of total production. The remaining fry were released into Paxson (38%) and Crosswind Lakes (12%). In 1990, 5.1 million fry were released into Crosswind Lake, 12 million into Summit and 10 million into Paxson Lake at the Gulkana I and II hatchery sites. Seven thousand smolt were tagged from the 1989 release into Crosswind Lake. The annual goal for Crosswind Lake was increased to 50,000 CWT smolt in 1990.

Fry released into Summit Lake are thought to have a lower survival rate than those released into Paxson or Crosswind Lakes. Therefore assuming commercial fisheries contribution rates for Paxson and Crosswind Lakes to be the same as that estimated from Summit Lake tag data is probably incorrect. Timing of adult returns may also differ between release sites. Recovery of tagged sockeye salmon from Crosswind Lake will help to answer these questions.

The percent of Summit Lake sockeye salmon smolt which was tagged is estimated from escapement sampling during the year of return. Gunn Creek, the only significant tributary into Summit Lake, is walked at least once (in 1985) and an average of twice each year. The percent tagged has ranged from 0.43% (1988) to 3.13% (1986).

The chinook salmon enhancement project is relatively new. Eggs were first collected from the Gulkana River system for incubation in 1987. The current plan is to collect 50,000 eggs per year, release fry into Monsoon Lake, and tag all migrating smolt captured. This will continue for a life cycle to evaluate results before allowing incubation to increase towards the permitted maximum of 250,000 eggs.

APPENDIX B.
PROPOSED FISHERIES MONITORING AND RESEARCH PROJECTS FOR COPPER RIVER SOCKEYE AND CHINOOK SALMON

To ensure continued productivity of wild sockeye salmon stocks of the Copper River drainage, escapement goals must be determined and appropriate measures taken to achieve these goals each year. The Department's success in achieving these goals depends on the accuracy of abundance forecasts, timing predictions, and the assumption that delta stocks can withstand the same exploitation rate as upriver stocks (Appendix A). Success in achieving the chinook salmon escapement goal (15,000) is more difficult since this species is mixed with, but much less abundant than, sockeye salmon. Again the Department's ability to forecast abundance and timing is the key to achieving the chinook salmon escapement goal.

Forecasts have been quite accurate since 1985. The average forecast error has been 9% for sockeye and 17% for chinook salmon (Table 2). Based on CWT recovery estimates, (Table 1), the average forecast error for the sockeye salmon hatchery run was 23% for 1988 and 1989. It is more difficult to evaluate run timing forecasts. Recoveries of large numbers of tags, as was achieved in 1989 (230 tags), will allow examination of inter-annual variations in run timing for the hatchery run. Since tagging was not done in 1987 and 1988 information obtained on run timing from tag releases made during 1989-1990 will be important in management of runs in 1992 and 1993.

The hatchery component of the upriver run appears to have the latest mean date of arrival in the commercial fishery (Figure 4). It's average entry pattern was estimated from CWT recovery data (1984-1989) and appears bimodal, overlapping completely with both the upriver and delta wild stocks (1984-1987). The average hatchery contribution to the commercial fishery has been small (97,900) in comparison to the wild stocks (Figure 4). Yet, when average returns reach the maximum permitted level (250,000) the hatchery run could represent 20% to 25% of the commercial catch. This increase in hatchery production will alter overall run timing and stock composition (delta versus upriver). Protection of delta run stocks may become increasing difficult at increased levels of enhancement. Estimates of delta run escapement cannot be made in a timely manner, and the accuracy of these estimates is unknown. Unfortunately, recent delta sockeye salmon escapements (60,300; 1986-1989) have been half the amount seen the previous ten years (115,800; 1976-1985). If the delta run cannot support the same level of exploitation as the upriver run, the addition of hatchery sockeye salmon may lead to over-exploitation of the delta run.

If timing and abundance forecasts are not accurate managers will need weekly estimates of hatchery contributions to determine exploitation rates on wild stocks. This will require preseason estimates of the percent of the hatchery run which was tagged. Until 1989, only sockeye salmon released into Summit Lake were tagged. In 1989, tagging of Crosswind Lake smolt began. While these releases represent an average, 64% of the total release, survival and adult migratory timing may not be the same among release sites (the first return of Crosswind CWT will be in 1992). This would make estimates of hatchery contributions to the commercial fisheries inaccurate since these estimates assume equal survival,

return timing, and commercial exploitation for all hatchery releases (Table 1). Large annual variability (CV= 75%) in the tagged to untagged ratio (Table 2) also makes it difficult to expand commercial sampling results using an historic mean. Management of these stocks would benefit from either a preseason, brood-year specific, estimate of the percent of the hatchery run tagged or a reduction in the variance of the historic mean.

An expanded program of fisheries research and monitoring projects is needed to implement the Gulkana Hatchery Policy. The following is a list of projects, various combinations of these and/or others should fulfill policy objectives.

ESCAPEMENT ENUMERATION

1. Place weirs on major delta run spawning systems to estimate adult sockeye salmon abundance. Conduct research to estimate stream life and develop a model to convert aerial survey indices into total abundance estimates.

2. Upgrade Miles Lake hydroacoustic gear by purchasing dual beam equipment. Evaluate mid-channel salmon passage, determine the need for multiple transducers, and evaluate our ability to count chinook salmon.

3. Place weirs on the outlet of Crosswind and Summit Lakes to count the return of hatchery run sockeye salmon to those release sites.

AGE, SEX, AND SIZE SAMPLING

1. Develop a multiple strata sampling design for estimating age, sex, and size composition for escapements enumerated with weirs.

2. Estimate the age, sex, and size composition of hatchery adult sockeye salmon at each release site. If future results show no difference in age composition and percent tagged among sites, sample only major release groups.

STOCK IDENTIFICATION PROJECTS

1. Increase catch sampling goals for the delta/upriver run scale pattern analysis project to estimate stock composition on a weekly basis.

2. Evaluate the ability to estimate stock composition (minimum upriver versus delta) during the season using presence of parasites, DNA (nuclear or mitochondrial), genetic stock identification (GSI), otolith marking, or any discriminating feature among these stocks.

3. Tag (CWT) hatchery run smolt from all release sites. At a minimum, tag smolt from release sites where they predominate (over wild stock) and represent a substantial percent of total release (i.e. Summit, Crosswind, and Monsoon Lakes).

4. Increase funding of the smolt tagging project to allow tagging crews to begin before June 1 to insure tagging is conducted in proportion to abundance across the entire run.

5. Enumerate smolt migrating from each release site. At a minimum, estimate the number of smolt migrating from Summit and Crosswind Lakes. This will provide preseason estimates of tag to untagged ratios, which are needed to estimate commercial catch contribution rates during the season.

6. As all hatchery sockeye salmon are released into the Gulkana River and its tributaries, treat the entire Gulkana return (wild and hatchery runs) as enhanced. Enumerate and tag migrating smolt at a common downriver location. Use this tag rate to estimate commercial catch contributions of the Gulkana System return.

7. Tag (half-length CWT) a percent (to be determined later) of the sockeye salmon fry prior to stocking. Use different tag codes for each release site. At a minimum, tag fry released at the Gulkana Facility that rear in Paxson Lake. Holding facilities for rearing fry will be needed to evaluate tag retention before release.

MODELING OR DATA ANALYSIS PROJECTS

1. Use data from escapement monitoring and stock identification projects to reconstruct the upriver and delta runs and estimate run specific exploitation rates. This information can be used to evaluate run timing and escapement goals.

2. Estimate fishery specific exploitation rates for the Copper River chinook salmon return. Evaluate present escapement goal and management strategy. Prepare a plan to prevent over harvest.

3. Determine sample sizes needed for CWT placement into sockeye and chinook salmon to obtain weekly estimates of catch contributions.

4. Estimate the contribution of hatchery stocks to the upriver run for each brood year. Estimate brood year production.

5. Document, in a Department publication, forecast and total run estimation methods used for Copper River sockeye and chinook salmon.

Table 1. Estimates of the hatchery component of the upriver Copper River sockeye run, based on Summit Lake survival rates.

Year	Brood[a] Year	Comm.[b] Catch	Percent Scanned for Tags	Tags[c] Recovered	Fish[d] Per Tag	Est.[e] Summit Lk Return	%[f] Summit	Est.[g] Enhanced Catch	Expl.[h] Rate	Total[i] Enhanced Return	Preseason[j] Estimate	Published[k] Forecast
1984	1979	899,776	27.9%	3	94	1,012	55%	1,839	62.6%	2,936	24,461	
1985	1980	931,132	29.3%	44	67	10,052	35%	28,720	68.1%	42,178	52,492	55,500
1986	1981	780,808	31.5%	74	32	7,506	25%	30,024	60.5%	49,607	80,332	82,300
1987	1982	1,180,782	31.9%	87	84	22,913	46%	49,810	70.9%	70,205	94,129	99,000
1988	1983	576,950	37.7%	54	234	33,532	44%	76,209	54.2%	140,722	108,191	118,000
1989	1984	1,025,923	42.2%	230	157	85,878	45%	190,841	67.7%	281,692	208,469	210,000
1990	1985						64%				235,856	234,000
1991	1986						56%				223,977	
1992	1987						57%				212,217	
1993	1988						50%					

[a] Assumed all sockeye salmon return as 5 year old adults.
[b] Commercial catch includes Copper River District (212) only.
[c] Percent of catch scanned and number of tags decoded from FRED tag lab database.
[d] Ratio of tagged to untagged sockeye salmon from escapement sampling at Summit Lake.
[e] Estimated Summit Lake catch contribution = Tags Recovered/ Percent Scanned * Fish per Tag
[f] Represents the percent of total hatchery fry released into Summit lake.
[g] Total enhanced catch contribution = Summit Lake Estimate / Percent Summit Lake
[h] Exploitation rate = Commercial Catch / (Commercial Catch + Miles Lake Sonar Estimate)
[i] Total enhanced return = Estimated enhanced catch / exploitation rate.
[j] Preseason estimate of enhanced return = Fry released from brood year * 1%.
[k] Multi-year class forecast published in the Statewide forecast RIR.

Table 2. Accuracy of Copper River sockeye and chinook salmon forecasts.[a]

Year	Sockeye Salmon Forecast	Sockeye Salmon Return	Sockeye Salmon % Error	Chinook Salmon Forecast	Chinook Salmon Return	Chinook Salmon % Error
1985	1,780,000	1,645,000[b]	8%	45,000	50,000	-10%
1986	1,559,000	1,433,000	9%	45,000	68,000[b]	-34%
1987	1,659,000	1,824,000	-9%	47,000	58,000[b]	-19%
1988	1,379,000	1,173,000	18%	50,000	46,000	9%
1989	1,730,000	1,725,000[b]	0%	57,000	51,000[b]	12%
1990	1,373,000			52,000		

[a] Source: annual report (1985-90) titled, *Preliminary forecasts and projections for Alaska salmon fisheries*.

[b] This figure was corrected from that published in footnote [a] by Ken Roberson.

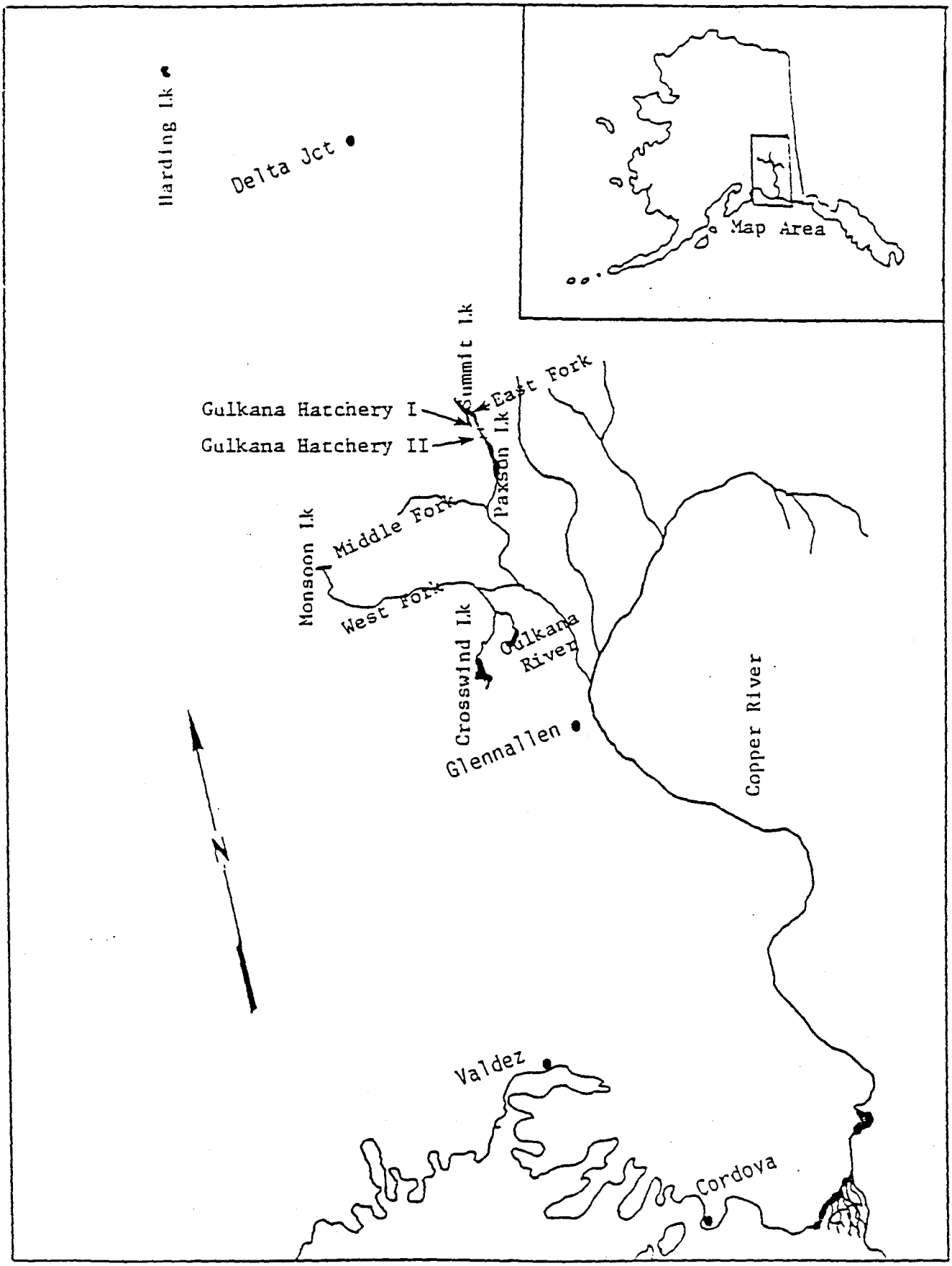

Figure 1. Location of the Gulkana Hatcheries and fry stocking lakes in relation to the Copper River watershed.

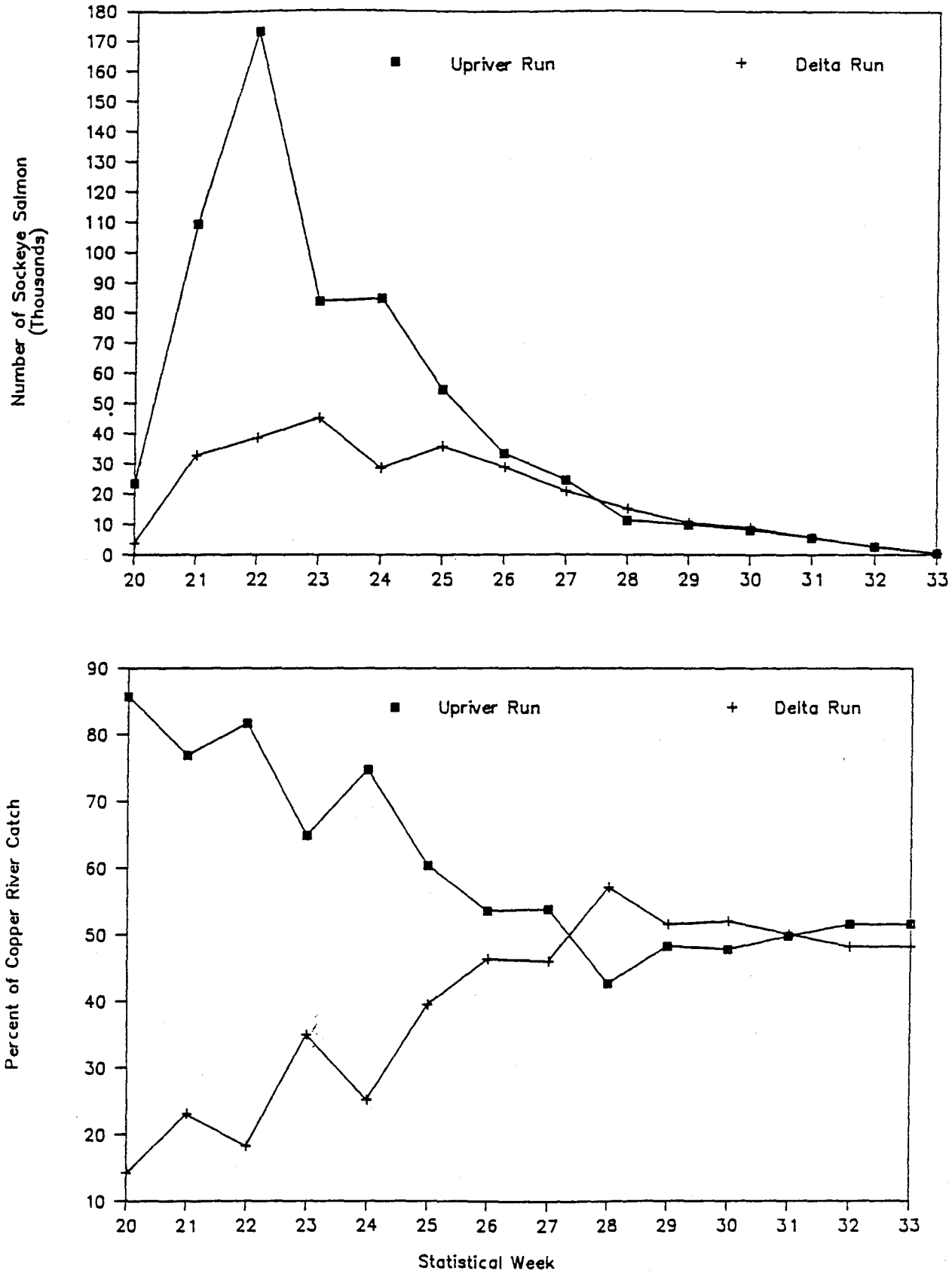

Figure 2. Average number of sockeye (top) and percent (bottom) present in the Copper River District commercial catch (1982–87).

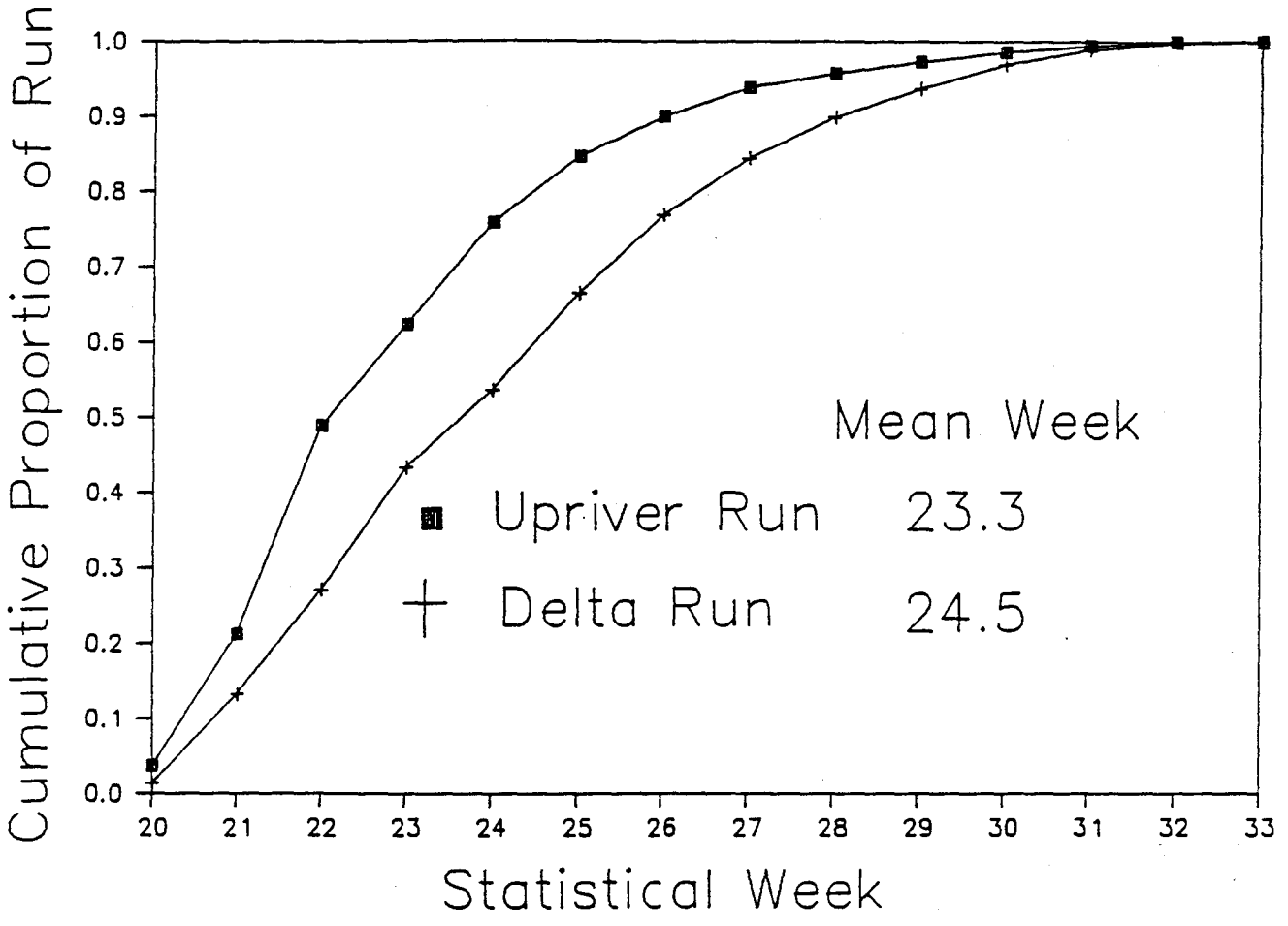

Figure 3. Cumulative proportions of the upriver and delta runs of sockeye salmon in the Copper River District commercial catch by statistical week (1982–87 average).

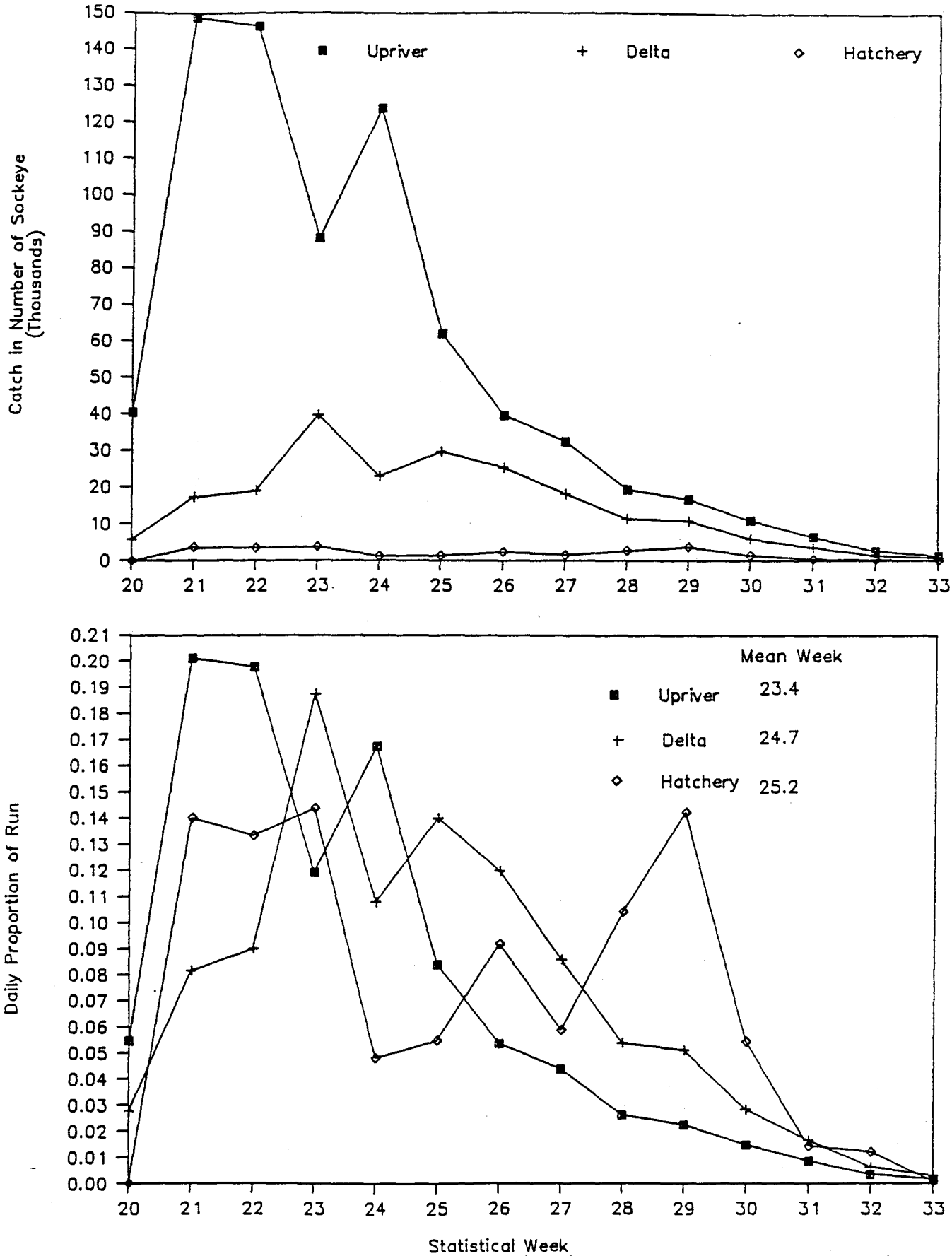

Figure 4. Average number of sockeye (top) and weekly proportion (bottom) present in the Copper R. District commercial catch (1984–89).