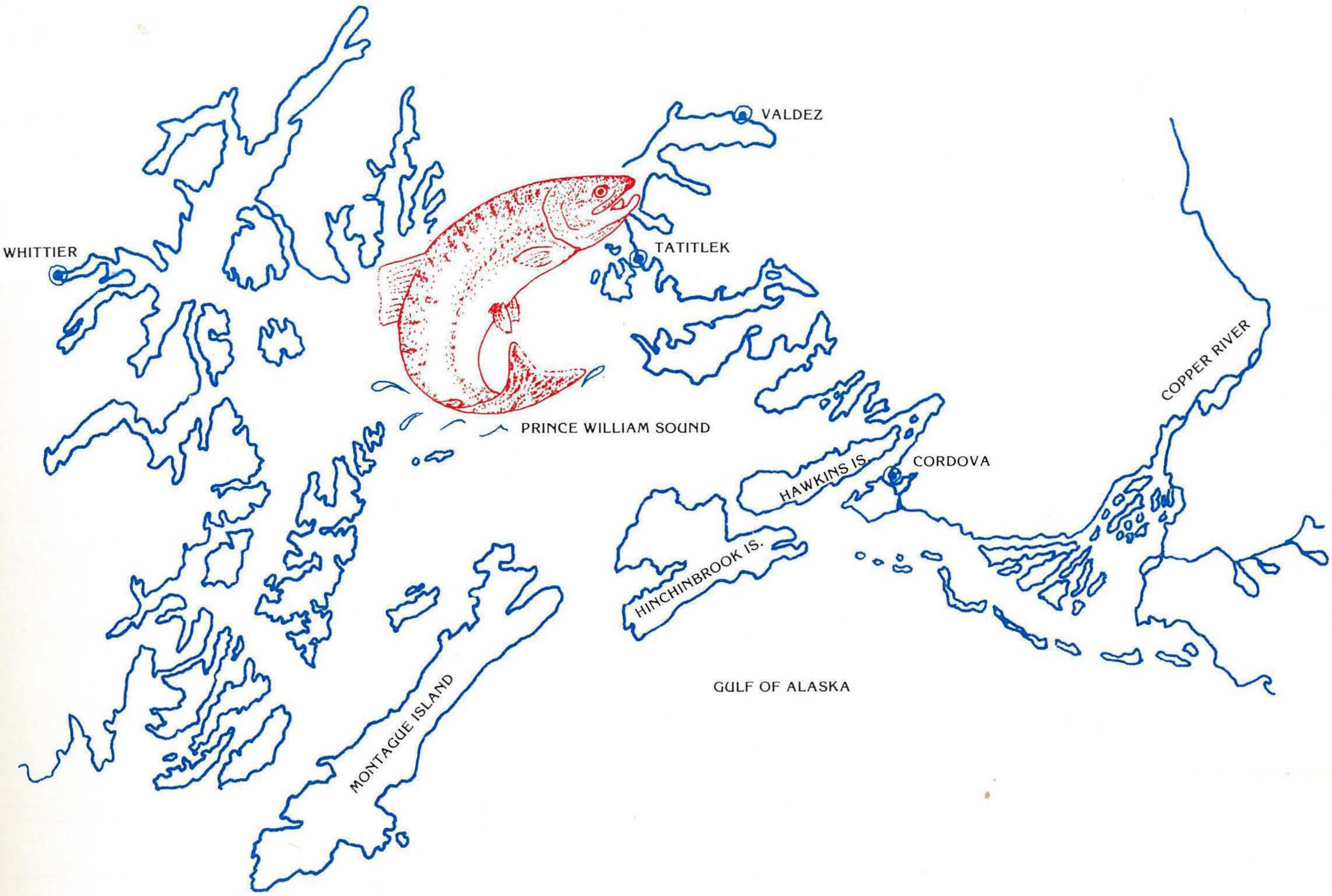

Prince William Sound — Copper River Comprehensive Salmon Plan

Phase I — 20 Year Plan (1983-2002)

Prince William Sound Regional Fisheries Planning Team.

16.4.1

STATE OF ALASKA

BILL SHEFFIELD, GOVERNOR

DEPARTMENT OF FISH AND GAME

OFFICE OF THE COMMISSIONER

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JUNEAU, ALASKA 99802
PHONE: (907) 465-4100

September 20, 1983

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

Dear Mr. McCurdy:

This letter is to inform the members of the Prince William Sound Regional Fisheries Planning Team (PWSRPT) and you, as team chairman, of my formal approval of the Prince William Sound-Copper River Comprehensive Salmon Plan, Phase I - 20 Year Plan.

This plan has been reviewed by the Directors of the Alaska Department of Fish and Game (ADF&G) divisions responsible for managing, enhancing, and protecting Alaska's fishery and its habitat. Previous to my review, an opportunity was provided for comment by ADF&G technical staff and the general public. Comments and suggestions generated during the technical review and public review of the draft document were addressed prior to the final draft being developed and submitted to the Department.

I believe that a viable and responsible document has been produced as a result of considerable effort by the members of the PWSRPT. I offer my congratulations and appreciation to all members of the team and Planner, Tom Namtvedt, for cooperating with the Department and me in producing a comprehensive salmon plan for the Prince William Sound-Copper River Region.

Sincerely,

Don W. Collinsworth

Don W. Collinsworth
Commissioner

cc: PWSRPT Members
ADF&G Division Directors
Tom Namtvedt

11-K12LH

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CHAPTER 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

This document is the comprehensive plan for the management, rehabilitation and enhancement of the Prince William Sound Region's salmon resources during the next twenty years. The Region encompasses Alaska Department of Fish and Game (ADF&G) Commercial Fisheries Management Area E and includes the marine waters and freshwater drainages between Cape Suckling and Cape Fairfield (Figure 1-1). The communities of Valdez, Cordova, Glennallen, Whittier, Chitina, Copper Center, Gulkana, Gakona, Chistochina, Tatitlek, McCarthy, Paxson and Mentasta Lake are located within the Region.

Salmon resources of the Region are heavily utilized by commercial, sport and subsistence fishermen from within the Region and from nearby communities, such as Anchorage, Fairbanks and Seward. Fishermen from other communities, states and countries also derive benefit from the resource.

Commercial fishermen since 1960 have taken approximately 99 percent of all salmon harvested in the Region. From 1960 through 1981 the average commercial catch of the Region was 6.6 million salmon or 12.3 percent of the statewide harvest.

The average sport catch during this period cannot be determined. A regional harvest survey has only been conducted since 1977. The average sport harvest from 1977 through 1981 was approximately 39,208 anadromous salmon or 9.0 percent of the statewide sport harvest of anadromous salmon.

The average annual reported subsistence harvest during the years 1962 through 1981 was 23,395 salmon. The average reported catch during recent years, 1974 through 1979, constituted approximately 3 percent of the reported statewide subsistence harvests.

The history of the Region's commercial salmon fishery is characterized by drastic fluctuations in harvest levels and a depressed period between the 1940's and the 1970's (Figures 1-2 through 1-7 and Appendix 1-1). The pink and chum salmon fisheries were essentially closed during 1954, 1955, 1959, 1972 and 1974. The Copper River commercial sockeye salmon fishery experienced extensive closures in 1979 and 1980. The Copper River subsistence fishery was also adversely affected in 1979 and 1980. Since 1979, however, the commercial pink salmon fishery has achieved record high levels. The chum salmon fishery in 1981 also experienced record catches.

Catches of all salmon species statewide have displayed similar bust and boom patterns. It is not known how long the current high phase in the pink and chum salmon fisheries will continue. The unstable nature of these fisheries has been at times catastrophic for commercial fishermen, processors and others dependent on the resource for their well being.

Legislative Background

The State Legislature recognized the distressed nature of salmon fisheries statewide and took action during the 1970's to seek solutions to these recurring problems. In 1971, the Legislature created the Fisheries Rehabilitation, Enhancement and Development (FRED) Division within ADF&G. The FRED Division's goals were to plan, rehabilitate, enhance and develop the fisheries using the latest techniques and scientific advancements available worldwide.

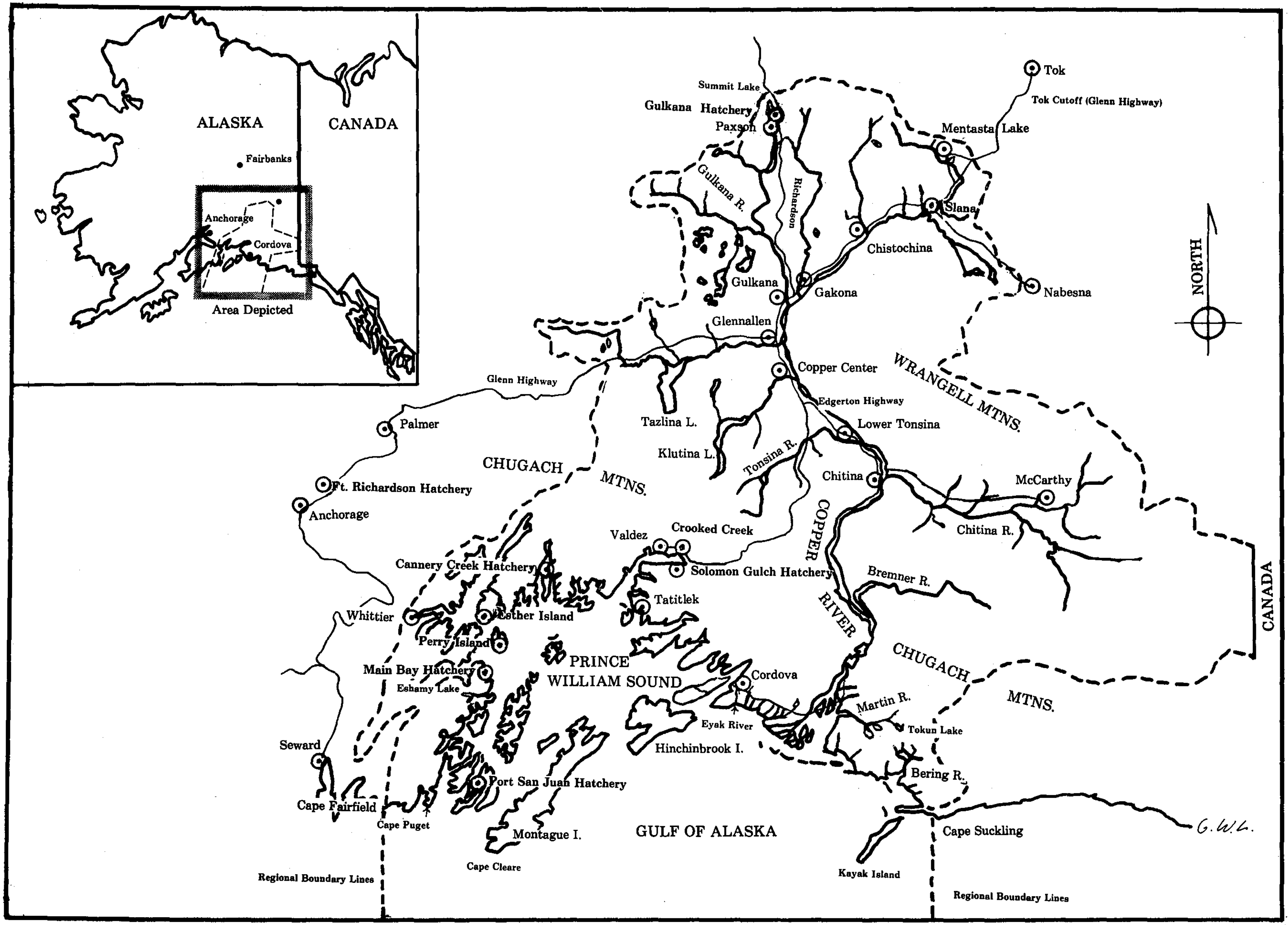

Figure 1-1. The Prince William Sound Region.

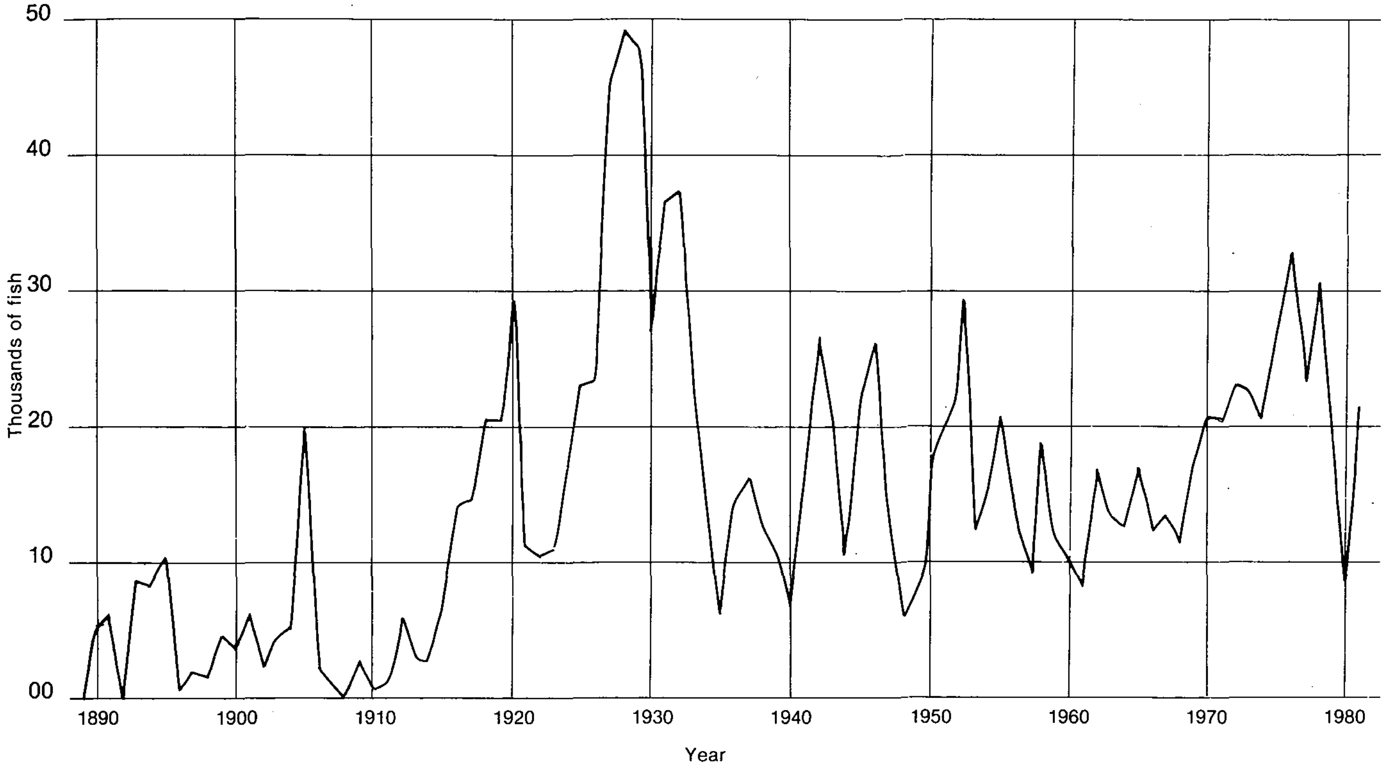

Figure 1—2. Commercial catches of king salmon, all districts, Prince William Sound Region, 1889 — 1981.

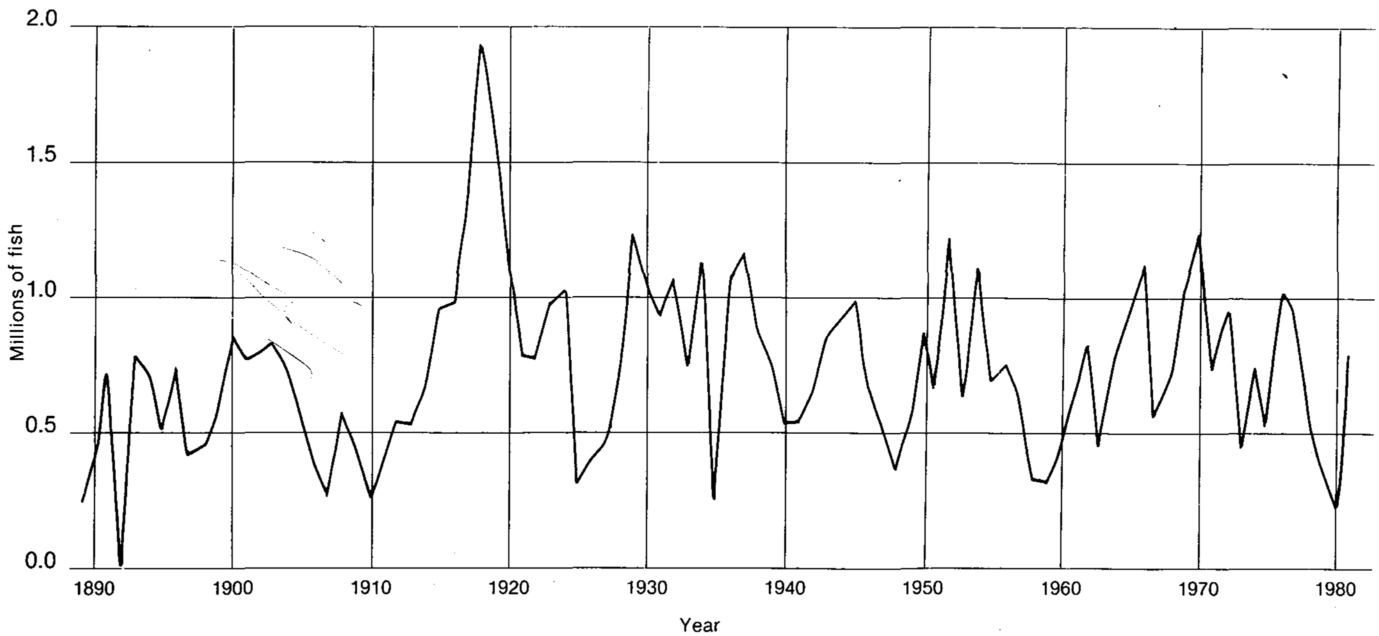

Figure 1—3. Commercial catches of sockeye salmon, all districts, Prince William Sound Region, 1889 — 1981.

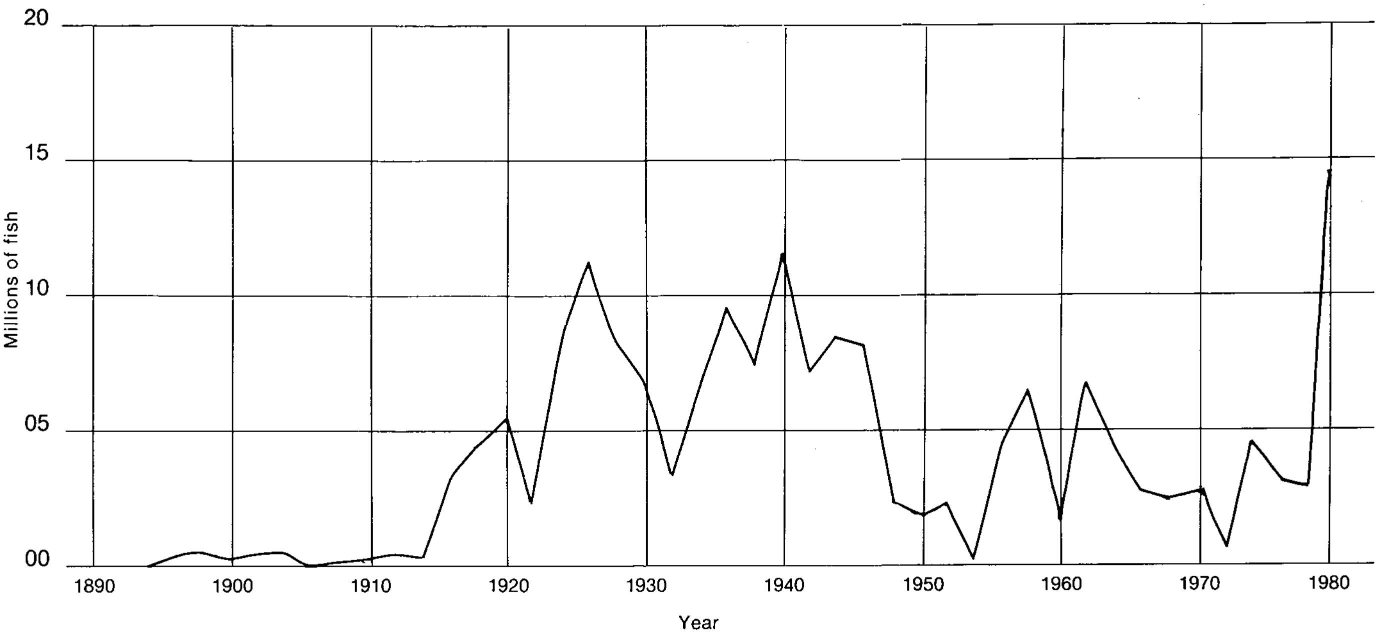

Figure 1—4. Commercial catches of even year pink salmon, all districts, Prince William Sound Region, 1889 — 1981.

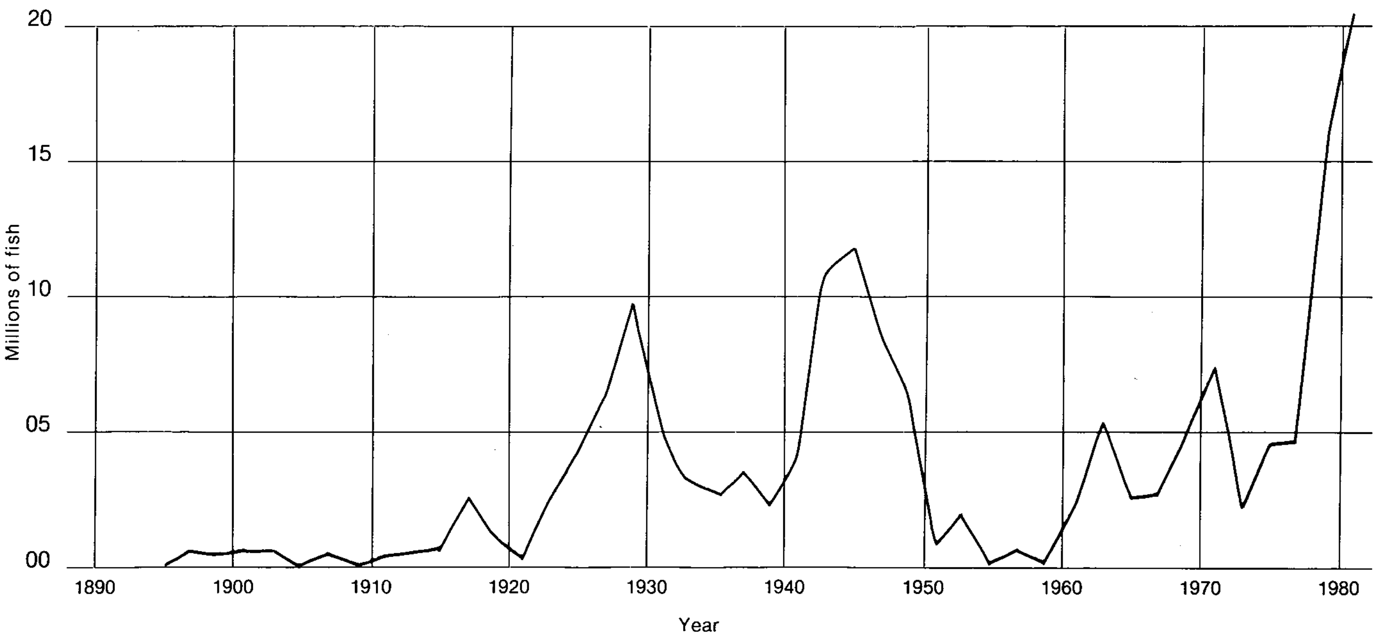

Figure 1—5. Commercial catches of odd year pink salmon, all districts, Prince William Sound Region, 1889 — 1981.

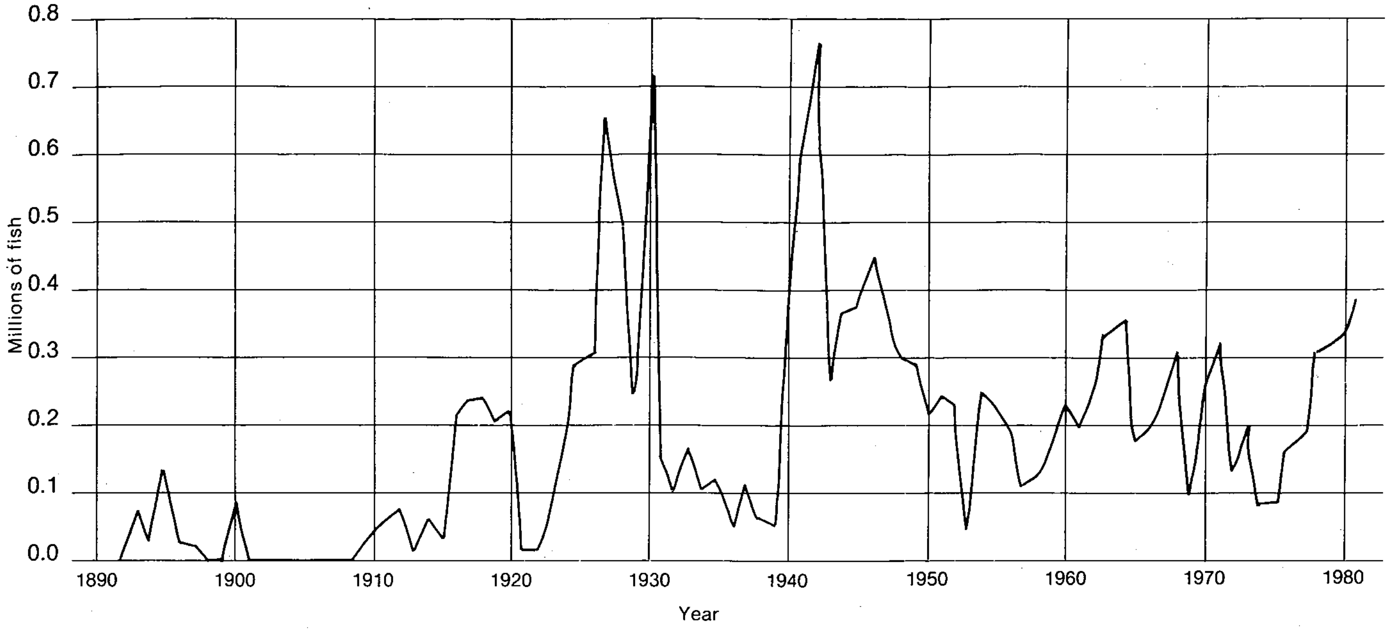

Figure 1—6. Commercial catches of coho salmon, all districts, Prince William Sound Region, 1889 — 1981.

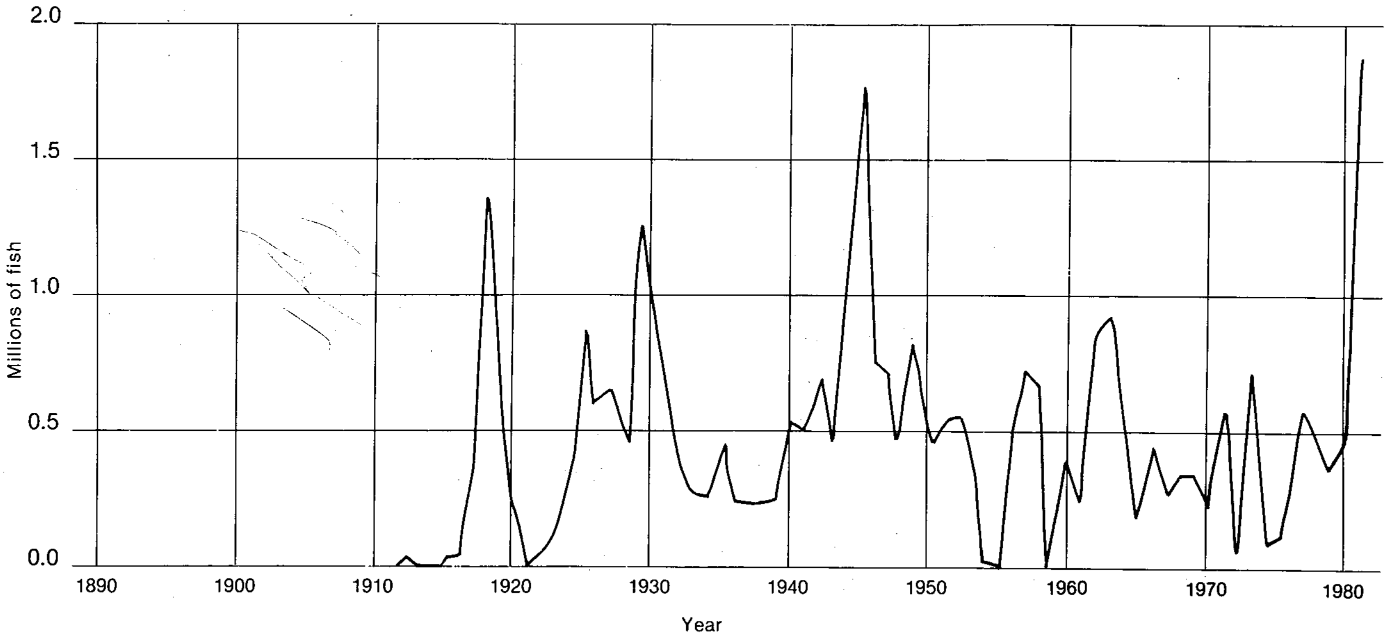

Figure 1—7. Commercial catches of chum salmon, all districts, Prince William Sound Region, 1889 — 1981.

Limited entry legislation was promulgated shortly thereafter in an effort to stem the increasing numbers of fishermen in economically distressed fisheries. In 1974 the Legislature passed the Private Nonprofit (PNP) Hatchery Statutes. It was the intent of the 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."[1] A "nonprofit corporation" is defined as a corporation in which no part of the income or profit can be distributed to its members, directors or officers. Reasonable compensation may, however, be paid to its members, directors or officers for services rendered.[2]

Two PNP hatchery corporations were established in the Prince William Sound Region in 1974, the Prince William Sound Aquaculture Corporation (PWSAC) and NERKA, Inc. A third group, the Valdez Fisheries Development Association (VFDA) was formed in 1978.

In 1976, Governor Jay Hammond established by executive order the Alaska Fisheries Council. The Council was given the charge to "...develop a long-range plan for the restoration of salmon fisheries including the development of a Statewide system of private nonprofit hatcheries." The Council "...provided the first forum in Alaska where technological, social, economic and political problems associated with a major salmon development program could be discussed and solved."[3]

Footnotes to the text are presented at the end of the text on page 175.

The Alaska Salmon Fisheries Plan (draft) was prepared in 1976 by ADF&G in response to the Council's recommendation. This plan was generally an internal statement of ADF&G goals. Supplemental production objectives in the Plan were the basis for major hatchery bond issues approved by the voters in subsequent years. The Council was also influential in the creation in 1976 of regional planning teams (RPT). Legislation was enacted which directed the Commissioner of ADF&G to establish regional planning teams, planning regions, regional associations and regional salmon plans (Appendix 1-2). This legislation created, for the first time, the means by which the public could become involved in fisheries planning on a local level.

In 1979, a sum of $100,000 was granted by the Legislature through ADF&G to each qualified regional association. The funds were to be used "...to participate with the department on the regional planning teams in the development of a comprehensive salmon plan for each respective region."[4] Additional funds have been granted to regional associations to complete the comprehensive plan.

Prince William Sound Aquaculture Corporation (PWSAC)

PWSAC is a voluntary organization concerned with the planning, rehabilitation, enhancement and maintenance of the Prince William Sound Region's salmon fishery. The Corporation is controlled by a 45 member board of directors. It is comprised of commercial fishermen of each gear type, sport fishermen, subsistence fishermen, processors, community groups, native corporations and other interested groups. Commercial fishermen who are members of the Cordova Aquatic Marketing Association (CAMA) constitute 60 percent of the Board.

PWSAC has its offices in Cordova and conducts its affairs openly under scrutiny of the public. The large membership and diversity of the Board of Directors and the Corporation's newspaper substantially contribute to public involvement and awareness in the operation of the corporation.

PWSAC is recognized by the Commissioner of ADF&G as the qualified "regional association" in the Prince William Sound Region and as such has been given a diverse role by the State Legislature. As an "association" PWSAC has the following responsibilities, rights and authorities:

(1) form a private nonprofit corporation for the purpose of building and operating salmon hatcheries;[5]

(2) organize and execute, in accordance with State statutes, a voluntary and/or royalty assessment on the sale of salmon;[6]

(3) review and approve local nonprofit hatchery corporations for the purpose of qualifying corporations for State fisheries enhancement loans of up to $10 million (without regional association approval, the statutory loan limitation is $1 million);[7]

(4) has preference right among private nonprofit hatchery corporations to hatchery water sources in the region exceeding one cubic foot per second;[5]

(5) obtain from the Alaska Department of Commerce and Economic Development a $100,000 planning and organizational grant;[5]

(6) advise the Commissioner of Fish and Game on a wide range of matters relating to salmon production and planning in the region;[5]

(7) form a regional salmon enhancement authority;[5]

(8) appoint three members of the regional planning team;[5]

(9) enter into cooperative agreements with other agencies and

(10) act as a contractor for the purpose of doing fisheries planning and research.

PWSAC predates the legislation creating the regional association concept and was incorporated December 30, 1974. It is recognized by the Internal Revenue Service as a (c) 3 "tax exempt organization" and is authorized to accept tax deductible estate and gift contributions. The regional assessment is a self imposed tax on the sale of salmon. It serves as collateral for State loans and operating funds for PWSAC. CAMA members have voted to assess themselves on a voluntary basis.[8] Other fishermen, processors and tender operators have also contributed.

Regional Planning Team (RPT)

The RPT brings together biological and technical expertise with the needs and concerns of the user groups in an effort to achieve concensus on the directions of resource development. Public involvement in the planning process is formally channeled through PWSAC.

It is the responsibility of the RPT to:

(1) develop and recommend regional comprehensive salmon plans for approval by the Commissioner of ADF&G;

(2) solicit public input and arrange for public review of the plans throughout the region;

(3) review and comment on hatchery permit applications and other proposed enhancement and non-regulatory rehabilitation projects and

(4) review and comment on proposed hatchery permit suspensions and/or revocations.[5]

The Commissioner has sole legal authority for the approval of plans and recommendations presented by the RPT.

The RPT consists of three members appointed by the Board of Directors of PWSAC, three members representing ADF&G, an elected chairman and one non-voting member from the US Forest Service. During the development of this Phase 1 plan the members were:

Chairman, Mike McCurdy,
Commercial Fisheries Div.,ADF&G

Robert Blake, PWSAC

Connie Taylor, PWSAC

Armin Koernig, PWSAC

Paul Krasnowski, FRED Div., ADF&G

(Alternate) Jerald Madden,
FRED Div., ADF&G

Dennis Haanpaa,
Commercial Fisheries Div., ADF&G

(Alternate) Alan Kingsbury,
Commercial Fisheries Div., ADF&G)

Dave Watsjold,
Sport Fish Div., ADF&G

The chairman had no voting power; therefore, there were six voting members.

To augment the RPT, a planner, Thomas B. Namtvedt, was hired by PWSAC. It was his responsibility to coordinate all planning activities and serve as principal writer of the plan. Meetings were held on a periodic basis.

Two-Phase Planning

The fisheries plan for the Prince William Sound Region will be developed in two phases. This document is the Phase I plan. It integrates and assembles all relevant information regarding the development and protection of the salmon resources into a long-range strategic plan. It establishes the twenty-year objectives and sets forth the framework upon which the more detailed Phase II planning will take place.

The Phase II plans will deal with short-term (2 to 5 year) objectives and operational plans for individual projects. These taken together over time will achieve the long-term goals for the fishery.

Specifically this Phase I plan has been prepared to:

(1) describe the demography and economy of the Region;

(2) describe the Region's salmon production status;

(3) analyze the Region's harvest demands;

(4) describe the shortfalls or "gaps" in salmon production;

(5) describe the knowledge and data gaps;

(6) develop goals and objectives to eliminate these gaps and

(7) identify alternative strategies and recommended projects.

This plan is certain to undergo modification in its life span as goals are achieved or deemed unattainable and technological advances open new avenues and potentials. Changes in the plan must be brought about by the RPT.

This plan was completed during 1982; however, due to time constraints, catch and egg take data for 1982 are not included in this document.

Public participation

Public participation in the preparation of this Phase I plan was solicited in various ways: RPT meetings, a public involvement questionnaire and wide-spread distribution of the Public Review Draft.

RPT meetings were held in Anchorage and Cordova:

March 4, 1982	Anchorage
March 24, 1982	Anchorage
May 19, 1982	Cordova
June 16-17, 1982	Cordova
September 30, 1982	Cordova
October 29, 1983	Anchorage
November 29, 1982	Anchorage
January 12, 1983	Cordova
April 28, 1983	Anchorage

RPT meetings were advertised as public meetings in the legal advertisement sections of newspapers in Anchorage, Fairbanks, Cordova and Copper Center. In addition, these advertisements were broadcast as public service announcements on radio station KLAM in Cordova and notices were posted in the offices of the Cordova Aquatic Marketing Association.

The questionnaire is discussed in Chapter 4.

A total of 2,000 copies of the Public Review Draft Plan were made available for review. The RPT convened on April 28, 1983 and each comment was reviewed by the Team. Alterations, deletions or additions to the text were also discussed.

Approval and Authority of the Plan

This Plan has been approved by the Commissioner of ADF&G and is an official guideline for salmon enhancement efforts in the Prince William Sound Region.

Key Assumptions

A critical part of the planning process is the adoption of key assumptions. These describe the things that are probable and/or must occur if goals are to be achieved. Admittedly, assumptions are the weak point in the planning process, but by periodically reviewing, updating and testing these assumptions against reality, erroneous assumptions can be identified and plans can be revised.

Two levels of assumptions are utilized in the plan. The key assumptions listed below are important to the whole plan. Chapter assumptions have been included at the end of some chapters.

The key assumptions are:

(1) It is biologically feasible to bring about a sustained increase in harvest rates of salmon beyond the past twenty-year average if appropriate technology and management practices are utilized.

(2) National and worldwide markets will absorb the increased production of salmon.

(3) Marine and freshwater habitats will remain favorable for salmon survival.

(4) The technology exists or will be developed to meet the production objectives of the plan.

(5) Research programs will be implemented to obtain information needed for optimizing salmon production using the strategies of habitat protection, management, enhancement and rehabilitation.

(6) Political support will continue and sufficient funding will be provided to achieve the goals within the time frame indicated.

(7) This plan, its goals and objectives will be periodically reviewed and revised as needs, knowledge and resources change.

(8) This plan utilizes the best data available and most accepted interpretation of these data.

CHAPTER 2

REGIONAL PROFILE

CHAPTER 2

REGIONAL PROFILE

The Region encompasses 38,000 square miles. Natural resources of economic importance are abundant and include fisheries, wildlife, timber and minerals. The Region is comprised of three geographic entities: Prince William Sound drainages and estuary, the Copper River drainage and estuary and the Bering River drainage and estuary. Prince William Sound is a relatively deep, island studded embayment. The Copper River is Alaska's fifth largest river and drains large portions of interior Alaska as well as Canada. Its headwaters are heavily glaciated. The Bering River is a relatively short river, draining the Bering Glacier. Each of these areas has relatively distinct salmon fisheries.

Exploration of the Region by caucasians initiated in the 18th century. Early explorers included Russians, Englishmen and Spaniards. The natives residing in the Region in the 18th century were the Chugach Eskimo, the Ahtna Indians, Eyak Indians and the Tlingit Indians. Chugach Eskimo were dominant along the coastal areas of the Region. Ahtna Indians occupied the Copper River Basin.[9] Eyak natives occupied the area of present-day Cordova and the Copper River Delta.[9a] Tlingit Indians were principally residents of areas southeast of the Region but extended westward to the mouth of the Copper River in later times.[9] Aleuts were transported into the area by Russians and today's native population reflects the intermarriage of these native groups as well as other races.

American influence started with the Alaska purchase in 1867 and accelerated successively with the development of commercial salmon fishing, the discovery of oil, the gold rush and the discovery and mining of copper and gold. The first salmon cannery was established in the Region at Eyak in 1889. Oil was discovered at Katalla in 1894. Valdez became an important point of debarkation for Klondike gold seekers in 1898. The Kennicott copper discoveries were made between 1899 and 1901. Development of the copper mines led to the establishment of the communities of Cordova, Chitina and McCarthy. Copper mines were also developed at Latouche Island and Ellamar. Gold mines were staked throughout the Region. Fox farming was conducted on many of the islands of Prince William Sound. The Kennicott Copper Mines closed in 1938, and, until the construction of the trans-Alaska pipeline and terminal at Valdez, salmon fishing was the mainstay of the Region's economy.[10]

Climate

The climate of the Region is largely influenced by the Gulf of Alaska and the coastal mountains. Three climate zones are definable: maritime, continental and transitional (Figure 2-1). The maritime zone is characterized by heavy precipitation, relatively cool summers and warm winters, and heavy surface winds in most areas. Within this zone are the northernmost ice-free ports in Alaska, Valdez and Whittier. The relatively warm, moist climate of this zone is important to the maintenance of stream flows and the production of pink and chum salmon in the numerous streams of Prince William Sound. The continental zone is noted for extreme temperature differences between summer and winter, light precipitation and light surface winds. The transition zone has intermediate weather conditions.[11]

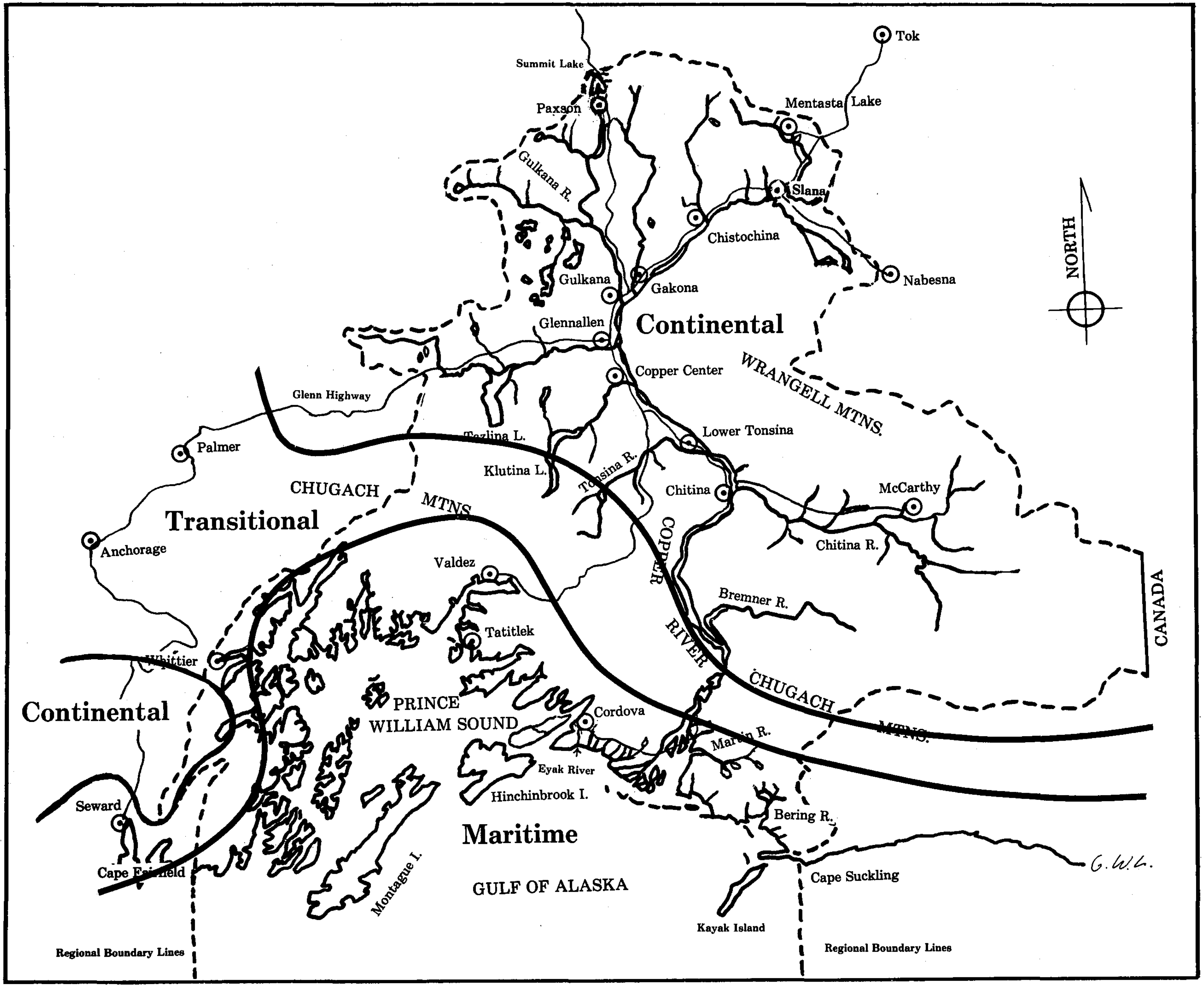

Figure 2-1: Climate zones of the Prince William Sound Region (adapted from Anonymous, 1974).

Geologic Aspects

Landforms of this diverse and complex Region have been shaped over the past several million years by the actions of ice, meltwaters, winds and earthquakes. Mountains comprize a significant portion of the land area. Mountain ranges include: the Kenai, Chugach, St. Elias, Wrangell, Mentasta and Talkeetna mountains. Twelve volcanos are located within or near the Region. One volcano, Mt. Wrangell, erupted steam in 1966. The others have probably been dormant since at least 1760.[11] The Region is heavily glaciated. Alpine, valley and piedmont glaciers and icefields are present. Many glaciers calve directly into the fiords of Prince William Sound. Water clarity of many of the lakes, streams and estuaries is affected by glacial melt. The flats around Glennallen are underlain by thin to moderately thick permafrost, the maximum depth of which is 600 ft. The coastal region is generally free of permafrost.[9]

Approximately six percent of the world's earthquakes occur along the numerous fault systems of Southcentral Alaska. The Region is located on the boundary between the Pacific plate and the North American plate. Earthquakes occur as the Pacific plate slides under the North American plate. Mountains and volcanos of the Region and the Alaska Peninsula and Aleutian Islands attest to the forces at work in this subduction zone.[12]

The majority of the earthquakes within the Region have, since 1899, been concentrated in the Valdez area. The epicenter of the Good Friday earthquake of 1964, which registered 8.5 on the Richter scale, was located near the head of College Fiord. Since 1899, a minimum of 86 earthquakes have occurred that have exceeded 6.0 on the Richter scale, 19 have exceeded 7.0 and 4 have exceeded 8.0.

The Good Friday earthquake caused areas in and around the Sound to experience both horizontal and vertical movement. Lands shifted seaward as much as 64 ft. The greatest subsidence, 8 ft., occurred in the northwest portion of the Sound. The greatest uplift, 38 ft., occurred on the southwest side of Montague Island (Figure 2-2). Salmon habitat was severely disrupted. Only a few streams in a small area across the northcentral part of the Sound were unchanged (Figure 2-2).[13]

Extensive slides occurred producing a number of highly destructive waves. Valdez and Chenega were extensively damaged by these waves. In Valdez, the docks and waterfront warehouses and fish processing plants were destroyed and the business district was inundated. The village of Chenega was partially swept away. Both townsites were abandoned. Valdez was rebuilt 4 miles from the old site, and Chenega is being rebuilt on Evans Island.

Land around Cordova and the Copper River Delta rose approximately 6 ft. This resulted in serious damage to waterfowl habitat and destruction of shellfish and their habitat.The Cordova small boat harbor required dredging to be usable. Bridges along the Copper River Highway were destroyed or badly damaged.

Major changes in the salmon spawning and rearing environment occurred. Of approximately 223 primary salmon streams in the Sound, 138 were uplifted 3 to 31 ft., 43 subsided 2 to 6 ft. and 42 remained at essentially the same level (-1 to + 2ft.). The water level of Bering Lake was lowered 2 to 3 ft., and, subsequently, some shoreline spawning habitat was destroyed.[14]

A serious effect of uplift or subsidence was disruption of stream gradient. In uplifted

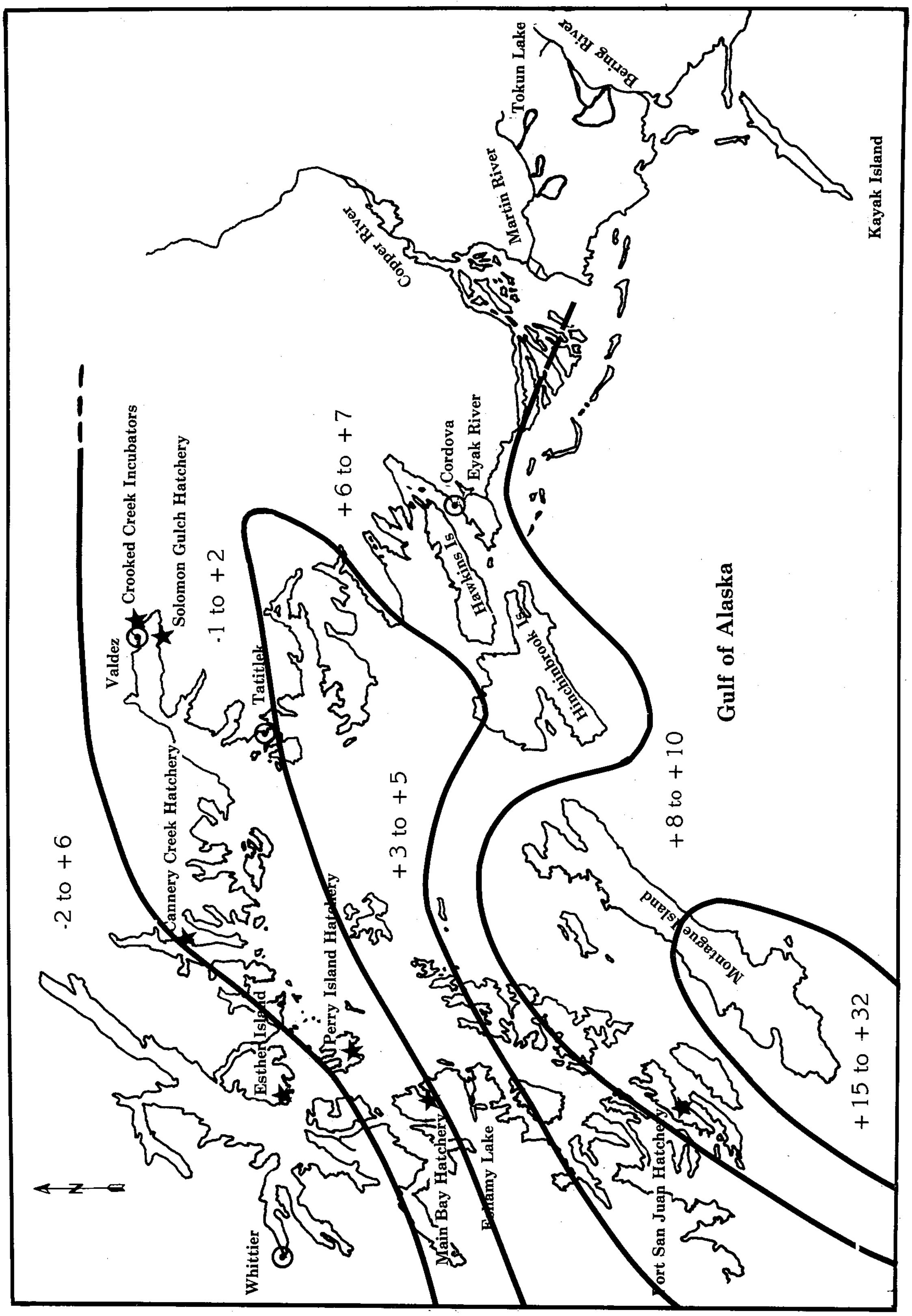

Figure 2-2. Approximate zones of uplift and subsidence (in feet) associated with the Good Friday earthquake of 1964 (adapted from Roys, 1971).

streams, soft materials of former sea floors were readily subject to scouring. The action of scouring and resultant filling of downstream areas often resulted in braided and abandoned channels. Salmon eggs and alevins were destroyed by dislodgement, mechanical shock, exposure (scouring), suffocation (filling) and dessication or freezing (abandoned channels).[15]

In a few uplifted streams, notably on the northeast part of Montague Island, water flows were insufficient to cut through exposed beach materials and these streams subsequently now flow underground prior to entering the ocean. Salmon, therefore, are prevented from utilizing these streams.[15]

Subsided streams were affected by sea water intrusion of formerly productive spawning areas and fouling and blockage of spawning areas by silt and blow down of dead trees. In some instances subsidence was beneficial. Hobo Creek, for example, was rendered accessible by the subsidence and drowning of a former barrier near the mouth.[15]

Before the earthquake, generally 70-77 percent of even-year pink salmon and 35-57 percent of odd-year pink salmon spawned in intertidal reaches of streams. After the earthquake, stocks in uplifted streams were displaced downstream into newly created, unstable reaches of streams. Stocks in subsided streams were displaced upstream.[14]

The net effect of the earthquake was to increase the amount of potential spawning area by several million square yards.[16] As streams regain equilibrium and accumulated sediments in uplifted intertidal zones are reduced, the salmon production potential of the Sound may increase. It may take many years, however, for salmon to utilize these areas.

Evidence of earlier marked changes in land elevation in the Sound have been observed. Captain George Vancouver in May and June 1794 observed at Port Chalmers, Montague Island that: "...stumps of trees, with their roots still fast in the ground, were ... found in no very advanced state of decay nearly as low down as the water of spring tides."[15,17] Thorsteinson et al. (1971) stated: "Evidence of this subsidence, or perhaps a more recent one, is shown by stumps still standing on a bare beach along Wild Creek in Port Chalmers." Similar observations were made by Grant and Higgins (1910).

The Region borders what seismologists term the "Yakutat Gap." The "Gap" spans an area between Cape Yakataga and Kayak Island. This area has been seismically inactive since 1899-1900, and the probability of a major earthquake occurring within the near future is considered high.[18,19]

Fisheries Resources

Fish have long been a source of sustenance, income and enjoyment in the Region. Natives and others have utilized fish, primarily salmon, as an important part of their diet. Commercial fisheries for numerous species have developed, prospered or waned, including: salmon, herring, razor and cockle clam, Dungeness crab, king crab, Tanner crab, shrimp, bottom fish and halibut. Commercial fishermen in 1981 received 69.2 milion dollars for their catches. Salmon contributed 84.3 percent of these revenues. Approximately 5,000 sport fishermen harvested an estimated 29,991 anadromous salmon in the Region in 1981.[20] Subsistence permits were issued to 4,162 individuals or households in 1981, and these fishermen harvested an estimated 56,101 salmon.[21]

Salmon

Five species of Pacific salmon occur within the Region. In Prince William Sound, pink salmon are dominant followed by chum, sockeye and coho salmon. The freshwater distribution of these species is depicted in Figures 2-3 through 2-7. King salmon are few in number and are not known to spawn in the streams of the Sound. Those harvested are generally immature feeding fish. Many of the 551 documented salmon spawning streams within the Sound are usable by salmon only near tide water; and, subsequently, pink and chum salmon stocks capable of successfully spawning in intertidal waters have evolved.[22]

In the Copper River and delta area, sockeye salmon are dominant, followed by coho and king salmon. Pink and chum salmon population levels are insignificant.

In the Bering River and delta area, sockeye and coho salmon are codominant. Small populations of pink and chum salmon also spawn in the area.

The causes of fluctuations in salmon catches in Figures 1-2 through 1-7 are not fully understood. Numerous factors affecting egg deposition and survival have been identified and these include: escapement magnitude, substrate freezing, redd superimposition, flooding, siltation, dewatering, salinity, low oxygen, temperatures and predation.[16] Estimates of the number of pink and chum salmon adults returning per spawner suggest that factors other than escapement have been major causes of run fluctuations. A comparison of parent escapements (index areas) and subsequent returns (catch plus index escapement) indicate that, since 1960, the number of adult pink salmon returning per spawner has varied from approximately 0.7 to 14.6 with an unweighted average of 4.8 (Figure 2-8). Since 1960, chum salmon data indicate a range in return per spawner of 0.9 to 14.3 with an unweighted average of 3.7 (Figure 2-9). In Prince William Sound, pink and chum salmon spawn commonly in short, steep streams, and these streams are particularly vulnerable to freezing, flooding, siltation and dewatering.

Commercial Salmon Fishery

The commercial salmon fishery in the Region has perhaps gone through three phases since its inception and now is in a fourth phase. During the initial phase, 1889-1915, a single cannery was operated at Eyak. Sockeye salmon were the preferred species followed by king and coho salmon. The major fishery occurred where these species were most abundant, the Copper River Delta. Prince William Sound, due to its relatively small sockeye salmon runs, was of secondary importance. Pink salmon were only taken incidentally, and chum salmon were avoided.[16]

During the second phase, 1915-1959, canneries were constructed and operated at: Port San Juan, Port Ashton, Drier Bay, Port Nellie Juan, Unakwik Inlet, Valdez, Ellamar, Shepard Point, Miles Lake and Cordova. The fishery was managed by the federal government. Pink and chum salmon fisheries developed, and the sockeye salmon fishery declined. Fish trap (floating and pile driven) and purse seine fisheries became established in the Sound. Set and drift gill net and troll fisheries also occurred. Catches of pink and chum salmon escalated to high levels and peaked between 1922 and the late 1940's (Appendix 1-1). Average annual catches of even-year and odd-year pink salmon and chum salmon were

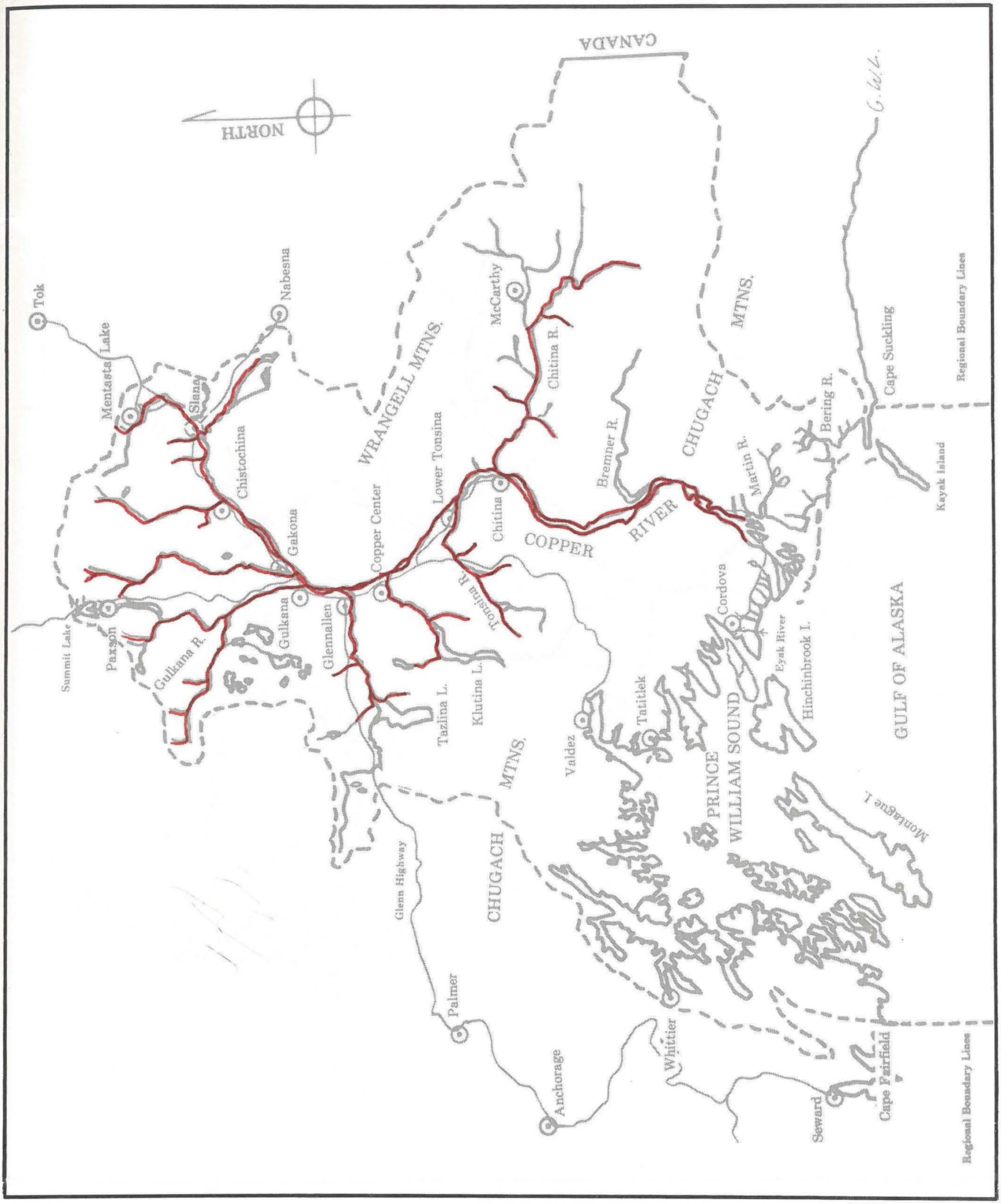

Figure 2-3. King salmon migration, spawning and/or rearing areas within the drainages of the Prince William Sound Region (adapted from Alaska Department of Fish and Game, 1982).

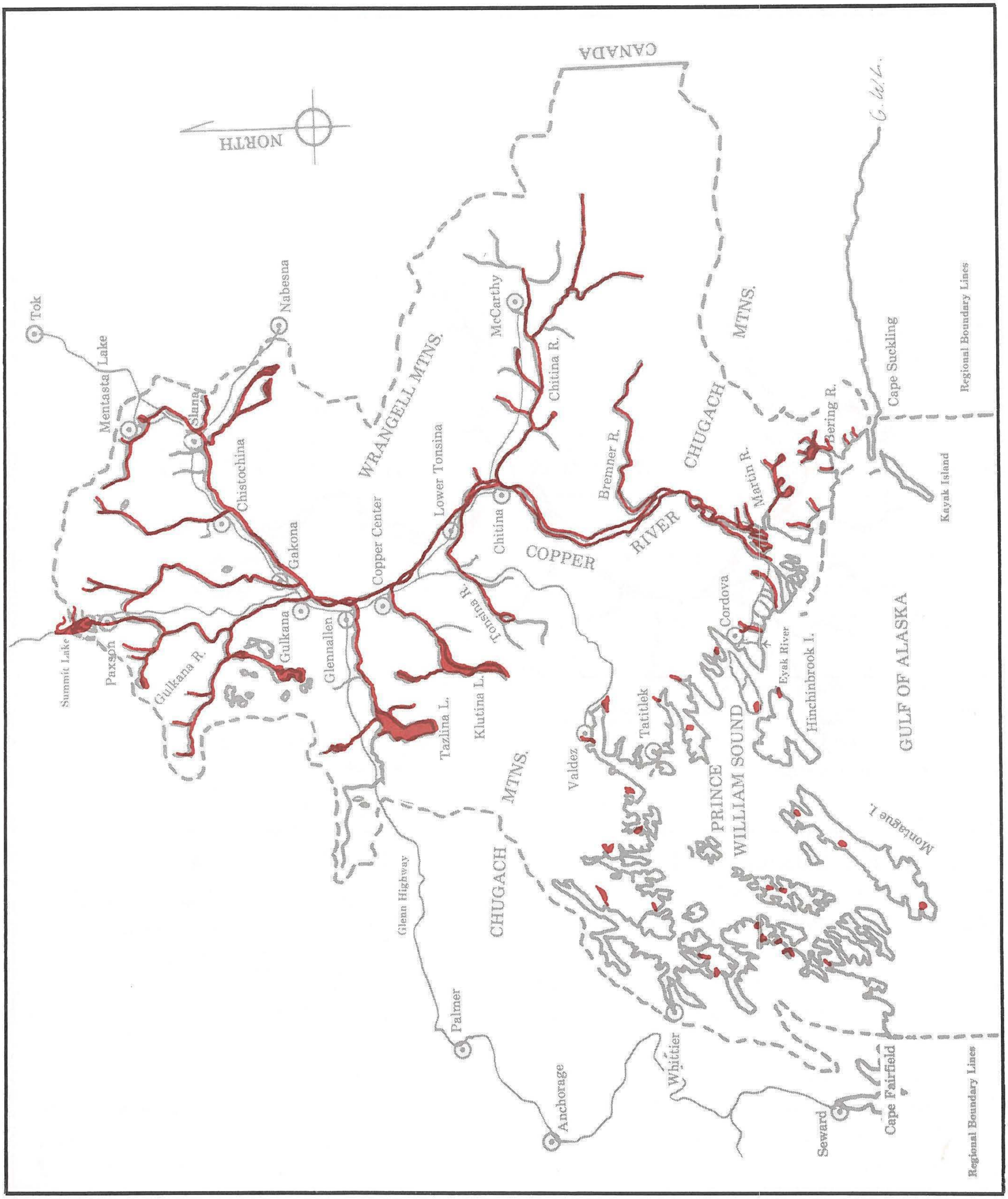

Figure 2-4. Sockeye salmon migration, spawning and/or rearing areas within the drainages of the Prince William Sound Region (adapted from Alaska Department of Fish and Game, 1982).

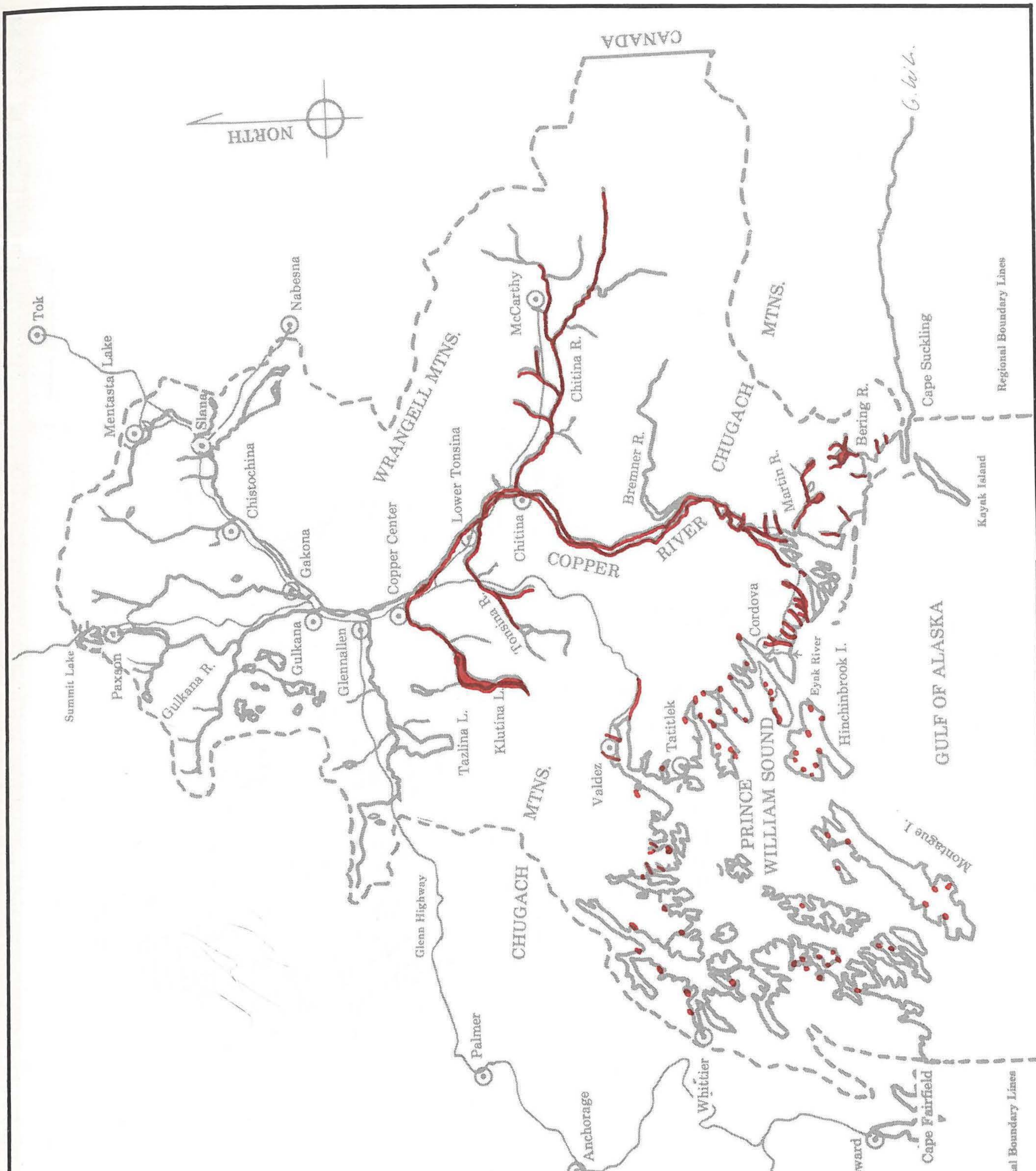

Figure 2-5. Coho salmon migration, spawning and/or rearing areas within the drainages of the Prince William Sound Region (adapted from Alaska Department of Fish and Game, 1982).

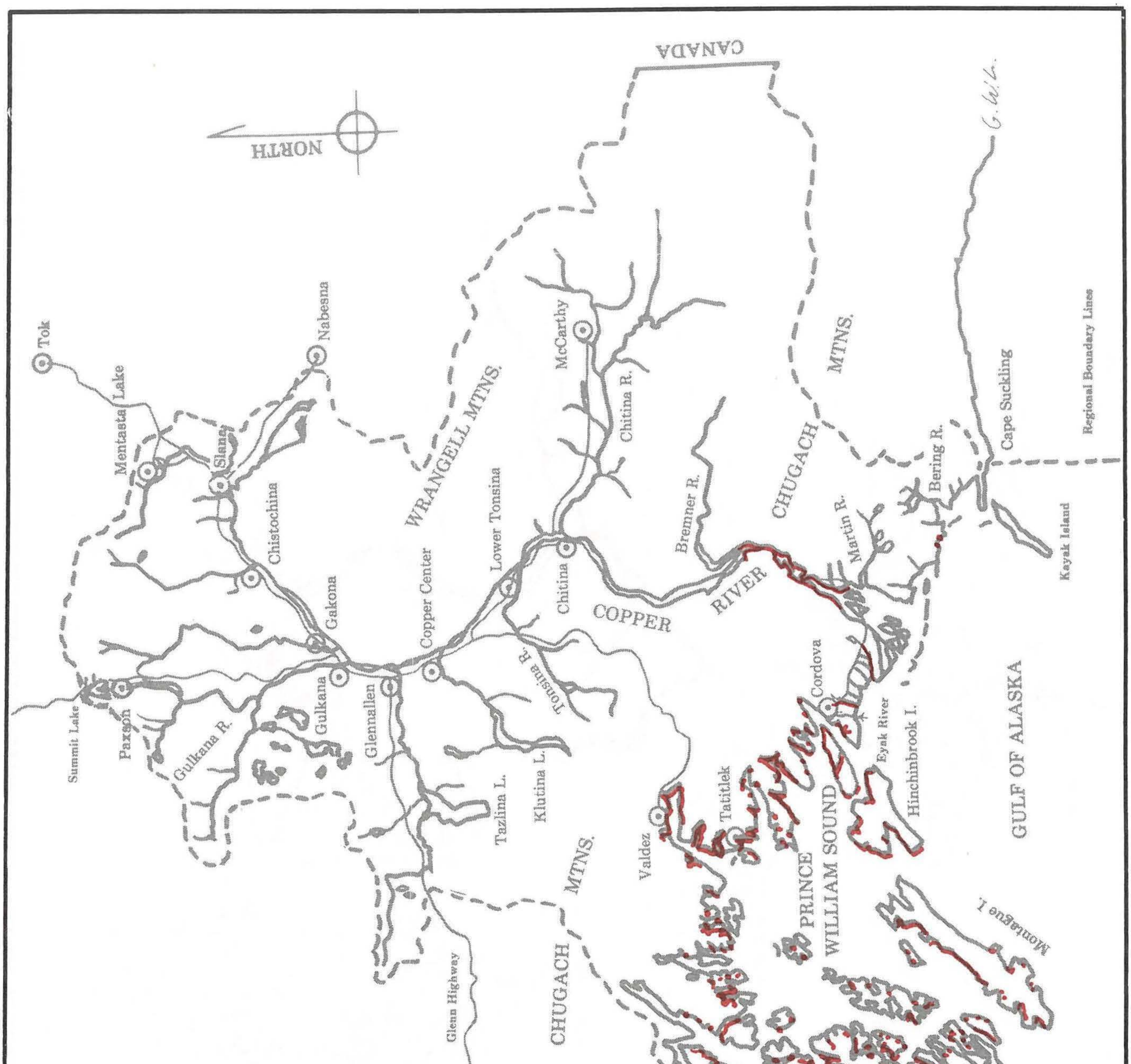

Figure 2-6. Pink salmon spawning and/or migration areas within the drainages of the Prince William Sound Region (adapted from Alaska Department of Fish and Game, 1982).

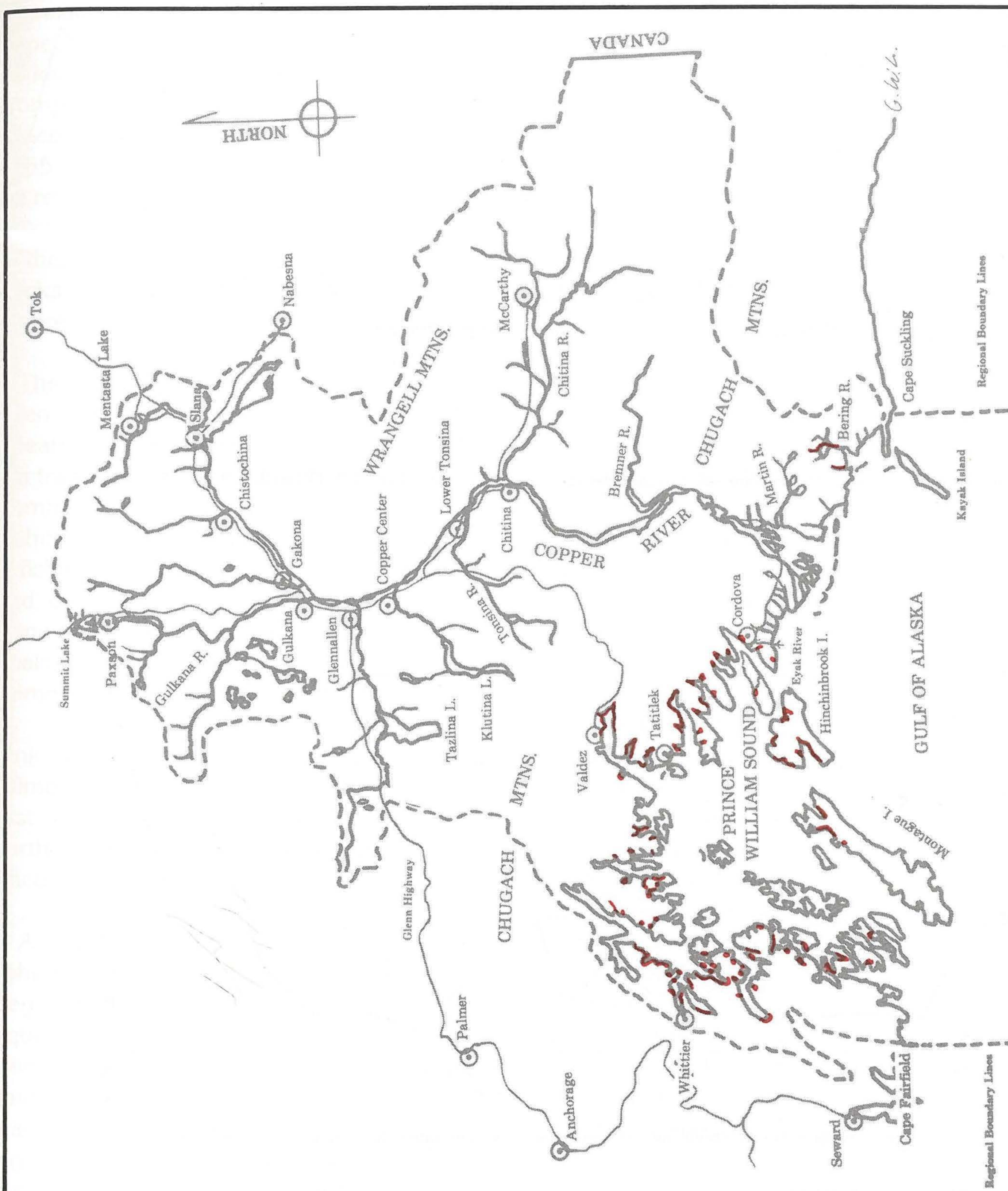

Figure 2-7. Chum salmon spawning and/or migration areas within the drainages of the Prince William Sound Region (adapted from Alaska Department of Fish and Game, 1982).

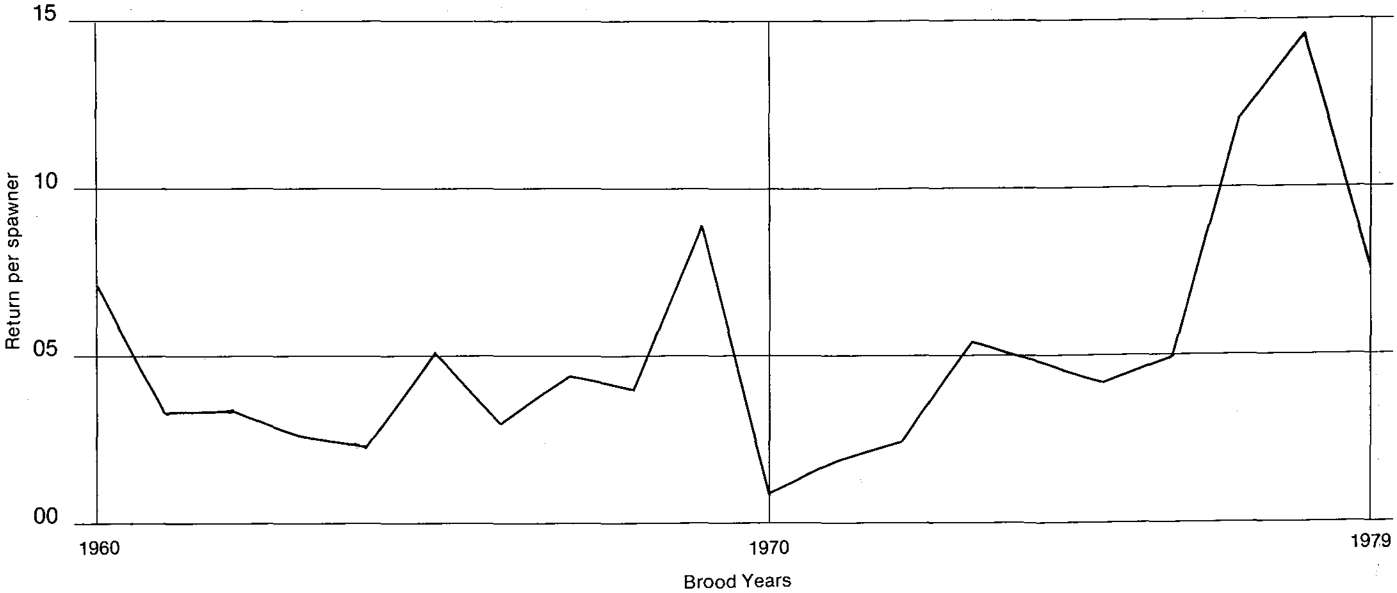

Figure 2-8. Prince William Sound pink salmon return per spawner ratios for brood years 1960-1979.

Figure 2-9. Prince William Sound chum salmon return per spawner ratios for brood years 1960-1977.[1]

1) Assuming all 4 year old fish.

approximately 8.0, 6.0 and 0.7 million fish, respectively. Catches of these stocks declined to low levels thereafter. Dwindling catches prompted the federal government to close the Prince William Sound fishery in 1954 and 1955. These closures resulted in an increase in the returns of even-year pink salmon. Odd-year pink salmon returns, however, did not increase. At the close of the era of federal management, stocks of pink and chum salmon were apparently at half of the historic high levels.[16]

The third phase of the fishery started in 1960 when the State took over management, research and enforcement responsibilities and fish traps were prohibited. With Statehood, the Commissioner of ADF&G was granted authority to adjust fishing time and open areas to fishing. Optimum escapement goals for pink and chum salmon were established and the seine fishery was managed according to these goals. Formal forecasting of pink and chum salmon returns was was initiated in 1961.

Pink (even and odd-year stocks) and chum salmon stocks upsurged temporarily during the first few years of this period. The 1964 earthquake, however, caused these stocks to once again decline.

A fourth and ongoing phase in the salmon fishery was initiated in 1971 when the Legislature initiated a large-scale salmon aquaculture program by creating the FRED Division within ADF&G. Private nonprofit salmon hatchery and limited entry legislation was enacted shortly thereafter. These significant events, coupled with legislation authorizing the establishment of regional associations, planning teams and the regional salmon planning process, set the stage for a new era in the fishery.

Unfortunately, this era began with two successive harsh winters, hampering the recovery of earthquake-impacted pink and chum salmon stocks. Complete closures of the seine fishery were implemented as a result in 1972 and 1974, and catches in 1973 were minimal. Unusually favorable survival conditions occurred in the late 1970's, however, and pink salmon catches soared to record high levels in 1979 and continued through 1981. In addition, record high chum salmon catches occurred in 1981.

Exvessel prices (the price the fishermen receive for fish) increased dramatically beginning in 1973 (Appendix 2-1). Fishermen, in response to higher fish prices, larger catches and stable competition, have commonly upgraded their boats and fishing gear. Many wooden boats have been replaced by larger fiberglass boats.

Limited entry regulations have brought about a relative stabilization of fishing gear quantity. The number of permit holders in 1982 was: 271 purse seine (259 permanent, 1 hatchery and 11 interim), 541 drift gill net (529 permanent and 12 interim) and 31 set gill net (26 permanent, 1 hatchery and 4 interim).[23] PWSAC holds, to date, the only hatchery seine permit; however, VFDA is currently applying for a hatchery seine permit. NERKA, Inc. currently has a hatchery set net permit. Hatchery permits are only usable in the special harvest areas.[24] Interim permits have been issued to fishermen whose qualification for permanent permits is being contested by the Commercial Fisheries Entry Commission. The market value of limited entry permits has increased dramatically since the inception of limited entry.

Subsistence Salmon Fishery

Subsistence salmon fishing is restricted to Alaskan residents, and permits are required to participate. Regulations restrict locations, methods and quantity of fish harvested. Subsistence salmon fishing is allowed in marine waters open to commercial salmon fishing and a 100 mile portion of the main Copper River above Wood Canyon (Figure 2-10)[25]

Marine waters have been open to subsistence fishing during open commercial fishing periods. Legal fishing gear has consisted of drift and set gill nets and purse seines. Freshwater subsistence fishing normally has been open June 1 through September 30. Restrictions occurred in 1978, 1979 and 1980 when sonar counters at Miles Lake indicated a smaller than desired run. Dip nets and fishwheels constitute the legal gear.[25]

Catches by species, gear type, area and year are presented in Appendix 2-2 through 2-4.

Sport Salmon Fishery

The sport fishery has until recent times been the least documented salmon fishery in the Region. The harvest data base initiated in 1966 for the Upper Copper River and 1977 for all waters (Appendix 2-5 and 2-6). These data indicate that sport users have harvested the least number of salmon. Favored salmon sport fishing areas have been the Gulkana River, Valdez Bay, Passage Canal and Eyak River (Appendix 2-6).

Socioeconomics

According to government censuses, the population of the Region in 1980 was 7,650 residents. Population increases occur annually with the influx of seasonal workers, fishermen (commercial, subsistence and sport), job seekers, tourists and vacationers. The largest city in the Region is Valdez (Appendix 2-7). The population of the Region has increased by over 100 percent since 1970. This has been largely due to the construction and operation of the Alyeska Pipeline Terminal at Valdez and pump stations between Valdez and Glennallen. Projections of population growth between 1980 and 2002, the target year of this plan, are presented in Appendix 2-8.

The economy of the Region centers around the Alyeska Pipeline, fishing, fisheries processing, tourism, miscellaneous services and government employment (federal, State and local).

Fish Processors

The majority of local processing has in recent years been done by five processors in Cordova and Seward Fisheries in Seward. The major Cordova processors are: Morpac, Inc.; North Pacific Processors; St. Elias Ocean Products; Chugach Alaska Fisheries, Inc. and the Copper River Fisheries Cooperative. Of the major processors, four have canning lines and all have freezers.

The daily processing capacity of the processors located within the Region, including Seward Fisheries, was estimated by ADF&G in December, 1981, to be 597,000 canned salmon and 100,000 frozen salmon.[26,27] Pink salmon constitute the majority of the fish canned in the Region. Some chum salmon are also canned. All species are frozen.

The five major processors operating at full

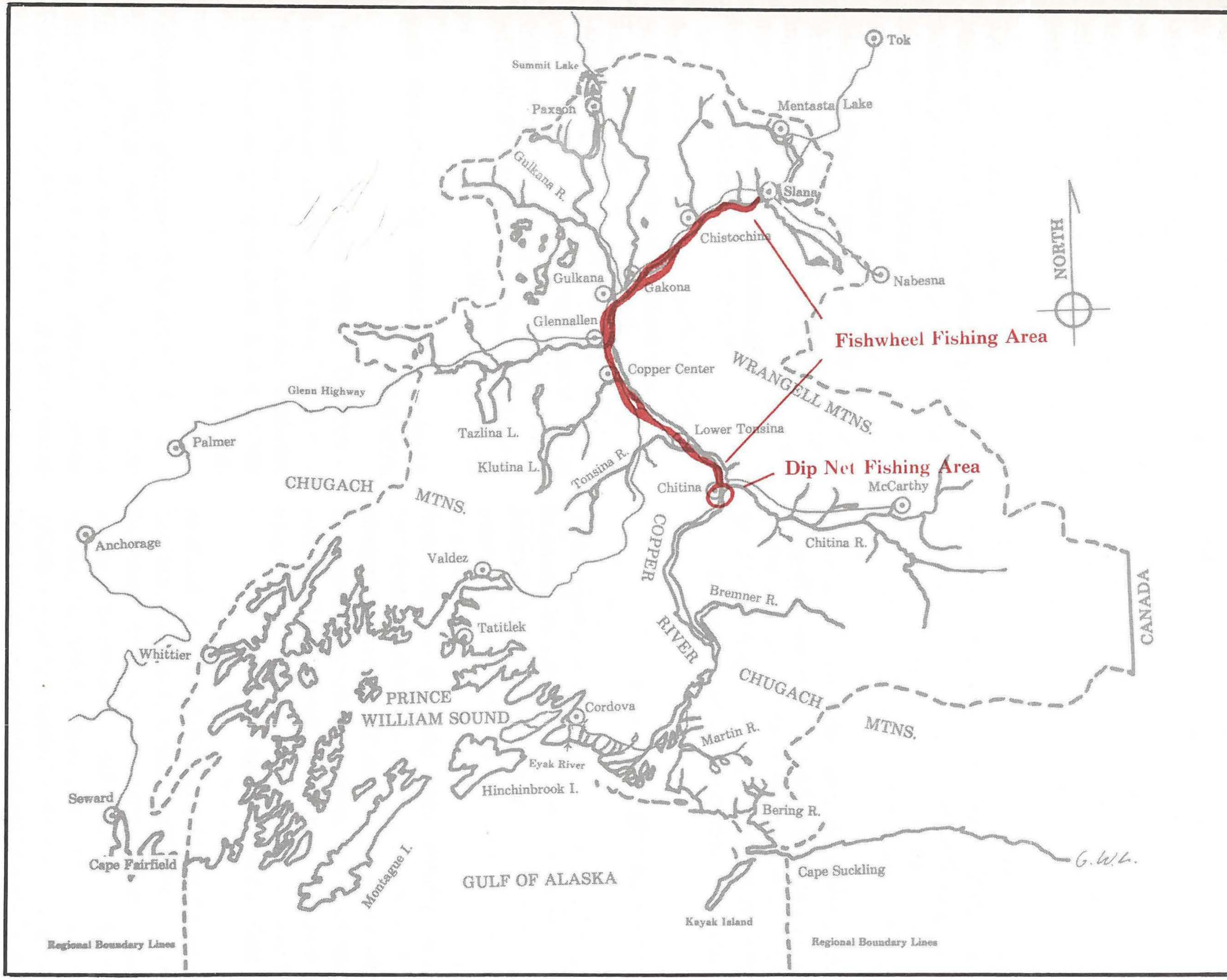

Figure 2-10. Subsistence fishing areas of the Upper Copper River.

capacity have employed approximately 800 workers, of which roughly one third have been Alaskan residents.[28]

Large local runs in recent years have been adequately handled by tendering fish to outlying Alaskan plants and freezing fish on floating freezer ships. As many as 250,000 to 500,000 fish have been exported from the Region daily by these methods. The processing capacity of these plants is largely dependent on salmon run strength in their respective regions. Capacity, subsequently, varies annually.

Processing capacity, obviously, is a major concern among fishermen. The full utilization of the salmon resources of the Region will be highly dependent on the development of adequate processing facilities and outlets.

Land Ownership and Status

Land ownership and status is of importance in fisheries planning. The policies and plans of owners and administrative agencies determine land use. Access and continued use of stream and lake-side lands are important considerations when planning for recreation and subsistence needs and rehabilitation and enhancement projects. Development projects such as coal mining and timber harvest will require coordination with the Habitat Protection Division of ADF&G to minimize or mitigate fisheries habitat losses.

Land ownership has changed dramatically in recent years. The State and the regional and village native corporations have received portions of their land entitlements under provisions of the Alaska Statehood Act and the Alaska Native Claims Settlement Act (ANSCA). Conveyance of lands is continuing. Native land selections have generally focused on areas containing valuable resources, principally timber, gravel and mineral resources and recreational lands. A large holding of federal land became a national park with the passage of the Alaska National Interest Lands Conservation Act (ANILCA). The boundaries of the Chugach National Forest were expanded through ANILCA. Portions of the Forest are currently classified as Wilderness Study Areas and other portions are under consideration for wilderness status. The wilderness classification of lands may have a major impact on major enhancement projects. It may not be feasible to construct and operate cost-effective hatcheries under guidelines established for wilderness areas.

Agencies Involved with the Salmon Fisheries

Various federal and State agencies and private organizations are directly involved with the salmon fisheries of the Region. The Regional Fisheries Planning Team serves to guide these agencies and organizations in fisheries matters through recommendations made to the Commissioner of ADF&G. These agencies are as follows.

Alaska Department of Fish and Game (ADF&G)

ADF&G is the principal agency and is involved with fisheries management, rehabilitation, enhancement and research. Five divisions deal, in varying degrees, with salmon fisheries.

The **Division of Commercial Fisheries** is responsible for the management of the commercial and subsistence fisheries and commercial fisheries research. The Area Office of the Prince William Sound Management Area is located in Cordova. A satellite office is maintained in Glennallen.

The **Division of Sport Fisheries** is responsible for the management and research of the State's sport fish species. A goal of the division is to provide maximum sport fishing opportunities while maintaining stocks at a high level of productivity.[29] The Area Office is located in Glennallen.

The **Division of Subsistence** performs research on subsistence users and needs and serves the Alaska Board of Fisheries in an advisory capacity.

The **FRED Division** has the responsibility to "(1) develop and continually maintain a comprehensive, coordinated state plan for the orderly present and long-range rehabilitation, enhancement and development of all aspects of the state's fisheries...; (2) encourage the investment by private enterprize in the technological development and economic utilization of the fisheries resources; and (3) through rehabilitation, enhancement and development programs do all things necessary to insure perpetual and increasing production and use of the food resources..."[30] Offices are located in Cordova, Glennallen and Anchorage. FRED Division operates hatcheries at Cannery Creek, Main Bay and Gulkana.

The **Cannery Creek Hatchery** is located on the east shore of Unakwik Inlet and has been operated by FRED Division since 1979 (Figure 1-1). The hatchery consists of: a 7,000 sq. ft. hatchery building, a bunkhouse, three single family residences, a power generating module, eight 10 ft. by 100 ft. outside raceways, a large lake level control dam and a stream level control weir. Cannery Creek is a short coastal stream with a watershed of 3.34 sq. mi. The creek drains a 130 surface acre lake, Cannery Lake.

The hatchery currently has sufficient incubation trays to incubate approximately 50.5 million pink salmon eggs. There exists sufficient floor space, however, to increase the capacity to 80 million eggs.[31]

During 1980 and 1981, an estimated 232,000 pink salmon returned from fry released at Cannery Creek and Hobo Creek (Appendix 2-9). It is estimated that approximately 125,000 of these fish were captured by commercial fishermen.

Several critical factors currently limit the production of salmon at this hatchery. An immediate concern is the lack of adequate adult salmon holding facilities. This reduces the efficiency of egg take operations, and as a result it is estimated that a maximum of 50 million eggs can be taken during any spawning season.[31] A captital improvement request has been submitted to improve the fish handling facilities.

The development of a large chum salmon brood stock would require use of a donor stock with an earlier run timing than that of the pink salmon in Cannery Creek. Early run fish, however, would emerge early and would require long-term feeding. The water in the hatchery raceways during spring is thought to be too cold for effective freshwater rearing.[32] Emergent chum salmon normally feed for a brief period in fresh or brackish water. This initial freshwater rearing period is apparently of major importance to the survival of chum salmon fry. Emergent pink salmon fry, conversely, do not thrive in freshwater and migrate promptly to the estuary.[33]

Short-term feeding of pink salmon fry in saltwater is not feasible due to the lack of rearing pens. It is estimated that marine survival can be enhanced approximately 2.9 fold by doubling the weight of emergent fry through short-term feeding (Appendix 3-16).

The **Gulkana Incubation Facility** consists of twenty 4 ft. by 4 ft. by 8 ft. incubation boxes situated in a spring area (Figure 1-1). Fertilized sockeye salmon eggs are placed on gravel or artificial material and spring water is fed by gravity into the bottom of each box via a system of pipes. To date, approximately 19.8 million fry have been produced (Appendix 2-10). It has not been possible to determine the number of adult salmon that have been produced. Overall survival from fry to adult has been estimated to range from one-half to one percent.[34] The capacity of the facility is presently 10.3 million sockeye salmon eggs. Currently, only about 10 percent of the water of the spring flows through the hatchery. Other springs also exist in the area, and, therefore, the potential for expansion is high. Work is progressing at this time to evaluate the feasibility of stocking nearby lakes: Paxson, Summit, Crosswind, Monsoon and Dickey.

The **Main Bay Hatchery** is located within Main Bay in the western part of the Sound (Figure 1-1). This new facility consists of 7 structures, water pipelines, a sewage treatment system and a hydroelectric plant. The water source of the hatchery is an 826 acre lake set within a 3,900 acre watershed.

The capacity of the facility currently is approximately 95 million "green" (freshly fertilized) eggs. Rearing facilities presently consist of indoor freshwater raceways. These contain sufficient space to rear 25 million chum salmon to fingerling size*. No outdoor saltwater rearing facilities exist for chum or pink salmon.

The hatchery became operational during the summer of 1982. Brood stock development started in the spring of 1981 when 2.95 million pink salmon juveniles were transported from the Port San Juan Hatchery and released at the Main Bay Hatchery site. Plans with the existing facility are to direct efforts toward chum salmon.

It is estimated that the existing hatchery at full capacity of 95 million eggs will produce approximately 808,000 adult chum salmon. It is estimated that returns could be increased by 492,000 adult chum salmon if rearing facilities for all fry were to be provided.

The **Division of Habitat Protection** is responsible for cataloging, protection and improvement of fish habitat. It oversees proposed and on-going activities in anadromous fish streams and critical habitat areas.

Alaska Board of Fisheries

This regulatory body promulgates regulations covering commercial, sport and subsistence fishing activities in State waters and seaward biological influence zones. These zones encompass areas within the 200 mile limit where finfish or shellfish indigenous to Alaska are available for harvest. The Board also sets regulations governing private non-profit hatcheries and special harvest areas.

*A fingerling is defined as juvenile salmon that is twice the weight of an emergent fry.

Alaska Commercial Fisheries Entry Commission

This commission administers the licensing of fishermen and fishing vessels and strives to limit fishing gear in distressed fisheries. In this Region, salmon and herring commercial fishing gear has been limited by the Commission.

Alaska Division of Fish and Wildlife Protection

This agency enforces State fishing, hunting and trapping regulations. Officers are stationed in Cordova, Valdez and Glennallen.

North Pacific Fishery Management Council (NPFMC)

The Council is composed of members representing Alaska, Washington, Oregon and federal fisheries agencies and is responsible for the development of management plans for all fishery resources harvested in the Fishery Conservation Zone adjacent to Alaska. The Zone encompasses marine waters 3 to 200 miles offshore. The broad representation on the Council reflects the concept that fishery resources of this Zone are commonly shared by these north Pacific states. Plans for the salmon fishery will deal primarily with the troll fishery.[29] The Board of Fisheries declared salmon trolling west of Cape Suckling to be no longer legal in 1976. Proposals have been introduced to the Board of Fisheries, however, to reinstitute trolling as legal gear in this area.

US Forest Service (USFS)

The Forest Service manages fish habitat in the Chugach National Forest and has been actively involved in fish habitat improvement projects within the Forest. Projects entail habitat inventory, fish pass installation, channel stabilization and stream clearance and improvement. The Forest Service has worked with the State on the selection of hatchery, lake stocking and lake fertilization sites. District offices are located in Cordova, Anchorage and Seward. The Forest Supervisor's office is in Anchorage.

Bureau of Land Management (BLM)

BLM administers federal lands under the multiple-use principle. The Bureau's first management priority regarding fisheries is the identification and protection of salmon spawning habitat.[35] This agency is currently involved in a cooperative study of Monsoon and Dickey lakes in the Upper Copper River drainage. These lakes are candidates for sockeye salmon fry stocking.

Prince William Sound Aquaculture Corporation (PWSAC)

PWSAC operates the Port San Juan Hatchery on Evans Island in western Prince William Sound (Figure 1-1). The hatchery is one of the largest and most successful pink salmon hatcheries in the world. The hatchery is built on the site of a cannery formerly operated by the San Juan Fishing and Packing Company. Construction and operation of the hatchery commenced in 1975. The site was chosen mainly because of low initial cost, land status and the time savings that could be achieved by utilizing the old cannery buildings, dock and water source. Following major seine fishery closures in 1972 and 1974, organizers of PWSAC were anxious to get a hatchery on line to aid the fishery and lend credibility to the program.

During 1977 through 1981, an estimated 4.5 million pink salmon returned to the hatchery and common property fishery from 73.2 million fry released (Appendix 2-11). Chum salmon brood stock build up is ongoing. To date, approximately 20,000 chum salmon adults have returned to the hatchery and common property fishery.

The permitted egg capacity of the facility is presently 150 million pink salmon eggs and 13 million chum eggs.[36] The short-term rearing capacity of the hatchery is estimated to be 100 million pink salmon fry and 10 million chum salmon fry.[37]

Members of the Cordova Aquatic Marketing Association (CAMA), a regional fishermen's association, have voted to assess their salmon catch on a voluntary basis. This self-imposed tax has served as collateral for State loans and operating funds for PWSAC. Prior to 1982, two assessment rates were utilized. Copper River and Bering River fishermen voluntarily paid 2 cents per fish sold and Prince William Sound fishermen paid 3 cents per fish sold. A higher rate was selected for the Prince William Sound fishermen because the first hatchery was located in this area. It was the intent to direct the greater cost to the users who would benefit the earliest from the PWSAC hatchery program. The assessment rate was changed to 2 cents for all fishermen in the spring of 1982. Non-CAMA fishermen have also contributed.

Processors have cooperated oftentimes by matching the amount contributed by the fishermen. One processor, North Pacific Processors, Inc., contributed the scheduled amount regardless of whether the fisherman had contributed or not.

Between 1975 and 1981, fishermen assessed themselves a total of $1,629,535.28 or 76 percent of the potential assessment associated with the total catch. Processors contributed $1,317,617.85 or 81 percent of the amount contributed by fishermen.

In addition to cash, fishermen, processors and tender operators have contributed personal services and/or surplus equipment.

Other revenues have been aquired through the harvest of salmon in the Port San Juan Special Harvest Area. Between 1975 and 1981, approximately 1,416,546 salmon were harvested (Appendix 2-11).

Fishermen have received direct benefit from the hatchery by catching returning adults in the common property fishery. Tender operators, processors and communities have subsequently benefitted from these increased catches.

Valdez Fisheries Development Association (VFDA)

VFDA, a private non-profit corporation, has operated a stream-side egg incubation box system at Crooked Creek in Valdez since 1979. VFDA has been permitted by the State to take and incubate eggs under provisions of a scientific and educational permit and a private non-profit permit. Educational research is conducted in conjunction with the Prince William Sound Community College in Valdez.

A major objective of the Crooked Creek facility has been the development of donor stocks for the new Solomon Gulch Hatchery. The new hatchery is located at the mouth of Solomon Gulch Creek, several miles from Crooked Creek. The Association is permitted by the State to incubate at this facility 50 million pink salmon eggs, 18 million chum salmon eggs and 1 million coho salmon eggs.[35] Water for the hatchery comes from a hydroelectric plant reservoir.

Approximately 8.5 million pink salmon fry and 1.2 million chum salmon fry have been released to date (Appendix 2-12).

NERKA, Inc.

NERKA, a private non-profit corporation, has operated a small harchery on Perry Island since 1976. The facility is located 40 miles east of Whittier and consists of a residence, warehouse and water system. NERKA currently has only the capacity to incubate 300,000 eggs. The present water system becomes low during extremely cold weather and production is thereby limited. Releases amd returns to the facility have been low (Appendix 2-13). NERKA has applied for a State Fisheries Enhancement loan to upgrade the facility to incubate 20 million eggs.

Agencies Involved with Access and Campgrounds

Access routes to fishing areas and campground facilities are both of major concern to sport and subsistence fishermen. Various agencies and corporations are involved in the provision and maintenance of these recreational facilities. Some facilities are not located near salmon fishing areas.

ADF&G, Division of Habitat Protection

Reservation of lands for access routes to sport and subsistence fishing areas is a function of the Division.

ADF&G, Division of Sport Fisheries

The Division recommends access lands for reservation or purchase in an effort to preserve or provide for increased sport fishing opportunities.

Alaska Department of Natural Resources (ADNR), Division of Parks

The Division maintains 122 overnight campsites in 8 parks within the Region. No additional roadside campgrounds have been proposed; however, marine parks within Prince William Sound have been proposed. The Division has a program to procure lands for recreation purposes.

Alaska Department of Transportation and Public Facilities (DOTPF)

This agency maintains wayside rest areas, including two heavily utilized rest areas near Chitina. No overnight camp spaces are provided.

Bureau of Land Management (BLM)

BLM maintains 52 camp spaces in 4 campgrounds within the Region. The Bureau also has boat ramps and access easements across native lands.[38]

US Forest Service (USFS)

The Forest Service maintains 21 recreational cabins within the Region. Cabins must be reserved and a $10 daily fee is charged.[39] The Forest Service also maintains three boat launching sites and is developing a system of mooring buoys to enhance recreation in poor anchorage areas. The Draft Forest Plan calls for the addition of 18 recreation cabins, 18 tent platforms and 1 campground by 1993. The Forest Service is also maintaining public easements across private land. This program is a cooperative effort with the native corporations.

AHTNA Native Corporation

This corporation is a major land owner in the Upper Copper River drainage and maintains 20 camp spaces within two campgrounds along the Gulkana River. A $10 annual fee is required to utilize AHTNA lands. The Corporation has no plans for future campground development.[40]

Eyak Corporation

Eyak Corporation maintains 17 camp spaces within two campgrounds near Cordova. User fees vary form $3 to $5 per day. The Corporation also maintains a cabin at Simpson Bay, which can be rented for $15 per day. The Corporation has no plans to develop other recreational facilities.[41]

CHAPTER 3

ANALYSIS OF THE REGION'S CURRENT AND FUTURE SALMON HARVESTS

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To derive an estimate of management, rehabilitation and enhancement needs, we must first make an educated guess about probable future average catches of natural and supplemental stocks if no significant increases in management efficiency or rehabilitation and enhancement activities were to occur. These baseline data when compared with projected user demands, provide estimates of future production gaps or shortfalls. Chapter 7 will address the various management, rehabilitation and enhancement projects needed to resolve these gaps.

Without this plan, some increase in management precision will undoubtedly occur, as will increases in rehabilitation and enhancement activities. This plan sets forth an organized process which serves to guide the various agencies involved with salmon production and to provide a measure of progress.

Harvest data for natural and supplemental stocks are presented by gear type. It is assumed that over the next 20 years the proportion of natural runs caught by each user group will not significantly change despite projected increases in population and anticipated increases in sport and subsistence fishing effort. Finally, it is assumed that significant increases in catches by all user groups will only be realized after the management program is improved and after new rehabilitation, enhancement and access projects are implemented.

Harvests of Natural Stocks

Catch data for natural stocks have been compiled and analysed by gear type and user group to project probable catch magnitudes 20 years from now. Under the circumstances outlined above, it may be surmised that catches of most stocks during the next twenty years will probably be similar to catches that occurred between 1960 and 1981. The average run size will probably be similar, and runs will probably fluctuate within the ranges that occurred in the past (Figure 1-2 through 1-7). It is assumed, of course, that no major environmental changes will occur. The year 1960 was chosen as the general starting point because this was the year that fish traps were eliminated and the State took over fisheries management. Shorter time frames have been chosen for some stocks affected by various events, such as the 1964 earthquake, unusual fisheries closures or changing fishing practices. Drift and set gill net catches in the Eshamy District were combined prior to 1967, and, therefore, only data for 1967 through 1981 were employed.

Purse Seine Catches of Natural Stocks

The purse seine fishery is, by regulation, restricted to the following districts: Eastern, Northern, Unakwik, Coghill, Northwestern, Southwestern, Montague and Southeastern (Figure 3-1). Management of the purse seine fishery is based on aerial surveys of salmon abundance in the fishing districts, pink and chum salmon catch data and aerial and ground surveys of pink and chum salmon escapement.

The purse seine fishery has been opened annually by field announcement according to the early run strength of pink salmon. Fishing time has normally been divided into weekly fishing periods encompassing 6:00 am Monday to 9:00 pm Friday.[26]

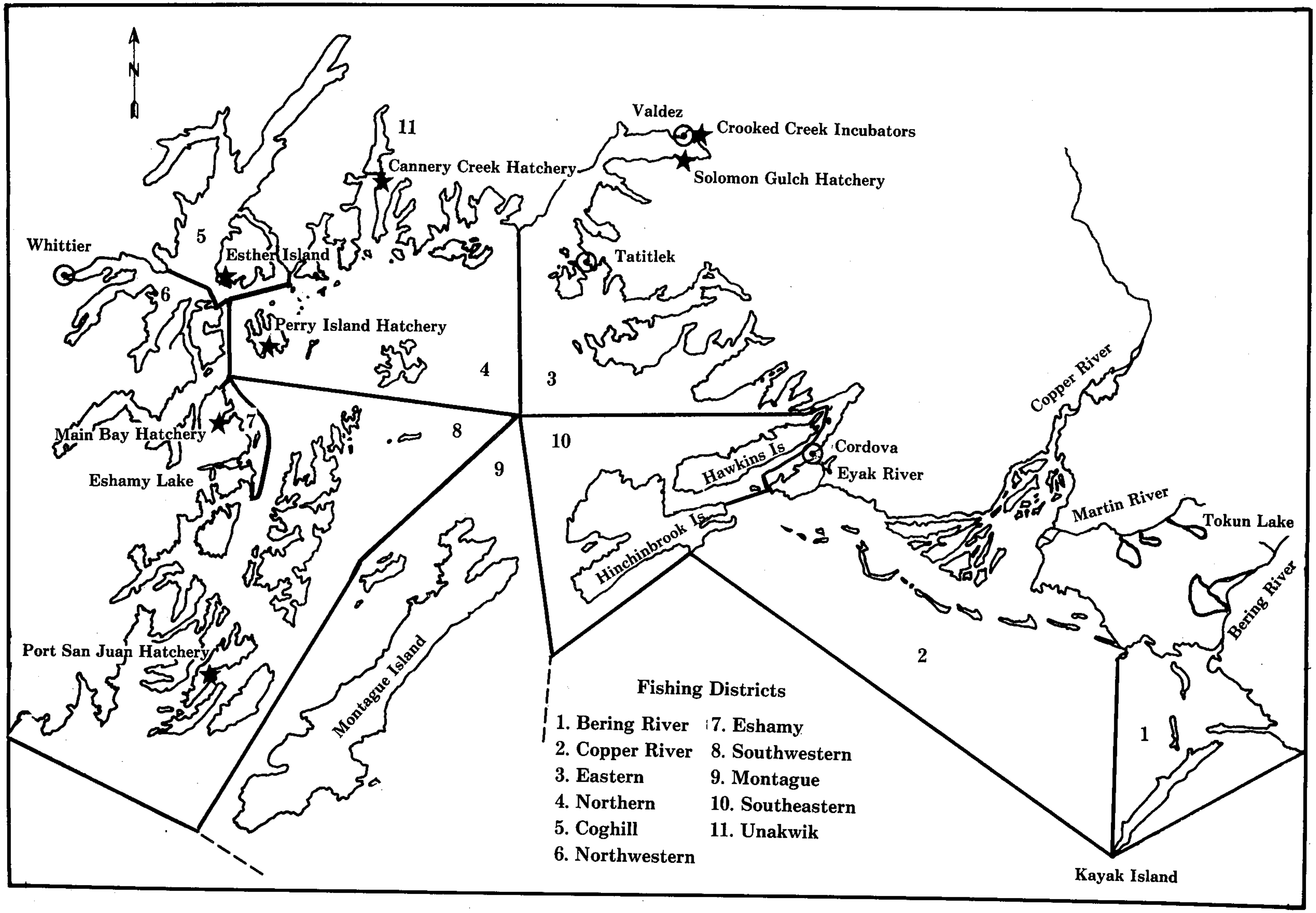

Figure 3—1. Commercial fishing districts of the Prince William Sound Region (adapted from Randall et al., 1982).

District and fishing time restrictions have been imposed when concentrations of salmon in bays and index streams were less than desirable. District escapement goals have been established for pink and chum salmon (Appendix 3-1 and 3-2). These goals are based on an overview of historic escapements in index streams. Major management efforts have centered on the dominant species, pink salmon. Only relatively minor efforts have been made to manage runs of chum and coho salmon. No efforts have been made to manage the runs of sockeye and king salmon. King salmon do not spawn in the seine districts and catches are relatively insignificant.

Escapement counts of pink and chum salmon are generally index counts based on periodic aerial and ground estimates of escapement magnitude in selected streams. Total escapement estimates are available only for Coghill Lake and Eshamy Lake. Seining is not allowed in the Eshamy District. The index stream system encompasses 196 of 522 streams that have been documented as pink salmon spawning streams in the Sound and 94 of 219 streams that have been documented as chum salmon spawning streams in the Sound.[22,42] It has been estimated that approximately 75 percent of pink and chum salmon in the Sound spawn in the index streams.[43]

Six hatcheries are located within districts open to seining: Port San Juan, Cannery Creek, Main Bay, Solomon Gulch, Crooked Creek and Perry Island. Significant returns have been realized at the Port San Juan and Cannery Creek hatcheries. Returns to these six facilities will be harvested in the seine districts and terminal areas.

During years of low natural run abundance, commercial fishery openings may largely be limited to terminal areas. Openings in these limited areas will facilitate adequate escapement of natural stocks and the desired common propery harvesting of hatchery stocks.

ADF&G prepares annually a formal forecast of natural pink and chum salmon runs returning to Prince William Sound and a management outlook of projected catches of other species in all districts. Forecasts of hatchery returns have been prepared by FRED Division and PWSAC. Forecasts and outlooks are of value to the fisheries manager, fishermen and processors in their preseaon planning activities. Various estimates of marine survival are utilized to estimate total returns. Precise verification of total returns and common property interception rates has been stymied by the lack of funds for marking and recovery sampling and by the lack of technology. Accurate forecasts are a precondition for the complete utilization of harvestable fish by fishermen. This can occur only if the processing and marketing industry is adequately informed and prepared.

King salmon

King salmon catches have been relatively minor but have undergone relatively major fluctuations (Appendix 3-4). The cause of these fluctuations is unknown. The average catch for all years since 1960 was 1,325 king salmon, and it is projected that the average catch in future years will be approximately 1,300 king salmon.

Sockeye salmon

Catches since 1960 have, with several exceptions, been relatively stable (Appendix

3-4). The fishery was restricted during 1972 and 1974, and catches have increased significantly in recent years. This recent upturn is likely due to the concentration of fishing effort that has occurred in the Southwestern District. Seine catches of mid to late-run Eshamy Lake stocks in this area have probably been higher than in previous years. Seiners have concentrated in this area to harvest the large natural pink salmon runs that have occurred since 1979. It is probable that these large natural pink salmon runs will not continue and that fishing activities in the Southwestern District will be restricted during weak natural runs. The interception of Eshamy Lake sockeye salmon would be reduced under these circumstances. The average catch during 1960 through 1981 was 47,924 sockeye salmon. It is assumed that future catches will be similar to those that have occurred since 1960 and that average catches will be approximately 47,900 sockeye salmon.

Coho salmon

Reported catches have declined markedly commencing in 1972 (Appendix 3-4). This has probably been due to a reduction in late-season fishing time, earthquake disruption of spawning and rearing areas and/or misidentification of fish. No escapement data are available, and, therefore, it is not possible to determine if these stocks have declined in abundance. The exvessel price of seine-caught coho salmon dropped below the price of chum salmon beginning in 1973, and, it is possible that significant numbers of coho salmon were sold as chum salmon by fishermen. The average reported catch during 1960 through 1981 was 15,810 coho salmon. It is projected that average catches in future years will be apporoximately 15,800 coho salmon.

Pink salmon

Catches and escapements declined briefly following the Good Friday earthquake of 1964 and rebounded to record high levels beginning in 1979 (Appendix 3-4 and 3-5). The cause of these high returns is not entirely understood. Mild winters and optimum estuarine conditions are thought to be major contributing factors. It is probable that these high catches will not continue or that they will reoccur only infrequently. The average harvest during 1960 through 1981 was 4,758,965 pink salmon. It is projected that average catches of natural stocks in future years will be approximately 4,759,000 pink salmon.

Chum salmon

Catches have followed roughly the same pattern as pink salmon catches (Appendix 3-4). Escapement data indicate marked declines beginning in 1974 of Southwestern and Southeastern district stocks and a depletion of Montague District stocks (Appendix 3-6). These decreases were caused by land upheaval and habitat destruction associated with the 1964 earthquake. Catch data for the years 1974 through 1981 are used as indicators of future harvest magnitude. The average catch during this period was 447,504 chum salmon. It is projected that average catches in future years will be approximately 447,500 chum salmon.

Drift Gill Net Catches of Natural Stocks

The drift gill net fishery has, by regulation, been conducted in the following districts: Copper River, Bering River, Coghill, Unakwik and Eshamy (Figure 3-1). The fishery has been managed according to catch data and escapement counts. Various methods have been employed to derive escapement estimates. Sonar counters have been utilized at Miles Lake, and weirs have been utilized at Coghill and Eshamy lakes. Escapement estimates in other areas have generally consisted of index area counts. Index counts of sockeye, king and coho salmon have been "peak" counts and have only been obtainable after the majority of fish have been harvested. The peak or greatest number of salmon observed at any time in an area has been the index. No effort has been made to derive stream-life factors or to estimate total seasonal spawning populations within index areas. Escapement goals have been established for sockeye salmon but not for other species (Appendix 3-3).

Fishing seasons in all drift gill net districts are opened and closed by emergency order. The fishery in the Copper River District, where most of the drift gill net caught salmon are harvested, is normally opened in mid May. The fishery in the Bering River normally opens in mid June, and the fishery in the Coghill and Unakwik districts normally opens the third week of June. The fishing season in all districts is divided into weekly fishing periods.

Currently two hatcheries are located in districts open to drift gill netting. The Main Bay Hatchery is located in the Eshamy District and the Gulkana Hatchery is located in the headwaters of the Copper River District (Figure 3-1).

King salmon

The majority of king salmon in the Region have been caught in the Copper River District (Appendix 3-7). This species spawns in the Copper River drainage (Figure 2-3). No spawning populations are known to occur in the other districts, and king salmon harvested in these districts are generally feeding fish. King salmon catches in the Copper River District have exhibited a slight upward trend during the past 22 years. The upward trend cannot be explained and may not continue. It is estimated that during the next 20 years the average catch of king salmon in the Copper River District will be similar to the average catch that has occurred since 1960. The same time frame was also used in the projection of Bering River District catches. Shorter time frames were employed for the Coghill and Unakwik districts, reflecting an increase in effort in recent years. It is projected that the average harvest for all districts will be approximately 16,800 king salmon.

Sockeye salmon

Spawning populations of sockeye salmon occur in each drift gill net district (Figure 2-4). The Copper River produces the majority of sockeye salmon in the Region. Long-term catch averages were used to project future harvests of Copper and Bering river stocks (Appendix 3-8). These data do not indicate any upward or downward catch trends. Data for 1979 and 1980 were excluded in the determination of catch averages due to unusual fisheries closures that occurred. Short-term catch averages were used for the Coghill and Unakwik districts because of changes in fishing effort and increases in catch magnitude. It is projected that the average harvest for all gill net districts will be approximately 759,200 sockeye salmon.

Coho salmon

Coho salmon spawning populations are most abundant on the Copper and Bering river deltas. Few spawning populations occur in other gill net districts. Catches of coho salmon, like sockeye salmon, have generally exhibited no upward or downward trend since 1960 (Appendix 3-9). It is estimated that the average drift gill net harvest for all districts will be approximately 217,900 coho salmon.

Pink salmon

Spawning populations of pink salmon in the gill net districts are most abundant in the Coghill District. Overall catches indicate a trend toward increased abundance, and, subsequently, recent catch data were used to project future harvests (Appendix 3-10). Catches in the Bering River District increased beginning in 1979 due to an increase in fishing effort on the east side of Kayak Island (Figure 1-1). Larger boats have recently entered the gill net fishery, and these boats allow fishing to occur in these rough, outside waters. It is projected that average harvests within all districts will be approximately 216,500 pink salmon.

Chum salmon

The majority of chum salmon in the gill net districts spawn in the Coghill District. Catches have displayed generally the same trends as pink salmon (Appendix 3-11). It is projected that the average harvest for all districts will be approximately 91,100 chum salmon.

Set Gill Net Catches of Natural Stocks

The set gill net fishery is, by regulation, conducted in the Eshamy District (Figure 3-1). The fishery is managed according to the sockeye salmon escapement at the Eshamy Lake weir. The escapement goal has been 20,000 to 30,000 sockeye salmon (Appendix 3-3). Sockeye salmon escapement to Eshamy Lake has often been less than desired; therefore, fishing periods have been curtailed by emergency order. The fishery has been closed 8 fishing seasons since 1967 (Appendix 3-12).

No efforts have been made to manage the set net fishery for other species. Spawning populations of pink salmon rivaling those of sockeye salmon occur within the district. Only minor numbers of coho and chum salmon have been observed.

Set net catch data for each species was combined with drift gill net data prior to 1967; therefore, the data base for projecting future harvests of each species encompasses 1967 through 1981 (Appendix 3-12). Years of fishery closure were included in the analysis of these data because it is likely that, unless corrective rehabilitation efforts are implemented, these frequent closures will continue.

During 1967 through 1981, the average harvest of each species was 6 king salmon, 8,543 sockeye salmon, 90 coho salmon, 12,728 pink salmon and 2,855 chum salmon (Appendix 3-12). It is projected that average future harvests will include approximately 8,500 sockeye salmon, 100 coho salmon, 12,700 pink salmon and 2,900 chum salmon. It is assumed that king salmon catches will be negligible.

Subsistence Catches of Natural Stocks

Subsistence catch data have been divided by area: Upper Copper River, Copper River Delta, and Prince William Sound (Appendix 2-2 through 2-4). Catch reports indicate that the majority of subsistence-caught salmon have been harvested in the Upper Copper River area.

Upper Copper River

Fishing effort and catches increased markedly during the 1960's and stabilized between 1970 and 1981 (Appendix 2-2). The sockeye salmon subsistence fishery in the Upper Copper River is currently managed according to a management plan adopted by the Alaska Board of Fisheries.[25] This plan establishes allowable harvest levels for differing levels of projected escapement. The escapement of sockeye salmon is monitored by means of sonar counters located below Miles Lake on the Copper River. The minimum and desired escapement goals are currently 250,000 and 350,000 sockeye salmon, respectively. The plan allows for a subsistence harvest of 25,000 sockeye salmon when it is projected that the desired escapement goal will be achieved. From 1970 through 1981, the average reported subsistence catch of sockeye salmon was 27,995 fish. It is anticipated that the desired escapement goal will generally be achieved and that future harvests, assuming that the management plan will remain unchanged, will average approximately 25,000 sockeye salmon.

Management strategies for the king and coho salmon fisheries are limited due to the lack of total escapement estimates and escapement goals. The average reported catch of king and coho salmon from 1970 through 1981 was 1,731 and 348 fish, respectively (Appendix 2-2). Natural king salmon stocks may not be able to sustain a higher exploitation rate than this average level. Coho salmon stocks are not abundant, and catches may remain low even if effort increases significantly. It is projected that the average catches of king and coho salmon will be 1,700 and 400 fish, respectively.

Copper River Delta

Subsistence catches on the Copper River Delta exhibit no clear upward or downward trends (Appendix 2-3). The average catch during 1960 through 1981 was 38 king salmon, 117 sockeye salmon and 44 coho salmon. It is assumed that future harvests of king and coho salmon will be negligible and that sockeye salmon harvest will average approximately 100 fish.

Prince William Sound

Reported subsistence catches in Prince William Sound have noticeably decreased since the 1960's (Appendix 2-4). This may be due to regulations prohibiting commercial salmon net permit holders from obtaining salmon subsistence permits. The catch still occurs, but it is unreported. It is assumed that future reported harvests will be negligible.

Sport Catches of Natural Stocks

The data base for salmon sport catches is relatively brief and in this document has been organized into five areas. Upper Copper River sockeye and king salmon catches have been estimated by the Sport Fish Division of ADF&G since 1966 (Appendix 2-5). Data for other areas and all species have been derived since 1977 (Appendix 2-6). These data have been generated by means of an annual statewide harvest survey. The Gulkana River is a preferred fishing area in the Upper Copper River drainage; therefore, there is some overlap between tables.

Upper Copper River

Sockeye salmon catches in the Upper Copper River peaked in 1971 and 1973 and declined when snagging in freshwater was prohibited (Appendix 2-5). The average catch of sockeye salmon in the Upper Copper River from 1976 through 1981 was 1,916 fish. It is assumed that the snagging prohibition will be maintained and that catches will not increase beyond the 1976-1981 level. It is projected that the future average catch will be approximately 1,900 sockeye salmon.

King salmon catches in the Upper Copper River reached a relatively high level during 1979 through 1981 (Appendix 2-5). The average catch during this period was 2,255 king salmon. It is assumed that catches of this magnitude may be sustainable and that the average catch in future years will be approximately 2,300 king salmon.

Valdez Bay

Valdez Bay has, since 1977, been the preferred marine salmon fishing area in the Region (Appendix 2-6). During 1977 through 1981, catches of all species were relatively stable. The average catch during that time period was 118 king salmon, 342 sockeye salmon, 4,965 coho salmon, 11,288 pink salmon and 799 chum salmon. It is assumed that future catches will be similar and that average harvests will include approximately 100 king salmon, 300 sockeye salmon, 5,000 coho salmon, 11,300 pink salmon and 800 chum salmon.

Passage Canal (Whittier)

Fishing effort in this area increased considerably from 1978 to 1979 (Appendix 2-6). Coho salmon captured in this area are generally hatchery-produced fish reared at Ft. Richardson and planted in Passage Canal. Natural stocks harvested since 1979 include only minor numbers of king and pink salmon. The average catch of king and pink salmon was 18 and 869 fish, respectively. The fishery is limited by access and availability of boat slips. It is projected that average future catches of natural stocks in Passage Canal will include negligible numbers of king salmon and approximately 900 pink salmon.

Eyak River

The Eyak River fishery is the second most popular freshwater salmon fishery in the Region (Appendix 2-6). Effort increased substantially beginning in 1979, and the average catch from 1979 through 1981 was 3,468 coho salmon. Catches of sockeye salmon during all years of record have been relatively minor. The average catch from 1977 through 1981 was 162 sockeye salmon. Total in-season escapement estimates are lacking for both species, subsequently, these fisheries are difficult to manage. It is questionable whether it is feasible to increase the exploitation rate of coho salmon unless the commercial salmon fishery is curtailed. It is projected that the average catch in future years will be approximately 3,500 coho salmon. Regulations prohibiting snagging may preclude any increases in sockeye salmon catches, and it is assumed that average catches will be approximately 200 sockeye salmon.

Other Areas

Other popular fishing areas include: Orca Inlet, Coghill River, Eshamy Creek, Shrode

Creek, Copper River Highway streams and other freshwater and marine areas. The average catch from 1977 through 1981 was 432 king salmon, 3,943 sockeye salmon, 3,441 coho salmon, 6,446 pink salmon and 651 chum salmon (Appendix 2-6). It is projected that average harvests in these areas will be approximately 400 king salmon, 3,900 sockeye salmon, 3,400 coho salmon, 6,400 pink salmon and 700 chum salmon.

Harvests of Supplemental Stocks

The supplemental harvest data presented herein represent the projected harvest contribution of existing rehabilitation and enhancement projects when fully operational or fully utilized and when brood stocks are completely developed.

Fish Pass and Stream Improvement Projects

The US Forest Service has completed fish pass or stream improvement projects in more than 50 locations in Prince William Sound since 1962. The benefits associated with many of these projects are difficult to quantify. It is estimated that 13 of the more significant projects will annually contribute approximately 5,500 sockeye salmon to the drift gill net fishery and approximately 120,600 pink, 12,000 chum, 20,300 sockeye and 1,100 coho salmon to the purse seine fishery (Appendix 3-13 and 3-14).

Some of these projects have contributed in recent years to the seine fishery; however, the total returns are difficult to estimate. Catch data presented for natural stocks in Appendix 3-4 include some fish created as a result of these projects; however, no effort has been made to estimate the relative proportion.

Hatchery Projects

Existing facilities include seven hatcheries all of which are in various stages of completion or brood stock development (Appendix 3-15). The projected contribution of these facilities to the user groups is summarized in Appendix 3-17.

Various survival and catch rate assumptions were employed in Appendix 3-17 and 3-18. In some instances no data are available for a facility, and standard ADF&G planning assumptions have been employed (Appendix 3-16). The ADF&G assumptions are generally conservative when compared with assumptions for the Solomon Gulch Hatchery estimates of return rates experienced at Port San Juan and Cannery Creek. The actual number of fish returning to ADF&G facilities may be greater than initially anticipated. Survival and catch rate assumptions will be periodically revised as return data are compiled.

Summary

A projection of the total catches of natural and supplemental stocks for each user group is summarized in Appendix 3-18. These data will be compared with estimates of user demand in the next chapter to derive estimates of harvest shortfalls or gaps.

Assumptions

The key assumptions in projecting harvests of natural and supplemental stocks during the next 20 years are:

1) Spawning and rearing areas and conditions will remain unchanged.

2) Regulations governing methods, means and open fishing areas will remain unchanged.

3) Catches of natural stocks will be generally similar in averge magnitude and degree of fluctuation to those that occurred from 1960 through 1981.

4) Spawning and rearing habitat, including the new areas created by the 1964 earthquake, will be utilized to the same degree as in the past.

5) The proportion of natural runs caught by each user group will not change significantly despite projected increases in population and anticipated increases in sport and subsistence fishing effort.

6) Significant increases in average catch will be realized after the management program is improved and after new rehabilitation and enhancement projects are implemented.

7) Processing and market capacity will be equal to the number of fish commercially harvested annually.

CHAPTER 4

ANALYSIS OF USER DEMAND

CHAPTER 4

ANALYSIS OF USER DEMAND

The Regional Planning Team undertook an intensive public involvement effort to identify and plan for user needs. The Team drafted a 48-part questionnaire (Appendix 4-1) for distribution to sport, subsistence, commercial and nonfishermen (non-consumptive users). Provisions were made to include the input of fishermen who have never fished in the Region but would like to in the future.

The Team chose to make the questionnaire available to everyone rather than to randomly solicit participants. It was decided that a statistically accurate sampling scheme would be inordinately time consuming and difficult to implement. The foremost problem was the lack of a list of Regional sport fishermen, commercial crew members, non-permit holding subsistence fishermen and aspiring fishermen. Many of these fishermen reside outside the Region's boundaries and the development of the pools of names from which to draw would be extremely difficult.

Despite the short commings of the questionaire distributon proceses, the questionaire does provide valuable information about the general direction of long-range fisheries planning in the Region. Subsequent user-group surveys should be carefully conducted on a periodic basis to insure that the plans are aligned with user needs.

Questionnaire participants were solicited through newspaper ads, printed notices and letters and by direct contact. To reach sport fishermen, future fishermen and non-consumptive users, ads with mail-in coupons were printed four times in 13 newspapers circulated within and around the Region. Notices with mail-in coupons were placed in ADF&G offices within and around the Region as well as the offices of the Cordova Aquatic Marketing Association (CAMA), PWSAC and VFDA. Questionnaires were handed out to sport fishermen at the March meeting of the Alaska Sport Fishing Association in Anchorage and the Annual Sport Fishing Fair in Anchorage. Subsistence fishermen were contacted primarily through a list of fishermen who applied for Prince William Sound or Copper River subsistence permits in 1981. Commercial fishermen of the Region were contacted primarily through the mailing list of the *PWSAC Aquaculture News*. All commercial fishermen of the Region receive the *PWSAC News*. Questionnaires were made available at the office of CAMA and PWSAC.

Approximately 2,000 questionnaires were distributed, and 811 were returned. Of the respondents, 533 had sport fished in the Region, 471 had subsistence fished in the Region and 152 had commercial fished in the Region. Those people who have not fished for salmon in the Region but plan or hope to do so in the future included 75 sport fishermen, 31 subsistence fishermen and 5 commercial fishermen. Many respondents were members of more than one user group. Only one non-consumptive user participated.

Questionnaires were sorted by user group and gear type. Questionnaires from commercial fishermen were sorted by degree of participation (permit holder or crew member) and they were also sorted according to the Area E salmon fishery that the fisherman participated in during 1981, i.e. drift gill net only, seine only or drift and seine. This allowed for the analysis of needs and opinions of discrete groups (such as drift-only or seine-only fishermen) and all fishermen of a given group. In this manner the true problems or needs of a group of fishermen could be defined without having to deal with the biases of a related group. Groups of fishermen were further sorted according to their history of participation and their satisfaction with the fishery of 1981:

1. Fishermen who fished in the Region in 1981.
   a. Fishermen satisfied with their 1981 salmon catch or salmon fishing income.
   b. Fishermen with no opinion about their 1981 salmon catch or salmon fishing income.
   c. Fishermen dissatisfied with their 1981 salmon catch or salmon fishing income.
2. Fishermen who have fished in the Region in the past but not in 1981.
3. Fishermen who have never fished in the Region but plan or hope to do so in the future.

These groupings provided some understanding of the reasons why some fishermen were satisfied and others were not, and it helped define levels of satisfaction and user needs.

Harvest demand of sport and subsistence fishermen was estimated by two methods:

1) Minimum demand

A measure of the minimum satisfactory catch is the average catch of satisfied 1981 fishermen. The average catch of these fishermen generally exceeded the average catch of the dissatisfied fishermen, and it may be surmised that a threshold of satisfaction does exist. The total minimum demand, the number of fish required to satisfy the majority of the fishermen, can be estimated by multiplying the average catch of the satisfied fishermen by the number of fishermen in the Region. The minimum demand for the year 2002 can be estimated by multiplying the current minimum demand by the projected increase in population of the Region.

2) High demand

The high demand is the number of salmon that fishermen stated they desire to catch. This demand is several fold greater than the minimum demand. Theoretically, the high demand is the catch required to satisfy 100 percent of the fishermen. The total high demand is the average desired catch multiplied by the number of fishermen who fish in the Region. The high demand for the year 2002 is the current high demand expanded by the projected population increase of the Region.

The minimum demand of commercial fishermen is the minimum income required to sustain his or her commercial fishing boat or set net site and provide necessary personal income. Commercial fishermen differ in one basic aspect from sport or subsistence fishermen. They are engaged in a business and, as businesspeople, desire to earn as much profit as possible. Their high demand is, subsequently, difficult if not impossible to derive or calculate.

Commercial fishermen, in addition to garnering income from fishing, also often times take home a portion of their catch for their personal use. This is done without need of a subsistence permit. Demand, therefore, is in the form of earnings and personal-use fish.

The minimum demand of commercial fishermen was estimated in various ways:

1) Permit holders and crew members were asked how much they need to gross in an average year to pay their fishing and living expenses and make a reasonable profit from their fishing investments. They were also asked what percentage of their gross income they would prefer to earn from a given fishery. The current desired gross earnings from a given fishery was derived by multiplying the desired gross income by the desired percentage from the fishery. These data provide an estimate of the desired minimum income of commercial fishermen in view of the costs that prevailed in the spring of 1982. Demand estimates for seine permit holders were adjusted to reflect anticipated upgrading of boats. Processors may require refrigeration of the catch of seiners.

2) Estimates of investments and costs made by Larson (1980) and Wiese (personal communication) were compared with the data derived above. These data provided a check of the accuracy of the desired income data (above).

3) The average 1981 earnings of permit holders and crew members for each fishery were calculated and compared with the satisfaction rate of fishermen who participated soley in a given fishery. This provided a gross indication of the adequacy of the seine and drift gill net incomes in 1981.

4) The number and species of salmon taken out of the commercial catch for personal use was calculated for each group of fishermen.

Satisfaction of commercial fishermen needs is dependent on several variables, including costs of operation, exvessel prices and quantity of fish. The questionnaire provides an estimate of income needs at a point in time, i.e. spring, 1982. These data are the basis for establishing the initial long range objectives for the commercial salmon fishery. The variables listed above, particulary exvessel prices and quantity of fish, have and will undergo annual fluctuations. It is obvious that a change in fisherman costs will result in a change in income needs and that as exvessel prices move up or down, the number of fish required to meet the minimum income needs of commercial fishermen will change. At this time we can only make general assumptions about the long range trends of these variables. Periodic reevaluation of these variables and adjustment of the objectives will be required to insure that this plan keeps pace with the needs of the fishermen.

Finally, it should be noted that user demands transcend numbers of fish caught or dollars earned. Some users rank other aspects higher than lack of fish or lack of earnings, i.e. unstable prices, overcrowded fishing areas and lack of access. Many sport and subsistence fishermen view fishing as a total outdoor experience and the number of fish caught is often of secondary importance. It may be more cost effective in some situations to promote improved campgrounds and access routes rather than increase the number of salmon.

Commercial Fishermen

Commercial salmon fishing in the Region in 1981 was conducted by means of drift gill nets and purse seines. The set gill net fishery did not open in 1981 due to lack of sockeye salmon escapement in the Eshamy District. An estimated 1,377 fishermen participated in the salmon fishery in 1981.

Purse Seine Permit Holders

Approximately 19 percent (51) of the purse seine permit holders completed a questionnaire. The vast majority of these fishermen (80 percent) were satisfied with their earnings from salmon fishing in Area E in 1981 (Appendix 4-2, Q 24). Both seine-only and seine-drift fishermen exhibited satisfaction rates approximating this magnitude. The total exvessel value of the salmon harvested by the seine fishermen in 1981 was $45.9 million. Average earnings for each of the 266 permit holders that participated in the fishery were $172,000.

The four most important problems of the salmon fisheries of the Region, as ranked by the seine-only fishermen, were: unstable prices (13), lack of processors (4), lack of enforcement (3), and too much gear (1) (Appendix 4-2, Q 44). It should be noted that the questionnaire was distributed immediately after the botulism scare occurred in 1982. Many processors were experiencing pack recalls and canned salmon sales were temporarily slowed or halted.

Seine-only fishermen when asked what they needed to gross in an average year to pay their fishing and living expenses and make a reasonable profit from their fishing expenses responded that they'd like to gross $148,000, 70 percent of which ($104,000) they'd like to make by salmon seining in Area E. Seine-drift fishermen responded that they'd like to gross $163,000, 66 percent of which ($108,000) they'd like to earn by salmon seining in Area E. Collectively, these groups desired to gross $156,000, 68 percent of which ($106,000) they desired to earn from salmon seining in Area E (Appendix 4-2, Q 30 and 33).

Estimates of the minimum revenue requirements of some seine permit holders suggest that a desired gross income of $106,000 for seine permit holders is reasonable (Appendix 4-3). The difference between the hypothetical income requirement of $121,350 and the desired income level expressed by the respondents may largely be due to lower average permit and gear payments. The majority of respondents indicated that their permits were owned free and clear (Appendix 4-2, Q 34). The desired gross income from seining of $106,000 is probably a reasonable approximation of current demand.

Minimum demands of seine permit holders, in 1981 dollars, are expected to increase during the next 20 years due to the anticipated mandatory upgrading of boats. The maintenance of existing prices and markets and the development of new markets, may depend largely on the improvement of fish quality. Heretofore, it has been common practice to carry fish in dry, unchilled fish holds for as long as 12 hours. It is probable that all boats will be required to have chilled fish holds. Chilled sea water equipment is perhaps the most practical. Many boats in the fleet cannot be converted, and these boats will have to be replaced. It has been estimated by Jack Shaw (personal communication) that a seine boat with a chilled sea water system will cost a minimum of $200,000 in 1981 dollars. This represents approximately a 100 percent increase in boat value over estimates used in the compilation of the hypothetical revenue requirements in Appendix 4-3. To increase the cost of an average seine boat in Appendix 4-3 from approximately $98,000 to $200,000 may cause annual boat, permit and gear payments to increase by 36 percent and insurance costs to roughly double. This assumes that the boat, permit and gear are financed under the conditions set forth in Appendix 4-3. The net effect in Appendix 4-3 would be an increase in costs of approximately $18,000. This represents an overall increase in revenue requirements of approximately 15 percent. It may be reasonable to assume that if the average value of seine boats increase to $200,000, the current desired gross income of $106,000 may increase by approximately 15 percent. An estimate of future demand is therefore $122,000.

Seine-only fishermen preferred foremost to fish for pink salmon (9), followed by sockeye salmon (7), chum salmon (6) and king salmon (1) (Appendix 4-2, Q 37). Preferred districts for seining, as indicated by all seine respondents were: Southwestern (21), Southeastern (8), Northern (8) and Eastern (7) (Appendix 4-2, Q 42). Preferred districts for new enhancement and rehabilitation projects, as indicated by seine-only fishermen, included: Eastern (4), Northern (4), Coghill (4), Copper River (2), Northwestern (2) and Southwestern (2) (Appendix 4-2, Q 43).

Most of the seine permit holders (78 percent) indicated that they take a portion of their commercial catch home for personal use (Appendix 4-2, Q 38). When asked which species they preferred to take home, the seine-only fishermen responded: sockeye salmon (10), king salmon (9) and coho salmon (1) (Appendix 4-2, Q 39). The average take-home catch of seine-only fishermen in 1981 was 0.6 king salmon, 3.8 sockeye salmon, 4.5 chum salmon, 3.6 pink salmon, 3.2 coho salmon (Appendix 4-2, Q 40).

Drift Gill Net Permit Holders

In Area E there are currently 529 permanent and 12 interim salmon drift gill net permit holders. Interim permit holders include fishermen who have disputed claims for permanent permits. A total of 110 drift permit holders (20 percent) completed a questionnaire. Of these, 53 (48 percent) participated only in the drift fishery in 1981, 55 (50 percent) participated in both the drift and seine fisheries in 1981 and 2 (2 percent) did not fish for salmon in Area E in 1981 (Appendix 4-4).

When asked what are the four most important problems with the salmon fisheries of the Region, the fishermen who drift fished only in 1981 replied: lack of fish (12), management of the fisheries (10), too much gear (8) and lack of processors (5) (Appendix 4-4, Q 44).

The majority of the drift-only fishermen (62 percent) were dissatisfied with their earnings from salmon fishing in Area E in 1981. The majority (73 percent) of the drift-seine fishermen, however, were satisfied with their earnings from salmon fishing in Area E in 1981 (Appendix 4-4, Q 32). The seine fishery of 1981 encompassed record high pink and chum salmon catches.

The total exvessel value of salmon caught by drift fishermen in 1981 was approximately $12.5 million. Average earnings for each of the 541 permits were $23,037. It is currently not known how many permit holders actually participated in 1981. Peak fishing effort consisted of 409 boats. Assuming that no more than 409 permit holders fished in 1981, the average earnings of permit holders who drift gill net fished were approximately $30,600.

Dissatisified drift-only fishermen, when compared with the satisfied drift-only fishermen, had less experience in the drift fishery, and higher proportions of these fishermen were financing their permit and/or boat (Appendix 4-4, Q 26, 34 & 36).

Most of the drift-only fishermen indicated that they wished to continue participating in the fishery in the same capacity. The majority of those who wished to participate in the seine and set net fisheries were dissatisfied fishermen (Appendix 4-4, Q 27). Obviously, diversification was viewed as a solution to poor earnings experienced in 1981.

When asked, "What do you need to gross in an average year to pay your fishing and living expenses and make a reasonable profit from fishing investments?" drift-only fishermen gave an average response of $66,000. These fishermen indicated that they'd prefer to make on the average 83 percent of their gross income from salmon drift gill netting in Area E. This equates to a desire to earn approximately $55,000 from drift gill netting. Drift-seine fishermen indicated a need to gross $100,000, 45 percent of which ($45,000) they'd prefer to derive from salmon drift gill netting in Area E. Collectively, both of these groups registered a need to gross $79,000, 63 percent of which ($50,000) they'd prefer to derive from salmon drift gill netting in Area E (Appendix 4-4, Q 30 and 33). The average desired income is similar to estimated minimum revenue requirements of hypothetical drift gill net permit holders of approximately $49,150 (Appendix 4-3). Considering current costs and prices, the desired gross income of $50,000 is perhaps a reasonable estimate of current minimum demand.

The future minimum demand is difficult to estimate. Average values of boats, permits and costs may increase at a rate faster than inflation. Salmon prices may in the long run decline. At present, it is perhaps most logical to assume that these factors will remain relatively constant with regard to inflation and that the demand will be $50,000 (1981 dollars) in the year 2002. Periodic evaluation will be required to affirm this.

Drift-only fishermen indicated that they prefer foremost to fish for sockeye salmon (40) followed by king salmon (7) and coho salmon (3) (Appendix 4-4, Q 37). Preferred fishing districts for gill netting, as ranked by all drift fishermen, were: Copper River (65), Coghill (33), Bering River (9) and Eshamy (1) (Appendix 4-4, Q 41). Preferred districts for new enhancement or rehabilitation projects, as ranked by drift-only fishermen, were: Copper River (25), Coghill (11), Bering River (4) and Eshamy (3) (Appendix 4-4, Q 43).

The majority of drift-only fishermen (83 percent) indicated that they take a portion of their commercial salmon catch home for personal use. The average take, during 1981, of drift-only fishermen was: 2.7 king salmon, 16.3 sockeye salmon, 0.2 chum salmon, 0.6 pink salmon and 9.2 coho salmon (Appendix 4-4, Q 40). Sockeye salmon (24) were preferred for personal use followed by king salmon (22) and coho salmon (2) (Appendix 4-4, Q 39).

Set Gill Net Permit Holders

Of the 26 permanent and 4 interim set net permit holders in Area E, only 3 fishermen responded to the questionnaire (Appendix 4-5). These fishermen were dissatisfied with their earnings from salmon fishing in Area E in

1981 (Appendix 4-5, Q 32). The salmon set gill net fishery, which is only conducted in the Eshamy District, did not open in 1981. Insufficient sockeye salmon escaped to Eshamy Lake to allow the fishery to open.

Respondents indicated that lack of fish was the most important problem with the salmon fisheries of the Region (Appendix 4-5, Q 44).

Respondents indicated a desire to gross an average of $16,000 from the set gill net fishery (Appendix 4-5, Q 33). Estimates of the minimum revenue requirements of hypothetical set gill net permit holders suggest that a desired gross income of $16,000 is reasonable (Appendix 4-3). The desired gross income of $16,000 is therefore the estimate of current demand and future demand (1981 dollars).

Respondents indicated that they preferred to fish for sockeye salmon and that the Eshamy District was the preferred location for new rehabilitation or enhancement projects (Appendix 4-5, Q 37 & 43).

Two fishermen indicated that they take a portion of their commercial catch home for their personal use. Sockeye salmon were the preferred species for personal use (Appendix 4-5, Q 38 & 39).

Crew Members

It is estimated that approximately 851 seine crew members and possibly 170 drift gill net crew members participated in the salmon fisheries of the Region in 1981. This is predicated on an average seine crew size of 3.2 fishermen (excluding the permit holder) and an average drift crew size per permit of 0.3 fishermen (excluding the permit holder).[44] No set gill net crew members participated in that fishery in 1981 due to a complete closure of the fishery.

Respondents included 9 crew members who participated only in the seine fishery in 1981, 12 drift permit holders who were also seine crew members in 1981, 3 fishermen who participated as crew members in both the seine and drift fisheries in 1981 and one former set gill net crew member (Appendix 4-5 and 4-6).

Crew members are normally paid a percentage of the gross revenues less some expenses such as food. Crew share percentages normally range from 8 to 13 percent, with a mean of about 10 percent. Seine crew members, in 1981, probably earned an average of $17,000. Drift crew earnings for 1981 are difficult to estimate. Average earnings probably were between $2,000 and $5,000.

The majority of the seine crew members were satisfied with their earnings from salmon fishing in Area E in 1981 (Appendix 4-6). Seine crew members as a whole indicated a need to earn approximately $17,000 from salmon seining (Appendix 4-6, Q 33). The seine-crew-only fishermen considered the most important problems with the commercial salmon fisheries to have been: unstable prices (5), lack of fish (1), lack of enforcement (1), and lack of processors (1) (Appendix 4-6, Q 44)

The 3 drift-crew respondents were not satisfied with their earnings from salmon fishing in Area E in 1981. These fishermen indicated a need to earn on the average $6,000 from salmon gill netting (Appendix 4-5, Q 33). They considered lack of processors and unstable prices to have been the most important problems of the commercial salmon fishery in 1981.

The former set gill net crew member indicated a need to gross $10,000 from salmon set gill netting in Area E (Appendix 4-8, Q 33).

Most of the seine-crew-only and drift-crew fishermen indicated that they take a portion of their commercial salmon catch home for personal use (Appendix 4-5 and 4-6, Q 40). Seine-only fishermen indicated an average take of 0.9 king salmon, 3.9 sockeye salmon, 5.4 chum salmon, 3.7 pink salmon and 3.3 coho salmon (Appendix 4-6, Q 40). Drift crew fishermen indicated an average take of 1.7 king salmon, 6.7 sockeye salmon, 5.0 chum salmon and 8.3 coho salmon (Appendix 4-5, Q 40).

Subsistence Fishermen

Respondents to the questionnaire included 445 subsistence fishermen who fished in the Region in 1981, 26 fishermen who have fished in the Region but did not do so in 1981 and 31 aspiring subsistence fishermen who have not fished in the Region but would like to do so (Appendix 4-7 and 4-8). Of the 1981 fishermen, 356 used dip nets, 58 used fishwheels, 13 used gill nets and 18 indicated that they used more than one type of gear.

Dip Net Fishermen

These fishermen are the largest group of subsistence fishermen in the Region. A total of 3,555 dip net permits were issued in 1981. Of these, 2,739 were issued to families and 816 were issued to individuals. A total of 356 dip net fishermen who fished in 1981 responded to the questionnaire. Respondents indicated that the four most important problems with the fishery in 1981 were: overcrowded fishing areas (65), restrictive regulations (51), lack of open areas (44) and lack of access (41) (Appendix 4-7, Q 23). Lack of fish was ranked fifth. The fishery is limited to the Chitina Subdistrict on the main Copper River (Figure 2-10).

Assuming that only one response was received per permit, the respondents who fished in 1981 constituted approximately 10 percent of the individiuals or families who were issued permits in 1981. Respondents tended to be more successful than the average fishermen. Respondents caught approximately 6,124 salmon or 21 percent of the reported total catch of 28,872 salmon.

The majority of respondents were dissatisfied with their catch in 1981: dissatisfied 52 percent, satisfied 44 percent and no opinion (or no answer) 4 percent (Appendix 4-7, Q 19)). Satisfied respondents caught an average of 22.8 salmon, dissatisfied respondents caught an average of 11.7 salmon and no opinion respondents caught an average of 29.7 salmon (Appendix 4-7, Q 18). It is estimated that the 3,199 non responding permit holders caught approximately 22,748 salmon or 7.1 salmon per permit holder.[21]

Satisfied respondents caught more king, sockeye and coho salmon than dissatisfied respondents (Appendix 4-7, Q 18). All dip net respondents indicated the following species preference: sockeye salmon (216), king salmon (111), silver salmon (31) and pink salmon (4) (Appendix 4-7, Q 17). These data suggest that fisherman satisfaction was related primarily to the catch of sockeye salmon and secondarily to the catch of king salmon. It is not known, however, if these fishermen were satisfied because they caught 19.2 sockeye salmon, 19.2 sockeye salmon plus 1.6 king salmon or if they were satisfied because they caught a total of 22.8 salmon.

Satisfied respondents caught slightly more sockeye and coho salmon than no opinion respondents, fewer king salmon than no opinion respondents and fewer total salmon than no opinion respondents (Appendix 4-7, Q 18). It is not known why the no opinion respondents were not satisfied or did not answer question 19.

In view of the apparent bias in the sample of dip net fishermen and the anticipated limited rehabilitation and enhancement opportunities for king and coho salmon in the Copper River drainage, the most realistic definition of current minimum demand at this time may be the average total catch of 22.8 salmon. It is assumed that efforts to meet this demand will center on sockeye salmon. Unfortunately, no alternate or independent unbiased estimates of minimum demand are available to confirm the accuracy of the questionnaire results. Further evaluation encompassing an unbiased sample of all dip net fishermen will be required to refine these estimates.

The current minimum demand, as indicated by the number of 1981 permits issued, is estimated to be 81,100 salmon. Knapp (1982) projects that the population of the Region will increase by 43 percent between 1980 and 2002 (Appendix 2-8). The projected minimum demand in the year 2002, assuming a 43 percent increase in permits, is estimated to be 116,000 salmon.

Approximately 92 percent of the 407 respondents who have dip net fished or hope to do so in the future, completed both the sport and subsistence sections of the questionnaire. These data suggest that a portion of the high dip net demand can be met if both the minimum sport and dip net demands are satisfied. If the minimum sport demand of an average catch 12.4 salmon were to be met by the 92 percent contingent of the 3,555 dip net fishermen who were sport fishermen, approximately 40,600 salmon would be harvested. If the minimum dip net demand of an average catch of 22.8 salmon were to be met by all dip net permit holders, then approximately 81,100 salmon would be harvested. The total harvest from both sources of all dip net permit holders would thereby be 121,700 salmon. The average harvest would be 34.2 salmon. All dip net respondents when asked, "How many salmon do you and your family need per year?" responded with an average of 40 salmon (Appendix 4-7, Q 22). The difference between the number of salmon provided if both the minimum sport and dip net demands were met (34.2 salmon) and the high demand of all dip net fishermen (40 salmon) is 5.8 salmon. For 3,555 dip net permit holders, this equates to approximately 20,600 salmon. The current high demand of dip net fishermen can thereby be satisfied, disregarding species composition, if the current minimum sport demand of 62,000 salmon were to be met, the current minimum dip net demand of 81,100 salmon were to be met and an additional 20,600 salmon were to be provided.

No attempt has been made to adjust the minimum demands of dip net fishermen to account for participation by sport fishermen. It is assumed that the minimum demand of sport-subsistence fishermen is the minimum sport fish demand of an average of 12.4 salmon plus the minimum dip net demand of an average of 22.8 salmon and not some lesser number.

The high demand in the year 2002, assuming a 43 percent increase in permits and the continuation of the same degree of joint participation by sport fishermen, may be achieved if an estimated 29,500 salmon are provided in addition to fish required to meet the combined future minimum demand of sport and dip net fishermen of 204,600 salmon.

Satisfaction of the future high sport demand of 196,000 salmon would provide more than the 29,500 salmon required to meet the future high dip net demand. It is estimated that approximately 92 percent or 3,271 of the 3,555 dip net permit holders who fished in 1981 were also sport fishermen. These joint fishermen constituted approximately 65 percent of the estimated 5,000 sport fishermen who fished in 1981. Should the number of sport and dip net fishermen increase at the same rate during the next 20 years and should the high sport demand of 196,000 salmon be realized, then approximately 65 percent of these fish or 127,000 salmon would be provided to sport-dip net fishermen.

Fishwheel Fishermen

During 1981, 501 fishwheel permits were issued to families and 22 fishwheel permits were issued to individuals. A total of 58 fishwheel fishermen responded to the questionnaire (Appendix 4-7). Repondents indicated that the foremost problems with the subsistence fisheries of the Region were: lack of access (9), lack of fish (8), overcrowded fishing areas (5), restrictive regulations (5) and lack of open areas (5) (Appendix 4-7, Q 23). The fishwheel fishery is conducted in the Glennallen Subdistrict on the main Copper River (Figure 4-1).

The total catch of all fishwheel fishermen in 1981 was 26,924 salmon. Assuming no more than one response from any permit, responses were received from approximately 11 percent of the individuals or households permitted to fish in 1981.

The respondents caught 2,621 salmon or approximately 10 percent of the total 1981 fishwheel catch. Respondents caught 33 percent of the king salmon harvested, 9 percent of the sockeye salmon harvested and 100 percent of the coho salmon harvested. As with dip net respondents, fishwheel respondents caught more king and coho salmon than the average fisherman.

Fishwheel respondents demonstrated the same species preferences as the dip net respondents: sockeye salmon (39), king salmon (17) and coho salmon (2) (Appendix 4-7, Q 17).

The majority of the respondents, 62 percent were satisfied with their subsistence salmon catch in 1981. Approximately 29 percent were dissatisfied and 9 percent registered no opinion or did not answer the question (Appendix 4-7, Q 19).

Satisfied respondents caught an average of 3.5 king salmon, 39.8 sockeye salmon and 4.6 coho salmon (Appendix 4-7, Q 18). The average catch of fishwheel fishermen was higher than that of dip net fishermen because fishwheel permit holders, depending on income and family size, are allowed to harvest 15 to 500 salmon. Dip net permit holders are allowed to harvest 15 to 30 salmon. As with dip net fishermen, it is not known if fishwheel fishermen were satisfied because they caught more sockeye salmon, more sockeye and king salmon or because of their total catch.

The minimum demand is estimated to be the sum of the average catch by species of satisfied fishermen or 48 salmon. Because of the limited rehabilitation and enhancement opportunities which may prevail with king and coho salmon in the Copper River and the preference for sockeye salmon, it is assumed that most of the demand will be met with sockeye salmon. The total current minimum demand is tentatively estimated to be approximately 25,100 salmon. Assuming a 43 percent increase in permits, the minimum demand in the year 2002 is projected to be 35,900 salmon.

Approximately 62 percent of the 58 respondents who have subsistence fished with a fishwheel or hope to do so in the future, completed both the sport and subsistence sections of the questionnaire. These data suggest that a portion of the high fishwheel demand will be satisfied if the minimum sport and fishwheel demands are met. If the minimum sport demand of an average catch of 12.4 salmon were to be met by the 62 percent of the 523 fishwheel fishermen who were sport fishermen, approximately 4,000 salmon would be harvested. If the minimum fishwheel demand of an average catch of 48 salmon were to be met by all permit holders, then approximately 25,100 salmon would be harvested. Fishwheel permit holders would thereby realize a total harvest from both sources of 29,100 salmon. The average harvest would be 55.6 salmon. All fishwheel fishermen when asked, "How many salmon do you and your family need per year?" responded with an average of 111 salmon (Appendix 4-7, Q 22). The difference between the number of salmon provided if both the minimum sport and fishwheel demands were met (55.6 salmon) and the high demand of all fishwheel fishermen (111 salmon) is 55.4 salmon. For 523 fishwheel permit holders, this equates to approximately 29,000 salmon. The current high demand of fishwheel fishermen can thereby be satisfied, disregarding species composition, if the current minimum sport demand of 62,000 salmon were to be met, the current minimum fishwheel demand of 25,100 salmon were to be met and an additional 29,000 salmon were to be provided.

No attempt has been made to adjust the minimum demands of fishwheel fishermen to account for joint participation by sport fishermen. It is assumed that the minimum demand of sport-subsistence fishermen is the minimum sport fish demand plus the minimum fishwheel demand and not some lesser number.

The high demand in the year 2002, assuming a 43 percent increase in permits, may be met if the future minimum sport and fishwheel demands of 124,600 salmon are achieved and an additional 41,500 salmon are provided.

Satisfaction of the future high sport demand of 196,000 salmon would provide approximately 11,800 of the 41,500 salmon required to meet the future high fishwheel demand. It is estimated that approximately 62 percent or 324 of the 523 fishwheel permit holders were also sport fishermen. These multi-gear fishermen constituted approximately 6 percent of the estimated 5,000 sport fishermen who fished in 1981. Should the number of sport and fishwheel fishermen increase at the same rate during the next 20 years and should the high sport demand of 196,000 salmon be realized, then approximately 6 percent of these fish or 11,800 salmon would be provided to sport-fishwheel fishermen. Satisfaction of the high demands of fishwheel fishermen would thereby require that 29,700 salmon be provided in addition to sufficient fish to meet the future minimum fishwheel demands and the future high sport demands.

Gill Net Fishermen

During 1981, 72 gill net permits were issued for the Copper River Flats and 11 were issued for Prince William Sound. Of the permitted fishermen, 29 were successful in catching salmon, 4 were unsuccessful, 25 did not fish and 25 did not return their permits.[21] A total of 13 gill net subsistence fishermen responded to the questionnaire. Of these, 11 respondents caught salmon. The respondents considered the most important problems with the subsistence fisheries of the region to have been: lack of enforcement (2), overcrowded fishing areas (2) and restrictive regulations (2) (Appendix 4-8, Q 23).

Assuming no more than one response per permit, 11 successful respondents comprised approximately 38 percent of the successful permitted individuals or households. Respondents caught approximately 310 salmon; whereas, the total reported catch in 1981 was 331 salmon.[21] As with the sport, dip net and fishwheel respondents, more successful fishermen completed and returned a questionnaire than unsuccessful fishermen.

Of the 13 respondents, 8 were satisfied with their salmon subsistence catch in 1981 (Appendix 4-8, Q 19). Satisfied respondents caught an average of 32.5 salmon, and dissatisfied respondents caught an average of 16.0 salmon. Satisfied respondents caught slightly more king salmon and considerably more sockeye and coho salmon than the dissatisfied respondents (Appendix 4-8, Q 18). King salmon were the preferred species followed by sockeye salmon (Appendix 4-8, Q 17).

In view of the apparent bias in respondents, estimates of user demand should be regarded as tentative. The apparent minimum demand, as indicated by the catch of satisfied respondents, is approximately 32.5 salmon. The current total minimum demand for the 83 permit applicants is approximately 2,700 salmon. Assuming a 43 percent increase in permits, it is estimated that the demand in the year 2002 will be approximately 3,900 salmon.

Approximately 68 percent of the 34 respondents who have subsistence fished with a gill net or hope to do so in the future, completed both the sport and subsistence sections of the questionnaire. These data suggest that a portion of the high gill net demand may be met if both the minimum sport and gill net demands are satisfied. If the minimum sport demand of an average catch of 12.4 salmon were to be achieved by 68 percent of the 83 gill net fishermen, approximately 700 salmon would be harvested. If the minimum gill net demand of an average catch of 33 salmon were to be met by all gill net permit holders, then approximately 2,700 salmon would be harvested. The total harvest from both sources would thereby be 3,400 salmon. The average harvest would be 41.0 salmon. All gill net respondents when asked, "How many salmon do you and your family need per year?" responded with an average of 42 salmon (Appendix 4-8, Q 22). The difference for all permit holders is less than 100 salmon. The current and future high demands of gill net fishermen will virtually be satisfied, therefore, if the minimum sport and gill net demands are achieved. Increases in sport harvests beyond the minimum demand level will provide the additional 100 salmon required.

Sport Fishermen

It is estimated that approximately 5,000 anglers fished for salmon in the Region in 1981 (Watsjold, personal communication), and, of these, 396 or 8 percent completed a questionnaire. Other respondents included 137 fishermen who have fished in the Region but did not do so in 1981 and 75 fishermen who have never fished in the Region but would like to (Appendix 4-9, Q 1).

According to the fishermen who fished in the Region in 1981, the four most important problems with the salmon sport fisheries of the Region were: overcrowded fishing areas (76), lack of fish (57), lack of access (56) and restrictive regulations (48) (Appendix 4-9, Q 14).

Of the fishermen who fished in the Region in 1981, approximately 45 percent were dissatisfied with their salmon catch, 43 percent were satisfied and 12 percent had no opinion or did not answer the question (Appendix 4-9, Q 10). Fishermen registering "no opinion" often indicated in the margin of the questionnaire that they did not know or were unsure if their catch was adequate. Some fishermen felt that the number of fish caught was not important.

Satisfied fishermen on the average caught more salmon of each species than dissatisfied fishermen (Appendix 4-9, Q 9). The dissatisfied fishermen regarded the food aspects of sport fishing more highly than the satisfied fishermen (Appendix 4-9, Q 6), and, as is indicated by the answers to Question 12, their desired catch was generally higher than the desired catch of the satisfied fishermen.

It should be noted that Question 9 (Appendix 4-1) erroneously did not specifically ask the questionnaire participant to record only the number of salmon caught and kept. Some fishermen noted the number kept and the number released, and the latter fish were excluded in the analysis of the data. It is assumed that the data in Appendix 4-9, question 9 encompass insignificant numbers of released fish.

The 1981 fishermen perceived differing Regional problems according to the area they selected as their favorite fishing area. The four favored areas were: the Gulkana River (119), Valdez Bay (68), the Eyak River (27) and Passage Canal (Whittier) (24) (Appendix 4-9, Q 7).

Fishermen who preferred the Gulkana River ranked the most important problems: overcrowded fishing areas (27), lack of access (18), restrictive regulations (18), management of the fisheries (12) and lack of fish (10).* The Gulkana River flows across large holdings of land owned by the AHTNA Native Corporation. A fee is required of fishermen to gain access to AHTNA land.

Fishermen who preferred Valdez Bay ranked the most important problems as: lack of fish (15), overcrowded fishing areas (11), lack of access (10) and lack of enforcement (10).* Freshwater salmon fishing is prohibited in Valdez Bay, and trolling is the principal means of harvesting salmon.

Fishermen who preferred Eyak River ranked the most important problems as: lack of enforcement (7), overcrowded fishing areas (2), lack of access (2) and inadequate campgrounds (2).* Boat traffic on this

*Data not included in Appendix 4-9.

relatively small river is heavy during the salmon run. A boat is generally required to reach the best fishing areas.

Fishermen who preferred Passage Canal (Whittier) ranked the most important problems as: lack of fish (6), lack of access (6), lack of enforcement (3), overcrowded fishing areas (3) and lack of boat slips (2). Spawning populations of preferred species are few in number. The fishery is heavily dependent on supplemental coho salmon transplants. Access is available by means of the Alaska Railroad.

Fishermen who selected these four areas were, with the exception of the Eyak River fishermen, generally dissatisfied with their salmon catch in 1981. It cannot be determined, however, if they considered the salmon fishing in their favorite area to have been unsatisfactory or if this related to fishing in the Region as a whole.

A comparison of the total 1981 harvest of the respondents and the total harvest of all fishermen indicate that questionnaire results are biased toward successful fishermen. The respondents who sport fished in the Region in 1981 comprised approximately 8 percent of the total number of anglers, and the respondents caught approximately 3,880 or 13 percent of the estimated total harvest of 29,991 anadromous salmon. Land-locked salmon are not included in this plan. Respondents caught the following percentage of the total 1981 catch: king salmon 19 percent, sockeye salmon 29 percent, coho salmon 16 percent, pink salmon 5 percent and chum salmon 28 percent.

A comparison of the average 1981 catch of the satisfied respondents (the minimum demand) and minimum acceptable catch rate data derived for Cook Inlet fishermen suggests that the aforementioned bias is of minor consequence. Fourteen years of data collected in Seward indicate that angler dissatisfaction increases sharply when catch rates fall below 0.5 coho salmon per angler day. Minimum daily catch data for other species in the Cook Inlet fishery have been defined and they are as follows: 0.2 king salmon, 0.6 sockeye salmon, 0.7 chum salmon, and 1.0 pink salmon.[45] To compare these data with the average seasonal catch of satisfied questionnaire respondents, an expansion of the minimum acceptable catch data is required. The average angler in the Prince William Sound Region fished 5.7 days for salmon in 1981.[20] By expanding the Cook Inlet data by 5.7, an estimate of the minimum acceptable seasonal catch can be obtained. A general similarity is evident between the expanded Cook Inlet data and the average seasonal catch of satisfied respondents:

A comparison of the average 1981 catch of satisfied fishermen (minimum demand) and the minimum acceptable catches (expanded) for Cook Inlet fishermen.

	King	Sockeye	Chum	Pink	Coho
Average seasonal catch of satisfied respondents (Appendix 4-9, Q 9)	1.2	3.6	1.2	2.4	4.0
Minimum acceptable catch per season (expanded Cook Inlet data)	1.1	3.4	4.0	5.7	2.8

The greatest disparity exists between estimates for chum and pink salmon. These species, according to Appendix 4-9, Q 8, were preferred least by sport fishermen of the Prince William Sound Region. Respondents as a whole ranked their favored species as: king salmon (227), silver salmon (153), sockeye salmon (140), chum salmon (1) and pink salmon (1). The average catch of the estimated 4,604 fishermen, who fished in the Region 1981 but did not complete a questionnaire, was estimated as follows: 0.4 king salmon, 0.6 sockeye salmon, 0.2 chum salmon, 3.0 pink salmon, and 1.6 coho salmon. With the exception of pink salmon, these estimates are less than the minimum acceptable catch or demand data presented above. The estimated average catch of non respondents was also generally less than the average catch of dissatisfied or no opinion fishermen in Appendix 4-9, Q 9. It may be surmised that non respondents were generally dissatisfied or had no opinion about the adequacy of their sport harvest and that satisfied anglers probably constituted a minority of the fishermen.

The current (1983) minimum demand can be estimated by multiplying the catch of the satisfied repondents by the number of fishermen who presently fish for salmon in the Region. The number of anglers residing in the Region has probably not changed significantly since 1981, and, therefore, the total number of salmon required to meet current minimum demand can be estimated as follows:

Estimates of the current minimum seasonal demand

	King	Sockeye	Chum	Pink	Coho
Average seasonal catch of satisfied respondents	1.2	3.6	1.2	2.4	4.0
Estimated number of fishermen, 1981	5,000	5,000	5,000	5,000	5,000
Current minimum seasonal demand	6,000	18,000	6,000	12,000	20,000

The minimum demand 20 years from now can be estimated by use of population projections. The minimum seasonal demand in the year 2002 is:

Estimates of the minimum seasonal demand by the year 2002

	King	Sockeye	Chum	Pink	Coho
Current minimum seasonal demand	6,000	18,000	6,000	12,000	20,000
Projected population increase, 1980-2002	43%	43%	43%	43%	43%
Projected minimum seasonal demand, 2002	8,600	25,700	8,600	17,200	28,600

It is assumed that the population did not significantly change between 1980 and 1981 and that the number of sport fishermen will increase at a rate proportionate to the population of the Region.

The current high demand can be estimated from the answer of all respondents to Question 12 (Appendix 4-1): "As a sport fisherman, how many of the following fish do you need to catch per season to feel satisfied?"

Estimates of current high demand

	King	Sockeye	Chum	Pink	Coho
Average desired seasonal catch of all respondents	3.9	10.4	1.9	2.6	8.6
Estimated number of fishermen	5,000	5,000	5,000	5,000	5,000
Current high seasonal demand	19,500	52,000	9,500	13,000	43,000

It is assumed that fishermen responded to Question 12 (Appendix 4-1) with the number of salmon they'd like to catch and keep. Approximately 63 percent of the 1981 sport fish respondents also participated in the regional subsistence fishery and, therefore, it is likely that the majority used those fish for food. Some respondents viewed Question 12 as difficult to answer and, subsequently, did not specify a desired catch. These fishermen were perhaps more interested in aesthetics as opposed to catching food.

Using the aforementioned population projections, the high demand for the year 2002 can be estimated as:

Estimates of high demand by the year 2002

	King	Sockeye	Chum	Pink	Coho
Current high seasonal demand	19,500	52,000	9,500	13,000	43,000
Projected population increase, 1980-2002	43%	43%	43%	43%	43%
Projected high seasonal demand, 2002	27,900	74,400	13,600	18,600	61,500

Assumptions

The following assumptions must be considered in the analysis of user demand:

1) The average of the catches of satisfied sport and subsistence fisherman who responded to the questionnaire is representative of minimum satisfactory catch rates.

2) Population projections are correct.

3) Desired income and cost data are representative of commercial fishermen.

4) Median household income data are representative of commercial fishermen in this Region.

5) The average values of drift gill net boats will remain relatively constant.

6) The average values of purse seine boats will increase to $200,000 (1981 dollars) by the year 2002.

CHAPTER 5

ANALYSIS OF REGIONAL GAPS

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ANALYSIS OF REGIONAL GAPS

Gaps are the shortfalls between the projected needs of the fishermen and the projected conditions that will probably exist in the year 2002. Gaps encompass both tangible items such as salmon, earnings, access roads and campgrounds and intangible items such as knowledge. Gaps in catches of salmon or earnings have been calculated and are summarized for commercial, subsistence and sport fishermen. Other gaps have also been evaluated and these are discussed collectively.

Commercial Harvest Gaps

A comparison of future natural and supplemental production estimates (Appendix 3-19) and the desired gross income levels of all permit holders, suggests that major shortfalls in earnings will soon occur among purse seine and drift gill net permit holders unless remedies are quickly implemented (Figure 5-1 and Appendix 5-1).

Purse Seine Permit Holders

It is projected that seine permit holders will experience a shortfall in earnings of $11.7 million by the year 2002. The total minimum demand is projected to be $32.9 million annually; whereas, the exvessel value of the average harvest of natural and supplemental stocks is projected to be $21.2 million. This equates to average earnings per permit holder of $79,000 annually or 65 percent of the projected minimum demand of $122,000.

Projected exvessel values are considerably less than the record high average earnings of $172,000 experienced in 1981. Recent record high returns of pink salmon have largely been due to unusually high survival of natural stocks. A comparison of parent year index escapements and the returns that occurred during 1979 through 1981 indicate an average return per spawner of 11.0 pink salmon (Appendix 3-5). During the preceding 17 years, the average return per spawner was 3.7 pink salmon. During 1979 to 1981, the Port San Juan Hatchery contributed an estimated 2.7 million pink salmon to the common property seine fishery (Appendix 2-11). The total seine catch during these three years, excluding fish harvested by PWSAC, was 48.7 million pink salmon (Appendix 3-5).

A reduction in catches from the recent high levels will probably cause permit prices to decrease and the upgrading of boats will be reduced to a minimum. Capital investments and minimum revenue requirements will probably fall to a level commensurate with the actual value of catch. This will occur at the expense of lost investments, and the frequency of bankruptcies will undoubtedly increase. Permit holders may find themselves in a financial squeeze at a time when the maintenance of existing markets or prices may be dependent on the installation of expensive chilled sea water or ice equipment on their seine boats.

Drift Gill Net Permit Holders

It is projected that drift gill net permit holders will experience a shortfall in earnings of $13.9 million by the year 2002. The total minimum demand is projected to be $27.0 million annually. The exvessel value of the average harvest of natural and supplemental stocks is projected to be $13.1 million annually. This equates to average earnings per permit holder

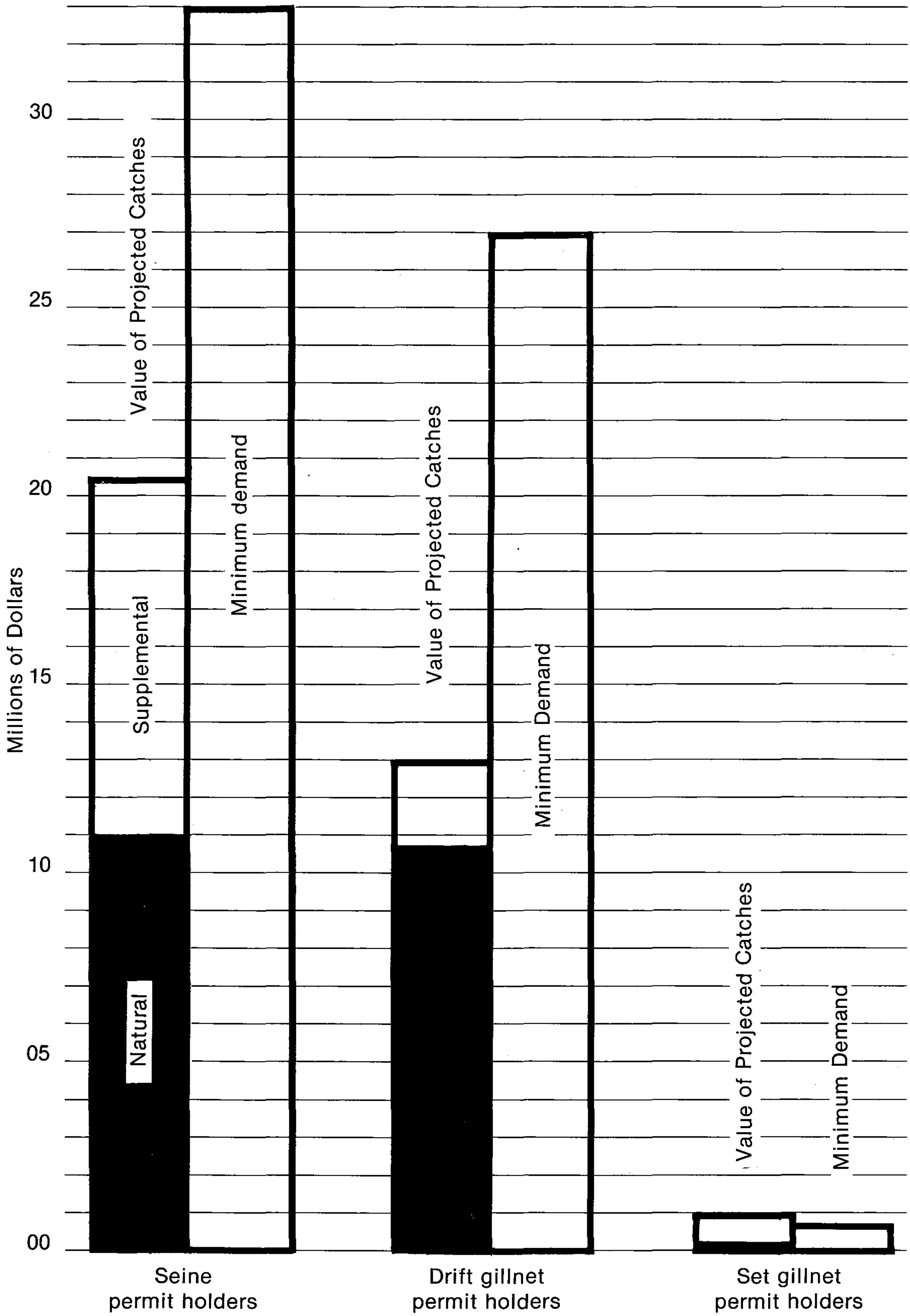

Figure 5—1. Projected catches and minimum demands of commercial fishermen.

of $24,000 annually or 48 percent of the projected minimum demand of $50,000.

Set Gill Net Permit Holders

A comparison of the minimum demand estimates based on three responses to the questionnaire and the projected commercial harvests in Appendix 5-1 suggests that no shortfall in earnings will occur in the set net fishery. The total projected minimum demand is estimated to be $480,000 annually. It is estimated that the total exvessel value of catches may be $906,000 annually. Further knowledge of the income requirements of these fishermen and the contribution of the Main Bay Hatchery will be required before a gap can be credibly defined.

Crew Members

The demands of crew members, as indicated by the questionnaires, have not been incorporated into Appendix 5-1. It is assumed that permit holders considered crew shares in their estimates of desired gross income. To meet the demands of crew members would widen the gaps in earnings in these fisheries (Appendix 5-1).

Subsistence Harvest Gaps

Major shortfalls in Upper Copper River subsistence salmon catches are projected in 20 years (Figure 5-2). These will coincide with anticipated massive shortfalls in drift gill net revenues and sport catches (Figure 5-1 and 5-3). The Gulkana Hatchery, at present capacity, will not satisfy the demand for subsistence fish.

It is projected that a minimum harvest gap of 125,900 salmon will exist for all subsistence gear types by the year 2002 (Appendix 5-2). Estimates of high demand and high gap are complicated by the large numbers of subsistence fishermen who are also sport fishermen. High subsistence demands and gaps may largely be resolved through the combined satisfaction of minimum subsistence and sport demand and high sport demands. Unfortunately, the questionnaire did not ask the joint sport-subsistence fishermen how many fish they would prefer to catch on sport gear vs. subsistence gear. It is assumed, however, that these fishermen would prefer to catch the majority of salmon on sport gear.

Sport Harvest Gaps

Major shortfalls in sport salmon catches are anticipated (Appendix 5-3). The projected total minimum and high gaps are approximately 37,000 and 142,900 salmon, respectively. Gaps in harvests of the preferred species, king, coho and sockeye salmon, are of primary importance to the sport fishermen.

Many sport fishermen have indicated that they prefer to fish in the Gulkana River, Valdez Bay, Eyak River and Passage Canal (Whittier). Fish created to resolve the gaps should, therefore, be distributed, when available, in these areas.

Knowledge Gaps

Lack of knowledge limits the management, rehabilitation and enhancement of salmon fisheries. Knowledge gaps encompass biological, environmental, technical and sociological matters. Gaps listed below are not

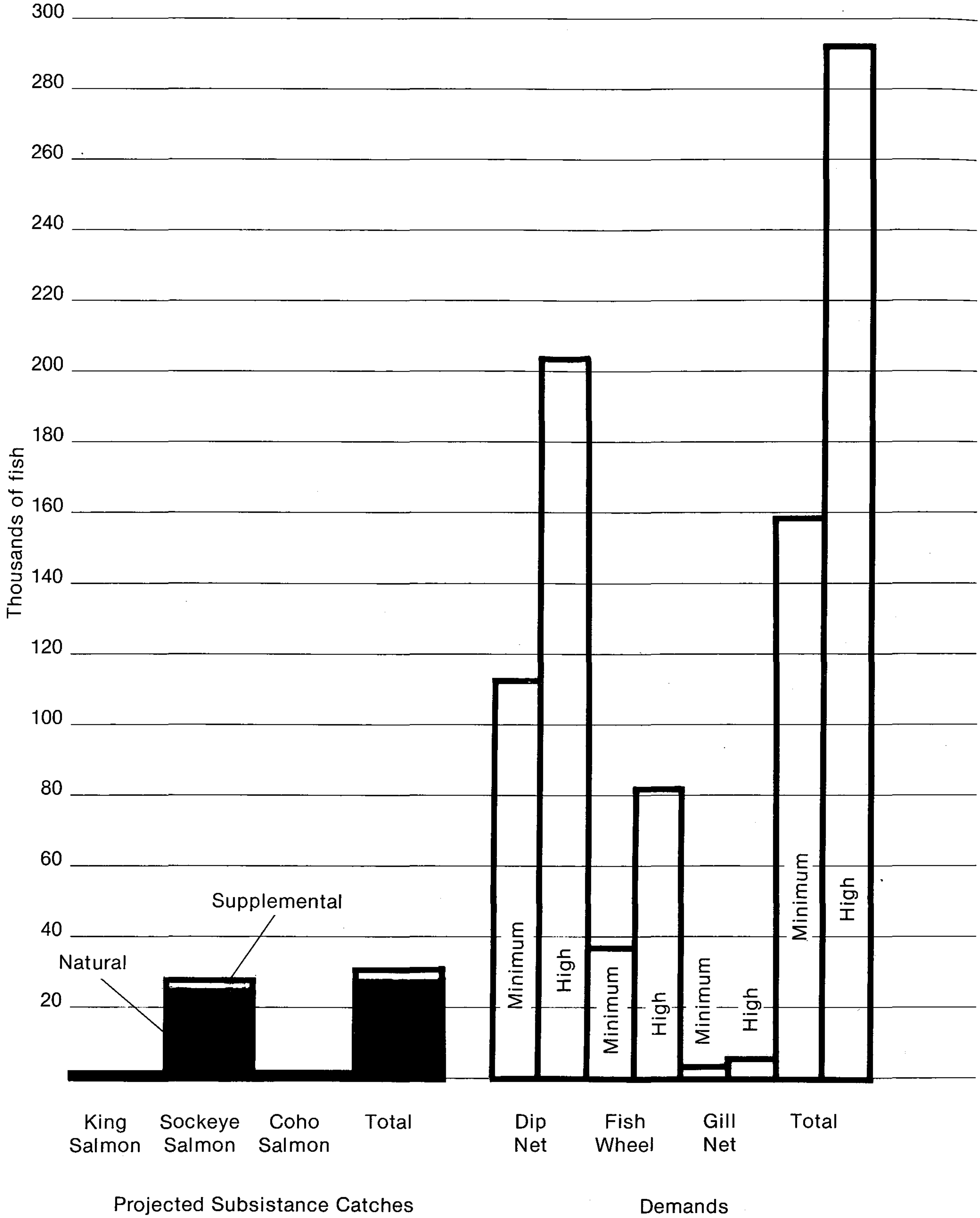

Figure 5—2. Projected catches and demands of subsistence fishermen.

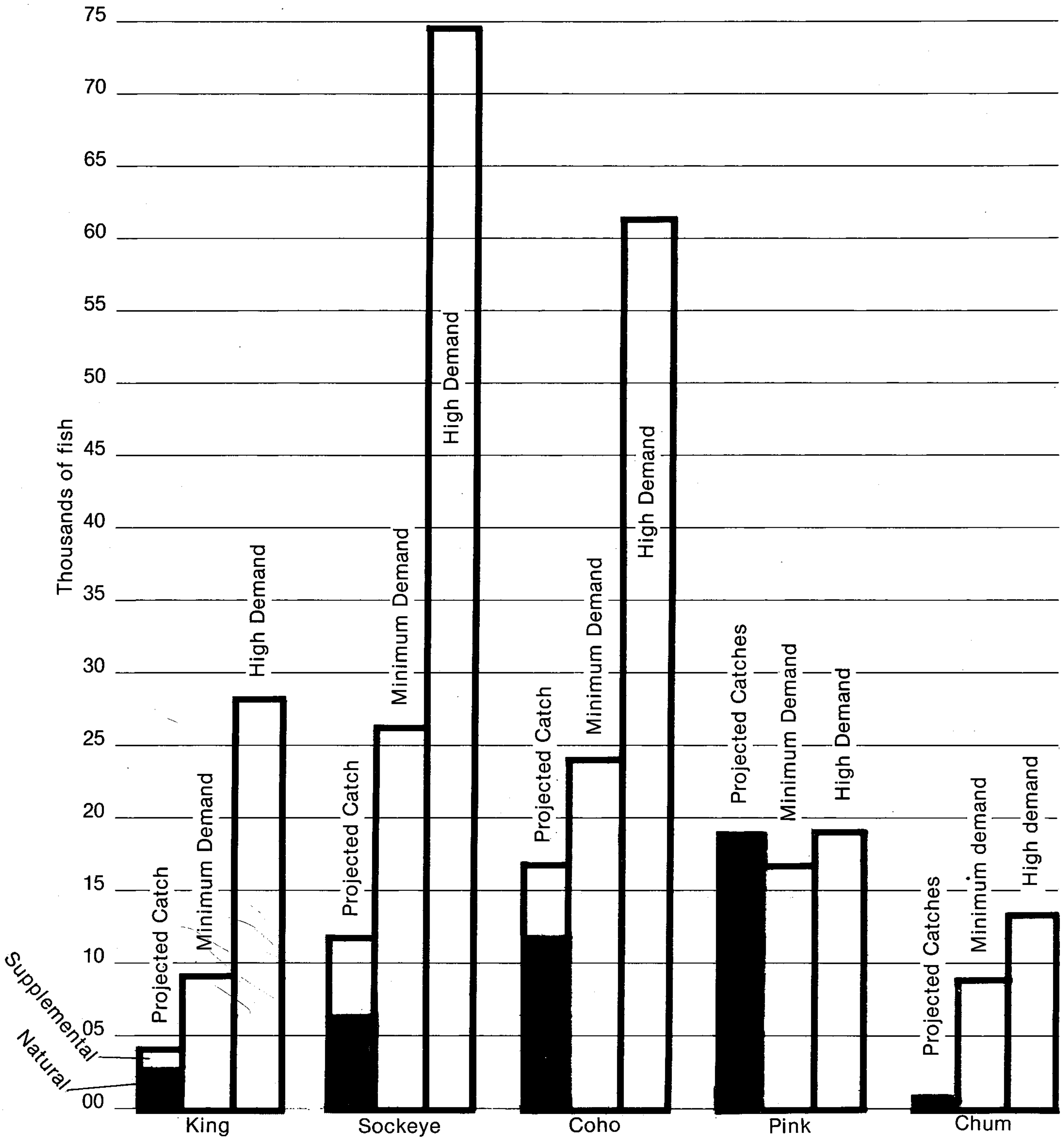

Figure 5—3. Projected catches and demands of sports fishermen.

necessarily in order of importance nor is this listing all inclusive.

Carrying Capacity

A major gap is the lack of knowledge of the carrying or stocking capacity of the freshwater and marine areas of the Region. The satisfaction of future demand will require major introductions of salmon fry in lakes of the interior and western Prince William Sound. Knowledge of the carrying capacity is required to achieve the optimum utilization of rearing areas.

Migration Routes and Milling Areas

Knowledge of the migration routes and milling areas of individual stocks, natural stocks as a whole or hatchery stocks is incomplete. This information is needed to protect natural stocks from over fishing.

Run Forecasts

Long-range run forecasting in the Region has been restricted to pink and chum salmon in the seine districts. Forecasts of runs of other species is generally not feasible due to the large number of streams and stocks. Facets lacking in the existing program are the knowledge of marine rearing conditions, time of emergence and the physical condition of fry. It is believed that knowledge of these factors combined with an increase in stream sampling would enhance the accuracy of the forecast. The planning efforts of the fishery manager, processors and fishermen would be enhanced by improved forecasts.

In-season Run Magnitude

Long-range forecasts cannot take into account rearing conditions on the high seas. A program, subsequently, is needed to define the ultimate size of the runs as they enter the fishing districts. Early knowledge of run size would enhance the implementation of appropriate harvest strategies.

Escapement Enumeration

Escapement counts provide a critical measure of the effectiveness of management practices. Escapement estimates for most stocks are presently index counts derived by aerial and ground estimation. The completeness of these counts is a function of water clarity, observer bias and percentage of the total escapement that is present during the survey. Not all spawners are necessarily present at any one time, and surveys or index counts are commonly partial estimates. In glacial drainages, index counting can commonly only occur after fish reach clearwater spawning areas. This may not occur until the majority of fish have been caught. Increased funding and improved data gathering and evaluation techniques are needed.

Stock Composition of Commercial Catches

Determination of the commerical harvest of individual natural stocks is currently not feasible. It may be feasible, however, to determine the relative harvest magnitude of individual hatchery stocks and natural stocks as a whole. This would provide a means to detect weak natural runs and implement protective measures.

Optimum Escapement

Knowledge of optimum escapement levels is required to attain the maximum harvest from each stock. Escapement goals are often based on fragmentary information. More information is needed on the stream life of spawners and the utilization of spawning areas.

Processing Gaps

Full utilization of salmon runs will require that adequate processing facilities be available to handle the harvests of commercial fishermen and private nonprofit hatcheries. The processing capacity of shore-based plants in the Region has been estimated to be approximately 697,000 salmon per day. Additional fish have been tendered daily to outlying Alaskan plants or have been processed on freezer ships. These processing outlets, however, have not been reliable. Commercial catches in 1981 often exceeded 1.0 million salmon per day. Catches of at least the same magnitude as experienced in 1981 may be required to sustain seine permit holders in the future. Should exvessel prices decline, then even larger catches and greater processing capacity will be required.

Access and Campground Gaps

Sport and subsistence fishermen cited lack of access, crowded fishing areas and lack of campgrounds as major problems with the fisheries of the Region. These problems are directly related to each other in that lack of public access crowds anglers into readily accessable public areas that lack adequate facilities. The public land base along many water bodies is decreasing due to the State land disposals and settlement of native land entitlements. Additional campgrounds, access roads and trails leading to quality fishing areas are needed.

Assumptions

1) Limited entry legislation will remain in force and the number of permit holders will not change.

2) Estimates of the contribution of existing facilities and stream improvement projects are accurate.

3) Estimates of the production status of natural runs are accurate.

4) Projections of fish prices are accurate.

5) Variables affecting user demand will not change significantly and estimates of user demand are accurate.

CHAPTER 6

REGIONAL GOALS AND OBJECTIVES

CHAPTER 6

REGIONAL GOALS AND OBJECTIVES

Goals encompass the production of additional harvestable fish, the acquisition of data and knowledge, the development of additional access routes to sport and subsistence fishing areas and development of additional campground spaces. Objectives are goals generally stated in quantifiable and realistic terms. This Phase I Plan deals with long-term, or 20 year objectives. Phase II plans, will deal with short-term or 2 to 5 year objectives.

The overall goals of this plan are to:

1. Identify user needs, problems areas and gaps.

2. Recommend means to protect and maintain the natural runs of salmon.

3. Recommend biologically sound rehabilitation and enhancement activities and projects necessary to satisfy the needs and demands of each user group.

4. Provide as many fish as possible to each user group.

5. Promote the investment of funds.

Commercial Harvest Objectives

It is an objective to provide sufficient salmon to meet the desired income levels of commercial fishermen. Once these needs are met, it is an objective to continue increasing production and harvests to improve the profits of fishermen.

Purse Seine Fishery

It is an objective to increase the average harvests and gross income of purse seine permit holders from the base level of $21.2 million to $32.9 million by the year 2002.

Purse seine permit holders indicated that they prefer, in descending order, to fish for pink, sockeye, chum and king salmon. The greatest potential for increased production lies in pink and chum salmon. These fishermen ranked their preferred fishing districts in descending order: Southwestern, Southeastern and Northern (tied) and Eastern. Their preferred districts for new rehabilitation and enhancement projects were: Eastern, Northern and Coghill (all tied). Efforts, therefore, should be concentrated on providing the preferred species in the preferred areas.

Constraints to these objectives include mixing and overharvesting of wild stocks, prices and costs. Wild stocks may mix with hatchery stocks and overharvesting of the wild stocks may occur. Terminal harvest areas, however, may allow for the total harvest of hatchery stocks without impairing wild stocks. The exvessel prices of pink and chum salmon may decline at a rate faster than harvests can be increased. Finally, the costs of permits and boats may increase faster than revenues are enhanced.

Drift Gill Net Fishery

It is an objective to increase the average harvest and gross income of drift gill net permit holders from the base level of $13.1 million to the minimum revenue requirements of $27.0 million by the year 2002.

Drift gill net permit holders expressed a preference to fish for sockeye salmon, followed in descending order by king, coho, chum and pink salmon. The greatest potential for increased production lies in pink, chum and perhaps sockeye salmon. Efforts should be concentrated on those species that are both preferred and have the greatest potential for increased production.

Drift gill net permit holders expressed a preference to fish in the Copper River District followed, in descending order, by the Coghill, Bering River, Eshamy and Unakwik districts. These fishermen when asked which districts they would prefer to have enhanced or rehabilitated, ranked these districts in the same order. Enhancement and rehabilitation opportunities are limited in the Bering River District, and efforts should be concentrated in the other preferred districts.

Constraints to the production of these fish and the satisfaction of the minimum needs of these fishermen include rearing area, fish prices and costs. Sockeye salmon rearing area in the districts listed may not be sufficient to rear the needed salmon. Exvessel prices may drop at rate faster than additional fish can be produced. Finally, the costs of commercial gill netting may increase faster than revenues can be enhanced.

Set Gill Net Fishery

It is an objective to increase the average harvests and gross income of set gill net permit holders beyond the base levels projected in Chapter 3 of $906,000.

Set gill net fishermen indicated that they preferred to fish for sockeye salmon and that they preferred that new rehabilitation and enhancement projects be conducted in the Eshamy District. It is recommended that new rehabilitation and enhancement projects in the Eshamy District should focus on sockeye salmon.

The objective may be limited by unforeseen problems with the proposed lake fertilization and stocking projects and the interception of sockeye salmon by the seine fleet.

Subsistence Harvest Objectives

Dip Net and Fishwheel Fisheries

It is an objective to provide sufficient fish by the year 2002 to meet and surpass the high catch demands of dip net and fishwheel fishermen. It is assumed that the high catch demands of most subsistence fishermen will be met if both the high sport catch demands and the minimum subsistence catch demands are met.

The objectives are to increase dip net and fishwheel catches from a combined base level of approximately 29,900 salmon to:

1) A dip net harvest of at least 116,000 sockeye salmon by the year 2002.

2) A fishwheel harvest of at least 65,600 sockeye salmon by the year 2002.

Dip net and fishwheel fishermen indicated that they desire to subsistence fish on the Copper River. It is an objective, therefore, to provide these fish in the Copper River.

Constraints to the production or harvest of these fish are similar to those described for sport fishermen. Participation in the fishery may be limited by overcrowded fishing areas, lack of access and lack of open areas. The Copper River Subsistence Management Plan currently limits subsistence harvests according to levels of escapement magnitude.

Gill Net Fishery

It is an objective to increase gill net harvests to a minimum of 4,000 salmon by the year 2002.

These fishermen indicated a preference for king salmon followed by sockeye and coho salmon. They indicated a desire to catch these fish primarily on the Copper River Flats and secondarily in the Coghill District. It is recommended that efforts be directed to provide the preferred species in the areas indicated.

Constraints to the production and harvest of these fish include rearing capacity of lakes and streams and escapement magnitude.

Sport Harvest Objectives

It is an objective of this plan to provide sufficient fish by the year 2002 to meet and surpass the high catch demands of sport fishermen. The objectives in order of user preference and priority are:

1) king salmon - increase the harvest from the base level of approximately 4,300 fish to a harvest of at least 27,900 fish by 2002

2) coho salmon - increase the harvest from the base level of approximately 16,900 fish to a harvest of at least 61,500 fish by 2002

3) sockeye salmon - increase the harvest from the base level of approximately 11,700 fish to a harvest of at least 74,400 fish by 2002

4) chum salmon - increase the harvest from the base level of approximately 1,400 fish to a harvest of at least 13,600 fish by 2002

No gap in pink salmon harvests is anticipated.

Efforts should be made to provide these fish in preferred areas.

Major constraints to these objectives include access, escapement magnitude and the rearing capacity of lakes and streams. Sport harvests have been limited to a large degree by access and not necessarily by lack of fish. The magnitude of future sport harvests will largely be dependent on the accessibility and size of salmon populations. In order to sustain angler interest, these salmon populations will have to be of sufficient magnitude to sustain acceptable catch rates. There may not be sufficient rearing capacity in lakes and streams to provide the catches of king, sockeye or coho salmon.

Management and Research Goals and Objectives

Lack of knowledge limits our ability to manage, plan, improve and fully utilize the salmon resources. An overall goal is to increase our knowledge of the salmon resources and user groups and improve the ability to manage the salmon resources. The following is a list of objectives that may be attainable by the year 2002.

★ Improve the accuracy of all salmon forecasts.
★ Determine run magnitude and timing by species and by hatchery stocks as salmon enter the western entrance to Prince William Sound.
★ Assess spatial and temporal distribution and

migration paths of salmon in Prince William Sound.

★Determine the harvest contribution of hatchery stocks.

★Assess the stock composition of sockeye salmon catches.

★Improve the accuracy of escapement enumeration.

★Refine estimates of optimum escapement levels for all species.

★Determine the factors that limit the abundance of adult pink and chum salmon in Prince William Sound.

★Inventory and catalog spawning and rearing habitat in conjunction with habitat protection activities, stream clearance and improvement activities, carrying capacity and productivity assessments, lake fertilization assessments and barren-lake stocking assessments.

★Explore means to encourage pink salmon to utilize new habitat made available through fish pass installation, barrier removal and stream improvement activities.

★Achieve solutions to disease problems hampering supplemental production of sockeye and king salmon.

★Achieve maximum production of hatchery produced fish.

★Evaluate any impacts that salmon hatchery production may have on local natural stocks.

★Fully utilize the productive capacity of lakes in Prince William Sound.

★Periodically reevaluate user demands.

Access and Campground Acquisition Objectives

Sport and subsistence fishermen cited the lack of access to fishing areas and the lack of adequate campgrounds to be major problems with the salmon fishery of the Region. It is an objective, therefore, to promote activities leading to the acquisition and improved maintenance of access routes and campgrounds.

Plan Revision Objectives

It is an objective to review and update major components of this Plan every five years henceforth: 1987, 1992, 1997, and 2002.

CHAPTER 7

STRATEGIES
AND
RECOMMENDED PROJECTS

CHAPTER 7

STRATEGIES AND RECOMMENDED PROJECTS

This chapter describes the strategies and projects which may be employed to attain the goals and objectives outlined in Chapter 6. The basic strategies involved in improving salmon production are harvest management, habitat protection, rehabilitation and enhancement. Each of these strategies is of value in improving production of salmon. The application of these strategies may vary according to the peculiarities of the species, stocks and prevailing stream or lake conditions.

Closely aligned with these strategies are research and evaluation activities. Research explores new methods and unknowns. Evaluation provides timely feedback regarding the value of our efforts or methods. Without these, progress would be inhibited.

Another aspect beyond the production of more salmon is the creation and control of access roads and campground facilities for sport and subsistence fishermen and the creation of road-side salmon viewing areas for all people, fishermen and non-fishermen alike.

Projects implemented as a result of this plan will increase, perhaps in differing proportions, the catches of the various user groups. The Planning Team, when it recommends projects to the Commissioner of ADF&G, is in a defacto sense recommending the allocation of projected increases in salmon runs to user groups. The Planning Team does not have authority to allocate resources but can only make recommendations to the Commissioner. The authority to allocate fisheries resources is vested in the Alaska Board of Fisheries by AS 16.251-255.

Harvest Management Strategies and Projects

Management strategies aim at maintaining and improving salmon runs by achieving the proper escapement for each stock and the full utilization of fish that are surplus to escapement needs. It is an essential strategy for both wild and supplementally produced fish.

Management precision is generally limited by insufficient knowledge of run size, stock composition, timing, escapement rates, behavioral characteristics and optimum escapement levels. Increased knowledge of these would increase management precision, improve the harvest and/or improve the quality or value of the catch. Unlike rehabilitation and enhancement projects, the benefits derived from management projects are difficult to quantify. The following is a descriptive list of recommended projects. The costs of most of these projects are not known at this time.

Project: Forecast improvement.
Agency: ADF&G, Division of Commercial Fisheries.
Location: Prince William Sound districts.
Objectives: To improve the accuracy of pink and chum salmon forecasts.
Narrative: Forecasts are of value to fisheries managers, fishermen, processors and government agencies in their preseason planning activities. The full utilization of large (natural and/or hatchery) runs and the protection of small natural runs require adequate preparation and planning. As hatchery returns increase in magnitude, natural

stocks will become increasingly vulnerable to overharvest. Protective strategies and measures must be developed prior to the arrival of weak natural runs in the cape fishery areas. In years of low natural run abundance, the fishing fleet may be restricted to harvest areas near hatcheries. Additional manpower, vessel charter and environmental monitoring equipment is required to improve forecasts.

Project: In-season run assessment.
Agency: ADF&G, Division of Commercial Fisheries.
Location: All districts.
Objectives: To continually assess run strength and timing of each species and major stock within the fishing districts.
Narrative: To most effectively manage the fisheries, the manager needs to constantly assess run strength and timing for each species and major stock. It would be ideal to be able to monitor the fish as they enter the fishery, as they are available for harvest and as the fish escape the fishery. Information concerning test fishing, catch magnitude, stock composition, timing, migration paths, milling areas and escapement can be computerized and a program can be developed to allow the manager to compare daily fisheries data with historic data. In this manner the ultimate size of the run can be accurately estimated early enough in the season to affect changes in fishing time and escapement rates. This would be of particular value in the Copper and Bering river districts where silty water conditions preclude run size and escapement estimates until the fish cross the sonar counters at Miles Lake on the Copper River or are visible in clearwater streams. Additional funding is needed to develop the computer program and input data.

Project: Test fishing.
Agency: ADF&G, Division of Commerical Fisheries.
Location: Ocean entrances from Cape Puget to Cape Cleare.
Objectives: To determine the magnitude of pink, chum and sockeye salmon returns immediately prior their entry into the Prince William Sound fishery and to determine the relative magnitude of natural runs and hatchery runs.
Narrative: The majority of pink, chum and sockeye salmon that spawn in Prince William Sound are believed to enter the Sound through the 21-mile wide ocean entrance between Cape Puget and Cape Cleare. It may be feasible to determine run magnitude and run composition by test fishing with a purse seine and/or gill net and by monitoring with sonar. The project would be conducted much the same as the test fishing project at Port Moller in Bristol Bay. Fishing stations would be established across the ocean entrance, and fishing would be briefly conducted at each station on a periodic basis throughout the season. Catches would be used to derive in-season estimates of total run strength. Scales would be collected for racial scale-pattern analysis, and fish would be examined for coded-wire nose tags. The tags would be implanted in a portion of juvenile salmon released from regional hatcheries. The proportion of natural and hatchery stocks migrating into the Sound may thereby be determined. Additional funding is required for vessel charter, personnel and equipment.

Project: Stock identification.
Agency: ADF&G, Division of Commercial Fisheries and FRED Division.
Location: All districts.
Objectives: To identify the origin of commercially harvested salmon and to

apportion the catch accordingly.

Narrative: The ability to identify stocks in the fishing districts and assign these fish to streams and/or lakes of origin is necessary to develop forecast relationships, assess optimum escapement and evaluate success of rehabilitation and enhancement activities. This ability has been lacking within the Region. Required projects entail the collection of scale and fish length data, tagging and tag recovery. Scales and lengths would have to be collected from fish both in the escapement and the catch. Scale pattern and length data would be analyzed by computer to determine differences between stocks of salmon. Microwire tags would be implanted in a portion of juvenile salmon produced at each hatchery and incubation site. Sensing devices would be employed to identify tagged fish. Additional funds are needed for personnel, aircraft and vessel charter, computer analysis and microwire tagging and recovery equipment.

Project: Escapement enumeration.

Agency: ADF&G, Division of Commercial Fisheries.

Location: Region wide.

Objectives: To improve the accuracy of escapement counts, to obtain counts earlier and to derive total escapement counts in more locations.

Narrative: Accurate and timely escapement information is vital to a successful management program. The present and future well-being of the resource users is dependent on the ability of the manager to estimate escapement rates and total escapement and to attain the optimum escapement level in each lake or stream. Escapement numbers are compared to fry, smolt or adults produced over a period of years to derive optimum escapement estimates. Both the escapement and catch magnitude must be known to assess forecast accuracy and improve forecasts.

Additional weirs, aerial and ground surveys, and sonar counters are needed to improve accuracy and coverage. It may be desirable to install and man weirs at Eyak Lake, Tokun Lake, Shepherd Creek at Bering Lake, and Salmon Creek at McKinley Lake and other selected sites.

Total estimates of pink and chum salmon escapement in Prince William Sound are actually index counts based on the expansion of periodic ground and aerial counts in the major spawning streams. The total of these estimates is thought in some years to equal perhaps 75 percent of the total escapement throughout the Sound. No efforts are currently made to estimate escapements in non-index streams. Periodic counts are expanded by a "stream-life" factor to derive the total escapement for a given stream. The accuracy of these estimates is limited by the number of visits to the streams and the accuracy of the stream life factor utilized. Additional personnel, aircraft and vessel charter funds will be required to improve escapement survey estimates. Stream-life studies are needed annually.

Escapement estimates of sockeye and coho salmon in the Sound and all salmon species in the Copper and Bering river districts are commonly based on the highest or peak survey count obtained during several surveys, and no efforts are made to expand these counts by stream-life factors. Total escapement counts are only available at Eshamy and Coghill lakes (weirs) and at Miles Lake (sonar counters). Peak counts are only indices of escapement because all spawners are not necessarily present in a stream or lake at one time. In any given area early fish may spawn, die and disappear before late fish appear. Additional manpower and survey funds and perhaps stream-life studies are needed to increase the accuracy of these escapement estimates. Sonar counters may be beneficial in various turbid streams to provide early and accurate escapement counts. Suitable sites need to be explored and funding is needed to provide personnel and equipment.

Project: Optimum escapement and carrying capacity studies.
Agency: ADF&G, Division of Commercial Fisheries and FRED Division.
Location: Region wide.
Objectives: To determine optimum escapement levels and to determine the stocking capacity of selected lakes and streams
Narrative: The determination and refinement of escapement goals is required to achieve maximum production of individual stocks. Projects may entail the measurement of spawning and rearing areas, plankton sampling, water chemistry analysis, assessments of predator and competitor species and assessments of the abundance of existing stocks. Knowledge of stocking capacity is needed to optimize the returns of adult salmon resulting from fry planted in barren lakes. Funding is needed to provide personnel, aircraft and vessel charters and equipment.

Enhancement and Rehabilitation Strategies and Projects

Enhancement involves the building of stocks to production levels beyond their former capabilities. Rehabilitation entails the restoration of depressed stocks to previous high levels of abundance. Various projects may be implemented including hatchery expansion, the construction of new hatcheries, lake and stream stocking, lake fertilization, fish pass installation and stream improvement and clearance.

Project: Main Bay Hatchery short-term rearing expansion.
Agency: ADF&G, FRED Division.
Objectives: To expand facilities at Main Bay to allow for the short-term rearing of 86 million chum salmon fry.
Narrative: This facility currently has only sufficient raceway space to rear 25 million fish to fingerling size. When the hatchery is in full production, an estimated 44 million emergent fry will be released into the estuary without benefit of short-term rearing. According to FRED Directive No. 3, short-term rearing of fish to fingerling size may increase survival from an estimated 0.7 percent for unfed fry to 2.0 percent. It is estimated that an additional 492,000 chum salmon adults will be produced if the rearing facilities are provided.

Project: Cannery Creek Hatchery fish handling and short-term rearing facilities.
Agency: ADF&G, FRED Division.
Objectives: To provide adult fish handling facilities and to provide salt water rearing facilities for 68 million pink salmon fry.
Narrative: The lack of adequate fish handling facilities currently limits annual egg takes to a maximum of 50 million pink salmon eggs. The addition of needed facilities will enable hatchery personnel to take an additional 30 million eggs annually. A $550,000 captial improvement request has been submitted to provide the fish handling facilties.

The addition of salt water rearing facilities may, according to FRED Directive No. 3, result in an increase in marine survival from 0.7 percent to 2.0 percent. It is estimated that an additional 755,000 adult pink salmon will be produced if these project are implemented.

Project: Gulkana Hatchery expansion.
Agency: ADF&G, FRED Division and/or Division of Commercial Fisheries.

Location: Glennallen.
Objectives: To increase the capacity of the hatchery by an unspecified amount.
Narrative: This facility at the present capacity of 10.3 million eggs is utilizing approximately 10 percent of the available spring water at the site. The hatchery, therefore, may have potential for significant expansion. Knowledge of the stocking capacity of the numerous lakes in the Copper River drainage is incomplete at this time. Proposals for expanding the facility may be presented as data become available.

Project: Esther Lake Hatchery construction.
Agency: PWSAC.
Location: Esther Island in the Coghill District, 25 miles east of Whittier.
Design capacity: The egg capacity of the facility is tentatively 50 million early chum salmon eggs, 50 million mid-late chum salmon eggs, 200 million mid-late pink salmon eggs, 10 million sockeye salmon eggs, 1.0 million coho salmon eggs, and 1.0 million king salmon eggs.
Objectives: To increase the catches of commercial, sport and subsistence fishermen.
Narratve: The proposed hatchery site is located on State land at the outlet of Esther Lake in Lake Bay. Two lakes form the drainage system. Both are clear and barren of salmon. This site was selected because of the large, high quality water supply and because it is located in an area where both purse seine and drift gill net gear may be used. Facilities upon completion may include: a shallow and deep water intake in the lake, pipelines, a hydroelectric plant, hatchery buildings, shops and storage buildings, personnel quarters and a dock and road system.

Project: Additional hatchery construction.
Agency: To be determined.
Location: Yet to be determined (see Appendix 7-1).
Objectives: To increase the catches of commercial, sport and subsistence fishermen.
Narrative: Twenty-one potential hatchery sites have been identified in Prince William Sound (Appendix 7-1). The evaluation process has yet to be completed; therefore, it is not possible to prioritize this listing.

Project: Lake stocking.
Agency: ADF&G, FRED Division, PWSAC and/or USFS.
Location: Numerous potential stocking sites have been identified (Appendix 7-2).
Objectives: To plant juvenile salmon in barren or underutilized lakes and streams and, thereby, increase the catches of commercial, sport and subsistence fishermen.
Narrative: Underutilized or barren lakes can be stocked to establish a run of salmon or supplement existing runs. Some lakes are barren due to impassable barriers. These lakes and barriers need to be evaluated from a biological and engineering standpoint. Sockeye, coho and king salmon runs can be established by the construction of a fish pass system and the stocking of fry. Summit, Crosswind, Monsoon and Dickey lakes are currently under consideration as stocking sites for sockeye salmon fry incubated at the Gulkana Springs incubation box facility. Other lakes that may be suitable stocking candidates for sport fish enhancement are listed in Appendix 7-2.

Project: Lake enrichment.
Agency: ADF&G, FRED Division, PWSAC and/or USFS.
Location: Region wide.
Completion date: As soon as possible.
Objectives: To increase the production of sockeye salmon juveniles in selected lakes.
Narrative: Lake nutrients are a necessary

ingredient in the production of lake rearing salmon such as sockeye and coho fry. The survival of fry to adulthood has been shown to be directly related to the size of the fish when migrating to sea. This size is directly dependent on the availability of zooplankton in the lake. Many lakes when once depleted of salmon are slow to recover due to the lack of spawned-out carcasses, a major source of nutrients in some lakes. Salmon fry in these lakes grow slowly and commonly remain in the lake longer than normal. Fry hatched in following years must compete with the older fry for available food. Fertilization increases zooplankton production, and, subsequently, fry grow more quickly and outmigrate sooner. Eshamy Lake, Summit Lake and Tokun Lake (Martin River drainage) are potential fertilization candidates. Additional limnological sampling is required to ascertain feasibility, desirability and benefit-cost factors.

Project: Stream stocking.
Agency: ADF&G, FRED Division, PWSAC and/or USFS.
Location: Region wide.
Objectives: To increase sport and commercial catches of salmon.
Narrative: Streams that are barren, depleted, slow to rebuild naturally or underutilized by rearing fry can be planted to establish a run or enhance the existing run of salmon. Coho salmon smolt have been planted at Whittier Creek and Cove Creek in Passage Canal. These fish imprint in these streams, migrate to sea and return to be harvested by sport fishermen. The streams offer no rearing potential, consequently this constitutes a supplemental plant. Bear Lake near Seward has been the egg source heretofore. The Ft. Richardson incubation and rearing facility has been used to incubate the eggs and rear the fry to smolt size. The Bear Lake donor stock is no longer usable due to disease, and, therefore, alternate brood sources need to be identified and utilized. Other streams that may be suitable stocking candidates for sport fisheries enhancement are listed in Appendix 7-3.

Project: Fish pass installation.
Agency: USFS and/or ADF&G, FRED Division.
Location: Prince William Sound.
Objectives: To provide salmon access to unutilized habitat and increase the catches of commercial, sport and subsistence fishermen.
Narrative: Fish passes (fish ladders, steep passes or fish ways) allow salmon to utilize habitat upstream of falls or velocity barriers. Suggested streams for fish pass installation are listed in Appendix 7-4.

Project: Stream improvement.
Agency: USFS and/or ADF&G, FRED Division.
Location: Region wide.
Objectives: To improve and increase spawning and rearing habitat for salmon and increase commercial, sport and subsistence catches of salmon.
Narrative: Stream improvement involves the creation of spawning channels, resting pools, channel containment and flow control structures and other structures which improve the stream environment for spawning and/or rearing. Streams in which improvement efforts may be beneficial are listed in Appendix 7-5.

Project: Stream clearance.
Agency: USFS and/or ADF&G, FRED Division.
Location: Region wide.
Objectives: To clear stream of obstruction and allow salmon access to unutilized habitat and to increase the salmon catches of commercial, sport and subsistence fishermen.

Narrative: Stream clearance is often the simplest and least costly technique of rehabilitation. It is useful when removable obstructions limit access to spawning and/or rearing areas. Suggested streams for clearance are listed in Appendix 7-6.

Habitat Protection Strategies and Projects

Habitat protection is critical to the maintenance of wild salmon stocks. Spawners will not successfully reproduce if spawning or rearing areas are disrupted, polluted or destroyed. It is recognized that logging, mining, urban growth, road construction, and hydroelectric and industrial development are potentially detrimental to salmon habitat. There is a strong likelihood that these activities will increase or take place in the future. Major projects may include the construction and operation of a hydroelectric dam at Silver lake, in Galina Bay of Valdez Arm, coal mining at Bering Lake and commericial logging in numerous areas of the Sound. The transfer of large tracts of public lands into private ownership will be a major factor. We need to maintain and increase the surveillance and enforcement activities of the Habitat Protection Division of ADF&G and other agencies to keep pace with potentially destructive activities. The following habitat project is urgently needed:

Project: Habitat inventory.
Agency: ADF&G, Habitat Protection Division, the US Forest Service and/or the Bureau of Land Management.
Location: Region wide.
Objectives: To inventory and categorize fisheries habitat and to make these data available to fisheries managers, land use planners and land managers.

Access and Campground Strategies and Projects

With population growth and transfer of public lands into private ownership, pressure on the accessible resources will increase dramatically. Additional access roads, trails, campgrounds, boat ramps, mooring slips and salmon viewing areas will be required to enhance and preserve the recreational qualities of the Region.

Project: Access and campground development.
Agency: ADF&G, Divisions of Habitat Protection and Sport Fish, ADNR, Division of Parks, USFS and BLM.
Location: Region wide.
Objectives: To provide access and campgrounds to sport and subsistence fishermen.
Narrative: Sport and subsistence fishermen have cited lack of access and campgrounds to be major problems with the salmon fisheries of the Region. Additional access will diversify fishing pressure and will increase the harvest of fishermen.

Planning Strategies and Projects

Project: Plan reevaluation and update.
Agency: PWSAC and the Prince William Sound Regional Fisheries Planning Team.
Location: Cordova.
Objectives: To update this fisheries plan.
Narrative: This fisheries plan is a "living" document and as such will change as the salmon resource, environment and social and economic elements of the Region, State and world change. Periodic update will be needed to reevaluate user demands, to evaluate our progress in meeting demands and to evaluate and prioritize needed projects.

Appendices

Appendix 1-1. Historical commercial catches of salmon in numbers of fish, by species, Prince William Sound Region, 1889 — 1981.[1]

Year	King	Sockeye	Coho	Pink	Chum	Total
1889	0	242,790	0	0	0	242,790
1890	5,491	411,190	0	0	0	416,681
1891	6,185	710,740	0	0	0	716,925
1892	0	0	0	0	0	0
1893	8,674	792,690	72,000	0	0	873,364
1894	8,494	710,000	17,000	0	0	735,494
1895	10,248	507,630	142,937	0	0	660,815
1896	1,407	738,575	31,862	308,180	0	1,080,024
1897	2,044	410,756	25,605	302,290	0	740,695
1898	1,850	456,554	0	375,246	0	833,650
1899	4,682	554,194	0	212,907	0	771,783
1900	3,462	854,477	88,175	50,565	0	996,679
1901	6,558	781,438	0	313,806	0	1,101,802
1902	2,500	800,044	0	375,408	0	1,177,952
1903	4,600	814,345	0	398,926	0	1,217,871
1904	5,667	734,230	0	573,967	0	1,313,864
1905	20,000	420,000	0	0	0	440,000
1906	2,276	380,030	0	0	0	382,306
1907	869	281,249	0	252,373	0	534,491
1908	0	583,432	0	18,018	0	601,450
1909	3,067	467,100	0	0	0	470,167
1910	974	290,115	32,560	196,871	0	520,520
1911	1,358	430,689	53,944	156,349	0	642,340
1912	6,181	544,962	59,801	401,892	495	1,013,331
1913	3,310	518,845	406	425,574	70	948,205
1914	3,043	653,509	55,193	224,906	0	936,651
1915	7,338	976,453	19,013	465,250	2,175	1,470,229
1916	14,272	983,130	217,951	3,316,352	45,985	4,577,690
1917	14,615	1,305,329	249,042	2,599,408	370,309	4,538,703
1918	20,323	1,914,469	254,844	4,308,779	1,342,576	7,840,991
1919	20,268	1,621,117	203,033	1,008,312	558,522	3,411,252
1920	29,525	1,146,861	227,167	5,314,747	260,963	6,979,263
1921	11,469	783,529	9,693	12,644	3,499	820,834
1922	10,433	777,690	8,962	2,421,272	50,517	3,268,874
1923	10,955	988,286	51,612	2,447,776	111,582	3,610,201
1924	17,192	1,036,433	191,350	8,396,087	385,274	10,026,336
1925	23,130	310,056	294,802	4,085,310	780,960	5,494,258
1926	23,567	406,078	309,056	11,153,883	587,351	12,479,935
1927	45,139	459,409	669,166	6,124,911	655,159	7,953,784
1928	48,972	714,935	494,676	8,034,200	468,260	9,761,043
1929	47,690	1,232,961	249,955	9,613,500	1,282,150	12,426,256
1930	26,921	1,037,002	705,444	6.776,860	979,800	9,526,027
1931	36,095	919,570	146,999	4,860,083	560,271	6,523,018
1932	37,310	1,086,075	99,856	3,466,435	350,895	5,040,571
1933	23,386	755,,832	171,801	3,030,586	285,824	4,267,429
1934	16,858	1,135,529	100,331	6,792,072	261,479	8,306,269
1935	6,203	286,770	113,279	2,618,185	471,050	3,495,487
1936	14,564	1,065,976	43,783	9,581,539	218,550	10,924,412
1937	16,061	1,161,270	105,597	3,334,462	227,468	4,844,858
1938	12,796	883,856	52,735	7,547,696	250,224	8,747,307
1939	10,620	754,277	43,061	2,078,528	273,053	3,159,539

Appendix 1-1. Historical commercial catches of salmon in numbers of fish, by species, Prince William Sound Region, 1889 — 1981, continued.[1]

Year	King	Sockeye	Coho	Pink	Chum	Total
1940	6,516	512,160	318,561	11,542,576	532,327	12,912,140
1941	12,707	518,959	613,582	3,785,693	507,538	5,438,479
1942	26,768	658,618	773,626	7,003,688	702,472	9,165,172
1943	20,542	865,458	259,056	10,815,321	475,877	12,436,254
1944	10,618	910,554	359,826	8,346,755	1,208,587	10,836,340
1945	22,011	999,603	368,001	11,632,238	1,754,087	14,775,940
1946	26,022	661,140	442,711	8,026,032	757,173	9,913,078
1947	15,807	553,489	344,972	8,077,210	706,189	9,697,667
1948	5,981	380,846	301,723	2,460,760	457,618	3,606,928
1949	9,295	535,172	288,680	6,089,394	827,665	7,750,206
1950	18,335	875,036	220,642	1,850,770	455,947	3,420,730
1951	21,109	663,599	248,360	802,998	549,255	2,285,321
1952	29,466	1,210,640	228,512	2,167,840	550,754	4,187,212
1953	12,296	621,532	66,878	1,996,579	352,760	3,050,045
1954	15,765	1,105,878	250,341	12,286	6,344	1,390,614
1955	20,563	683,750	228,904	27,072	4,676	964,965
1956	12,341	738,348	197,582	4,526,585	507,258	5,982,114
1957	9,190	637,247	107,081	650,869	706,888	2,111,275
1958	19,078	345,110	125,367	6,298,828	687,448	7,475,831
1959	11,357	327,166	191,942	1,175	67	531,707
1960	10,325	428,733	238,744	1,842,400	382,178	2,902,380
1961	8,899	656,911	195,858	2,299,887	224,508	3,386,063
1962	16,868	804,324	262,038	6,744,196	892,395	8,719,821
1963	13,259	458,460	339,892	5,296,925	942,985	7,051,521
1964	12,858	779,991	352,343	4,207,444	539,109	5,891,745
1965	16,492	945,020	168,111	2,461,274	201,406	3,792,303
1966	12,108	1,130,278	189,873	2,700,135	426,744	4,459,138
1967	13,497	565,708	247,239	2,626,916	274,454	3,727,814
1968	11,276	721,201	309,694	2,456,710	343,412	3,842,293
1969	17,424	1,020,513	94,304	4,829,427	321,221	6,282,889
1970	20,432	1,243,403	252,641	2,810,642	231,349	4,558,467
1971	20,142	741,945	327,697	7,312,730	579,552	8,982,066
1972	23,003	976,115	124,670	57,090	46,088	1,226,966
1973	22,638	473,044	199,019	2,065,844	740,017	3,500,562
1974	20,602	741,340	76,041	458,619	89,210	1,385,812
1975	22,325	546,634	84,109	4,453,041	101,286	5,207,395
1976	32,755	1,009,035	160,495	3,022,426	370,657	4,595,368
1977	22,864	943,943	179,417	4,536,459	573,166	6,255,849
1978	30,435	505,509	312,930	2,917,494	489,771	4,256,144[2]
1979	20,078	369,583	315,774	15,638,258	349,615	16,693,303[3]
1980[4]	8,735	230,193	331,837	14,219,566	477,699	15,268,030[5]
1981[4]	21,374	795,392	382,347	19,476,807	1,884,845	22,560,765[6]

1) Includes catches by all gear types from the General purse seine, Coghill, Unakwik, Eshamy, Copper River and Bering River districts. From Pirtle (1976) and Randall et al. (1982).
2) Includes 133,648 pinks from PWSAC hatchery harvests.
3) Includes 223,761 pinks from PWSAC hatchery harvests.
4) Preliminary.
5) Includes 346,828 pinks from PWSAC harvests.
6) Includes 707,037 pink, 118 chum and 1 sockeye salmon from PWSAC hatchery harvest.

Sec. 16.10.375.REGIONAL SALMON PLAN. The commissioner shall designate regions of the state for the purpose of salmon production and have developed and amend as necessary a comprehensive salmon plan for each region, including provisions for both public and private nonprofit hatchery systems. Subject to plan approval by the commissioner, comprehensive salmon plans shall be developed by regional planning teams consisting of department personnel and representatives of the appropriate qualified regional associations formed under §380 of this chapter. (§2 ch 161 SLA 1976; am§ch 154 SLA 1977)

Sec. 16.10.380. REGIONAL ASSOCIATIONS. (a) The commissioner shall assist in and encourage the formation of qualified regional associations for the purpose of enhancing salmon production. A regional association is qualified if the commissioner determines that:

(1) it is comprised of associations representative of commercial fishermen in the region;
(2) it includes representatives of other user groups interested in fisheries within the region who wish to belong;
(3) it possesses a board of directors which includes no less than one representative of each user group that belongs to the association.

(b) In this section "user group" includes but is not limited to, sport fishermen, processors, commercial fishermen, subsistence fishermen, and representatives of local communities. (§ch 161 SLA 1976)

Note: Section 1, ch 161, SLA 1976, provides: "It is the intent of this Act to produce salmon for the common property fisheries of the state."

Appendix 2-1. Exvessel value of Prince William Sound Region commercial salmon harvest, in thousands of dollars, 1960-81.[1]

Year	King	Sockeye	Coho	Pink	Chum	Total
1960	64	633	272	884	260	2,113
1961	55	965	235	1,099	151	2,505
1962	105	1,216	335	3,403	663	5,722
1963	68	616	449	2,095	759	3,987
1964	78	1,168	614	1,716	402	3,978
1965	97	1,494	194	775	119	2,679
1966	73	2,001	271	1,058	305	3,708
1967	68	993	378	1,729	266	3,434
1968	81	1,380	626	1,415	371	3,873
1969	134	1,931	202	2,610	453	5,330
1970	158	2,352	606	1,303	207	4,626
1971	174	1,571	660	4,166	530	7,101
1972	273	2,176	332	44	56	2,811
1973	353	2,396	667	3,009	2,537	8,962
1974[2]						
1975[2]						
1976[2]						
1977	897	6,865	1,328	7,138	2,059	18,287
1978	1,133	4,374	3,191	3,888	1,770	14,356
1979	838	3,612	3,147	21,856	1,671	31,124
1980	337	1,356	3,308	20,429	1,911	27,077
1981	918	7,501	3,726	38,189	8,003	58,337

1) From Pirtle (1976) and Randall et al. (1982).
2) No data available.

Appendix 2-2. Upper Copper River subsistence fishery data, 1960—1981.[1]

	Catch		Permits Issued			Catch by Species			
Year	Dip Net	Fishwheel	Dip Net	Fishwheel	Total	Sockeye	King	Coho	Other
1960	1,179	5,660	32	26	53	6,739	136	25	
1961	1,777	12,419	307	59	366	15,472	388	553	
1962	3,203	11,101	435	117	552	14,543	343	331	
1963	2,124	12,395	514	110	624	14,055	464	553	
1964	4,133	7,749	794	158	952	11,915	725	103	
1965	7,215	5,813	982	115	1,097	12,760	644	52	
1966	7,452	9,183	1,132	110	1,242	16,718	555		
1967	6,146	8,360	1,166	125	1,291	14,457	419		
1968	8,040	6,071	1,235	112	1,347	14,819	644	233	
1969	18,054	6,220	1,415	113	1,528	27,604	719	224	
1970	22,700	9,886	3,220	267	3,487	36,500	427	554	
1971[2]	28,115	9,370	4,168	374[2]	4,542	37,517	1,363	363	
1972[3]	18,996	7,854	3,485	205	3,690	26,850	1,501	243[3]	
1973[4]	16,407	10,943	3,840	305	4,145	27,350	1,856	51[4]	
1974[5]	15,143	7,657	3,305	288	3,593	22,800	1,141	163[5]	
1975	7,694	5,626	2,452	350	2,802	13,320	1,705		
1976	12,130	8,321	2,512	451	2,963	20,451	2,017	17	
1977	22,612	12,751	3,526	540	4,066	35,363	2,171	454	
1978	12,569	6,638	3,313	392	3,705	19,207	2,050	633	
1979	11,887	10,251	2,730	470	3,200	22,138	2,372	705	
1980	14,661	9,716	2,804	399	3,203	21,437	2,256	636	125
1981	28,872	26,924	3,555	523	4,078	53,008	1,913	849	26
Average Years						27,995 1970-1981	1,731 1970-1981	348 1970-1981	

1) From Randall et al. (1982).
2) Last use of Dip Net / Fishwheel Combination permits.
3) First issue of permits at Chitina.
4) Last year permits were denied fishermen who failed to return their previous year permits.
5) Issue of permits at Chitina and Glennallen only.

Appendix 2-3. Copper River Delta gill net salmon subsistence catch and effort, 1960-1981.[1]

	Permits Returned					Catch			
Year	Permits Issued	Unused	Unsuccessful	Successful	Total	King	Sockeye	Coho	Total
1960	13	No Record	No Record	Unknown	No Record			158	158
1961	14	No Record	No Record	Unknown	14	60	137	99	296
1962	14	No Record	No Record	Unknown	No Record	44	135	3	182
1963	8		2	6	8	3	13	157	173
1964	5	2			3	14			14
1965	31	5	2	13	20	12	459	85	556
1966	45	10	2	19	31	47	175		222
1967	61	19	9	28	56	83	153		236
1968	17	8	1	6	15	11	36		47
1969	49	13	7	13	33	16	63	85	164
1970	32	3	1	23	27	66	179		245
1971	29	9	12	5	26	10	32	4	46
1972	104	5		75	80	149	569	53	771
1973	94			89	89	153	326	180	659
1974	9	2	2	1	5	5	4	2	11
1975	2			2	2		5		5
1976	27			14	14	1	10		11
1977	23			22	22	10	71		81
1978	34	19		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
Average years						38 1960-1981	117 1960-1981	44 1960-1981	

1) From Randall et al. (1982).

Appendix 2-4 Prince William Sound salmon subsistence catch and effort, 1960-1981[1].

	PERMITS		CATCH						
Year	Issued	Returned	King	Sockeye	Coho	Pink	Chum	Unknown[2]	Total
1960	50			139	505	1292	75	150	2,161
1961	12	1	41	123	732	3			900
1962	9				119	214	142		475
1963	9		3		406	298	24		731
1964	15			11		900			911
1965	22	16				179	25		204
1966	3	3		3	19	20	50		92
1967	4	3			4	4			8
1968	4	3			20	156		22	198
1969	7	3			16				16
1970	1	1							
1971	3	2				46			46
1972									
1973	19	16			289				289
1974	3	1							
1975	2								
1976									
1977	4	4							
1978	3	2							
1979	15	2							
1980	26	15		7	6				13
1981	12	8		3	29		2		34

1) From Randall et al. (1982). Does not include Copper and Bering River districts.
2) Catches not reported by species.

Appendix 2-5. Sport harvest of sockeye and king salmon, Upper Copper River Drainage, 1966-81.[1]

Year	Sockeye Salmon	King Salmon
1966	300	150
1967	400	150
1968	700	300
1969	1,500	500
1970	1,800	600
1971	4,000	600
1972	2,000	750
1973	4,000	850
1974	3,000	900
1975	200	750
1976	1,000	400
1977	3,662	532
1978	1,606	641
1979	1,599	2,948
1980	2,109	2,101
1981	1,523	1,717

1) Estimates provided by Fred Williams, ADF&G.

Appendix 2-6. Annual sport harvest of salmon in five selected areas of the Prince William Sound Region, 1977-1981.

		Sport Harvest					
Area	Year	King	Sockeye	Coho[1]	Pink	Chum	Effort[2]
Gulkana River	1977	421	1,180				4,165
	1978	606	662				6,570
	1979	2,440	545				17,323
	1980	1,688	1,248				13,752
	1981	1,469	1,447				14,430
	Average	1325	1016	0	0	0	
Valdez Bay	1977	247	557	5,277	12,020	219	19,423
	1978	58	78	3,582	7,910	1,444	12,687
	1979	88	141	6,402	13,217	845	19,068
	1980	121	568	5,545	11,606	913	18,707
	1981	76	367	4,018	11,686	572	18,716
	Average	118	342	4,965	11,288	799	
Passage Canal (Whittier)	1977[3]						
	1978[3]						
	1979	29		761	573		4,134
	1980	26		1,541	1,343		3,756
	1981			32	691		4,875
	Average	18	0	778	869	0	
Eyak River	1977		209	1,229			3,544
	1978		127	704			2,003
	1979		362	2,633			4,653
	1980		69	4,822			6,954
	1981		43	2,948			3,910
	Average	0	162	2,467	0	0	
Other Areas	1977	292	8,228	2,592	13,405	521	47,532
	1978	70	5,314	4,965	8,390	1,541	35,936
	1979	733	4,323	4,580	4,182	682	33,690
	1980	568	4,073	3,565	3,858	112	32,587
	1981	496	1,848	1,501	2,397	400	29,761
	Average	432	3,943	3,441	6,446	651	

1) Does not include land-locked coho salmon.
2) Angler-days spent fishing for all species, salmon and non-salmon.
3) Only minor effort and catches.

Appendix 2-7. Population census of the Prince William Sound Region, 1980.[1]

Highway	Location	Population
Glenn Highway	Eureka	11
	Tazlina	31
	Glennallen	511
	Gulkana	104
	Gakona	87
	Chistochina	55
	Slana	49
	Mentasta Lake	59
Richardson Highway	Valdez	3,694[2]
	Ptarmigan	2
	Tonsina	135
	Copper Center	213
	Sourdough	11
	Paxson	30
Edgerton Highway	Chitina	42
	Lower Tonsina	40
McCarthy Road	McCarthy	22
Non-highway[4]	Cordova	2,241[3]
	Eyak	47
	Whittier	198
	Tatitlek	68
	Total	7,650

1) Except where otherwise noted, data based on U.S. Government census. Data provided by Linda Leask, University of Alaska, Institute of Social and Economic Research.

2) State census data.

3) City census data.

4) No estimates are available for other locations.

Appendix 2-8. Projected population growth estimates for the Prince William Sound Region and selected census areas of Southcentral Alaska, 1980-2002.[1]

	Year		
Location	1980	2002	% increase
Prince William Sound Region	7,650	10,940	43%
Anchorage	179,047	247,196	38%
Fairbanks	52,145	68,044	30%
S.E. Fairbanks	5,501	6,557	19%
Matanuska/Susitna	17,249	23,063	34%
Kenai/Cook Inlet	21,148	30,394	44%
Seward	3,235	5,341	65%
Total	285,975	391,535	37%

1) Data provided by Gunnar Knapp, University of Alaska, Institute of Social and Economic Research.

Appendix 2-9. Pink and chum salmon production data, Cannery Creek Hatchery, 1978-1982[1].

Brood Year	Species	Stock	Green Egg Take	Fry Released	Estimated Total Adult Return	Estimated Fishery Harvest	Marine Survival %
1978	Pink	Cannery Cr.	4,038,974[2]	2,825,634	90,348	53,348	3.2[3]
	Chum	Wells R.	667,020[2]	21,045			
1979	Pink	Cannery Cr.	1,189,468	999,261	84,651	71,840[3]	8.5[3]
	Pink	Jonah Cr.	2,369,990	1,695,412[4]	56,677[5]		3.4[3]
	Chum	Siwash Cr.	613,299	469,124			
1980	Pink	Cannery Cr.	17,299,478	14,388,752	760,389	688,814	5.3
	Pink	Port San Juan	6,925,210[6]	6,950,000[4]	4,200[8]		
	Chum	Siwash Cr.	673,116	484,954			
	Chum	Eaglek R.	2,067,115	1,963,657			
1981	Pink	Cannery Cr.	14,544,078	13,932,987			
	Pink	Port San Juan	35,288,000[6]	33,000,000[7]			
	Chum	Siwash Cr.	953,376	866,981			

1) Data provided by Tim McDaniel, ADF&G.
2) Incubated at Port San Juan Hatchery.
3) Estimated by mark-recovery method.
4) Fry transported to and released at Hobo Creek, Port Wells.
5) Estimated 49,660 adults returned to Port San Juan and 7,017 returned to Hobo Creek.
6) Eyed eggs from Port San Juan Hatchery.
7) Fry transported to and released at Main Bay to develop brood stock for Main Bay Hatchery.
8) Adults returned to Hobo Creek.

Appendix 2-10. Sockeye salmon production data for the Gulkana Incubation Facility, 1973-82.

Year	Eggs Taken	Fry Produced	Survival Rate (%)
1973—74	225,800	179,311	79.4
1974—75	1,266,552	886,556	70.0
1975—76	1,276,570	727,607	57.0
1976—77	1,288,142	627,387	48.7
1977—78	1,361,149	581,227	42.7
1978—79	1,320,472	1,040,563	78.8
1979—80	3,563,568	2,446,056	68.6
1980—81	6,228,897	5,249,173	84.2
1981—82	9,166,596	8,033,000	87.6
		Unweighted Average	68.6

Appendix 2-11 Pink and chum salmon production data for the Port San Juan Hatchery, 1975-1982.

Brood Year	Species	Eggs taken	Eyed eggs incubated at PSJ	Fed fry released at PSJ	Unfed fry released at PSJ	Total Fry Released at PSJ	Estimated Total Adult Return	Estimated Common Property Harvest	Brood Stock[3]	Sales Fish	Marine Survival%
1975	Pink	6,254,460[1]	no estimate		1,000,000	1,000,000	44,000	4,000	40,000		4.4
1976	Pink	15,017,934[2]	11,351,110	1,304,332	9,706,245	11,010,577	154,620	0	40,432	114,188	1.4
	Chum	17,112[4]	no estimate	10,000		10,000	no estimate				
1977	Pink	23,424,000[5]	17,788,000	1,859,629	15,081,149	16,940,778	553,000	275,000	54,207	223,748	3.3
	Chum	1,445,700[6]	1,356,000	1,014,000		1,014,000	20,000	12,000	2,037	7,669	2.0
1978	Pink	28,645,626[7]	25,180,220	4,684,590	18,090,140	22,774,730	1,485,500	1,038,700	100,026	346,729	6.5
	Chum	441,192[6]	256,000	247,548		247,548	1,000[8]	600[8]		416	0.4[8]
1979	Pink	28,401,415[7]	22,749,500	21,576,000	65,757	21,641,757	2,264,700	1,358,900	198,721	707,037	10.5
	Chum	570,556[6]	407,800	395,000		395,000					
1980	Pink	94,689,000[7]	82,036,000[9]	69,662,000	124,000[10]	69,786,000					
	Chum	3,605,000[11]	943,000	745,668		745,668					
1981	Pink	143,500,000[7]	100,633,000[12]	70,495,000	4,000,000	74,495,000					
	Chum	8,593,000[11]	8,180,000	7,294,000	322,000	7,616,000					

1) From stream 603 in Ewan Bay.
2) From Millard Creek, Duck River and Larsen Creek.
3) Includes fish allowed to spawn in Larsen Creek and mortalities.
4) From Duck River.
5) From streams in Crab Bay, Hardins Bay, Port Ashton, and Port San Juan.
6) From streams 84, 85 and 87A in Port Fidalgo.
7) From Larsen Creek at Port San Juan.
8) These data only pertain to the return of 3 year old fish in 1981. The majority of chum salmon in Prince William Sound return as 4 year old fish.
9) 6,925,210 eyed eggs transported to the Cannery Creek Hatchery.
10) 2,752,000 fry released at Main Bay.
11) From stocks in stream 83 and 87 and Larsen Creek.
12) 35,288,000 eyed eggs transported to the Cannery Creek Hatchery.

Appendix 2-12 Pink and chum salmon production data for the Crooked Creek Hatchery, 1981-1982.

Species	Brood Year	Donor Source	Number Eggs	Number Released (Date)	Returns to Hatchery (Date)	Estimated C.P.[1] Harvest
Pinks (Sci/Ed)	1980	Crooked Creek	25,000	22,000 (1981)	---- (1982)	---- (1982)
(PNP)	1981	Siwash Creek	9,976,000	8,500,000 (1982)	---- (1983)	---- (1983)
	1982					
Chums (Sci/Ed)	1979	Crooked Creek	342,000	330,000 (1980)	---- (1980)	---- (1982)
					---- (1983)	---- (1984)
					---- (1984)	---- (1984)
	1980	Crooked Creek	363,000	318,000 (1981)		
	1981	Crooked Creek	188,000	160,000 (1982)		
(PNP)		Crooked Creek	506,000	430,000 (1982)		

1) Common property harvest.

Appendix 2-13 Pink salmon production data for the Perry Island Hatchery, 1976-1982

Species	Brood Year	Donor Source	No. Eggs Transplanted (Date)	No. Fry Released (Date)	Returns to Hatchery	Est. C.P.[11] Harvest
Pink	1976	Lambert Lagoon	78,000[1]	33,000[2] (1977)	4,000[3] (1978)	N.E.[4]
	1977	—[5]				
	1978	Lambert Lagoon	208,000[6]	150,000[7] (1979)	5,000[8] (1980)	N.E
	1979 (1980)	Mink Cr. (1981)	686,000	250,000	200	N.E.
	1980	Hatchery Cr. & Lambert Lagoon	307,000[9]	149,000[10] (1981)	(1982)	
	1981	Hatchery Cr.	2,250	(1982)	(1983)	

1) Approximately 46,000 green eggs planted in upstream barren areas; remainder incubated.
2) 10,000 fry emigrated from incubator —an assumed 50% emergence from egg plant.
3) Combined return from wild fish reproduction and hatchery operations — cannot be distinguished: over 20 fish entered the hatchery stream which has no natural run.
4) No estimate.
5) No odd-year pink salmon are present naturally in South Bay, Perry Island.
6) About 47,000 planted in upstream barren areas as eyed eggs.
7) 115,000 released from incubator and an estimated 35,000 downstream migrants from egg plant.
8) Combined return from wild fish reproduction and hatchery operations — cannot be distinguished; over 500 fish entered the hatchery stream which has no natural run.
9) 73,000 eyed eggs were planted in upstream barren area.
10) 113,000 released after short-term rearing — estimated 36,000 from eyed egg plant.
11) Common property harvest.

Appendix 3-1 Escapement goals and average escapement estimates for pink salmon, Prince William Sound Region, 1960-81.[1]

District / System	Escapement Goals[2]	Average Escapement[2]
Eastern	403,760—484,500	451,962
Northern	140,000—168,000	151,735
Northwestern and Coghill	262,500—315,000	332,278
Southwestern and Eshamy	112,500—135,000	126,346
Montague	106,250—127,500	142,837
Southeastern	225,000—270,000	297,557
Total	1,250,000—1,500,000	1,503,930

1) From Randall et at. (1982).
2) Index area escapement counts.

Appendix 3-2 Escapement goals and average escapement estimates for chum salmon, Prince William Sound Region, 1960-81.[1]

District / System	Escapement Goals[2]	Average Escapement[2]
Eastern	87,200—109,000	101,026
Northern	29,400—36,750	47,560
Northwestern and Coghill	48,600—60,750	48,811
Southwestern and Eshamy	3,400—4,250	2,575
Montague	11,400—14,250	10,668
Southeastern	20,000—25,000	20,138
Total	200,000—250,000	224,778

1) From Randall et al. (1982).
2) Index area escapment counts.

Appendix 3-3 Escapement goals and average escapement estimates for sockeye salmon, Prince William Sound Region.[1]

District / System	Escapement Goals[2]	Average Escapement
Copper River (main)	250,000—350,000	315,300[2]
Copper River Delta	80,000—90,000[3]	53,215[4]
Bering River	30,000—40,000[3]	30,500[5]
Eshamy	20,000—30,000[3]	16,441[6]
Coghill	40,000—60,000[3]	60,548[7]
Total	420,000—570,000	467,004

1) From Randall et al. (1982).
2) Based on sonar counts, 1978-1981.
3) Randall (personal communication).
4) Peak index counts, 1970-1981.
5) Peak index counts, 1974-1981.
6) Weir count, 1972-1981.
7) Weir count, 1974-1981.

Appendix 3-4. **Commercial purse seine catches of natural stocks by species, Prince William Sound Region, 1960-1981.**[1] [2]

Year	King	Sockeye	Coho	Pink	Chum
1960	1,584	35,176	30,722	1,841,896	381,858
1961	406	478	9,651	2,174,873	199,071
1962	1,830	16,765	27,998	6,663,730	847,154
1963	2,293	43,339	48,641	5,292,689	937,635
1964	65	38,110	30,967	4,201,106	534,553
1965	880	34,565	45,176	2,263,829	151,896
1966	620	29,552	23,157	2,610,535	402,667
1967	3,569	8,900	40,522	2,391,041	224,051
1968	1,458	45,696	11,579	2,337,992	296,863
1969	3,263	88,919	12,534	4,779,683	280,706
1970	1,031	50,676	10,848	2,692,074	211,064
1971	3,478	41,346	30,497	7,227,763	519,599
1972[3]	396	0	192	2	0
1973	2,224	25,079	1,013	1,973,930	633,891
1974[4]	1,260	4,273	570	54,272	7,720
1975	1,789	34,827	5,783	4,353,229	67,971
1976	970	50,054	6,099	2,963,028	280,977
1977	497	121,299	1,011	4,088,187	432,431
1978	390	19,068	1,431	2,728,464	383,871
1979	798	65,037	4,997	14,878,407	269,209
1980	88	153,278	2,429	12,409,899	410,696
1981	260	147,897	1,998	16,770,596	1,737,153
Average Years	1,325 1960-81	47,924 1960-81	15,810 1960-81	4,758,965 1960-81	447,504 1974-81

1) From Randall et al. (1982) and Pirtle (1976).
2) Includes relatively minor troll catches (1960-76) but does not include Port San Juan sales fish or estimates of hatchery fish intercepted by commercial fishermen.
3) Purse seine fishery closed in all districts.
4) Purse seine fishery restricted to Coghill District.

Appendix 3-5. Pink salmon runs, Prince William Sound districts, 1960-1981.[1]

	Escapements							Commercial	
			Northwestern	Southwestern					
Year	Eastern	Northern	Coghill	Eshamy	Montague	S. eastern	Total	Catch	Total Ru
1960	475,073	133,653	203,575	155,788	214,987	167,747	1,350,823	1,841,896	3,192,71
61	706,790	123,900	448,180	133,990	289,290	496,830	2,198,980	2,298,218	4,497,19
62	650,300	253,490	417,190	107,950	317,360	271,720	2,018,010	6,742,316	8,760,32
63	378,050	77,760	354,230	49,760	78,750	417,190	1,355,740	5,295,378	6,651,11
64	485,470	349,010	353,030	172,800	121,220	360,150	1,841,680	4,206,896	6,048,57
1965	258,680	54,970	187,760	62,720	77,000	255,930	897,060	2,460,471	3,357,53
66	489,800	255,710	200,940	110,980	42,050	201,150	1,300,630	2,699,418	4,000,04
67	321,520	167,300	544,080	109,750	23,800	300,270	1,466,720	2,626,340	4,093,06
68	360,300	136,630	201,790	165,510	44,100	183,440	1,091,770	2,452,168	3,543,93
69	328,960	147,880	264,750	132,510	63,470	218,060	1,155,630	4,828,579	5,984,20
1970	328,730	109,240	170,130	69,260	73,190	139,640	944,190	2,809,996	3,754,18
71	529,820	161,540	614,530	104,080	337,540	373,900	2,121,410	7,310,964	9,432,37
72	317,450	91,610	66,270	27,680	28,860	75,550	607,420	54,783	662,20
73	264,850	44,840	563,510	66,030	106,340	184,340	1,229,910	2,056,878	3,206,79
74	229,370	186,130	200,520	141,750	11,800	89,170	858,740	448,773	1,307,51
1975	570,830	44,270	580,170	77,860	110,950	234,210	1,618,290	4,452,805	6,071,09
76	446,470	123,380	116,730	51,200	12,260	115,560	865,600	3,018,991	3,884,591
77	465,970	62,150	426,670	226,060	196,970	315,510	1,693,330	4,513,082	6,206,41
78	268,940	159,870	200,950	220,610	48,680	156,830	1,055,610	2,913,721[2]	3,969,331
79	782,420	223,580	241,120	264,710	323,490	1,091,970	2,927,290	15,630,068[2]	18,557,35
1980	515,380	171,410	338,100	134,860	114,170	302,190	1,576,110	14,215,694[2]	15,791,804
81	768,000	259,850	588,880	193,750	506,140	594,890	2,911,510	19,442,859[2 3]	22,354,369
Average	451,962	151,735	332,278	126,346	142,837	297,557	1,503,930	5,105,468	6,609,398

1) Adapted from Randall et al. (1982).
2) Does not include hatchery sales.
3) Preliminary.

Appendix 3-6 Chum salmon runs, Prince William Sound districts, 1960-1981.[1]

Year	Escapements							Commercial	
			Northwestern	Southwestern					
	Eastern	Northern	Coghill	Eshamy	Montague	S. eastern	Total	Catch	Total Run
1960	92,100	24,729	40,458	4,800	16,782	23,008	201,877	381,858	583,735
61	117,950	50,420	70,940	4,750	34,380	59,910	338,350	224,401	562,751
62	238,660	67,670	96,020	10,610	34,190	39,690	486,840	891,880	1,378,720
63	148,090	68,390	114,250	5,330	15,070	20,030	371,160	942,900	1,314,060
64	176,840	64,750	136,590	3,560	31,650	29,160	442,550	539,047	981,597
1965	69,180	20,980	39,690	1,840	17,500	46,480	195,670	201,043	396,713
66	85,480	39,440	42,150	3,420	32,720	20,160	223,370	426,628	649,998
67	97,420	50,930	15,290	2,360	11,060	10,700	187,760	274,234	461,994
68	99,350	31,530	37,310	5,100	1,590	21,400	196,280	342,939	539,219
69	81,140	9,770	43,390	2,170	1,710	26,310	164,490	320,977	485,467
1970	58,180	6,100	22,000	770	3,370	11,910	102,330	230,661	332,991
71	79,930	16,190	34,570	1,210	25,620	9,260	166,780	574,265	741,045
72	134,780	79,030	50,520	2,850	5,190	29,310	301,680	45,370	347,050
73	267,210	143,420	89,790	1,130	2,930	42,110	546,590	729,839	1,276,429
74	92,840	53,830	45,010	200	90	2,910	194,880	88,544	283,424
1975	28,220	7,820	7,410	580		2,760	46,790	100,479	147,269
76	17,870	26,520	38,460	90		950	83,890	370,478	454,368
77	53,200	36,360	41,640	4,480	560	8,370	144,610	572,610	717,220
78	102,290	25,410	27,650	500		6,030	161,380[3]	485,147	646,527
79	57,450	17,040	18,660	80		4,450	97,680	326,414	424,094
1980	32,160	34,250	14,460	40	280	6,230	87,420	477,664[2]	565,084
81	92,240	39,740	47,590	770	0	21,890	202,230	1,874,484[3]	2,076,714[3]
Average	101,026	41,560	48,811	2,575	10,668	20,138	224,778	473,721	698,499

1) Adapted from Randall et al. (1982).
2) Does not include hatchery sales.
3) Preliminary.

Appendix 3-7. Commercial drift gill net catches of king salmon, by district, Prince William Sound Region, 1960-1981.[1]

Year	Copper River	Bering River	Coghill	Unakwik	Eshamy	Total
			District			
1960	8,678	63	—[2]	—[2]	—[4]	8,741
1961	7,621	872		—[2]	—[5]	8,493
1962	14,792	246				15,038
1963	10,871	95			—[4]	10,966
1964	12,751	36	6[3]	—[3]	—[4]	12,793
1965	15,390	3	219[3]	—[3]	[5]	15,612
1966	11,422	36	30[3]	—[3]	—[5]	11,488
1967	9,853	20	55[3]	—[3]	—[4]	9,928
1968	9,743	10	65[3]	—[3]	—[4]	9,818
1969	14,040	44	61[3]	—[3]	3	14,148
1970	19,375	26	0[3]	—[3]	—[5]	19,401
1971	16,486	105	73		—[4]	16,664
1972	22,349	107	67	2	49	22,574
1973	19,948	285	144	1	41	20,419
1974	18,980	32	156	5	18	19,191
1975	19,644	162	525	4	—[4]	20,335
1976	31,483	228	102	4	—[4]	31,817
1977	22,089	127	124	3	22	22,365
1978	29,062	331	469	24	—[4]	29,886
1979	17,678	385	543	11	—[4]	18,617
1980	8,449		196			8,645
1981	20,782	204	148		—[4]	21,134
Average Years	16,431 1960-81	155 1960-81	231 1971-81	5 1971-81	10 1967-81	16,832

1) From Randall et al. (1982).

2) Coghill District created and first opened in 1961. Unakwik District created and first opened in 1962.

3) Coghill and Unakwik data combined until 1971.

4) Fishery closed.

5) Drift and set net data were combined; therefore, these data are not presented.

Appendix 3-8. **Commercial drift gill net catches of sockeye salmon, by district, Prince William Sound Region, 1960-1981.**[1]

Year	District: Copper River	Bering River	Coghill	Unakwik	Eshamy	Total
1960	360,667	32,890	—[2]	—[2]	—[4]	393,557
1961	528,223	60,116	12,961	—[2]	—[5]	601,300
1962	77,626	72,230	13,846[3]	—[3]	—[5]	769,428
1963	375,029	23,127	16,965[3]	—[3]	—[4]	415,121
1964	699,548	13,469	28,864[3]	—[3]	—[4]	741,881
1965	818,277	10,651	66,071[3]	—[3]	—[5]	898,708
1966	1,005,615	24,949	49,336[3]	—[3]	—[5]	1,084,898
1967	508,327	11,866	36,615[3]	—[3]	—[4]	556,808
1968	573,261	26,136	76,108[3]	—[3]	—[4]	675,505
1969	696,836	38,093	134,986[3]	—[3]	4,984	874,809
1970	1,115,695	23,539	36,273[3]	—[3]	1,911	1,177,418
1971	616,801	36,776	45,514	1,508	—[4]	700,599
1972	727,144	51,445	134,628	10,010	15,117	938,344
1973	332,816	15,426	74,426	8,858	7,470	441,852
1974	607,766	4,208	95,610	10,449	12,640	734,946
1975	335,384	21,637	142,864	11,922	—[4]	513,792
1976	865,354	30,908	54,334	8,421	—[4]	965,183
1977	619,140	14,445	154,342	7,912	16,916	829,191
1978	249,872	33,554	193,899	9,116	—[4]	496,332
1979	80,528[6]	139,015	75,753	9,250	—[4]	307,647
1980	18,451[6]	0[6]	54,679	1,124	661	78,043
1981	486,982	55,973	102,094	2,445	—[4]	649,240
Average Years	610,018 1960-78, 81	35,260 1960-79,81	102,558 1971-81	7,365 1971-81	3,980 1967-81	759,181

1) From Randall et al. (1982).
2) Coghill District created and first opened in 1961. Unakwik District created and first opened in 1962.
3) Coghill and Unakwik data combined until 1971.
4) Fishery closed.
5) Drift and set gill net data combined; therefore, this data was not presented.
6) Excluded in calculation of average due to unusual closures.

Appendix 3-9. Commercial drift gill net catches of coho salmon, by district, Prince William Sound Region,1960-1981.[1]

Year	District					Total
	Copper River	Bering River	Coghill	Unakwik	Eshamy	
1960	137,957	70,065	—[2]	—[2]	—[4]	208,022
1961	133,987	50,883	13	—[2]	—[5]	184,883
1962	174,628	55,502	15[3]	—[2]	—[5]	233,093
1963	202,621	88,610	20[3]	—[3]	—[5]	291,251
1964	242,666	78,708	2[3]	—[3]	—[4]	321,376
1965	70,786	52,114	18[3]	—[3]	—[5]	122,953
1966	116,147	49,818	6[3]	—[3]	—[5]	166,344
1967	160,532	46,138	45[3]	—[3]	—[4]	206,715
1968	230,867	67,134	114[3]	—[3]	—[4]	298,115
1969	77,405	4,033	121		29	81,588
1970	161,892	79,264	62[3]	—[3]	60	1,278
1971	208,915	88,231	54		—[4]	297,200
1972	103,211	19,825	296		626	123,958
1973	132,272	65,348	237		71	197,928
1974	46,625	28,615	103	3	114	75,460
1975	53,805	24,162	357		—[4]	78,324
1976	111,900	42,423	72		—[4]	154,395
1977	131,356	47,218	49	2	49	178,674
1978	220,338	91,097	64		—[4]	311,499
1979	194,885	114,046	1,837	9	—[4]	310,777
1980	219,779	108,535	1,028	3	25	329,370
1981	303,801	76,161	387		—[4]	380,349
Average Years	156,198 1960-81	61,270 1960-81	407 1971-81	2 1971-81	65 1967-81	217,942

1) From Randall et al. (1982).
2) Coghill District created and first opened in 1961. Unakwik District created and first opened in 1962.
3) Coghill and Unakwik data combined until 1971.
4) Fishery closed.
5) Drift and set gill net data were combined; therefore, these data are not presented.

Appendix 3-10. Commercial drift gill net catches of pink salmon by district, Prince William Sound Region, 1960-1981[1]

Year	District					Total
	Copper River	Bering River	Coghill	Unakwik	Eshamy	
1960	375	126	—[2]	—[2]	—[4]	501
1961	1,639	30	10,019	—[2]	—[5]	11,688
1962	1,880		2,241[3]	—[3]	—[5]	4,121
1963	1,487	60	2,689[3]	—[3]	—[4]	4,236
1964	548		5,790[3]	—[3]	—[4]	6,338
1965	803		196,092[3]	—[3]	—[5]	197,170
1966	717		52,299[3]	—[3]	—[5]	71,310
1967	573	3	35,299[3]	—[3]	[4]	235,875
1968	4,343	199	114,176[3]	—[3]	[4]	118,718
1969	847	1	23,436[3]	—[3]	3,327	27,610
1970	645	1	73,596[3]	—[3]	5,689	79,931
1971	1,762	4	68,883	14,318	—[4]	84,967
1972	2,304	3	5,961	3,445	20,362	32,075
1973	8,964	2	61,328	119	11,777	151,108
1974	9,839	7	98,149	10,911	217,141	390,315
1975	236		99,492	84	—[4]	244,967
1976	3,392	43	53,219	2,744	—[4]	124,891
1977	23,185	192	332,859	257	63,036	649,744
1978	3,512	266	49,527	2,082	—[4]	123,561
1979	1,295	6,895	259,372	2,359	—[4]	308,481
1980	3,872		357,967	3,621	2,960	525,768
1981	23,772	10,176	529,998	4,488	—[4]	587,740
Average Years	8,037 1972-81	8,536 1979-81	174,250 1971-81	4,039 1971-81	21,619 1967-81	216,481

1) From Randall et al. (1982).
2) Coghill District created and first opened in 1961. Unakwik District created and first opened in 1962.
3) Coghill and Unakwik data combined until 1971.
4) Fishery closed.
5) Drift and set gill net data were combined; therefore, these data are not presented.

Appendix 3-11. Commercial drift gill net catches of chum salmon, by district, Prince William Sound Region, 1960-1981.[1]

Year	District					Total
	Copper River	Bering River	Coghill	Unakwik	Eshamy	
1960	314	6	—[2]	—[2]	—[4]	320
1961	106	1	2,412	—[2]	—[5]	2,517
1962	513	2	4,817[3]	—[3]	—[5]	5,332
1963	85		5,265[3]	—[4]	—[5]	5,350
1964	62		4,494[3]	—[3]	—[4]	4,556
1965	331	32	48,498[3]	—[3]	—[5]	48,861
1966	115	1	16,065[3]	—[3]	—[5]	16,818
1967	218	2	50,183[3]	—[3]	—[5]	50,403
1968	473		46,076[3]	—[3]	—[4]	46,549
1969	244		32,135[3]	—[3]	1,016	33,395
1970	687	1	13,966[3]	—[3]	949	15,603
1971	5,287		52,829	1,837	—[4]	59,953
1972	717	1	18,503	859	15,663	35,743
1973	10,173	5	68,311	91	16,632	95,212
1974	664	2	51,428	500	23,488	76,082
1975	807		32,438	70	—[4]	33,315
1976	178	1	89,140	331	—[4]	89,650
1977	335	221	127,476	141	8,344	136,517
1978	2,233	2,391	100,679	597	—[4]	105,900
1979	107	23,094	56,916	289	—[4]	80,406
1980	34	1	66,221	483	130	66,869
1981	1,752	8,491	135,962	1,369	—[4]	147,574
Average Years	2,026 1971-81	11,325 1978,79,81	72,718 1971-81	597 1971-81	4,415 1967-81	91,081

1) From Randall et al. (1982).
2) Coghill District created and first opened in 1961. Unakwik District created and first opened in 1962.
3) Coghill and Unakwik data combined until 1971.
4) Fishery closed.
5) Drift and set gill net data were combined; therefore, these data are not presented.

Appendix 3-12. Commercial set gill net catches, by species, Eshamy District, Prince William Sound Region, 1967-1981.[1]

Year	King	Sockeye	Coho	Pink	Chum	Total
1967	Closed					
1968	Closed					
1969	13	56,785	182	22,133	7,120	
1970		15,309	515	38,637	4,682	59,143
1971	Closed					
1972	33	37,771	520	25,013	10,345	73,682
1973	28	8,969	78	9,724	10,914	29,713
1974	4	6,394	11	68,300	5,408	80,117
1975	Closed					
1976	Closed					
1977	9	9,889	2	24,743	4,218	38,861
1978	Closed					
1979	Closed					
1980		2,000	38	2,371	134	4,543
1981	Closed					
Average	6	8,543	90	12,728	2,855	

1) From Randall et al. (1982).

Appendix 3-13 Estimated annual fish production attributed to existing fish pass and stream improvement projects by 2002.

Stream or Number	Name	Project Type	Year Completed	Species	New Habitat	Additional Harvestable Adults
52	Control Creek	Fish pass	1974	Pink	2 acres	12,200[1]
218	Billy's Hole	Rock removal	1981	Sockeye	84 acres	4,200[2]
300	Red Creek	Fish pass	1978	Sockeye	53 acres	2,600[2]
413a-414	Harrison Lagoon Creek	Log/Gabion Diversion	1972-3	Pink Chum	30,000 sq ft 30,000 sq ft	4,200[1] 3,000[3]
417	Hobo Creek	Fish pass	1978	Pink	264,000 sq ft	37,000[1]
455	Paulson Creek	Fish pass Wood gate	1981	Pink	66,000 sq ft	9,200[1]
476	Shrode Creek	Fish pass and weir	1962-72	Pink Sockeye	228,000 237 acres	32,000[1] 12,000[2]
687	Sockeye Creek	Fish pass	1982	Sockeye Coho	55 acres	2,800[2] 300[4]
688	Otter Creek	Fish pass	1982	Pink	7380 sq ft	1,000[1]
815	Constantine Creek	Defector Dam & Channel	1967-71	Pink Chum	2 acres 2 acres	12,200[1] 9,000[3]
841-1	Boswell Bay	Fish pass	1981	Sockeye	83 acres	4,200[2]
847	Hawkins Creek	Stream grading	1969	Pink	2 acres	12,200[1]
852	Forest Service Trail Creek	Fish pass	1980	Coho Pink	83 acres 4000 sq ft	800[5] 600[1]

1) Based on 0.14 harvestable adults produced per sq ft spawning area (USFS FY 84 budget document).
2) Based on 50 harvestable adults produced per acre of lake (USFS FY 84 budget document).
3) Based on 0.10 harvestable adults produced per sq ft spawning area (USFS FY 84 budget document).
4) Based on 5 harvestable adults produced per acre of lake. (Ken Holbrook, USFS)
5) Based on 10 harvestable adults produced per acre of lake. (Ken Holbrook, USFS)

Appendix 3-14. Summary of estimated annual fish production from completed fish pass and stream improvement projects, by species, district and gear type by 2002.

District	Stream / Lake Number	Pink	Chum	Sockeye	Coho
Eastern	52	12,200			
Northern	218			4,200	
Coghill	300			2,600	
Northwestern	413a-414	4,200	3,000		
	417	37,000			
	455	9,200			
	476	32,000		12,000	
Southwestern	687			2,800	300
	688	1,000			
Southeastern	815	12,200	9,000		
	841-1			4,200	
	847	12,200			
	852	600			800
Total		120,600	12,000	25,800	1,100
Probable drift gill net Catch[1]				5,500	
Probable seine catch[2]		120,600	12,000	20,300	1,100

1) 50% of production from stream 300 and 100% of production from stream 841-1.
2) 50% of production from stream 300 and 100% of production from remaining projects except stream 841-1.

Appendix 3-15 Current design capacity and projected adult returns of existing hatcheries, Prince William Sound Region, 1982.[1]

					Projected Adult Returns			
Facility	Species	Green Eggs[2]	Fry	Smolt	Total	Common Property Fishery[3]	Brood Stock	Hatchery Sales Fish
Port San Juan	Pink	116,000,000	100,000,000[4]		5,200,000[5]	3,694,000[6]	139,000[7]	1,367,000
	Chum	12,000,000	10,000,000[4]		200,000[8]	128,000[6]	10,000[7]	62,000
Cannery Creek	Pink	80,000,000	68,800,000[4]		482,000[4]	382,000[9]	100,000[10]	0
Main Bay	Chum	95,000,000	69,000,000[4]		808,000[4]	722,000[9]	86,000[10]	0
Solomon Gulch	Pink	50,000,000	38,500,000[11]		1,155,000[12]	808,000[13]	56,000[14]	291,000
	Chum	18,000,000	13,800,000[11]		276,000[15]	193,000[13]	13,000[14]	70,000
	Coho	1,000,000		600,000[16]	30,000[17]	15,000[13]	700[14]	14,300
Perry Island	Pink	300,000[18]	260,000[4]		1,800[4]	1,200[6]	400[4]	200
Fort Richardson	Coho	160,000		100,000[4]	5,000[17]	5,000[19]	0	0
	King	160,000		100,000[4]	3,000[47]	3,000[19]	0	0
Gulkana	Sockeye	10,300,000	7,500,000[20]		52,000[4]	45,900[19]	6,100[21]	0

1) At full utilization of existing facilities and with donor stock fully developed.
2) Freshly fertilized eggs.
3) Including commercial, sport and subsistence fisheries.
4) According to FRED Directive No. 3 (Appendix 3-16).
5) Assuming marine survival of 5.2 percent. This is the unweighted average survival rate for pink salmon fry released at Port San Juan, brood years 1975 through 1980 (Appendix 2-11).
6) Assuming a fisheries exploitation rate of 68 percent for pink salmon and 64 percent for chum salmon. These data are the unweighted average eploitation rates for the the Prince William Sound districts, 1960-1981. These estimates are maximum estimates.
7) Assuming an average fecundity of 1,675 eggs for pink salmon and 2,576 eggs for chum salmon (PWSAC Draft Annual Report, 1981). It is also assumed that 50 percent of the fish are females.
8) Assuming a marine survival rate of 2 percent (Brian Allee, PWSAC).
9) Assuming that all fish surplus to brood stock needs will be harvested by commercial users.
10) Assuming 50 percent of brood fish are females and an average fecundity of 1,600 eggs for pink salmon, 2,200 eggs for chum salmon, 2,800 eggs for coho salmon, 6,500 eggs for king salmon, and 3,000 eggs for sockeye salmon (FRED Directive No. 3).
11) Assuming a green egg to fry survival of 77 percent (Paul McCollum, VFDA).
12) Assuming a marine survival of 3 percent (Paul McCollum, VFDA).
13) Assuming a fisheries exploitation rate of 70 percent for pink and chum salmon and 50 percent for coho salmon (Jason Wells, VFDA).
14) Assuming an average fecundity of 1,800 eggs for pink salmon, 2,800 eggs for chum salmon, and 3,000 eggs for coho salmon (J. Wells, VFDA). It is also assumed that 50 percent of the fish are females.
15) Assuming a marine survival of 2 percent (Paul McCollum, VFDA).
16) Assuming a green egg to smolt survival of 60 percent (Paul McCollum, VFDA).
17) Assuming a marine survival of 5 percent (Dave Watsjold,ADF&G).
18) Current capacity.
19) Assuming that all fish surplus to brood stock needs will be harvested by commercial, sport and/or subsistence users.
20) Assuming a 73 percent survival from green egg to emergent fry. This is based on the unweighted survival of brood years 1973-1975 and 1978-1980 (Appendix 2-10).
21) Assuming an average fecundity of 3,400 eggs and 50 percent of the fish females (Ken Roberson, ADF&G).

Appendix 3-16. FRED Directive No. 3, July 9, 1979.

PROCEDURE:

For your guidance in planning, budgeting and evaluating, these values are to be used.

In the hatchery

Green Egg	to	Eyed Egg	90%
Eyed Egg	to	Emergent Fry	95%
Emergent Fry	to	Fed Fry*	95%
Fed Fry	to	Fingerling**	95%
Fingerling	to	Smolt (10 gram)	80%
Smolt (10 gram)	to	Post Smolt	90%
Green Egg	to	Smolt	62%

In lake or stream

Hatchery Produced

Eyed Egg (Plant)	to	Emergent Fry	50%
Emergent Fry (King, Coho, Sockeye)	to	Smolt	7%
Fed Fry	to	Smolt	10%
Fingerling (King, Coho, Sockeye)	to	Smolt	20%
Smolt (Coho, Sockeye)	to	Adult	10%
Smolt (King)	to	Adult	3%

Lake or Stream Produced***

Emergent Fry (Pink, Chum)	to	Adult	1%
Emergent Fry (King, Coho, Sockeye)	to	Smolt	10%

Hatchery Produced Fish Planted Near or in Tidewater

Emergent Fry (Pink, Chum)	to	Adult	0.7%
Fed Fry (Pink, Chum)	to	Adult	1%
Fingerling (Pink, Chum)	to	Adult	2%
Smolt (Coho, Sockeye)	to	Adult	10%
Smolt (King)	to	Adult	3%

To calculate the expected survival of a fish lot, multiply together all treatment values. For example: Coho salmon raised to smolt and planted at a stream mouth.

Green	to	Eyed	90
Eyed	to	Emergent	95
Emergent	to	Fed Fry	95
Feeding	to	Fingerling	95
Fingerling	to	Smolt	80
Smolt	to	Adult	10

.90 × .95 × .95 × .95 × .80 × .10 = .062 or 6.2% survival from Green Egg to Adult.

Sockeye salmon planted as fed fry in a lake

Green	to	Eyed	90
Eyed	to	Emergent Fry	95
Emergent Fry	to	Fed Fry	95
Fed Fry	to	Smolt in lake	10
Smolt	to	Adult	10

.90 × .95 × .95 × .10 × .10 = .0081 or .81 = survival from Green Egg to Adult.

Fecundities by Species (fecundity values may be changed where actual observations are available).

Chum	2,200
Pink	1,600
Coho	2,800
King	6,500
Sockeye	3,000

* Definition of Fed Fry — 25% weight gain from emergent (swim-up) weight.
** Definition of Fingerling — 100% weight gain from emergent (swim-up) weight.
*** Includes fry from egg plants, stream incubation boxes, incubation channels, etc.

Appendix 3-17 Summary of estimated annual harvestable fish production and catch by species and gear type, based on full utilization of existing hatcheries.

Harvestable Fish Production

District	Facility	King	Sockeye	Coho	Pink	Chum
Southwestern	Port San Juan				3,694,000	128,000
Eshamy	Main Bay					722,000
Northern	Perry Island				—[1]	
Unakwik	Cannery Creek				382,000	
Northwestern	Ft. Richardson	3,000		5,000		
Eastern	Solomon Gulch			15,000	808,000	193,000
Copper River	Gulkana		45,900			
	Total	3,000	45,900	20,000	4,884,000	1,043,000

Probable Seine Catch

	Port San Juan				3,694,000[2]	128,000[2]
	Main Bay					
	Perry Island				—[1]	
	Cannery Creek				260,000[3]	
	Ft. Richardson			2,500[4]		
	Solomon Gulch			7,500[4]	808,000[2]	193,000[2]
	Total			10,000	4,762,000	321,000

Probable Drift Gill Net Catch

	Main Bay					542,000[5]
	Cannery Creek				122,000[3]	
	Gulkana		27,500[6]			
	Total		27,500		122,000	542,000

Probable Set Gill Net Catch

	Main Bay					180,000[7]

Probable Subsistence Catch

			2,800[8]			

Probable Sport Catch

		1,500[4]	5,385[9]	5,000[10]		

1) Negligible contribution, 800 fish.
2) All fish harvested by seine fishermen.
3) Assuming a 68% exploitation.
4) Assuming a 50% exploitation.
5) Assuming a 75% exploitation.
6) Assuming a 60% exploitation.
7) Assuming a 25% exploitation.
8) Assuming a 15% exploitation rate on fish that escape the gill net fishermen.
9) Assuming a 35% exploitation rate on fish that escape the subsistence fishermen.
10) Assuming a 50% exploitation rate on fish that escape the seine fishermen.

Appedix 3-18 Summary of projected natural and supplemental catches by user group and species, Prince William Sound Region, 2002.

	King	Sockeye	Coho	Pink	Chum
Purse Seine Catches					
Natural	1,300	47,900	15,800	4,759,000	447,500
Supplemental[1]	0	20,300	11,000	4,882,600	333,000
Total	1,300	68,200	26,800	9,641,600	780,500
Drift Gill Net Catches					
Natural	16,800	759,200	217,900	216,500	91,100
Supplemental[1]	0	33,000	0	122,000	542,000
Total	16,800	792,200	217,900	338,500	633,100
Set Gill Net Catches					
Natural	0	8,500	100	12,700	2,900
Supplemental[1]	0	0	0	0	180,000
Total	0	8,500	100	12,700	182,900
Subsistence Catches					
Natural	1,700	25,100	400	0	0
Supplemental[1]	0	2,700	0	0	0
Total	1,700	27,800	400	0	0
Sport Catches					
Natural	2,800	6,300	11,900	18,600	1,500
Supplemental[1]	1,500	5,000	5,000	0	0
Total	4,300	11,300	16,900	18,600	1,500
Total Catches of Natural Stocks	22,600	847,000	246,100	5,006,800	543,000
Total Catches of Supplemental[1] Stocks	1,500	61,000	16,000	5,004,600	1,055,000
Total	24,100	908,900	262,100	10,011,400	1,598,000

1) Includes some natural stocks that will be rehabilitated by means of fish passes and stream improvement.

Appendix 4-1. Regional Planning Team Questionnaire.

QUESTIONNAIRE
FOR
FISHERMEN AND NON-FISHERMEN
WHO
USE OR MAY USE
THE SALMON RESOURCES
OF THE
PRINCE WILLIAM SOUND
COPPER — BERING RIVER
REGION

Dear salmon fisherman or non-fisherman:

The Prince William Sound Regional Salmon Planning Team needs your input in the preparation of the twenty-year plan for the rehabilitation, enhancement, and management of the region's salmon resources. This region encompasses the marine waters and freshwater drainages of the Prince William Sound, Copper River and Bering River Region (see map).

This questionnaire gives you the opportunity to quickly and easily tell us your needs as a fisherman or non-fisherman. We will present the results of this survey in the Comprehensive Fisheries Plan. The twenty-year goals and objectives of the plan will be developed from your input and the input of other users, agencies, and groups.

***We need you** to fill out the questionnaire and drop it in the mail before May 31, 1982.*

Sincerely,

Mike McCurdy
Chairman,
PWS Regional Planning Team

Do you need help filling this out?
Stop by your local Alaska Dept. of Fish and Game office
or call collect 424-7511

PWS-CR and BR Regional Salmon Planning Questionnaire

1. Which categories describe your sport fishing activities in the Prince William Sound — Copper and Bering River Region?

____ (012) I have sport fished for salmon in the region.

____ (013) I plan or hope to sport fish for salmon in the region.

If you are not a sport fisherman, or do not expect to become a sport fisherman, please skip over to question number 15.

SPORT FISHERMEN

2. In which areas in this region have you sport fished for salmon?

____ (014) Valdez Bay

____ (015) Passage Canal (Whittier)

____ (016) Orca Inlet

Other marine waters (please list):

____ (017) ____________________

____ (018) ____________________

____ (019) ____________________

____ (020) Gulkana River

____ (021) Eyak River

____ (022) Coghill River

____ (023) Eshamy Creek

____ (024) Eshamy Lake

____ (025) Shrode Creek

____ (026) Shrode Lake

Other lakes and streams (please list):

____ (027) ____________________

____ (028) ____________________

____ (029) ____________________

____ (030) ____________________

3. In which areas in the region do you think your the catch of salmon per day is too low?

____ (031) Valdez Bay

____ (032) Passage Canal (Whittier)

____ (033) Orca Inlet

Other marine waters (please list):

____ (034) ____________________

____ (035) ____________________

____ (036) ____________________

____ (037) Gulkana River

____ (038) Eyak River

____ (039) Coghill River

____ (040) Eshamy Creek

____ (041) Eshamy Lake

____ (042) Shrode Creek

____ (043) Shrode Lake

Other lakes and streams (please list):

____ (044) ____________________

____ (045) ____________________

____ (046) ____________________

____ (047) ____________________

4. How many years have you sport fished in this region?

____ (048-9) ________ years.

5. Which four methods of salmon sport fishing do you prefer? Rank in order of preference, your first preference number "1", etc.

____ (050) Casting from a boat

____ (051) Trolling

____ (052) Drift fishing in a boat

____ (053) Fishing from shore or wading

____ (054) Ice fishing for land-locked salmon

____ (055) Snagging in marine waters

Other (specify):

____ (056) ____________________

____ (057) ____________________

Answer questions for the Prince William Sound — Copper and Bering River salmon planning region only.

PWS-CR and BR Regional Salmon Planning Questionnaire

6 . Which four aspects about salmon sport fishing are most important to you? Rank in order of importance, the most important number "1", etc.

___ Scenery (058)
___ Catching your limit (059)
___ Fishing by yourself (060)
___ Boating (061)
___ Peace and quiet (062)
___ Fishing with your friends (063)
___ Eating your catch (064)
___ Hooking, playing and landing the fish (065)

Other (specify):

___ ______________________ (066)
___ ______________________ (067)

7 . In view of your answers to question 6, rank your four favorite salmon fishing areas, your first preference number "1", etc. Do not rank those areas that you have not fished.

___ Valdez Bay (068)
___ Passage Canal (Whittier) (069)
___ Orca Inlet (070)

Other marine waters (please list):

___ ______________________ (071)
___ ______________________ (072)
___ ______________________ (073)
___ Gulkana River (074)
___ Eyak River (075)
___ Coghill River (076)
___ Eshamy Creek (077)
___ Eshamy Lake (078)
___ Shrode Creek (079)
___ Shrode Lake (080)

Other lakes and streams (please list):

___ ______________________ (081)
___ ______________________ (082)
___ ______________________ (083)
___ No opinion (084)

8 . Which species of salmon do you prefer to fish for? Rank in order of preference, your first preference number "1", etc.

___ King (chinook) (085)
___ Red (sockeye) (086)
___ Dog (chum) (087)
___ Humpback (pink) (088)
___ Silver (coho) (089)

9 . How many salmon did you catch on sport gear in 1981 in the region?

___ King (chinook) (090-2)
___ Red (sockeye) (093-5)
___ Dog (chum) (096-8)
___ Humpback (pink) (99-101)
___ Silver (coho) (102-4)
___ Did not fish in the region in 1981 (105)

10. Overall, was your 1981 sport salmon catch adequate?

___ Yes
___ No
___ No opinion
(106)

11. Do you need to catch your daily limit to feel satisfied?

___ Yes
___ No
___ No opinion (107)

Answer questions for the Prince William Sound — Copper and Bering River salmon planning region only.

PWS-CR and BR Regional Salmon Planning Questionnaire

12. As a sport fisherman, how many of the following fish do you need to catch per season to feel satisfied?

____ (108-10) King (chinook)
____ (111-3) Red (sockeye)
____ (114-6) Dog (chum)
____ (117-9) Humpback (pink)
____ (120-22) Silver (coho)

13. What species of salmon do you think need to be enhanced?

____ (123) King (chinook)
____ (124) Red (sockeye)
____ (125) Dog (chum)
____ (126) Humpback (pink)
____ (127) Silver (coho)

14. What are the four most important problems with the salmon sport fisheries of the region? Rank them in order of importance, the most important number "1", etc.

____ (128) Lack of fish
____ (129) Management of the fisheries
____ (130) Lack of enforcement
____ (131) Overcrowded fishing areas
____ (132) Lack of access
____ (133) Lack of campgrounds
____ (134) Inadequate campgrounds
____ (135) Lack of boat slips
____ (136) Restrictive regulations
Other (specify):

____ (137) ____________________________

15. Which categories describe your subsistence fishing activities in the Prince William Sound — Copper and Bering River Region? A subsistence user is a person who harvests salmon under the current subsistence regulations and while in posession of a current subsistence use permit.

____ (138) I have subsistence fished for salmon in this region.
____ (139) I plan or hope to subsistence fish for salmon in this region.

If you are not a subsistence fisherman in this region and/or do not expect to become a subsistence fisherman in this region, please skip over to question number 24.

SUBSISTENCE FISHERMEN

16. What type of fishing gear do you use?

____ (140) Dip net
____ (141) Fishwheel
____ (142) Drift gill net
____ (143) Set gill net
____ (144) Purse siene
____ (145) Other ________________

17. Rank the species of salmon you like to eat in order of preference, your first preference number "1", etc.

____ (146) King (chinook)
____ (147) Red (sockeye)
____ (148) Dog (chum)
____ (149) Humpback (pink)
____ (150) Silver (coho)

Answer questions for the Prince William Sound — Copper and Bering River salmon planning region only.

PWS-CR and BR Regional Salmon Planning Questionnaire

18. How many subsistence salmon did you or your family catch in this region in 1981?

____ King (chinook) (151-3)
____ Red (sockeye) (154-6)
____ Dog (chum) (157-9)
____ Humpback (pink) (160-2)
____ Silver (coho) (163-5)
____ Did not fish in 1981 (166-8)

19. Was this adequate?

____ Yes
____ No
____ No opinion (169)

20. Where did you fish in this region in 1981.

____ Upper Copper River (170)
____ Copper River Flats (171)
____ Bering River District (172)
____ Unakwik District (173)
____ Coghill District (174)
____ Eshamy District (175)
____ Other ____________ (176)

21. Where do you prefer to fish? Rank in order of preference, your first preference number "1", etc.)

____ Upper Copper River (177)
____ Copper River Flats (178)
____ Bering River District (179)
____ Unakwik District (180)
____ Coghill District (181)
____ Eshamy District (182)
____ Other ____________ (183)

22. How many salmon do you and your family need per year?

____ ________ (number) salmon (184-7)

23. What are four most important problems with the salmon subsistence fisheries of the region? Rank them in order of importance, the most important number "1", etc.

____ Lack of fish (188)
____ Management of the fisheries (189)
____ Lack of enforcement (190)
____ Overcrowded fishing areas (191)
____ Lack of access (192)
____ Lack of campgrounds (193)
____ Inadequate campgrounds (194)
____ Too many other fishermen (195)
____ Restrictive regulations (196)
____ Lack of open areas (197)
Other (specify):
____ ________________________ (198)

24. Which categories describe your commercial fishing activities in Area E? Area E is the commercial salmon district in the Prince William Sound — Copper and Bering River Region; the district's eastern boundary is Cape Suckling and its western boundary is Cape Fairfield.

____ I have commercial fished for salmon in this region. (199)
____ I plan or hope to commercial fish for salmon in this region. (200)

If you are not a commercial fisherman in the region and/or do not plan to become a commercial fisherman in this region, please skip over to question number 45.

Answer questions for the Prince William Sound — Copper and Bering River salmon planning region only.

PWS-CR and BR Regional Salmon Planning Questionnaire

COMMERICAL FISHERMEN

25 . If you are not now a commercial fisherman in Area E but you plan or expect to become one, indicate in which fishery and in which capacity?

___ Salmon seine entry permit holder (201)
___ Salmon seine crew member (202)
___ Salmon drift net entry permit holder (203)
___ Salmon drift net crew member (204)
___ Salmon set net entry permit holder (205)
___ Salmon set net crew member (206)

26 . If you are now a commercial fisherman in Area E, indicate in which fishery and in which capacity?

___ Salmon seine entry permit holder ___ years (207) (208-9)
___ Salmon seine crew member ___ years (210) (211-2)
___ Salmon drift net entry permit holder ___ years (213) (214-5)
___ Salmon drift net crew member ___ years (216) (217-8)
___ Salmon set net entry permit holder ___ years (219) (220-1)
___ Salmon set net crew member ___ years (222) (223-4)

27 . If you are now a commercial fisherman in Area E, indicate in which capacity you would like to participate in the future.

___ Wish to continue in same capacity (225)

Wish to change to the following capacity in the future:

___ Salmon seine entry permit holder (226)
___ Salmon seine crew member (227)
___ Salmon drift net entry permit holder (228)
___ Salmon drift net crew member (229)
___ Salmon set net entry permit holder (230)
___ Salmon set net crew member___ (231)

28 . What percent of your gross 1981 income did you derive from the following sources:

Salmon seining (Area E)	___% (232-4)
Salmon drift gillnetting (Area E)	___% (235-7)
Salmon set gillnetting (Area E)	___% (238-40)
Other fisheries in Area E	___% (241-3)
Fisheries in other areas	___% (244-6)
Non-fishing sources	___% (247-49)
Total	___%

29 . Were you satisfied with the 1981 breakdown of your income?

___ Yes (250)
___ No (251)
___ Did not fish in 1981 (252)
___ No opinion (253)

30 . If not, what percent of your gross income would you prefer to come from the following sources:

Salmon seining (Area E)	___% (254-6)
Salmon drift gillnetting (Area E)	___% (257-9)
Salmon set gillnetting (Area E)	___% (260-2)
Other fisheries in Area E	___% (263-5)
Fisheries in other areas	___% (266-8)
Non-fishing sources	___% (269-71)
Total	___%

31 . Was your commercial catch of salmon in Area E adequate in 1981?

___ Yes
___ No
___ No opinion (272)

Answer questions for the Prince William Sound — Copper and Bering River salmon planning region only.

PWS-CR and BR Regional Salmon Planning Questionnaire

3 2 . Were you satisfied with your earnings from commercial salmon fishing in Area E in 1981?

____ Yes

____ No

____ No opinion
(273)

3 3 . What do you need to gross in an average year to pay your fishing and living expenses and make a reasonable profit from fishing investments?

$__ ___________
(274-80)

3 4 . Are you paying for your permit?

____ Yes

____ No
(281)

3 5 . Do you have a boat?

____ Yes

____ No
(282)

3 6 . Is your boat financed?

____ Yes

____ No
(283)

3 7 . Which species do you prefer to fish for? Rank in order of preference, your first preference number "1", etc.

____ King (chinook)
(284)

____ Red (sockeye)
(285)

____ Dog (chum)
(286)

____ Humpback (pink)
(287)

____ Silver (coho)
(288)

3 8 . Do you take a portion of your commercial salmon catch home for personal use?

____ Yes

____ No
(289)

3 9 . Which species do you prefer to take home for personal use? Rank in order of preference, your first preference number "1", etc.

____ King (chinook)
(290)

____ Red (sockeye)
(291)

____ Dog (chum)
(292)

____ Humpback (pink)
(293)

____ Silver (coho)
(294)

4 0 . How many of the following species did you to take home for personal use during the 1981 commercial season

____ King (chinook)
(295-7)

____ Red (sockeye)
(298-30-0)

____ Dog (chum)
(301-3)

____ Humpback (pink)
(304-6)

____ Silver (coho)
(307-9)

4 1 . In which district do you prefer to gill net for salmon? Rank in order of preference, your first preference number "1", etc.

____ Bering River
(310)

____ Copper River
(311)

____ Unakwik
(312)

____ Coghill
(313)

____ Eshamy
(314)

Answer questions for the Prince William Sound — Copper and Bering River salmon planning region only.

PWS-CR and BR Regional Salmon Planning Questionnaire

42. In which district do you prefer to purse seine for salmon? Rank in order of preference, your first preference number "1", etc.

____ Eastern (315)
____ Northern (316)
____ Northwestern (317)
____ Southwestern (318)
____ Montague (319)
____ Southeastern (320)
____ Unakwik (321)
____ Coghill (322)

43. Recognizing that hatcheries are in place at Port San Juan, Cannery Creek, Main Bay, Valdez, and Perry Island, which district would you prefer to have enhanced or rehabilitated? Rank in order of preference, your first preference number "1", etc.

____ Bering River (323)
____ Copper River (324)
____ Eastern (325)
____ Northern (326)
____ Northwestern (327)
____ Southwestern (328)
____ Montague (329)
____ Southeastern (340)
____ Unakwik (341)
____ Coghill (342)
____ Eshamy (343)

44. What are the four most important problems with the commercial salmon fisheries of the region? Rank them in order of importance, the most important number "1", etc.

____ Lack of fish (344)
____ Management of the fisheries (345)
____ Lack of enforcement (346)
____ Too much gear (347)
____ Unstable prices (348)
____ Lack of processors (349)
____ Lack of loans (350)
____ Restrictive regulations (351)
Other (specify):
____ ________________________________ (352)

NON-FISHERMEN ONLY

45. What is the most important thing to you about the salmon resource of the region?

____
____
____
____
____
____

46. What do you think should be done to increase man's benefits from the salmon of the region?

____
____
____
____
____
____
____

Answer questions for the Prince William Sound — Copper and Bering River salmon planning region only.

PWS-CR and BR Regional Salmon Planning Questionnaire

FISHERMEN AND NON-FISHERMEN

4 7 . Enhancing and rehabilitating the salmon runs and increasing man's benefits from this resource will require various activities to take place. Please indicate if you approve, disapprove or have no opinion concerning the following activities. Circle your answer.

Approve	Disapprove (353)	No Opinion	Construct fish hatcheries
Approve	Disapprove (354)	No Opinion	Install incubation boxes in or near streams
Approve	Disapprove (355)	No Opinion	Build fish ladders
Approve	Disapprove (356)	No Opinion	Fertilize lakes
Approve	Disapprove (357)	No Opinion	Remove undesireable fish from selected lakes and restock with desirable fish.
Approve	Disapprove (358)	No Opinion	Clear streams of logs and boulders
Approve	Disapprove (359)	No Opinion	Transport fish to barren lakes
Approve	Disapprove (360)	No Opinion	Build roadside viewing areas
Approve	Disapprove (361)	No Opinion	Build access roads
Approve	Disapprove (362)	No Opinion	Install boat slips and launching ramps
Approve	Disapprove (363)	No Opinion	Other (specify)

4 8 . Please write down your suggestions or comments below.

Answer questions for the Prince William Sound — Copper and Bering River salmon planning region only.

Appendix 4-2. Questionnaire responses of commercial salmon fishermen, seine permit holders.

	Seine Permit Only[1]			All Seine Permit Holders[2]					
	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Did not fish in 1981	Future Permit Holders	Total
24. Number of respondents:	18	4	1	40	9	1	1	0	51
26. Level of participation in Area E salmon fisheries and average years of experience:									
Seine entry permit holder (number/years)	18/3-6	4/2-5	1/8.0	40/5-7	9/7-2	1/8.0	1/4.0		51/6.0[3]
Seine crew member (number/years)	2/5-5		1/2.0	9/8.0	3/6.0	1/2.0			13/7.7[3]
Drift net permit holder (number/years)			1/2.0	26/9.8	4/17.8	1/2.0	1/5.0		32/10.4[3]
Drift net crew member (number/years)		1/4.0		1/3.0	1/4.0				2/3.5[3]
Set net entry permit holder (number/years)									
Set net crew member (number/years)									
27. Desired level of participation in the Area E salmon fisheries:									
Wish to continue in same capacity	16	3	1	34	8	1	1		44
Wish to change in the following capacity in the future:									
Salmon seine entry permit holder									
Salmon seine crew member									
Salmon drift net entry permit holder	2	3		3	3				6
Salmon drift entry crew member									
Salmon set net entry permit holder				1					1
Salmon set net crew member									
28. Percentage of gross 1981 income derived from the following sources:									
Salmon seining (Area E)	71	67	100	72	69	100			71[3]
Salmon drift gill netting (Area E)				8	17				9[3]
Salmon set gill netting (Area E)									
Other fisheries in Area E	6			9	3		100		9[3]
Fisheries in other area	1	3		1	1				1[3]
Non-fishing sources	22	30		10	10				10[3]
Total	100	100	100	100	100	100	100		100[3]
29. Number satisfied with the breakdown of their 1981 income:									
Satisfied	16	2		32	3				35
Dissatisfied	1	1		6	5				11
Did not fish in 1981							1		1
No opinion	1	1	1	2	1	1			4
30. Preferred sources of gross income (Question 28 revised):									
Salmon seining (Area E)	71	75	30	71	63	50	30		68[3]
Salmon drift gill netting (Area E)	1	8	10	12	25	25	10		14[3]
Salmon set gill netting (Area E)									
Other fisheries in Area E	10		60	9	2	25	60	9	
Fisheries in other areas	1	6		1	3				1[3]
Non-fishing sources	17	11		7	7				8[3]
Total	100	100	100	100	100		100		100[3]

1) Participated in the 1981 Area E salmon fishery as a seine permit holder only.
2) Participated in the 1981 Area E salmon fishery as a seine permit holder and in some instances a drift permit holder and drift crew member. Also included is a permit holder who did not fish in 1981.
3) Weighted mean.

Appendix 4-2. Questionnaire responses of commercial salmon fishermen, seine permit holders, continued.

	Seine Permit Only			All Seine Permit Holders					
	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Did not fish in 1981	Future Permit Holders	Total
31. Was the respondent's commercial catch in 1981 adequate?:									
Adequate	18			37					37
Not Adequate		2		3	7				10
No opinion		2	1		2	1	1		4
32. Number of respondents satisfied with their earnings from commercial salmon fishing in Area E in 1981:									
Satisfied	18			40					40
Dissatisfied		4			9				9
No opinion			1			1	1		2
33. Average gross earnings from salmon seining needed by respondent to pay his fishing and living expenses and make a reasonable profit from fishing investments:[1]									
$0—$9,999									
10,000—19,999									
20,000—29,999	2			3					3
30,000—39,999				1					1
40,000—49,999				4	1				5
50,000—59,999	2	1		3	2				5
60,000—69,999	2			3					3
70,000—79,999	1			1					1
80,000—89,999		2		1	2				3
90,000—99,999	1			1					1
100,000—109,999	1			3		1			4
110,000—119,999	1			1					1
120,000—129,999	3	1		5	2				7
130,000—139,999	1			3					3
140,000—149,999				1					1
150,000—159,999			1	2	1		1		4
160,000—169,999	1			1					1
170,000—179,999									
180,000—189,999	2			2					2
190,000—199,999									
200,000—209,999	1			2					2
210,000—219,999				1					1
220,000—229,999					1				1
250,000—259,999				1					1
Number of Respondents	18	4	1	39	9	1	1		50
Average	$105,000	86,000	150,000	106,000	102,000	100,000	150,000		106,000

Appendix 4-2. Questionnaire responses of commercial salmon fishermen, seine permit holders, continued.

	Seine Permit Only			All Seine Permit Holders					
	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Did not fish in 1981	Future Permit Holders	Total
34. Number of respondents paying for permits:									
Paying	6	3		13	5				18
Not Paying	12	1	1	27	4	1	1		33
35. Number of respondents who own a boat:									
Own a boat	17	3	1	39	8	1	1		49
Does not own boat	1	1		1	1				2
36. Number of respondents who have their boat financed:									
Boat financed	14	2	1	31	7	1	1		40
Boat not financed	4	1		9	1				10

1. Actual answered multiplied by desired seine percentage in question 30.

	Seine Permit Only: Satisfied	Seine Permit Only: Dissatisfied	Seine Permit Only: No Opinion	All Seine: Satisfied	All Seine: Dissatisfied	All Seine: No Opinion	Did not fish in 1981	Future Permit Holders	Total
37. The number "1" species preferred to fish for:									
King (chinook)	1			3	1				4
Red (sockeye)	4	2	1	12	3	1	1		17
Dog (chum)	5	1		5	2				7
Humpback (pink)	8	1		17	3				20
Silver (coho)				1					1
38. Number of respondents who take home a portion of their commercial catch for their own use:	12	3	1	33	5	1	1		40
39. The number "1" preference for personal use:									
King (chinook)	6	2	1	16	4	1	1		22
Red (sockeye)	8	2		16	3				19
Dog (chum)				1					1
Humpback (pink)									
Silver (coho)	1			2					2
40. Average number of fish by species taken home for personal use during the 1981 commercial season:									
King (chinook)	0.8			2.1	1.4	2.0			1.9[1]
Red (sockeye)	4.8	0.3		8.9	6.4	10.0			8.3[1]
Dog (chum)	5.8			2.7	0.2				2.2[1]
Humpback (pink)	4.2	1.7		2.2	3.3				2.3[1]
Silver (coho)	4.0	0.6		4.0	6.7	10.0			4.5[1]

1) Weighted average.

Appendix 4-2. Questionnaire responses of commercial salmon fishermen, seine permit holders, continued.

	Seine Permit Only			All Seine Permit Holders					
	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Did not fish in 1981	Future Permit Holders	Total
42. The number "1" preferred area for salmon seining:									
Eastern	4			7					7
Northern	1		1	7		1			8
Northwestern		1		1	1				2
Southwestern	10			19	1		1		21
Montague				1					1
Southeastern	3			5	3				8
Unakwik		1			1				1
Coghill									
43. Recognizing that hatcheries are in place at Port San Juan, Cannery Creek, Main Bay, Valdez, and Perry Island, respondents ranked their number "1" preference for enhancement or rehabiliation work:									
Bering River				2					2
Copper River	1		1	13	2	1	1		17
Eastern	3	1		5	1				6
Northern	3	1		4	2				6
Northwestern	1	1		1	1				2
Southwestern	2			3					3
Montague				2					2
Southeastern									
Unakwik	1			1					1
Coghill	3	1		5	2				7
Eshamy	1			1					1
44. The number "1" problem with the commercial salmon fisheries of the region:									
Lack of fish				1	1		1	n/a	3
Management of fisheries				2					2
Lack of enforcement	3			9					9
Too much gear	1			4	2	1			7
Unstable prices	10	2	1	16	3				19
Lack of processors	4			6					6
Lack of loans									
Restrictive regulations									

Appendix 4-2. Questionnaire responses of commercial salmon fishermen, seine permit holders, continued.

47. Enhancing and rehabilitating the salmon runs and increasing man's benefits from this resource will require various activities to take place. Respondents indicated their approval (A), disapproval (D), or no opinion (N) concerning the following activities:

	Seine permit only									All seine permit holders																	
	Satisfied with 1981 earnings			Dissatisfied with 1981 earnings			No Opinion about 1981 earnings			Satisfied with 1981 earnings			Dissatisfied with 1981 earnings			No Opinion about 1981 earnings			Did not fish in 1981			Future Permit Holders			Total		
	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
Construct fish hatcheries	15	1		3	1			1		33	2		8		1	1			1						43	2	2
Install incubation boxes in or near streams	16		1	4			1			35		2	8		1	1			1						45		3
Build fish ladders	16		1	4			1			33		4	9			1				1					44		4
Fertilize lakes	16		1	4			1			34		3	6	1	2	1			1						42	1	52
Remove undesirable fish from selected lakes and restock with desirable fish	7	2	5	4				1		17	5	12	5		1		1		1						23	6	13
Clear streams of logs and boulders	14	2	1	3		1	1			31	3	3	7		1	1			1						40	3	4
Transport fish to barren lakes	15	1	1	4			1			30	3	4	8			1			1						40	3	40
Build roadside viewing areas	6	5	6	1		3			1	10	14	12	1	4	3			1		1					11	19	16
Build access roads	3	7	6	1	3		1			5	21	9	1	7		1				1					7	29	9
Install boat slips and launching ramps	8	4	4	1	2	1			1	16	11	7	2	5	1	2	5	1		1					18	17	19

Appendix 4-3. Estimated minimum revenue requirements of hypothetical salmon purse seine, drift gill net and set gill net permit holders, Prince William Sound Region, 1981.[1]

Purse seine permit holders

Assumptions:
1. Market value of entry permit (second quarter, 1982) - $150,000
2. Market value of boat (second quarter, 1982) - $98,000[2]
3. Market value of gear (second quarter, 1982) - $34,000[3]
4. Percent of permit, boat and gear financed - 70%[4]
5. Loan terms - 14% for 10 years and equal annual payments
6. Return on investment equal to 10% of dollars invested annually[5]
7. Gross personal income requirement equal to median household income of Alaskan residents in 1980 of $25,109[6]
8. Average crew of 4.2 people including permit holder[7]
9. Average crew share of 10% per crew member[8]

Expenses:[9]	
Fuel	$2,500
Provisions	$2,700
Maintenance	$4,000
Supplies	$5,000
Transportation	$2,500
Insurance	$3,000
Moorage/storage	$1,000
Dues/licenses	$750
Vehicle	$1,000
Permit, boat and gear payments	$33,500
Subtotal	$55,950
Return on investment:	$8,500
Personal income (returns to labor and management):	$17,100[10]
Subtotal:	$81,550
Crew share:	$38,400
Assessment:	$1,400
Total:	$121,350

Drift gill net permit holders

Assumptions:
1. Market value of entry permit (second quarter, 1982) - $65,000
2. Market value of boat (second quarter, 1982) - $44,000[11]
3. Market value of gear - $15,600 (second quarter, 1982)[12]
4. Percentage of permit, boat and gear financed - 70%[4]
5. Loan terms - 14% for 10 years and equal annual payments
6. Return on investment equal to 10% of dollars invested[5]
7. Gross personal income requirement equal to median household income of Alaskan residents in 1980 of $25,109[6]
8. Average crew of 1.3 people including permit holder[7]
9. Average crew share of 10% per crew member[8]

Expenses:[9]	
Fuel	$2,000
Provisions	$2,000
Maintenance	$4,000

Appendix 4-3. Estimated minimum revenue requirements of hypothetical salmon purse seine, drift gill net and set gill net permit holders, Prince William Sound Region, 1981, continued.

Supplies	$500
Transportation	$1,600
Insurance	$1,400
Moorage/storage	$500
Dues/licenses	$250
Truck	$1,000
Permit, boat and gear payments	$14,800
Subtotal	$28,050
Return on investment:	$3,700
Personal income (returns to labor and management):	$15,800 [13]
Subtotal:	$47,550
Crew share:	$1,500
Assessment:	$100 [14]
Total:	$49,150

Set gill net permit holders[15]

Assumptions:
1. Market value of entry permit (second quarter, 1982) - $21,000
2. Market value of boat (estimate, no data available) - $5,000
3. Market value of gear (estimate, no data available) - $5,000
4. Market value of fishing site (estimate, no data available) - $25,000
5. Percentage of permit, boat and gear financed - 70%[4]
6. Loan terms - 14% for 10 years and equal annual payments
7. Return on investment equal to 10% of dollars invested[5]
8. Gross personal income requirement equal to median household income of Alaskan residents in 1980 of $25,109[6]
9. Average crew of 1.5 people including permit holder (estimate, no data available)
10. Average crew share of 10% per crew member[8]

Expenses:	
General operating (estimated from Cook Inlet)[7]	$4,000
Permit, boat and gear payments	$6,700
Subtotal	$10,700
Return on investment:	$1,700
Personal income (returns to labor and management):	$11,300 [16]
Subtotal:	$23,700
Crew share:	$1,200
Assessment:	$50 [11]
Total:	$24,950

1) Not necessarily representative of average permit holder.

2) Larson (1980) estimated the average market value of Area E purse seine boats during fall, 1979 to have been approximately $81,370. The average value was increased as per footnote 2 above without regard to the purchase of new vessels.

3) Larson (1980) estimated the average value of fishing gear to have been approximately $27,865 during fall 1979. This estimate was increased as per footnote 2.

4) Hypothetical, assuming equal payments annually.

5) To offset inflation.

6) Thomas (1982).

Appendix 4-3. **Estimated minimum revenue requirements of hypothetical salmon purse seine, drift gill net and set gill net permit holders, Prince William Sound Region, 1981, continued.**

7) Larson (1980).
8) Common crew share percentage.
9) Wiese (personal communication).
10) Median household income adjusted by 68%, the amount of gross income that fishermen indicated they desire to earn from salmon purse seining in Area E.
11) Larson (1980) estimated the average market value of Area E drift gill net boats during fall, 1979 to have been approximately $36,526. The Anchorage Consumer Price Index (CPI) increased 21% between January, 1980 and May, 1982. The average value was increased accordingly without regard to the purchase of new vessels.
12) Larson (1980) estimated the average value of fishing gear to have been approximately $12,905 during fall 1979. This estimate was increased by the increase in the CPI of 21%.
13) Median household income adjusted by 63%, the portion of gross income that fishermen indicated that they desire to earn from salmon drift gill netting in Area E.
14) Based on the number of fish needed to meet all of the foregoing revenue requirements and an assessment of 2¢ per fish.
15) Few data are available. Rough estimates and Cook Inlet data collected by Larson (1980) have been employed.
16) Median household income adjusted by 45%, the portion of gross income that fishermen indicated that they desire to earn from salmon set gill netting in Area E.

Appendix 4-4. Questionnaire responses of commercial salmon fishermen, drift gill net permit holders.

	Drift Gill Net Permit Only[1]			All Drift Gill Net Permit Holders[2]					
	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Did not fish in 1981	Future Permit Holders	Total
24. Number of respondents:	15	33	5	55	47	6	2	3	113
26. Level of participation in the Area E salmon fisheries and average years of experience:									
Seine entry permit holder (number/years)				26/6.7	4/13.0		1/4.0		31/7.4[3]
Seine crew member (number/years)	4/6.8	2/7.0	3/7.7	23/8.1	10/6.0	4/6.2			37/7.3[3]
Drift net entry permit holder (number/years)	13/9.9	32/6.5	5/2.6	52/8.6	45/7.4	6/2.5	2/3.0		105/7.6[3]
Drift net crew member (number/years)	1/2.0			2/2.5					2/2.5[3]
Set net entry permit holder (number/years)					2/9.0				2/9.0[3]
Set net crew member (number/years)									
27. Desired level of participation in the Area E salmon fisheries:									
Wish to continue in same capacity	12	29	4	44	38	4	2	n/a	48
Wish to change to the following capacity in the future:									
Salmon seine entry permit holder	2	6	2	12	9	2			23
Salmon seine crew member	1	4		1	6				7
Salmon drift net entry permit holder									
Salmon drift net crew member									
Salmon set net entry permit holder		1			1				1
Salmon set net crew member									
28. Percentage of gross 1981 income derived from the following sources:									
Salmon seining (Area E)				43	10	8		n/a	26[3]
Salmon drift gill netting (Area E)	90	76	67	42	64	61			52[3]
Salmon set gill netting (Area E)									
Other fisheries in Area E	2	1		9	1				5[3]
Fisheries in other areas		1	14		3	12	50		3[3]
Non-fishing sources	8	22	19	6	22	19	50		14[3]
Total	100	100	100	100	100	100	100		100[3]
29. Number satisfied with breakdown of their 1981 income:									
Satisfied	10	9	3	37	12	3		n/a	52
Dissatisfied	2	21	1	13	32	1			46
Did not fish in 1981							2		2
No opinion	3	3	1	5	3	2			10

1) Participated in the 1981 Area E salmon fishery as a drift permit holder only.
2) Participated in the 1981 Area E salmon fishery as a drift permit holder and in some instances as Area E salmon seine crewmen or seine permit holders. Also included in this category are those permit holders who didn't fish as drift permit holders in 1981 as well as aspiring fishermen who wish to enter the fishery.
3) Weighted average.

Appendix 4-4. Questionnaire responses of commercial salmon fishermen, drift gill net permit holders, continued.

	Drift Gill Net Permit Only			All Drift Gill Net Permit Holders					
	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Did not fish in 1981	Future Permit Holders	Total
30. Preferred sources of gross income (Question 28 answers revised):									
Salmon seining (Area E)		4		39	14		15		25
Salmon drift gill netting (Area E)	88	81	77	52	75	81	45	25	63
Salmon set gill netting (Area E)		5			1			12	1
Other fisheries in Area E	3	2		4	2		30	12	3
Fisheries in other areas	1	2	13		3	11		12	2
Non-fishing sources	8	6	10	5	5	8	10	39	6
Total	100	100	100	100	100	100	100	100	100
31. Number of respondents satisfied with their commercial salmon catch in Area E in 1981:									
Adequate	14	4		48	6			n/a	54
Not adequate	1	28	4	7	40	4			51
No opinion		1	1		1	2	2		5
32. Number of respondents satisfied with their earnings from commercial salmon fishing in Area E in 1981:									
Satisfied	15			55				n/a	55
Dissatisfied		33			47				47
No opinion			5			6	2		8

Appendix 4-4. Questionnaire responses of commercial salmon fishermen, drift gill net permit holders.

	Drift Gill Net Permit Only			All Drift Gill Net Permit Holders					
	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Did not fish in 1981	Future Permit Holders	Total
33. Average gross earnings from salmon drift gill netting needed by respondent to pay his fishing and living expenses and make a reasonable profit from fishing investments:[1]									
$ 0—9,999				5				n/a	5
10,000—19,999		2	1	5	2	1			8
20,000—29,999	1	2		8	5				13
30,000—39,999	3	2		8	4				12
40,000—49,999	1	2	2	4	4	2	1		11
50,000—59,999	2	8		4	12		1		17
60,000—69,999	3	6	2	5	6	3			14
70,000—79,999	3	4		5	5				10
80,000—89,999		2			2				2
90,000—99,999				1					1
100,000—109,999		3		4	4				8
110,000—119,999									
120,000—129,999									
130,000—139,999									
140,000—149,999									
150,000—159,999									
160,000—169,999									
170,000—179,999									
180,000—189,999					1				1
190,000—199,999									
200,000—209,999									
210,000—219,999									
220,000—229,999									
250,000—259,999									
Number of Respondents	13	32	5	49	45	6	2		102
Average	$53,000	57,000	47,000	43,000	57,000	49,000	49,000		50,000
34. Number of respondents paying for permits:									
Paying	4	14	4	21	18	4	1	n/a	44
Not Paying	11	19	1	34	29	1	1		65
35. Number of respondents who own a boat:									
Own a boat	15	32	5	55	45	6	2	n/a	108
Does not own boat					1				1
36. Number of respondents who have their boat financed:									
Boat financed	8	27	4	37	39	5	2	n/a	83
Boat not financed	7	5	1	18	6	1			25

1) Actual answer multiplied by desired drift gillnet percentage in question 30.

Appendix 4-4. Questionnaire responses of commercial salmon fishermen, drift gill net permit holders, continued.

	Drift Gill Net Permit Only			All Drift Gill Net Permit Holders					
	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Did not fish in 1981	Future Permit Holders	Total
37. The number "1" preferred species to fish for:									
King (chinook)	3	4		7	8			n/a	15
Red (sockeye)	11	27	2	31	33	5	2		71
Dog (chum)				2	2				4
Humpback (pink)				11	1				12
Silver (coho)		2	1	1	3	1			5
38. Number of respondents who take home a portion of their commercial catch for their own use:									
Yes	14	27	3	51	38	4	2	n/a	95
No	1	6	2	4	9	2			15
39. The number "1" preference for personal use:									
King (chinook)	6	14	2	27	21	2		n/a	50
Red (sockeye)	7	16	1	21	21	4			46
Dog (chum)				1					1
Humpback (pink)									
Silver (coho)		2		1	2				3
40. Average number of fish by species taken home for personal use during the 1981 commercial season:[1]									
King (chinook)	2.6	2.4	4.8	3.1	3.2	4.0		n/a	3.1[1]
Red (sockeye)	11.4	16.8	28.0	11.1	16.7	23.3			14.2[1]
Dog (chum)		0.3		0.3	0.5				0.4[1]
Humpback (pink)		1.0		0.2	0.7				0.4[1]
Silver (coho)	10.4	8.5	10.0	6.5	9.3	8.3			7.8[1]
41. The number "1" preferred area for salmon gill netting:									
Bering River		1		8	1			n/a	9
Copper River	8	16	2	32	28	3	2		65
Unakwik									
Coghill	7	15	1	14	16	3			33
Eshamy					1				1

1) Weighted average

Appendix 4-4. Questionnaire responses of commercial salmon fishermen, drift gill net permit holders, continued.

43. Recognizing that hatcheries are in place at Port San Juan, Cannery Creek, Main Bay, Valdez and Perry Island, respondents ranked their number "1" preference for enhancement or rehabilitation work:

	Drift Gill Net Permit Only			All Drift Gill Net Permit Holders					
	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Did not fish in 1981	Future Permit Holders	Total
Bering River		4		3	5		2	n/a	10
Copper River	10	14	1	35	21	5	1		61
Eastern		1		3	2		3		8
Northern				2			4		6
Northwestern									
Southwestern				1					1
Montague				2	1				3
Southeastern					1				1
Unakwik		1			1				1
Coghill	2	7	2	7	8				15
Eshamy		3			4				4

44. The number "1" problem with the commercial salmon fisheries of the region:

	Drift Gill Net Permit Only			All Drift Gill Net Permit Holders					
	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Did not fish in 1981	Future Permit Holders	Total
Lack of fish	3	9		7	13	2	n/a	2	24
Management of fisheries	3	6	1	7	6	1			14
Lack of enforcement	1			8	2				10
Too much gear	3	5		11	8	1			20
Unstable prices	1	2	1	11	4			15	
Lack of processors	1	3	1	6	3	1			10
Lack of loans		1			1				1
Restrictive regulations		3		1	3	1			5

47. Enhancing and rehabilitating the salmon runs and increasing man's benefits from this resource will require various activities to take place. Respondents indicated their approval (A), disapproval (D), or no opinion (N) concerning the following activities:

	Drift Gill Net Permit Only									All Drift Gill Net Permit Holders																	
	Satisfied with 1981 earnings			Dissatisfied with 1981 earnings			No Opinion about 1981 earnings			Satisfied with 1981 earnings			Dissatisfied with 1981 earnings			No Opinion about 1981 earnings			Did not fish in 1981			Future Permit Holders			Total		
	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
Construct fish hatcheries	9	1	1	25	6	1	4			43	2	2	38	6	1	5			2			1			89	8	3
Install incubation boxes in or near streams	8		2	31		1	4			42		5	43		2	5			2			1			93		7
Build fish ladders	9		2	27		5	2		1	40		8	40		5	2		1	2			1			85		3
Fertilize lakes	10		1	26	2	4	1		2	44			36	3	6	1		2	2				1		83	3	12
Remove undesirable fish from selected lakes and restock with desirable fish	3	1	5	18	8	7			3	22	6	18	23	9	1			3	2				1		47	16	32
Clear streams of logs and boulders	8		2	27	2	3	2		1	38	3	6	40	2	3	2		1	2			1			83	5	10
Transport fish to barren lakes	7		3	26	4	2	2	1		36	3	8	38	5	2	2	1		2			1			79	9	10
Build roadside viewing areas	1	4	5	5	19	7	1	1	1	7	20	18	5	27	11	1	1	1		2			1		13	51	30
Build access roads	0	6	4	3	6	2	1	2		5	31	9	4	35	4	1	2			2		1			11	70	13
Install boat slips and launching ramps	2	6	2	10	18	3	2	1		16	21	6	14	25	5	2	1			2		1			33	49	11

Appendix 4-5. Questionnaire responses of commercial salmon fishermen, set gill net permit holders, set gill net crew members and drift gill net crew members.

	Set Gill Net Permit Holders	Set Gill Net Crew Members	Drift Gill Net Crew Members
24. Number of Respondents:	3	1	3

26. Level of participation in area E Salmon Fisheries and average years experience:			
Salmon seine entry permit holder (number/years)			
Salmon seine crew member (number/years)	1/6.0	1/10	3/5.7
Salmon drift net entry permit holder (number/years)	2/12.5		
Salmon drift net crew member (number/years)		1/2.0	3/3.4
Salmon set net entry permit holder (number/years)	23/6.7	1.20	3.43
Salmon set net crew member (number/years)		1/2.0	1/2.0

27. Desired level of participation in the Area E salmon fisheries:			
Wish to continue in the same capacity	3		1
Wish to change to the following capacity in the future:			
Salmon seine entry permit holder			
Salmon seine crew member			
Salmon drift net entry permit holder			1
Salmon drift net crew member			
Salmon set net entry permit holder			
Salmon set net crew member			

28. Respondents derived the following percentages of their gross 1981 income from the following sources:			
Salmon seining (Area E)			10
Salmon drift gill netting (Area E)	33		14
Salmon set gill netting (Area E)			
Other fisheries in Area E			5
Fisheries in other areas			5
Non-fishing sources	67		66
Total	100		100

29. Number satisfied with breakdown of their 1981 income:			
Satisfied	0	0	0
Dissatisfied	2	1	3
Did not fish in 1981	1		
No opinion			

30. Preferred sources of income: (Question 28 revised):			
Salmon seining (Area E)	10		7
Salmon drift gill netting (Area E)	20	20	25
Salmon set gill netting (Area E)	45	20	7
Other fisheries in Area E			17
Fisheries in other areas		10	2
Non-fishing sources	25	50	42
Total	100	100	100

Appendix 4-5. Questionnaire responses of commercial salmon fishermen, set gill net permit holders, set gill net crew members and drift gill net crew members, continued.

	Set Gill Net		Drift Gill
	Permit Holders	Crew Members	Net Crew Members
31. Number of respondents satisfied with their commercial catch in Area E in 1981:			
Adequate	1		
Not Adequate	2	1	3
No opinion			
32. Number of respondents satified with their earnings from commercial salmon fishing in Area E in 1981:			
Satisfied			
Dissatisfied	3	1	3
No opinion			
33. Average gross earnings from salmon seining needed by Respondent to pay his fishing and living expenses and make a reasonable profit from fishing investments:			
0-$9,999	1		2
10,000-19,000	1	1	1
20,000-29,000			
30,000-39,999	1		
40,000-49,999			
50,000-59,999			
60,000-69,999			
70,000-79,999			
80,000-89,999			
90,000-99,999			
100,000-109,999			
110,000-119,999			
120,000-129,999			
130,000-139,999			
140,000-149,999			
150,000-159,999			
160,000-169,999			
170,000-179,999			
180,000-189,999			
190,000-199,999			
200,000-209,999			
210,000-219,999			
220,000-229,999			
250,000-259,999			
Number of Respondents	3	1	3
Average	$16,000	$10,000	$6,000
34. Number of respondents paying for permit:			
Paying	1	1	1
Not Paying	2		2
35. Number of respondents who own a boat:			
Own a boat	3	1	
Does not own boat			2

Appendix 4-5. Questionnaire responses of commercial salmon fishermen, set gill net permit holders, set gill net crew members and drift gill net crew members, continued.

	Set Gill Net Permit Holders	Set Gill Net Crew Members	Drift Gill Net Crew Members
36. Number of respondents who have their boats financed:			
Boat financed	2		
Not financed	1	1	3
37. The number "1" preferred species to fish for:			
King (chinook)		1	2
Red (sockeye)		2	1
Dog (chum)			
Humpback (pink)	1		
Silver (coho)			
38. Number of respondents who take home a portion of their commercial catch for their own use:			
	2	1	3
39. The "1" preferred for personal use:			
King (chinook)			
Red (sockeye)	3		1
Dog (chum)		1	1
Humpback (pink)			1
Silver (coho)			
40. Average number of fish by species taken home for personal use during the 1981 commercial fishing season:			
King (chinook)	1.9		1.7
Red (sockeye)	14.3		6.7
Dog (chum)	0		5.0
Humpback (pink)	0		
Silver (coho)	13.3		8.3
43. Recognizing that hatcheries are in place at Port San Juan, Cannery Creek, Main Bay, Valdez, and Perry Island, which district would the respondent rank as his number "1" preference for enhancement or rehabilitation work.			
Bering River			
Copper River	1		
Eastern			
Northern			1
Northwestern			
Southwestern			
Montague			1
Southeastern			
Unakwik			
Coghill			
Eshamy	2		

Appendix 4-5. Questionnaire responses of commercial salmon fishermen, set gill net permit holders, set gill net crew members and drift gill net crew members, continued.

44. The number "1" problem with the commercial salmon fisheries of the region:

	Set Gill Net		Drift Gill
	Permit Holders	Crew Members	Net Crew Members
Lack of fish	2		
Management of the fisheries			
Lack of enforcement			
Too much gear			
Unstable prices			1
Lack of procesors		1	1
Lack of loans			
Restrictive regulations			

47. Enhancing and rehabilitating the salmon runs and increasing man's benefits from this resource will require various activities to take place. Respondents indicate approval (A), disapproval (D), or have no opinion (N) concerning the following activities.

	Set Gill Net						Drift Gill		
	Permit Holders			Crew Members			Net Crew Members		
	A	D	N	A	D	N	A	D	N
Construct fish hatcheries	3			1			3		
Install incubation boxes in or near streams	2		1	1			3		
Build fish ladders	2		1	1			3		
Fertilize lakes	3			1			3		
Remove undesirable fish from selected lakes and restock with desirable fish	2		1	1			2	1	
Clear streams of logs and boulders	3				1		2	1	
Transport fish to barren lakes	2	1		1			3		
Build roadside viewing areas			3	1			2		1
Build access roads	1	1	1		1		2	1	
Install boat slips and launching ramps	2		1	1			3		

Appendix 4-6. Questionnaire responses of commercial salmon fishermen, seine crew members.

	Seine crew Only[1]			All Seine Crew[2]					
	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Did not fish in 1981	Future Permit Holders	Total
24. Number of respondents:	7	2	0	19	9	1	0	2	31
26. Level of participation in the Area E salmon fisheries and average years of experience:									
Seine entry permit holder (number/years)				1/2.5					1/2.0
Seine crew member (number/years)	7/7.3	2/3.0		18/7.6	9/4.0	1/6.0			28/6.4[3]
Drift net entry permit holder (number/years)				12/4.3	4/3.8				16/4.2[3]
Drift net crew member (number/years)	3/4.3	1/1.0		3/4.3	4/3.5	1/6.0			8/4.1[3]
Set net entry permit holder (number/years)									
Set net crew member (number/years)					1/20				1/20[3]
27. Desired level of participation in the Area E salmon fisheries:									
Wish to continue in same capacity	2			10	2				12
Wish to change to the following capacity in the future.									
Salmon seine entry permit holder	4	1		11	3	1			15
Salmon seine crew member	2			2	1				3
Salmon drift net entry permit holder	4	2		4	4	1			9
Salmon drift net crew member									
Salmon set net entry permit holder						1			1
Salmon set net crew member									
28. Percentage of gross 1981 income derived from the following sources:									
Salmon seining (Area E)	54	28		54	23	30		n/a	43[3]
Salmon drift gill netting (Area E)				28	17	70			26[3]
Salmon set gill netting (Area E)									
Other fisheries in Area E	1			1	1				1[3]
Fisheries in other areas	11			4	10				6[3]
Non-fishing sources	34	72		13	49				24[3]
Total	100	100		100	100	100			100[3]
29. Number satisfied with breakdown of their 1981 income:									
Satisfied	4	1		11	3	1			15
Dissatisfied	1	1		6	6				12
Did not fish in 1981									
No opinion	1			3					3

1) Participated in the 1981 Area E salmon seine fishery as a seine crew member only.

2) Participated in the 1981 Area E salmon fishery as a seine crew member and in some instances drift permit holder or drift crew member.

3) Weighted average.

Appendix 4-6. Questionnaire responses of commercial salmon fishermen, seine crew members, continued.

	Seine crew Only			All Seine Crew Only					
	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Did not fish in 1981	Future Permit Holders	Total
30. Preferred sources of income (Question 28 revised):									
Salmon seining (Area E)	45	38		43	21	30		50	37[1]
Salmon drift gill netting (Area E)	9	25		39	36	70			36[1]
Salmon set gill netting (Area E)					2			10	1[1]
Other fisheries in Area E	4			1	7				3[1]
Fisheries in other areas	7			3	8			15	5[1]
Non-fishing sources	35	37		14	26			25	18[1]
Total	100	100		100	100			100	100[1]
31. Number of respondents satisfied with their commercial catch in Area E in 1981:									
Adequate	7	1		16	1	1		n/a	18
Not Adequate		1		3	8				11
No opinion									
32. Number of respondents satisfied with their earnings from commercial salmon fishing in Area E in 1981:									
Satisfied	7			19				n/a	19
Dissatisfied		2			9				9
No opinion						1			1
33. Average gross earnings from salmon seining needed by respondent to pay his fishing and living expenses and make a reasonable profit from fishing investments:									
$0—$9,999	1	1		2	3			n/a	5
10,000—19,999	2	1		3	2				5
20,000—29,999	1			3	2	1			6
30,000—39,999				3					3
40,000—49,999	1			2					2
50,000—59,999									
Number of Respondents	5	2		13	7	1			21
Average	$19,000	10,000		24,000	11,000	21,000			17,000
34. Number of respondents paying for permits:									
Paying				8	2	1			11
Not Paying	5	2		9	7				16
35. Number of respondents who own a boat:									
Own a boat	4			16	5	1			22
Does not own a boat	3	1		3	3				6
36. Number of respondents who have their boats financed:									
Boat financed	4			11	3	1			15
Not financed	1			6	3				9

1) Weighted average.

Appendix 4-6. Questionnaire responses of commercial salmon fishermen, seine crew members, continued.

	Seine crew Only			All Seine Crew Only					
	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Did not fish in 1981	Future Permit Holders	Total
37. The number "1" preferred species to fish for:									
King (chinook)	1			2	3				5
Red (sockeye)	1	1		10	4				14
Dog (chum)	3			3					3
Humpback (pink)	2	1		3	1	1			4
Silver (coho)				1	1	1			3
38. Number of respondents who take home a portion of their commercial catch for their own use:	6	2		18	8	1			27
39. The number "1" species preferred for personal use:									
King (chinook)	3			10	3	1			14
Red (sockeye)	3	2		8	4				12
Dog (chum)					1				1
Humpback (pink)									
Silver (coho)									
40. Average number of fish by species taken home for personal use during the 1981 commercial season:									
King (chinook)	1.1			3.4	3.0				3.5[1]
Red (sockeye)	3.4	5.5		9.1	12.0				9.7[1]
Dog (chum)	6.4	2.0		2.4	2.8				2.4[1]
Humpback (pink)	4.6	0.5		1.7	0.1				1.1[1]
Silver (coho)	3.9	1.0		8.6	5.8				7.4[1]
42. The number "1" preferred area for salmon seining:									
Eastern	1			3					3
Northern	2			6	1				7
Northwestern									
Southwestern	3			9	3				12
Montague		1			3				3
Southeastern						1			1
Unakwik									
Coghill									

1) Weighted Average

Appendix 4-6. Questionnaire responses of commercial salmon fishermen, seine crew members, continued.

	Seine Crew Only			All Seine Crew					
	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Satisfied with 1981 earnings	Dissatisfied with 1981 earnings	No Opinion about 1981 earnings	Did not fish in 1981	Future Permit Holders	Total
43. Recognizing that hatcheries are in place at Port San Juan, Cannery Creek, Main Bay, Valdez, and Perry Island respondents ranked their number "1" preference for enhancement or rehabilitation work:									
Bering River				1	1				2
Copper River	1			11	2	1			14
Eastern	1			1					1
Northern									1
Northwestern									
Southwestern									
Montague	2			2	2				4
Southeastern									
Unakwik									
Coghill				1					1
Eshamy									
44. The number "1" problems with the commercial salmon fisheries of the region:									
Lack of fish									6
Management of the fisheries									1
Lack of enforcement									3
Too much gear									3
Unstable prices									10
Lack of processors									3
Lack of loans									
Restrictive regulations									

Appendix 4-6. Questionnaire responses of commercial salmon fishermen, seine crew members.

47. Enhancing and rehabilitating the salmon runs and increasing man's benefits from this resource will require various activities to take place. Respondents indicated their approval (A), disapproval (D), or no opinion (N) concerning the following activities:

	Seine crew only									All seine crew																	
	Satisfied with 1981 earnings			Dissatisfied with 1981 earnings			No Opinion about 1981 earnings			Satisfied with 1981 earnings			Dissatisfied with 1981 earnings			No Opinion about 1981 earnings			Did not fish in 1981			Future Permit Holders			Total		
	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
Construct fish hatcheries	7			1						18			8			1						2			19		
Install incubation boxes in or near streams	6		1	1						16		2	7		1	1						2			26		3
Build fish ladders	7			1						16		2	8			1						2			7		2
Fertilize lakes	4	1	2	1			13	1	4	7		1	1						2						26	1	5
Remove undersirable fish from selected lakes and restock with desirable fish	0	4	3	1						6	6	6	6	1	2	1						2			15	7	8
Clear streams of logs and boulders	6	1		1						16	1	1	7	1	0	1						2			26	2	1
Transport fish to barren lakes	5	2	0	1						14	2	2	8			1						2			25	2	2
Build roadside viewing areas	1	4	2	0	0	1				3	10	4	2	3	3	0	1	0				3			7	14	7
Build access roads	1	5	1	0	0	1				2	13	2	2	5	1	0	1	0				1	1	0	5	20	3
Install boat slips and launching ramps	4	2	1	1						7	7	2	5	2	0	1						1	1	0	14	10	2

Appendix 4-7. Questionnaire responses of subsistence salmon fishermen, dip net and fishwheel.

	Dip Net Fishermen				Fishwheel Fishermen				
	Satisfied with 1981 catch	No opinion about 1981 catch	Dissatisfied with 1981 catch	Total	Satisified with 1981 catch	No opinion about 1981 catch	Dissatisfied with 1981 catch	Total	Total this page
Number of respondents:	157	15	184	356	36	5	17	58	414
16. Type of fishing gear used by respondents:									
Dip net	157	15	184	356					356
Fishwheel					36	5	17		58
17. The number "1" preference for personal use:									
King (chinook)	47	2	62	111	8	2	7	17	128
Red (sockeye)	101	12	103	216	26	2	11	39	245
Dog (chum)									0
Humpback (pink)	3		1	4					4
Silver (coho)	13		18	31		1	1	2	33
18. Average number of salmon caught by respondent and family:									
King (chinook)	1.6	5.2	0.8	1.3[1]	3.5	4.6	1.3	2.9[1]	2.2[1]
Red (sockeye)	19.2	18.5	9.8	14.3[1]	39.8	76.6	27.5	39.4[1]	17.8[1]
Dog (chum)		2.0							0.1[1]
Humpback (pink)	0.2	2.7	0.3	0.3[1]					0.3[1]
Silver (coho)	1.8	1.3	0.8	1.3[1]	4.6		0.3	2.9[1]	1.5[1]
Did not fish in 1981									
19. Was this adequate for respondents own use:									
Adequate	157			157	36			36	193
Not Adequate			184	184			17	17	201
No opinion		15		15		5		5	20
20. Area where respondent fished in 1981:									
Upper Copper River	103	13	122	238	31	5	12	48	286
Copper River Flats	27[2]		40[2]	67[2]	4[2]	1[2]	3[2]	8[2]	75[2]
21. Respondent's preferred location to fish:.									
Upper Copper River	97	12	108	217	29	5	13	47	264
Copper River Flats	27	2	41	70	2	0	2	4	74
Bering River District									
Unakwik District									
Coghill District			2	2					2
Eshamy district									
Other									

1) Weighted average.

2) Assumed that these people actually meant upper Copper River.

22. Number of salmon respondent and family need per year (average):	31	40[1]	47	40[1]	43	250	216	111[1]	50[1]

1) Weighted average.

2) Assumed that these people actually meant upper Copper River.

Appendix 4-7. Questionnaire responses of subsistence salmon fishermen, dip net and fishwheel, continued.

23. The number "1" problem with the salmon subsistence fisheries of the region:.

	Dip Net Fishermen				Fishwheel Fishermen				
	Satisfied with 1981 catch	No opinion about 1981 catch	Dissatisfied with 1981 catch	Total	Satisified with 1981 catch	No opinion about 1981 catch	Dissatisfied with 1981 catch	Total	Total this page
Lack of fish	6	1	29	36	5	1	2	8	44
Management of the fisheries	9	1	8	18	3			3	21
Lack of enforcement	10	1	7	18	2		1	3	21
Overcrowded fishing areas	29	4	32	65	3		2	5	70
Lack of access	13	1	27	41	6	1	2	9	49
Lack of campgrounds	13	1	5	19					19
Inadequate campgrounds	6	2	6	14			2	2	16
Too many other fishermen	3	1	2	6	4			4	10
Restrictive regulations	16	3	32	51	2	1	2	5	56
Lack of open areas	28	1	15	44	3	2		5	49

47. Enhancing and rehabilitating the salmon runs and increasing man's benefits from this resource will require various activities to take place. Respondents indicated their approval (A), disapproval (D), or no opinion (N) concerning the following activities.

	Dip Net Fishermen									Fishwheel Fishermen											
	Satisfied with 1981 catch			No opinion about 1981 catch			Dissatisfied with 1981 catch			Satisified with 1981 catch			No opinion about 1981 catch			Dissatisfied with 1981 catch			Total this Page		
	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
Construct fish hatcheries	128	6	11	9	0	1	147	14	6	30	3	2	3	0	2	12	0	1	329	23	23
Install incubation boxes in or near streams	89	9	35	7	0	3	121	6	36	27	1	3	2	2	1	9	0	3	255	18	81
Build fish ladders	104	8	28	6	1	3	132	8	25	24	3	6	4	1	0	9	0	3	279	21	66
Fertilize lakes	92	12	31	6	1	4	103	21	40	19	4	10	4	0	1	8	1	2	232	39	88
Remove undesirable fish from selected lakes and restock with desirable fish	67	47	22	4	5	2	90	42	29	22	9	4	2	1	2	5	4	2	190	107	61
Clear streams of logs and boulders	38	70	29	1	7	3	66	66	33	16	7	10	2	3	0	6	1	4	129	154	79
Transport fish to barren lakes	108	15	13	9	0	2	131	17	19	31	1	1	4	1	0	11	0	1	294	34	36
Build roadside viewing areas	63	44	33	5	4	3	78	35	46	7	12	11	2	2	1	4	5	3	156	102	97
Build access roads	85	40	15	6	3	2	119	32	14	16	14	3	2	1	2	7	2	2	235	92	38
Install boat slips and launching ramps	71	34	31	2	2	7	99	29	32	11	10	10	1	3	0	8	2	2	192	80	82

Appendix 4-8. Questionnaire responses of subsistence salmon fishermen, other and multiple gear types.

	Other Gear Types			Multiple Gear Types			Have subsistence fished in the region but not in 1981	Have never subsistence fished in the region but would like to	Total
	Satisfied with 1981 catch	No opinion about 1981 catch	Dissatisfied with 1981 catch	Satisfied with 1981 catch	No Opinion about 1981 catch	Dissatisfied with 1981 catch			
15. Number of respondents:	8	2	3	6	0	12	26	31	88
16. Type of fishing gear used by respondent:									
Dip net				5		12	22	12	51
Fishwheel				6		12	2		20
Drift gill net	6	2	3				3	10	24
Set gill net	1			1		3	2	3	10
Purse siene								1	1
17. The number "1" preference for personal use:									
King (chinook)	5	1	2	1		2	8	7	26
Red (sockeye)	3	1	1	5		7	15	13	45
Dog (chum)						1			1
Humpback (pink)									
Silver (coho)						2	2	7	11
18. Number of subsistence salmon caught by respondent or his family in this region in 1981:									
King (chinook)	4.2		3.0	6.0		3.3	n/a	n/a	
Red (sockeye)	20.2		13.3	68.7		20.3			
Dog (chum)				3.3					
Humpback (pink)						3.0			
Silver (coho)	8.1					1.6			
Did not fish in 1981									
19. Was this adequate?									
Adequate	8			6			n/a	n/a	14
Not Adequate			3			12			15
No opinion		2							2
20. Where Respondent s fished:									
Upper Copper River	1			6		9	n/a	n/a	16
Copper River Flats	5		3			2			10
Bering River District									
Unakwik District									
Coghill District	1								1
Eshamy District									
Other	1					3			4
21. Respondent's preferred fishing location:									
Upper Copper River				5		8	15	n/a	13
Copper River Flats	5	2	2			4	4		17
Bering River District									
Unakwik District							1		1
Coghill District			1				1		2
Eshamy District							1		1
Other									

Appendix 4-8. Questionnaire responses of subsistence salmon fishermen, other and multiple gear types, continued.

	Other Gear Types: Satisfied with 1981 catch	Other Gear Types: No opinion about 1981 catch	Other Gear Types: Dissatisfied with 1981 catch	Multiple Gear Types: Satisfied with 1981 catch	Multiple Gear Types: No Opinion about 1981 catch	Multiple Gear Types: Dissatisfied with 1981 catch	Have subsistence fished in the region but not in 1981	Have never subsistence fished in the region but would like to	Total
22. Number of salmon respondent and his family need per year (average)	46	32	40	74		126	37	50	57[1]
23. The number "1" problem with the salmon subsistence fisheries of the region:									
Lack of fish	1			1		2	3	n/a	7
Management of the fisheries	1						2		3
Lack of enforcement	2						1		3
Overcrowded fishing areas	1		1	1		2	3		8
Lack of access				1		1	2		4
Lack of campgrounds							1		1
Inadequate campgrounds	1						1		2
Too many other fishermen	1			1			1		3
Restrictive regulations	1		1			6	3		11
Lack of open areas				1			3		4

47. Enhancing and rehabilitating the salmon runs and increasing man's benefits from this resource will require various activities to take place. Respondents indicated their approval (A), disapproval (D), or no opinion (N) concerning the following activities:

	Other Gear Types									Multiple Gear Types									Have subsistence fished in the region but not in 1981			Have never subsistence fished in the region but would like to			Total this page		
	Satisfied with 1981 earnings			No Opinion with 1981 earnings			Dissatisfied about 1981 earnings			Satisfied with 1981 earnings			No Opinion about 1981 earnings			Dissatisfied with 1981 earnings											
	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
Construct fish hatcheries	6	1	1	2			3			2	1					10		1	21	1	1	23	2	3	67	3	3
Install incubation boxes in or near streams	6		1	2			3			4						9		2	20		3	23	1	5	67		10
Build fish ladders	7		1	2			3			3						8	1	2	20		2	23	3	2	66	4	7
Fertlize lakes	6		1			2	3			5						6		5	16	1	6	21	1	6	57	2	20
Remove undersirable fish from selected lakes and restock with desirable fish	5		2	1		1	1	2		2	1					8	3		11	6	6	13	11	3	41	23	12
Clear streams of logs and boulders	7		1	1	1		3			3	1					4	4	3	12	4	4	15	8	3	45	18	11
Transport fish to barren lakes	7		1	2			3			4						10		1	21	1		27	1	1	74	2	3
Build roadside viewing areas	2	1	4		2		2	1		3		1				5	3	3	11	8	3	13	9	5	36	24	16
Build access roads	2	4	1		2		1	2		3						6	3	2	16	6	1	11	13	2	39	30	6
Install boat slips and launching ramps	3	2	2	1	1		2	1		2	1	1				9	2	0	14	5	4	16	8	3	47	20	10

1) Weighted average.

Appendix 4-9. Questionnaire responses of sport salmon fishermen.

	Sport fished in the region in 1981: Satisfied with 1981 catch	Sport fished in the region in 1981: No opinion about 1981 catch	Sport fished in the region in 1981: Dissatisfied with 1981 catch	Have sport fished in the region but not in 1981	Have never sport fished in the region but would like to	Total
1. Number of Respondents:	169	47	180	137	75	608
2. Areas in which respondents have sport fished for salmon:						
Valdez Bay	64	15	97	56		232
Passage Canal (Whittier)	32	7	37	50		126
Orca Inlet	31	5	11	14		61
Simpson Bay	9	1		2		12
Hinchinbrook Island waters	6		2	2		10
Other Marine Waters	34	11	39	13		97
Gulkana River	84	19	58	86		247
Eyak River	36	6	8	13		63
Coghill River	25	1	15	8		49
Eshamy Creek	14	4	10	10		38
Eshamy Lake	10	3	6	7		26
Shrode Creek	5	1	4	3		13
Shrode Lake	5	0	5	3		13
Klutina River	7	9	1	11		28
Little Tonsina River	5	4	2	4		15
Mendeltna Creek - Tazlina River	5	3	1	1		10
Other 42 locations						67
3. Areas in which respondents thought their daily catch of salmon to be too low:						
Valdez Bay	20	4	48	25		97
Passage Canal (Whittier)	11	3	23	16		53
Orca Inlet	6		6	5		17
Simpson Bay	1					1
Hinchinbrook Island Waters						
Other Marine Waters	1		2	1		4
Gulkana River	40	4	78	33		155
Eyak River	6		7	5		18
Coghill River	4	1	12	2		19
Eshamy Creek	6	1	6	3		16
Eshamy Lake	2		5	2		9
Shrode Creek		1	5			6
Schrode Lake			4	2		6
Kluthina River			5	1		6
Little Tonsina River			1			1
Mendeltna Creek-Tazlina River						
Other	3		5	3		11
4. Average number of years respondents have sport fished in the region.	9.0[1]	6.5[1]	8.1[1]	9.0[1]		8.5[1]

1) Weighted average.

Appendix 4-9. Questionnaire responses of sport salmon fishermen, continued.

	Sport fished in the region in 1981: Satisfied with 1981 catch	Sport fished in the region in 1981: No opinion about 1981 catch	Sport fished in the region in 1981: Dissatisfied with 1981 catch	Have sport fished in the region but not in 1981	Have never sport fished in the region but would like to	Total
5. Respondents ranked the following methods of salmon sport fishing their first perference.						
Casting from a boat	38	10	53	34	13	148
Trolling	19	5	23	24	12	83
Drift fishing in a boat	16	2	17	11	6	52
Fishing from shore or wading	84	26	80	63	22	275
Ice fishing for land-locked salmon	5	2	2	2	2	13
Snagging in marine waters	1	3	4	5	1	14
6. Respondents ranked the following aspects about salmon sport fishing as their most important aspect.						
Scenery	16	6	7	9	6	44
Catching your limit	22	3	22	18	6	71
Fishing by yourself	7	3	4	3	3	20
Boating	2	1	3	1	1	8
Peace and quiet	17	5	13	19	11	65
Fishing with your friends	35	5	19	21	6	86
Eating your catch	26	11	47	36	10	130
Hooking, playing and landing the fish	60	13	64	62	25	224
7. Respondents ranked the following areas as their favorite salmon fishing areas (in view of their answers to Question 6.)						
Valdez Bay	27		41	30	n/a	98
Passage Canal (Whittier)	7	2	15	8		32
Orca Inlet	5		3	4		12
Simpson Bay	2	10		1		13
Hinchinbrook Island waters	2	2				4
Gulkana River	47	10	62	53		172
Eyak River	24	2	1	5		32
Coghill River	8		2	2		12
Eshamy Creek	1		1	6		8
Eshamy Lake	1					1
Shrode Creek			1			1
Klutina River	2			2		4
Little Tonsina River			2			2
Mendeltna Creek-Tazlina River			1			1
No opinion	21	26	27	19		93
8. Respondents ranked the following species salmon as their number "1" preference to fish for:						
King (chinook)	71	15	103	61	27	227
Red (sockeye)	38	10	44	36	12	140
Dog (chum)	1					1
Humpback (pink)	1			1		2
Silver (coho)	58	11	29	39	16	153

Appendix 4-9. Questionnaire responses of sport salmon fishermen, continued.

	Sport fished in the region in 1981: Satisfied with 1981 catch	Sport fished in the region in 1981: No opinion about 1981 catch	Sport fished in the region in 1981: Dissatisfied with 1981 catch	Have sport fished in the region but not in 1981	Have never sport fished in the region but would like to	Total
9. Respondents in 1981 caught the following average number of salmon on sport gear in the region:						
King (chinook)	1.2	.6	0.9			1.0[1]
Red (sockeye)	3.6	1.4	2.3			2.7[1]
Dog (chum)	1.2	0	.4			.7[1]
Humpback (pink)	2.4	1.8	1.7			2.0[1]
Silver (coho)	4.0	2.2	3.2			3.4[1]
Did not fish in the region in 1981				137	75	212
10. Number of respondent who felt that their 1981 sport salmon catch in the region was adequate:						
Adquate	169					169
Not adequate			180			180
No opinion		47		137	75	259
11. Number of respondents who need to catch their daily limit to feel satisfied:						
Limit	22	2	52	16	6	98
No Limit	139	27	123	108	39	436
No opinion	8	18	5	13	30	74
12. Average catch of salmon needed by respondents to achieve satisfaction:						
King (chinook)	2.8	3.2	6.3	3.1	2.8	3.9[1]
Red (sockeye)	8.9	17.2	13.1	8.9	6.2	10.4[1]
Dog (chum)	2.0	.1	3.2	1.2	.7	1.9[1]
Humpback (pink)	3.0	1.2	2.9	2.2	2.3	2.6[1]
Silver (coho)	7.1	4.1	11.1	9.5	7.3	8.6[1]
13. Species of salmon needing enhancement:						
King (chinook)	157	14	131	87	n/a	389
Red (sockeye)	96	16	73	61		246
Dog (chum)	14	2	11	9		36
Humpback (pink)	11	1	18	9		39
Silver (coho)	96	14	91	63		264
14. The number "1" problem with the salmon sport fisheries of the region:						
Lack of fish	18	6	33	18	n/a	75
Management of the fisheries	12	3	14	10		39
Lack of enforcement	29	1	10	10		50
Overcrowded fishing areas	30	7	39	29		105
Lack of access	22	6	28	26		82
Lack of campgrounds	8	4	6	8		26
Inadequate campgrounds	4	1	5	4		14
Lack of boat slips	2		5	3		10
Restrictive regulations	17	2	29	18		66

1) Weighted average.

Appendix 4-9. Questionnaire responses of sport salmon fishermen, continued.

47. Enhancing and rehabilitating the salmon runs and increasing man's benefits from this resource will require various activities to take place. Respondents indicate approval (A), disapproval (D), or have no opinion (N) concerning the following activities:

	Sport fished in the region in 1981									Have sport fished in the region but not in 1981			Have never sport fished in the region but would like to			Total		
	Satisfied with 1981 catch			No opinion about 1981 catch			Dissatisfied with 1981 catch											
	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N	A	D	N
Construct fish hatcheries	130	14	10	35	4	2	150	8	9	114	8	7	52	7	8	481	37	36
Install incubation boxes in or near streams	123	7	23	34	1	5	131	3	27	94	5	29	40	5	19	422	21	103
Build fish ladders	129	12	16	36	0	5	129	11	22	108	5	15	51	3	10	453	31	68
Fertilize lakes	105	11	36	32	3	6	120	8	34	82	12	31	41	8	16	380	42	123
Remove undersirable fish from selected lakes and restock with desirable fish	81	51	23	18	12	11	94	38	29	75	28	22	34	19	12	302	148	97
Clear streams of logs and boulders	74	50	26	25	12	5	68	68	28	60	42	24	22	29	11	249	201	94
Transport fish to barren lakes	130	13	11	33	2	7	139	6	18	99	15	14	55	5	4	456	41	54
Build roadside viewing areas	68	52	32	14	9	17	84	38	36	58	32	38	30	16	18	254	147	141
Build access roads	75	6	10	21	14	16	118	35	14	71	36	19	46	16	5	331	167	54
Install boat slips and launching ramps	75	52	25	23	10	6	111	24	27	68	28	29	37	15	10	314	129	97

Appendix 5-1. Summary of projected commercial harvests of natural and supplemental stocks, minimum income demands and gaps, 2002.[1]

	King	Sockeye	Coho	Pink	Chum	Total
Seine Fishery						
Natural harvests	1,300	47,900	15,800	4,759,000	447,500	
Supplemental harvests	0	20,300	11,000	4,882,600	333,000	
Total	1,300	68,200	26,800	9,641,600	780,500	
Average wt (lbs) (1972-81)	12.7	7.4	8.2	4.0	8.7	
Average Price ($) (1981)[2]	1.65	1.40	0.44	0.44	0.5	
Total Exvessel Revenues ($)	27,242	706,552	96,694	16,969,216	3,395,175	21,194,879
Total Demand ($)						32,940,000
Gap ($)						11,745,121
Drift gill net fishery						
Natural harvests	16,800	759,200	217,900	216,500	91,100	
Supplemental harvests	0	33,000	0	122,000	542,000	
Total	16,800	792,200	217,900	338,500	633,100	
Average wt (lbs) (1972-81)	28.9	6.7	9.6	4.5	7.2	
Average Price ($) (1981)[2]	1.65	1.40	0.95	0.44	0.50	
Total Exvessel Revenues ($)	801,108	7,430,836	1,987,248	670,230	2,278,800	13,168,222
Total Demand ($)						27,050,000
Gap ($)						13,881,778
Set gill net fishery						
Natural harvest	6	8,500	100	12,700	2,900	
Supplemental harvests	0	0	0	0	180,000	
Total	6	8,500	100	12,700	182,900	
Average wt (lbs) (1972-81)	12.7	7.4	8.2	4.0	8.7	
Average Price ($) (1981)[2]	1.65	1.40	0.44	0.44	0.50	
Total Exvessel Revenues ($)	0	88,060	361	22,352	795,615	906,338
Total Demand ($)						480,000
Gap ($)						+426,388

1) These data do not include seine and drift gill net caught personal take home fish worth approximately $115,000 and $116,000, respectively.

2) It is assumed that prices will remain relatively constant in 1981 dollars.

Appendix 5-2 Summary of Subsistence demands, probable harvests and gaps, 2002.

	King	Sockeye	Coho	Total
Narural Harvests	1,700	25,100	400	
Supplemental Harvests		2,700		
Total	1,700	27,800	400	29,900
Minimum demands				
Dip net fisherman				116,000
Fishwheel fisherman				35,900
Gill net fisherman				3,900
Total				155,800
Gap				125,900

Appendix Table 5-3. Summary of sport fishery demands, probable harvests and gaps, 2002.

	King	Sockeye	Coho	Pink	Chum	Total
Minimum Demand 2002	8,600	25,700	28,600	17,200	8,600	88,700
High Demand 2002	27,900	74,400	61,500	18,600	13,600	196,000
Natural Production	2,800	6,300	11,900	18,600	1,500	41,100
Supplemental Production	1,500	5,500	5,000	0	0	12,000
Total	4,300	11,800	16,900	18,600	1,500	53,100
Gap Minimum	4,300	13,900	11,700	0	7,100	37,000
High	23,600	62,600	44,600	0	12,100	142,900

Appendix 7-1. Potential salmon hatchery sites in Prince William Sound.*

Eastern District

Stream 36 Sheep River, unnamed lakes, Sheep Bay: Eyak Corporation selection, conveyance pending.

Stream 100 Creek and lake unnamed, Boulder Bay, Tatitlek Narrows: Tatitlek Corporation selection, conveyance pending.

Northern District

Stream 202 Chuck's Creek, unnamed lake, Columbia Bay: Tatitlek Corporation selection, conveyance pending.

Stream 203 Unnamed creek and unnamed lake, Columbia Bay: Tatitlek Corporation selection, conveyance pending.

Stream 231 Unnamed creek, Island Lake, Cedar Bay: National Forest land.

Stream 285 Cascade Creek, unnamed lakes, Eaglek Bay: National Forest land. This is a high potential site and is currently under investigation.

Stream 289 Derickson Creek, unnamed lakes, Eaglek Bay: National Forest land.

Stream unnumbered and unnamed, South Bay, Perry Island: National Forest Land. Existing hatchery (NERKA).

Coghill District

Stream 311 Golden River, Davis Lake: National Forest land.

Stream 336 Esther River, Esther Lake, Esther Island: State and National Forest land. High potential hatchery site, currently in design and permitting process (PWSAC).

Northwestern District

Streams and lakes unnumbered and unnamed, east shore of McClure Bay, Port Nellie Juan: National Forest Land.

Stream 427 Unnamed creek and lake, Pirate Cove, Port Wells: National Forest land.

Stream 476 Shrode River, Jack Lake, Culross Passage: National Forest land. Lower lake in system, Shrode Lake, is serviced by a fish pass. Jack Lake, the largest lake in the system is blocked to migration by a 25 ft. waterfall a short distance above Shrode Lake.

Stream 480 Mink Creek, unnamed lake, Mink Harbor, Port Nellie Juan: National Forest land.

Stream 481 Unnamed creeek and unnaked lakes, Port Nellie Juan: National Forest land. Five lakes are contained within this watershed.

Eshamy District

Stream 501 Tiedeman Creek, unnamed lake, Foul Bay: National Forest land.

Stream 505 Hana Creek, Falls Lake, Falls Bay: National Forest land.

Southwestern District

Stream 603 Ewan Creek, Ewan Lake, Ewan Bay, Dangerous Passage: Chenega Corporation selection, conveyance pending.

Stream 617 Princeton Creek, unnamed lake, Icy Bay.

Stream 621 Totemoff Creek, unnamed lake, Chenega Island, Dangerous Passage: Chenega Corporation selection, conveyance pending.

Stream 628 Chenega Creek, unnamed lake, Chenega Island: Chenega Corporation selection, conveyance pending.

Stream and lake unnumbered and unnamed, west shore of Marsha Bay, Knight Island: National Forest land and Chugach Regional Corporation selection land, conveyance pending.

Appendix 7-2. Potential lake stocking sites.

The following is a list of lakes that are potential candidates for stocking. Several lakes are also candidates for fertilization and various outlet streams are potential candidates for fish pass construction, stream improvement and/or clearance. Some lakes have insurmountable barriers, and, subsequently, in these systems it will not be possible to establish populations capable of sustaining themselves. Fry will have to be implanted periodically. The rate of plankton regeneration will determine if stocking can be conducted annually or only every two or more years. Fertilization may be beneficial in some instances, thereby, allowing for annual fry introductions.

Eastern District

Stream 114 Turner Creek, Turner Lake, Galena Bay. Tatitlek Corporation land, conveyance pending.

Stream 115 Millard Creek, Millard Lake, Galena Bay. Tatitlek Corporation land, conveyance pending.

Northern District

Stream 202 Chuck's Creek, unnamed lake, Columbia Bay: Tatitlek Corporation land, conveyance pending. A large lake system is completely blocked to salmon by falls at the stream mouth. Ample spawning and rearing habitat for salmon is available.

*Listings in Appendix 7-1 through 7-6 have been adapted from Anonymous (1975), Nickerson (1978), Holbrook (personal communication), and Sanner (personal communication).

Stream 205 Unnamed creek, Columbia Lake, Columbia Bay: Tatitlek Corporation land, conveyance pending. A barrier falls at the lake outlet prevents salmon from utilizing this glacial lake.

Stream 219 Gravel Creek, unnamed lake, Long Bay: National Forest land.

Stream 228 Unnamed creek and lake, Cedar Bay. National Forest land.

Stream 282 and 283 Eaglek Bay: Odd year pink salmon could be enhanced with fry incubated at Cannery Creek Hatchery.

Stream 289 Derickson Creek, unnamed lakes, Derickson Bay, Eaglek Bay: National Forest land. An 11-ft. falls at tide water blocks access to an excellent upper watershed containing two lakes.

Coghill District

Stream 311 Golden River, Davis Lake, Port Wells: National Forest land. Maintenance stocking of salmon fry.

Stream 329 Pass Creek, Pass Lake, Esther Island, Port Wells: National Forest land. Maintenance stocking of salmon fry.

Stream 331 and 332 Unnamed creeks and lakes, Granite Bay, Esther Island: National Forest land.

Stream 344 Unnamed creek and lake, Shoestring Bay, Esther Island: National Forest land.

Stream 345 Unnamed creek and lake, Esther Island: National Forest land.

Northwestern District

Stream 427 Chasm Creek, unnamed lake, Pirate Cove, Port Wells: National Forest land. A major lake system is blocked by a series of falls near the tidal zone. This drainage system has a very large upper watershed and is recommended for maintenance stocking of salmon fry.

Stream 428 Unnamed creek and lake, Pirate Cove: National Forest land. Maintenance stocking of salmon fry.

Stream 436 Poe Creek, Poe Bay, Passage Canal: National Forest land. Maintenance stocking of salmon smolt.

Stream 438 Billings Creek, Passage Canal: National Forest land. Maintenance stocking of salmon smolt.

Stream 444, 445 and 446 Unnamed creeks, Shotgun Cove, Passage Canal: National Forest land. Maintenance stocking of salmon smolt.

Stream 452 and 453 Unnamed creeks, Surprise Cove lakes, Cochrane Bay: National Forest land. Maintenance stocking of salmon fry in lake at head of Stream 452. Fishpass on Stream 453 and two years of fry stocking to establish a run.

Stream 453a and 454 Unnamed creeks and lakes, Cochrane Bay: National Forest land.

Stream 459 Rainy Creek, unnamed lake, Cochrane Bay: National Forest land. A lake-fed fork of this stream is blocked to salmon by a falls.

Stream 466 Unnamed creek and lake, Cochrane Bay: National Forest land. This lake-fed system is blocked by falls near the mouth.

Stream 476 Shrode River: Shrode and Jack lakes, Culross Passage: National Forest land. A fish pass has been constructed at the downstream end of the system. Jack Lake is still blocked to salmon a short distance above Shrode Lake by a large waterfall.

Stream 478a Huckleberry Creek, Huckleberry Lake, Culross Island: National Forest land. Maintenance stocking of salmon fry in a deep, clearwater lake.

Stream 479 Culross Creek, unnamed lake, Culross Passage: National Forest land. Falls near tidewater block this system to salmon.

Stream 480 Mink Creek, unnamed lake, Mink Harbor, Port Nellie Juan: National Forest land. The lake-fed watershed upstream of a barrier may be suitable salmon habitat.

Stream 481 Unnamed creek and lakes, west of Mink Island, Port Nellie Juan: National Forest land. A chain of five lakes is blocked to salmon by small falls in the tidal zone.

Stream 491 Unnamed creek and lake, Deep Water Bay, Port Nellie Juan: National Forest land.

Stream 492 Unnamed creek and lake, McClure Bay, Port Nellie Juan: National Forest land. The stream appears to be suitable for salmon.

Stream 498 McClure Creek, unnamed lake, McClure Bay, Port Nellie Juan: National Forest land.

Stream and lake unnumbered and unnamed, south shore of Hidden Bay, Culross Island: National Forest land.

Stream and lake unnumbered and unnamed, Perry Passage, north of Hidden Bay: National Forest land.

Eshamy District

Stream 500 Unnamed creek and lake, Point Nellie Juan: National Forest land.

Stream 501 Tiedeman Creek, unnamed lake, Foul Bay: National Forest land.

Stream 505 Hanna Creek, Falls Lake, Falls Bay: National Forest land. The system has two large lakes that are completely blocked by a large series of falls at tidewater.

Stream 511 Eshamy Creek, Eshamy Lake, Eshamy Bay: Chenega Corporation land, conveyance pending. This is a lake fertilization candidate.

Southwestern District

Stream 603 Ewan Creek, Ewan Lake, Dangerous Passage: Chenega Corporation land, conveyance pending. Falls halfway to lake block more than half of the system to use by salmon. A fish pass could be erected to help establish sockeye or coho salmon runs, or water from the lake could be used to serve a salmon hatchery.

Stream 610 Kompkoff River, unnamed lake, Jackpot Bay: Chenega Corporation land, conveyance pending. Barrier falls prevent salmon from reaching most of the watershed. A small pink salmon run could be enhanced and a coho salmon run could be established.

Stream 617 Princeton Creek, unnamed lake, Icy Bay: National Forest land.

Stream 638 Unnamed creek and lake, Bainbridge Passage :National Forest land.

Stream 655 Unnamed creek and lake, Bainbridge Island: National Forest land.

Stream 687 Sockeye Creek, unnamed lake, Bay of Isles, Knight Island: National Forest land. A fish pass providing access to a 55 acre lake was completed in 1982.

Stream 688 Otter Creek, unnamed lake, Bay of Isles, Knight Island: National Forest land. A fish pass providing access to a 58 acre lake was completed in 1982.

Stream 689 Unnamed creek and lake, Louis Bay, Knight Island: National Forest land.

Stream 690 Unnamed creek, Solf Lake, Knight Island: National Forest land. This lake formerly was utilized by sockeye salmon until the outlet stream changed course and began to flow over impassable falls after the 1964 earthquake. Gabions and deflectors have been installed by USFS to divert the stream into a favorable channel. Restocking with sockeye salmon is desirable.

Stream and lake unnumbered and unnamed, west shore Marsha Bay, Knight Island: National Forest land and Chugach Regional Corporation land, conveyance pending.

Montague District

Stream 700 San Juan Creek, San Juan Lake: National Forest land. The lake in this sockeye salmon system dewatered as a result of a 32 ft. uplift caused by the 1964 earthquake. A dam with a fish pass could re-establish rearing area and create access.

Stream 759 Rocky Creek, unnamed lake, Rocky Bay: National Forest land. Falls prevent salmon from reaching an upper lake.

Southeastern District

Stream 844 Makarka Creek, Hawkins Island: National Forest land. A fish pass could allow salmon access to a lake system.

Stream 841-1 Unnamed creek and lake, Boswell Bay, Hinchinbrook Island: National Forest land. An 83 acre lake was opened to sockeye salmon with a fish pass in 1981. Stocking of sockeye salmon is desirable.

Stream 852 Forest Service Trail Creek, unnamed lake, Hawkins Island: Eyak Corporation land (?), conveyance pending. A fish pass installed in 1980 allows salmon access to an 83 acre lake. Stocking of lake with salmon may be desirable.

Stream 867 Trail Creek, unnamed lake Orca Inlet, Hawkins Island: National Forest land and Eyak Corporation land (?), conveyance pending.

Appendix 7-3. Potential stream stocking sites.

Northern District

Stream 282 and 283 Eaglek Bay: Odd year pink salmon could be enhanced with fry incubated at Cannery Creek Hatchery.

Northwestern District

Stream 436 Poe Creek, Poe Bay, Passage Canal: King salmon smolt. Maintenance stocking of king salmon smolt.

Stream 427 and 428 Pirate Cove, Port Wells: Maintenance stocking of coho salmon smolt.

Stream 438 Billings Creek, Passage Canal: Maintenance stocking of coho smolt.

Stream 444, 445 and 446 Shotgun Cove, Passage Canal: Maintenance stocking of coho salmon smolt.

Montague District

The 1964 earthquake caused numerous streams to be depleted of chum salmon. It may be feasible to reestablish chum salmon by stocking fry in the following streams:Stream 701 Trap Creek, Stream 702 Point Creek, Stream 707 McCleod Creek, Stream 710 Hanning Creek, Stream 711 Quadra Creek, Stream 739 Swamp Creek, Stream 741 Chalmers River, Stream 745 Wild Creek, Stream 746 Schuman Creek, Stream 747 Cabin Creek, Stream 770 Udall Creek, and Stream 775 Pautzke Creek.

Appendix 7-4. Potential fish pass sites.

Eastern District

Stream 38 Waterfall Stream, Sheep Bay: Eyak Corporation selection, conveyance pending. A small run of pink salmon that spawn below a falls near the high tide level could be enhanced by the installation of a fish pass and drop structures.

Stream 54 Carlsen Creek, Port Gravina: Eyak Corporation selection, conveyance pending. Small falls block most of the watershed to salmon.

Stream 119 Johnson Cove Creek, Valdez Arm: Tatitlek Corporation selection, conveyance pending.

Stream 123 Gregorioff Creek, Jack Bay: State selection and/or National Forest land. Falls are 2 to 3 ft. in height. The upstream habitat is of marginal quality.

Northern District

Stream 202 Chuck's Creek, unnamed lake, Columbia Bay: Tatitlek Corporation selection, conveyance pending. A large lake system is completely blocked to salmon by falls at the stream mouth. Ample spawning and rearing habitat for salmon could be made available.

Stream 205 Unnamed creek, Columbia Lake, Columbia Bay: Tatitlek Corporation selection, conveyance pending. A barrier falls at the lake outlet prevents salmon from utilizing this glacial lake.

Stream 219 Gravel Creek, Long Bay: National Forest land. A 6 ft. falls near tidewater prevents sockeye salmon from migrating upstreams during low water periods. This project is considered to be of marginal benefit.

Stream 231 Unnamed Creek, Cedar Bay: National Forest land. A 40 acre-lake is blocked to salmon by low falls at the lake outlet.

Stream 232 Unnamed creek, Wells Bay: National Forest land. Falls block access of pink salmon to most of the stream. Upstream habitat is of marginal quality.

Stream 239 Unnamed Creek, Unakwik Inlet: National Forest land: National Forest land. A falls at tidewater presently blocks access of pink salmon.

Stream 289 Derickson Creek, Eaglek Bay: National Forest land. An 11-ft. falls at tide water bocks access to an excellent upper watershed containing two lakes. This project is under consideration for 1986.

Stream 292 Papoose Creek, Squaw Bay: National Forest land. Low falls at stream mouth may not actually be a barrier to salmon. The habitat should be evaluated.

Northwestern District

Stream 427 Chasm Creek, Pirate Cove, Port Wells: National Forest land. A lake system is blocked by a series of falls near the tidal zone.

Stream 452 and 453 Surprise Cove, Cochrane Bay: State land. Velocity barriers at tidewater block both systems to salmon. Coho salmon in these streams would enhance the Whittier sport fishery.

Stream 478A Unnamed Creek, Huckleberry Lake, Culross Island: Chugach Natives, conveyance pending. Falls at tide water prevent salmon from gaining access to a barren, deep clearwater lake.

Stream 492 Unnamed, Port Nellie Juan: National Forest land. Kokanee 8 in. long inhabit this system. An inventory and survey is needed.

Eshamy District

Stream 500 Unnamed creek, Point Nellie Juan lakes, Point Nellie Juan: Light house reserve land. An 8 ft. falls block access to lake system.

Stream 501 Tiedeman Creek, Foul Bay: National Forest land. Falls at tidewater block this system to salmon.

Stream 510 Eleshansky Creek, Eshamy Lagoon: Chenega Corporation selection, conveyance pending. Falls near the tidal zone block most of watershed to pink salmon.

Southwestern District

Stream 603 Ewan Creek, Dangerous Passage: Chenega Corporation selection, conveyance pending. Falls halfway to lake block more than half of the system to use by salmon. A fish pass could be erected to help establish salmon runs, or water from the lake could be used for a salmon hatchery.

Stream 610 Kompkoff River, Jackpot Bay: Chenega Corporation selection, conveyance pending. Barrier falls prevent salmon from reaching most of the watershed.

Stream 667 Anderson Creek, Sawmill Bay, Evans Island: Chenega Corporation selection, conveyance pending. A fish pass could be installed at falls near upper tidal zone to allow pink salmon access.

Montague District

Stream 754 Dry Creek, Stockdale Harbor: National Forest land and/or Chugach Regional Corporation selection, conveyance pending (?). Falls near tidewater may block salmon from lake system. A survey is needed.

Stream 759 Rocky Creek, Rocky Bay: National Forest land. Falls prevent salmon from reaching an upper lake. A fish pass is tentatively going to be installed in 1983.

Southeastern District

Stream 844 Makarka Creek, Hawkins Island: National Forest land. Falls may block access to a lake system.

Stream 853 Whiskey Creek, Whiskey Cove, Hawkins Isalnd: Eyak Corporation selection, conveyance pending.

Appendix 7-5. Potential stream channelization and improvement sites

Eastern District

Stream 16 Rude River, Orca Bay: A portion of the water from a nonproductive major glacial river could be drawn off through a system of dikes and settling basins and combined with the small creeks on the south hillside to form a spawning channel for pink and chum salmon.

Stream 20 Spring Creek, East Arm, Simpson Bay: The existing moderately productive spawning channel could be made more efficient.

Stream 26 Simpson River, North Arm, Simpson Bay: Construction of dikes, a settling basin and general channel improvement to the side branch of the glacial stream would add to chum salmon production.

Stream 50 Gravina River, Port Gravina: The very muddy nonproductive main stream needs to be diked-off from the slightly productive east side overflow channel. General improvements also need to be made to the overflow channel.

Stream 51 Olsen Creek, West Fort, Olsen Bay, Port Gravina: Impassable falls block off most of the watershed. A spawning channel could be provided in the spring and marsh area east of the main channel.

Stream 83 through 87 Spring fed creek channels adjacent to Fidalgo and Sunny Rivers (glacial), Port Fidalgo: The area is used by a unique late chum population which presently has a very erratic survival pattern. Many minor improvements are needed including new channel construction, water collection, and flow control.

Stream 99 Lagoon Creek, Landlock Bay, Port Fidalgo: From time to time, this is an extremely productive pink salmon system. The previously constructed Alaska Department of Fish and Game spawning channel needs streambed resealing.

Stream 127 Naomoff River, head of Jack Bay, Valdez Arm: Salmon production could be improved by taking excess water from main glacial stream. Improvements would include: diking, constructing a settling basin and improving the northside overflow channel.

Stream 137 Canyon Slough, tributary to Lowe River, Port Valdez: The natural stock is made up of an off-year June run of pink salmon that spawn in mid-July and a late-run chum salmon stock that spawn in late August and early September. The area has large volume of year-around spring water. Construction of spawning channels for chum and pink salmon in the lower watershed would be productive. Additionally, the upper watershed could be rechannelled and improved for spawning and rearing coho salmon.

Stream 138 through 142 Spring and seepage creeks, Old Valdez townsite: Due to the abundance of seepage water, water collection facilities and spawning channels could be constructed.

Stream 143 Siwash Creek, Port Valdez: One of the best spring fed creeks in Prince William Sound. Channel clearing, widening and other improvements could increase salmon production. The watershed is, unfortunately, in a growing Valdez residential neighborhood. Early planning and zoning by the city is necessary to avoid destruction of the creek. The stream contains a unique late June - early July pink run and chum salmon. Both species would be enhanced by channel improvement.

Stream 147 Mineral Creek and Stream 148 Spring Creek, Port Valdez: Fish production in spring creek could be improved by diking and settling basin construction on the north side of the main creek to improve water flow.

Stream 152 Twin Falls Creek, Sawmill Bay, Valdez Arm: An excellent 1,000 yard long spawning channel could be made by constructing an overflow channel to cut across the oxbow on the main stream.

Northern District

Stream 214 Long Creek, East Long Bay: An excellent complex of intertidal sloughs and spring creeks that could be improved by adding water flow from the large, partially discolored and unstable main stream.

Stream 227 Granite Creek, Granite Bay: A stream with very low fish productivity due to an abnormal build-up of pure white granitic gravel in the streambed which causes the stream to overflow in an erratic manner. Construction of a channel through the center of the valley that would collect and discharge water in a stable manner would enhance fish production.

Stream 229 Cedar Creek, Cedar Bay: An excellent stream containing low barriers a short distance above the tidal flats. The barriers need to be removed.

Stream 264 Siwash Bay, Unakwik Inlet: Four natural spawning channels are located south of the main, unstable river. They are fed by overflow from the main stream and possibly by springs. The channels need to be widened and generally improved. A diversion structure on the main stream would insure a larger more stable flow. Much higher salmon production could be achieved.

Stream 276 Black Bear Creek, Eaglek Bay: A highly productive chum salmon stream that suffers from low stream flow. A high percentage of unspawned mortalities and serious bear predation have been observed. Two small adjacent creeks could be combined into one good channel at a higher elevation. This would greatly improve salmon production.

Stream 279 Canyon Creek, Eaglek Bay: An extremely unstable lower stream channel where water tends to go underground, leading to a unique inner lagoon, fed by an intertidal river. Construction of a stable spawning channel to collect and control all of the available water in one channel could greatly improve salmon production.

Coghill District

Stream 307 Village Creek, upper Esther Passage: A series of falls and log jams beginning at tide water blocks access to several productive upstream zones leading to headwater lake. Annual stream clearance is needed to improve stream productivity.

Stream 310 Golden Lagoon: Water from the adjacent Golden River which is not accessible to salmon could be piped to the streambed of the unnamed creek, possibly through an intermediate hatchery station. Enlargement of the creek to a sizeable spawning channel could also increase the natural run of pink salmon.

Stream 311 Golden River: A major lake watershed that is completely devoid of salmon due to stream blockage. Clearance is needed.

Stream 314 Avery River, Port Wells: Excellent riffles in a large hanging valley is blocked by large falls in the tidal zone. The 1964 earthquake destroyed the entire chum run by land subsidence of about 6 feet. The former chum spawning riffles below the high falls at the tidal limit are now in 0 ft. to 6 ft. tidal range which prevents chum egg survival. Placement of eight feet of sorted gravels could easily reinstate the 250,000 sq. ft. area. Approximately 80,000 cubic yards of gravel are needed. It is available from a large spit less than one-half mile away, and could easily be barged to the location.

Stream 318 through 320 Crescent and Amherst Rivers: These medium sized glacial streams are devoid of fish due to their instability. Seepage water could be collected from these non-productive watersheds and several spawning channels could be built in the large outwash plain.

Stream 321 Lafayette River: A spawning channel could be built that would enter the lower Coghill River where a shortage of good spawning grounds for chum salmon has been a problem ever since the old grounds were drowned by earthquake subsidence in 1964.

Northwestern District

Stream 414 Harrison Lagoon: One of the top ten pink salmon streams in Prince William Sound before the 1964 earthquake drowned the intertidal spawning grounds. The old intertidal zone could be rebuilt by filling or partitioning. Presently, the USFS and the ADF&G are working on a diversion project that will divert the stream to another channel.

Stream 421 Mill Creek, Bettles Bay, Port Wells: A major early run pink and chum salmon producer until the 1964 earthquake drowned the spawning grounds. A spawning channel could be constructed in the new tidal zone to increase salmon production.

Stream 424 North side of flats Hummer Bay: A good quality salmon stream until the adjacent glacial Hummer River changed its course around 1950. It is now a nearly dry channel. Water from the non-productive Hummer River could be diverted to this channel. The project would greatly increase salmon runs to Hummer Bay.

Stream 430 Meacham Creek and Stream 432 Swanson Creek, Pigot Bay, Port Wells: These streams were two of the top ten early pink salmon producers in Prince William Sound before the 1964 earthquake. A six foot subsidence drowned the heavily used intertidal spawning grounds. Large quantities of seepage water from the Pigot glacial River could be collected into man-made or improved natural spawning channels.

Southwestern District

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

Stream 681 Hogan Bay, Knight Island: This is a high gradient stream. The lower streambed is so shallow during average summer water flow that spawners cannot enter the stream. The stream occasionally has large runs of pink salmon, however, due to the periodic occurence of optimum conditions, the streambed gravel could be regraded and channelized to stabilize fish production in this stream.

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

Montague District

Stream 702 through 707 MacLeod Harbor, Stream 710 Hanning River, Hanning Bay, Stream 711 Quadra Creek, Hanning Bay: A 35 foot uplifting during the 1964 earthquake is causing the streams to cut new channels. Channel cutting is a slow evolutionary process. Stabilization could be speeded up by building man-made spawning channels.

Stream 712 through 737 Central west coast of Montague Island: This location is the largest non-productive area in the inside waters of Prince William Sound. The lack of productivity is caused by the heavy surf pounding the exposed beach. This phenomenon causes stream instability and barriers at some creeks. Channelization of the creeks could create a very productive fish zone.

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

Stream 768 through 770 Zaikoff and Udall Creek complex: These are highly unstable creeks. Fish production is very erratic. Because all of these small streams are close together they could all be diverted into one stable channel. The combined channel should consistently produce large pink and chum salmon runs. Heavy spring snow runoff water, however, would have to be diverted away from the new channel.

Stream 778 Beach River, Nellie Martin: Logging is being conducted in the vicinity, and it is imperative that the stream remain clear of debris. Nellie Martin is a very large producer.

Stream 779 Patton River, Patton Bay, Montague Island: A non-productive stream that needs a survey and investigation to determine why it is not producing salmon.

Southeastern District

Streams 810, 811, 812 and 815 Port Etches: These are unstable streams that suffer from gravel movement during floods. Channel stabilization to safeguard against floods would prevent gravel movement and greatly increase salmon production. The productive zone in these streams is potentially several miles long. Work is scheduled at Stream 815 Constantine Creek in 1984.

Streams 817, 818 and 819 Southwest Hinchinbrook Island: These streams are unstable. A stream stabilization program could significantly increase coho and pink salmon production.

Stream 831 Double Creek, Double Bay, Hinchinbrook Island: An unstable stream that meanders, changing channels frequently in the lower reach which is used by salmon. Stream stabilization in the lower creek could cure this problem.

Stream 834 and 835 Cutoff Creek, Dan Creek, Dan Bay, East Shore, Hinchinbrook Island: Lower two miles of both creeks is very unstable. The unstable zone, nevertheless, is heavily used by pink and chum salmon. Because the valley floor is very wide and there are many old abandoned stream channels, it would be easy to construct controlled flow channels. Benefits should be large in relation to the cost of construction.

Stream 847 Hawkins Creek, Hawkins Island: Work is scheduled for 1983.

Appendix 7-6. Potential stream clearance sites

Northern District

Stream 229 Cedar Creek, Cedar Bay: An excellent stream containing low barriers a short distance above the tidal flats. The barriers need to be removed.

Coghill District

Stream 307 Village Creek, upper Esther Passage: A series of falls and log jams beginning at tide water blocks access to several productive upstream zones leading to headwater lake. Annual stream clearance is needed to improve stream productivity.

Stream 311 Golden River: A major lake watershed that is completely devoid of salmon due to stream blockage. Clearance is needed.

Montague District

Stream 778 Beach River, Nellie Martin: Logging is being conducted in the vicinity. The stream may need to be rehabilitated when logging has been completed. Nellie Martin is a very large producer.

Stream 779 Patton River, Patton Bay, Montague Island: A non-productive stream that needs a survey and investigation to determine why it is not producing salmon. Logging is being done in the vicinity and logging practices should be closely monitored to minimize blow down and clearance activities.

Lists of Footnotes and Sources.

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KODIAK REGIONAL COMPREHENSIVE SALMON PLAN 1982 - 2002 PHASE II REVISION

DEVELOPED BY
KODIAK REGIONAL PLANNING TEAM
MARCH 1992

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

OFFICE OF THE COMMISSIONER

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April 27, 1992

Kodiak Regional Planning Team (KRPT)
P.O. Box 3407
Kodiak, AK 99615

Dear KRPT Members:

This letter is to officially inform KRPT members of my approval of the Kodiak Regional Comprehensive Salmon Plan 1982-2002, Phase II Revision. In compliance with Alaska Statute 16.10.375, the KRPT distributed a public review draft of the revised plan (December 6, 1991), solicited public comments on the proposed revisions through published notices in the local newspaper (Kodiak Mirror, December 3 and 30, 1991), and scheduled a KRPT meeting in Kodiak (January 8, 1992) to address public concerns and questions. The revised plan was also subjected to thorough technical reviews by Kodiak regional staff members from each of the fisheries divisions (i.e., Commercial Fisheries, Sport Fish, and Fisheries Rehabilitation, Enhancement and Development [FRED]) of the Alaska Department of Fish and Game (ADF&G) as well as staff members of the Kodiak Regional Aquaculture Association (KRAA) and the U.S. Fish and Wildlife Service, Kodiak National Wildlife Refuge. Accordingly, I am confident that the KRPT has been responsive to the comments and suggestions resulting from this thorough review process.

Based on the efforts of the KRPT in preparing this revision and comments I have received on the quality of those efforts, I believe a viable and responsible document has been produced that will further refine the goals, objectives, and strategies reflected in both the Phase I (approved on April 13, 1984) and Phase II plans (approved on September 15, 1987). Therefore, I offer my congratulations and appreciation to you and all members of the team for cooperating with the department and me in producing a truly comprehensive salmon plan for the Kodiak region.

Sincerely,

Carl L. Rosier

Carl L. Rosier
Commissioner

cc: ADF&G Division Directors

16.4.1

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EXECUTIVE SUMMARY

Kodiak's salmon fishery is at a crossroad. In the face of budget cutbacks, growing regional and international competition for salmon markets, and an uncertain future for Kodiak pink salmon, there has never been a better time for all user groups to work together to strengthen the salmon industry of Kodiak Island.

In the Phase I comprehensive plan, the Kodiak Regional Planning Team (KRPT) provided a framework for improving salmon stocks over the next 20 years by setting harvest goals, objectives, and strategies by species. In the Phase II comprehensive plan, short-term projects were identified according to management district, strategy, and species. The RPT planning process also provides an ongoing forum to exchange diverse points of view regarding the enhancement and rehabilitation of salmon in the region.

In 1990, the KRPT began the Phase II Revision of the comprehensive plan because (1) realization of initial goals and objectives for some species, (2) increase in fisheries (management and biological) data, and (3) changes in project priorities. This 1992 edition represents the current status of the comprehensive salmon planning process for the Kodiak region.

CHAPTER 1

INTRODUCTION

The Kodiak Regional Comprehensive Salmon Plan represents an on-going process of identifying salmon escapement and production goals for the Kodiak salmon management region, which includes the Kodiak Island Archipelago and the southern and eastern slopes of the Alaska Peninsula from Cape Douglas to the southern entrance of Imuya Bay near Kilokak Rocks (Figure 1). Kodiak and Afognak Islands have over 1,000 miles of coastline, numerous lakes, and 348 designated anadromous fish streams. The Kodiak region is home to all five species of salmon, steelhead, rainbow trout, Dolly Varden char, and numerous species of marine fish. Most of the area is located within the Kodiak National Wildlife Refuge, Alaska Peninsula Wildlife Refuge, Katmai National Park, and private landholdings.

The 19-year average annual harvest (1970-88) is 10.6 million salmon. The total harvest in 1988 was 18.6 million salmon. Harvest data for these periods, including contributions by species and the overall increase in 1988 over that for the 19-year annual average, are provided in Table 1.

Table 1. Average annual harvest of salmon for 1970-1988, contribution (%) by species, 1988 harvest, and percent increase in 1988 harvest over that for the 1970-1988 period.[a]

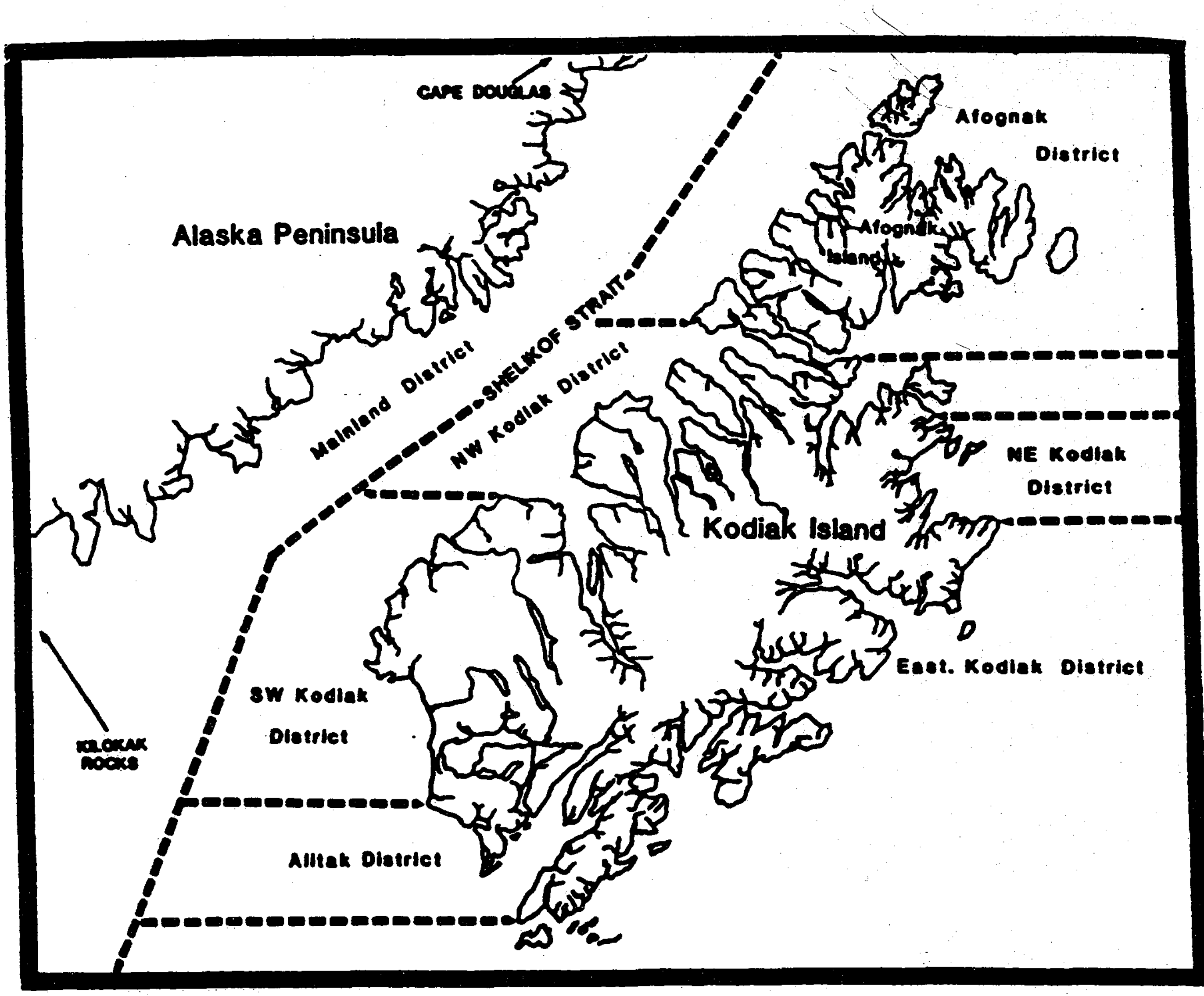
Species	1970-1988 Annual Average Harvest	% Harvest Contribution	1988 Harvest	% Increase
Pink	8,300,000	78.4%	14,200,000	71%
Sockeye	1,300,000	12.3%	2,700,000	108%
Chum	860,000	8.1%	1,400,000	63%
Coho	120,000	1.2%	300,000	147%
Chinook	3,000	0.0%[b]	20,000	539%
Total	10,583,000	100.0%	18,620,000	75%

[a] harvest numbers are approximate (i.e., rounded to the nearest 100,000 for pinks and sockeyes, 10,000 for chums and cohos, and 1,000 for chinook.

[b] harvest contribution was 0.03%.

The 1988 total harvest of 18,620,000 and escapements (actual & indexed) totaling 4,711,000 equal an indexed total return of 23,331,000 salmon for all species combined. The total 1988 harvest was 76% higher (i.e., 8,037,000 fish) than that for the 19-year annual average (Table 1). The commercial value of the 1988 Kodiak area salmon harvest was approximately $94.0 million. Sockeye salmon accounted for $41.9 million of that value (Source: Alaska Department of Fish and Game, Kodiak Area Salmon Management Report to the Alaska Board of Fisheries, 1988). Commercial Fisheries Entry Commission data indicated that of the 600 gear permits issued (380 purse seine, 32 beach seine, 188 set gillnet), 524 were utilized in 1988: 323 purse seine, 21 beach seine, and 180 set gillnet.

Figure 1. Kodiak Salmon Management Region



Authority for the Writing of the Phase II Plan

The Commissioner of the Alaska Department of Fish and Game (ADF&G), in accordance with Alaska Statutes 16.10.375-470, has designated salmon production regions throughout the state. In each region, the Commissioner is responsible for the development and amendment of a comprehensive salmon production plan. The Commissioner has placed this responsibility with regional planning teams (RPTs) that statutorily consist of representatives from ADF&G and the regional aquaculture associations. The mission of the RPTs is to plan for the long-term future of the salmon resource within its region by initiating and continuing an orderly process that examines the full potential of the region's salmon production capacity. The RPT is the only legislatively mandated planning group with ADF&G and private sector participation. Alaska statutes define certain duties of the RPT as follows:

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.

Creation of the Kodiak Regional Aquaculture Association

The Kodiak Regional Aquaculture Association (KRAA) was officially approved by the Commissioner of ADF&G on June 17, 1983. The main purpose of the association is to provide public and user-group assistance in the process of enhancing salmon production through the RPT planning process and its own enhancement efforts. In 1985 KRAA received a $100,000 grant from the Alaska Department of Commerce and Economic Development for organizational and planning purposes.

A regular exchange of information, discussion of objectives, and active cooperation between the association, RPT, affected land managers, and various divisions of ADF&G is possible with this planning effort. The actual comprehensive salmon plan consists of two phases: Phase I sets the goals, objectives, and strategies for the area; and Phase II identifies potential projects and establishes criteria for evaluating the enhancement and rehabilitation potentials of the salmon resource. While 20 years is a reasonable amount of time to consider long-term salmon production planning, experience has indicated a necessity for updating the plan on an annual basis.

Background of the Kodiak Comprehensive Salmon Plan

The Kodiak Regional Comprehensive Salmon Plan, 1982-2002 Phase I was approved by the Commissioner of ADF&G on April 13, 1984. Phase I identified the geographic planning area, provided a socioeconomic overview of the region, and documented the fishery status from an historical perspective. It also established long-range goals and objectives to be achieved during the 20-year life of the plan; however, in as much as the 1992 goals for pink and sockeye salmon were met during 1985 and returns of coho and chum salmon have been at all-time highs, it became necessary to reevaluate those intial goals and objective through the Phase II planning process. In 1986 the KRPT established a species prioritization for the Phase II plan that are ranked as follows: (1) sockeye, (2) coho, (3) chum, (4) pink, and (5) chinook salmon.

Phase I Survey Results:

To gather data for the Phase I plan, KRPT conducted a public involvement program. In February 1983, they mailed questionnaires to commercial (including crew members), subsistence, and sport fishermen in the Kodiak region. The purpose of this questionnaire was to obtain a representative sample of (1) the preferred fish to catch for each group, (2) problems each group was currently encountering, and (3) the preferred methods of fisheries rehabilitation and enhancement. A total of 600 questionnaires were sent to Area K permit holders.

The RPT received 214 (36%) responses. Major findings indicated (1) most respondents were not satisfied with their income, (2) 25 percent were involved in multiple fisheries, and (3) the preferred fish, in descending order, were sockeye and pink salmon; coho and chum salmon were equally preferred. Furthermore, the majority of respondents asked for more sockeye salmon enhancement projects in the Alitak and Southwest Kodiak Districts and pink salmon in the Northeast Kodiak District. To increase runs in these areas, fishermen preferred the stocking of unproductive lakes and associated fertilization techniques. The construction of more hatcheries appeared to be the least preferred method of enhancing the fisheries. Further information on the results of this questionnaire can be found in the Phase I plan.

Phase II Planning:

As part of the Phase II planning process, the RPT again solicited public input on potential rehabilitation and enhancement projects designed to improve the salmon fishery in the Kodiak region. Questionnaires were distributed to all limited-entry permit holders (599 mailed, 5% returned) and processors (11 mailed, 9% returned); representative samples of subsistence fishing permit holders (152 mailed, 8.5% returned) and sport fish license holders (486 mailed, 4.3% returned) in the area were sent questionnaires as well. Respondents generally indicated strong support for the salmon planning process conducted by KRPT. Additional public input was gathered through informal surveys conducted at the local docks and from meetings called to discuss the planning process.

Budgetary Constraints for Phase II:

The recent worldwide shift to lower prices for crude oil has resulted in a dramatic decline in revenues used to fund Alaska's capital and operating budgets. This decline in state revenue may mean that many programs already underway or soon scheduled to begin may have to be eliminated altogether. Only the most important functions and needs of government may be funded in the years ahead. Therefore, budgetary constraints were considered as KRPT identified and prioritized future fishery rehabilitation and enhancement projects in this Phase II plan.

Participants in the fishery should also realize that some of the projects identified in the plan may never be implemented because of a lack of funding. Never before in the Kodiak area has the need for a strong, active regional aquaculture association been more important. The KRAA has recognized this and stepped forward to fill the fiscal gap through cooperatively supporting enhancement projects with ADF&G or totally supporting facilities and programs that had been nearly lost to Kodiak fishermen through budget cuts by the state.

The KRPT will continue to meet at least once a year to update the comprehensive plan. These updates include the identification of new projects and an assessment of progress of ongoing projects toward achievement of their goals and objectives. This updating and annual reporting process will involve the RPT, KRAA, and implementing agencies. The RPT will continuously seek information from various user groups and the public on new recommendations for salmon rehabilitation and enhancement projects and programs. This information will be included as part of the annual report to the Commissioner of ADF&G.

Benefits to the Gear Groups

One of the primary goals of the Phase I plan was to improve the salmon fishery over a 20-year period. A requisite assumption to any project prioritization planning accomplished by KRPT was to identify projects that would benefit as many of the fishing user groups as possible. The selection of projects was based on the KRPT's knowledge of the fisheries and on information obtained from questionnaires.

Brief narratives of the benefits to each of the user groups follow. These benefits are based on the needs expressed by the groups during the Phase I planning process. The reader is encouraged to refer to that plan for additional background.

Salmon Purse Seine:

Between 1975 and 1983, salmon provided approximately 31 percent of the total earnings from the Kodiak regional fisheries (Manthey 1984), and the purse seine fleet harvested 75 percent (range = 65% to 85%) of the salmon. In 1988, approximately 60 percent of the active commercial salmon permit holders were purse seine operators. Purse seine operations occur throughout the area. The Alitak Bay, Red River, Southwest Kodiak, and Uganik Bay Districts are important seining areas because of strong sockeye and pinks salmon runs. Kitoi Bay, Afognak District, and the Cape Igvak section of Mainland District are also important seining areas. A majority of purse seiners fish the Northwest Kodiak District. The most recent survey indicates that purse seine fishermen would like more enhancement programs developed in the Alitak Bay, Northwest Kodiak, and Southwest Kodiak Districts.

Sockeye salmon projects underway at Frazer and Karluk Lakes are already showing signs of improved salmon production. Purse seiners would also like to see more sockeye enhancement projects in districts located at the northern end of Kodiak Island. Such projects might alleviate pressure on the major sockeye systems to the south by spreading out the effort area wide.

Pink salmon enhancement programs continue to do very well in the Kodiak area. For example, during 1985 Kitoi Bay Hatchery contributed approximately 3.4 million pinks to the harvest in what was an exceptional year.

Set Gillnet and Beach Seine:

Gillnet salmon permit holders account for approximately 30 percent of the total commercial salmon permits in Kodiak region; beach seiners for about five percent. Gillnet sites are mainly concentrated on the west side and part of the south end of Kodiak Island (Figure 2). Gillnet sites are often spaced every 900 feet along the shoreline. Beach seiners are permitted to fish area wide, except for a set-net-only area on the south end of Kodiak Island. While timing of the different stocks varies, all five species of salmon are taken in the Kodiak Management Area, and fall coho salmon runs are increasingly sought.

A majority of setnet sites in the Kodiak management area are located within the Kodiak National Wildlife Refuge. While the construction of salmon hatcheries in the refuge is restricted, other types of enhancement programs may be allowed on a case-by-case basis. The Karluk Lake fertilization program is an example. As sockeye salmon runs begin to grow to levels approaching reasonable harvest numbers, gillnet groups harvesting sockeye salmon bound for the Karluk Lake/River system will benefit. Salmon enhancement efforts identified in the Phase II plan, such as fish pass construction and fertilization projects, should also benefit the less mobile gear groups. A fair and proportionate distribution of salmon to these groups from both natural and supplemental production is a goal that the KRPT hopes to achieve with the projects recommended in Phase II.

Sport Fishermen:

Most of the effort by sport fishermen and the highest catches continue to occur in waters adjacent to the Kodiak road system. The principal areas fished include the Buskin (including the beach), Pasagshak, American, Olds, and Saltry Rivers. Results from the 1983 KRPT questionnaire sent to sport fishermen showed coho salmon to be the preferred sport fish species; however, the preferred enhancement species (ranked according to preference) were (1) chinook, (2) coho, and (3) sockeye salmon. Sport fishermen furthermore desired reductions in overcrowding on the fishing grounds; they also continue to support the lake-stocking and enhancement programs. Of growing concern among this group is the question of guaranteed access to traditional sport fishing areas. Since passage of the Alaska Native Claims Settlement Act (ANCSA) in 1971 and the Alaska National Interest Lands Conservation Act (ANILCA) of 1980, access disputes between fishermen and native land owners are on the rise. The question of guaranteed access to fishing sites could take several years to resolve. The ADF&G Sport Fish Division is projecting several projects by 1994. These include improvements in access at Russian Creek; potential land acquisition on the Karluk River for "angler" access; the same at Ayakulik River (Ayakulik Lagoon); and boat launch ramp and parking area at Woman's Bay near the Coast Guard Base.

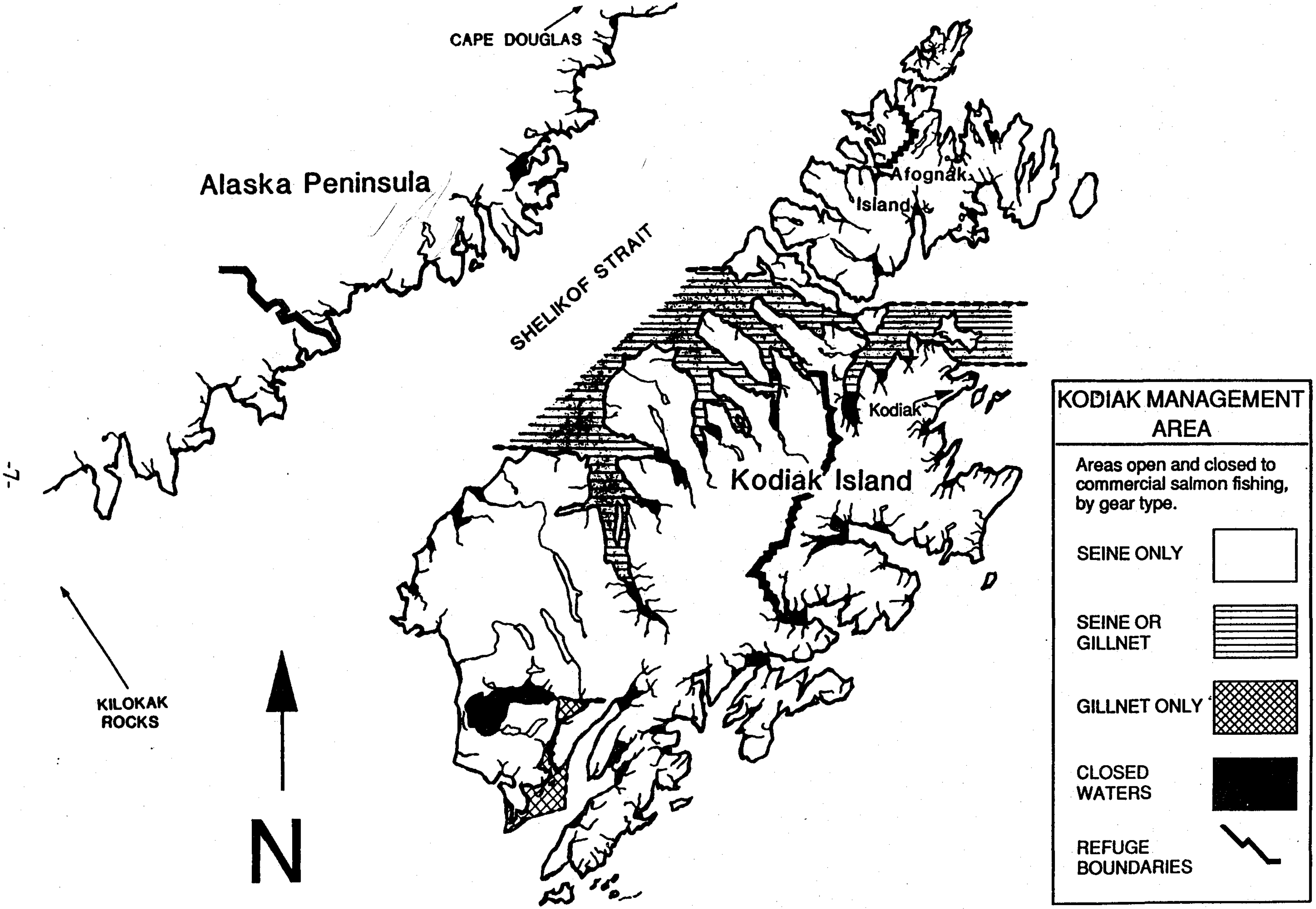


Figure 2. Areas open and closed to commercial salmon fishing by gear type in the Kodiak management area.

The spawning and rearing programs at Kitoi Bay Hatchery will continue to benefit sport fishermen, and coho salmon fry will be stocked annually in lakes and ponds along the road system to enhance sport fishing opportunities and to reduce sport fishing pressure on local wild stocks. During 1989, 700,000 coho salmon fry were produced for stocking at 12 locations. According to the Kitoi Hatchery 5-year plan, 1.4 million coho salmon eggs will be taken in 1994 for the lake-stocking program; a total return of 25,000 fish is anticipated (24,000 for harvest and 1,000 for brood stock).

Subsistence/Personal Use:

Subsistence and personal needs in the Kodiak Island area are met by several direct and indirect means. Management and enhancement activities at Port Lions, Ouzinkie, Afognak lake, Buskin Lake, and Karluk Lake have affected subsistence catches there. Subsistence needs were met at the village of Ouzinkie by planting 22,000 coho salmon fry from Kitoi Bay Hatchery into two small nearby lakes. This enhancement activity, which occurred in 1987 and 1988, resulted in the establishment of a self-sustaining run. At the village of Port Lions, an ongoing coho salmon lake-stocking project provides between 125,000 and 240,000 fry to nearby barren lakes each year. In 1991 nearly all of the subsistence needs of the community were realized when 5,000 adult coho salmon returned. Lake fertilization activities at Karluk and Afognak Lakes may indirectly increase harvest opportunities for the areas subsistence fishermen. The Buskin and Afognak Lakes sockey salmon runs are the most important contributors to resident subsistence fishermen who use the Kodiak road system for access to fishing areas. These runs are actively managed through weir escapement data and emergency closings and openings to provide for subsistence needs. A historic harvest summary of the Kodiak area's subsistence salmon fisheries is provided in Appendix A, Table 5.

CHAPTER 2

LONG-TERM OPPORTUNITIES (1982-2002)

Phase I Goals and Objectives

To achieve the overall goal of improved fisheries over the next 20 years, three major sub-goals were identified in Phase I: (1) Production/Harvest Goals, (2) research and Data-Gathering Goals, and (3) policy/Management Goals.

Production/Harvest Goals

The long-term harvest goals for odd and even years for 2002 are 31.0 and 26.0 million fish, respectively. With strong habitat protection measures and continued implementation of enhancement projects, increases in salmon production over the life of the plan should support an increase in annual harvests in both the even and odd years (Table 2). To express the number of salmon available for harvest by the user groups, production and harvest goals have been identified for the years 1992 and 2002 (Table 3). Future enhancement of the stocks will occur through implementation of projects identified for each district over the life of the plan. Depending on the enhancement strategies and their successes, the short-term harvest goals for 1992 are 15.6 million fish in even years and 10.6 million fish in odd years.

Table 2. Total projected harvest for 2002.

Species	Even Year	Odd Year
Pink Salmon	24,000,000	19,000,000
Sockeye Salmon	4,400,000	4,400,000
Chum Salmon	2,000,000	2,000,000
Coho Salmon	543,000	543,000
Chinook Salmon	15,000	15,000
	30,958,000	25,958,000

Research and Information Goals

Efforts to improve the quality and quantity of information required for more efficient salmon harvests in the Kodiak region will depend on the strategies undertaken over the next 20 years. Additional surveys of salmon habitat to determine the extent of available spawning

Table 3. Kodiak Comprehensive Salmon Plan 1982-2002: Harvest objectives for years 1992 and 2002[a].

		OBJECTIVES 1992	OBJECTIVES 2002
Sockeye			
Natural		1,000,000	2,700,000
Supplemental			1,700,000
Goal		**1,000,000**	**4,400,000**
1980-85 average commercial harvest: 1,362,000			
Coho			
Natural		120,000	161,000
Supplemental		2,000	383,000
Goal		**122,000**	**544,000**
1980-85 average commercial harvest: 213,000			
Chum			
Natural		900,000	900,000
Supplemental		67,000	1,100,000
Goal		**967,000**	**2,000,000**
1980-85 average commercial harvest: 957,000			
Pink			
Natural	odd year	6,200,000	7,500,000
	even year	11,200,000	12,600,000
Supplemental	odd year	2,390,000	11,500,000
	even year	2,390,000	11,500,000
Goal	**odd year**	**8,590,000**	**19,000,000**
	even year	**13,590,000**	**24,100,000**
1980-85 odd-year average commercial harvest: 7,425,000			
1980-85 even-year average commercial harvest: 12,070,000			
Chinook			
Natural		3,000	12,000
Supplemental		1,000	3,000
Goal		**4,000**	**15,000**
1980-85 average commercial harvest: 2,833			

[a] Assumptions in Chapter 6 of Phase I Salmon Plan Kodiak; the difference between the target harvest and the harvest resulting from natural production is the GAP; the goal is a figure that must be sustained at least over a 5-year period.

and rearing areas need to be done, and stream escapement monitoring should be expanded throughout the region. A better understanding of harvest pressures will occur with an expansion of stock separation studies. These methods may not directly result in more salmon in the short-term, but they are very important to the overall long-term health of the stocks.

Objectives to better meet these goals have already been identified in the Phase I plan (see Section 6.3). The scope of these objectives are expanded through the Phase II plan to identify candidates for an effective stream rehabilitation program. Survey and inventory work will include evaluation of stream rehabilitation potentials. The KRPT has recently identified a key objective: increase limnological studies and research aimed at increasing the knowledge of the region's lakes as potential rearing habitat for sockeye salmon.

Current projects such as the Karluk Lake fertilization program, if successful, will serve as the model for future studies under these objectives. A top priority for all research and evaluation objectives will be to collect data that assists in determining the optimum carrying capacity of a system and its escapement goals.

Recently, there has been a concerted effort by the Kodiak area FRED and Commercial Fisheries Divisions staff to identify and quantify potential lake systems suitable for enhancement or rehabilitation on Kodiak and Afognak Islands. Through the collection of fisheries and limnological data, over 20 lake systems have been identified as having fry stocking potential or needing analysis on current or potential production (see Appendix A: Table 5).

Implementation of all sockeye salmon stocking projects would require from 23 to 45 million fry[1] annually. During the initial phases of enhancement, Spiridon Lake (now barren) would require from 4 to 8 million fry; after 4 years of evaluation it may reach 11 million fry. In certain cases, lake fertilization techniques may also be used to further increase sockeye salmon production. The KRPT also recognizes the importance of coordinating with various local, state, and federal agencies in an effort to increase the amount of information on incidental high-seas salmon harvests occurring in Alaska waters. Recently, the legislature funded an on-board observer program that will better ensure compliance of high-seas commercial fishing operations with by-catch regulations, indicating that positive steps are being taken to close this management data gap.

Policy/Management Goals

The KRPT will continue to update the plan using specific criteria to address changing goals and objectives (see Chapter 5). This will require strong public participation in the salmon planning and project implementation processes throughout the life of the plan to better ensure an equal and just distribution of the economic benefits resulting from the projects.

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[1] based on euphotic volume calculations through 1991.

The salmon species presented in Table 3 are arranged in order of enhancement priorities; their respective 1992 objectives and 2002 goals are provided. Harvest averages from 1980 to 1985 are also provide to assess the status of the goals and objectives. In the 1992 updating of the comprehensive plan, the targeted harvest goals were examined in the context of known projects and their production potentials (Table 4). Although the supplemental production goals are considerable, the KRP felt they were achievable in the long term. The GAPs identified in Table 4 represent the differences between the targeted goals for 2002 and cureen natural and supplemental production by species.

Achieving Goals by 2002

Three strategies that will be undertaken to close the GAP by the year 2002 are (1) research and improved management, (2) enhancement and rehabilitation, and (3) habitat protection. Strategies will vary according to the unique characteristics of a species, site features, and governing land uses.

Research and Improved Management:

ADF&G fishery resource managers in Kodiak will work to increase the numbers of natural salmon stocks for harvest as well as maintain the brood stock population at a level that will maximize increased production. To achieve goals established within this plan without causing adverse impacts to the wild runs, supplemental salmon programs will be developed to produce more salmon on a sustained-yield basis.

Table 4. Supplemental salmon production necessary to meet desired 2002 GAP.

Species	Target Goal	Natural Runs	Supplemental Production	Total GAP
Pink				
odd year[a]	19,000,000	7,500,000	11,500,000	--
even year[a]	24,000,000	12,000,000	11,500,000	500,000
Sockeye	4,400,000	2,700,000		1,700,000
Chum	2,000,000	900,000		1,100,000
Coho	543,000	161,000		382,000
Chinook	15,000	12,000		3,000
Total catch:				
odd years	25,958,000	11,273,000	11,500,000	8,685,000
even years	30,958,000	15,773,000	11,5000,000	9,185,000

[a] pink salmon only.

A number of management programs already exist to increase salmon harvests beyond their present levels, while carefully providing for optimal escapements. Regulatory management plans are prepared for complex, mixed-stock fisheries; these plan are updated and reviewed through the Board of Fisheries process. Based on projected returns, harvest management strategies are updated and reviewed annually to implement those regulatory plans. To avoid undue hardship to longstanding historic fisheries, ADF&G, Commercial Fisheries staff manage the fisheries on a single-stock basis as much as possible.

It is difficult to achieve desired escapement goals when there is insufficient knowledge of run strengths, timing, run composition, and stream escapements. Improvements in these areas over the life of this plan are expected to complement management opportunities identified in the next chapter.

Enhancement and Rehabilitation:

Outstanding region-wide successes have been documented for some systems. Enhancement involves the building of salmon stocks to production levels beyond their former capabilities. Methods for achieving these production levels include (1) artificial or semiartificial production systems (e.g., hatcheries or fish passes), (2) increasing the physical productivity of an area (e.g., lake fertilization projects), or (3) egg-planting and rearing programs. Rehabilitation strategies apply to depressed natural stocks and attempts to increase run sizes of these fish to their former historical levels.

Habitat Protection

The success of this comprehensive salmon plan for the Kodiak region will depend on the level and quality of the area's habitat protection. Several key state and federal regulatory agencies exist to better ensure such protection. Besides the important work performed by ADF&G Habitat Division, the roles the Alaska Department of Natural Resources (DNR) and the U.S. Environmental Protection Agency plays in maintaining water quality and protecting salmon-producing systems from point and nonpoint source pollution is critical. In addition, since a large percentage of the region's lands are under the jurisdiction of the U.S. Department of Interior (USFWS & NPS), the planning nprocess also relies on federal mandates for protection of fishery resource habitat on those lands. Without aggressive enforcement of state water quality standards by the Department of Environmental Conservation (DEC), salmon production in the Kodiak planning area would probably be reduced over time by siltation from logging activities, land clearing and road construction and by pollution from improperly constructed septic systems, mining, and a variety of industrial activities. Loss of critical salmon spawning and rearing area to developments such as logging, subdivisions, and hydroelectric projects or the pollution of anadromous streams through indifferent industrial activities must not be permitted.

The DNR plays an important role in the long-term management of salmon habitat by regulating the allocation of fresh water and the use and disposal of state lands. A significant percentage of the flow of several salmon-producing streams on Kodiak have either been allocated or will be allocated for out-of-stream uses; for example, industrial water or hydroelectrical systems. The KRPT recognizes the problem that increasing demands for out-of-stream uses place on producing salmon streams. In future revisions to this plan, KRPT will be looking at necessary mitigative steps to reserve instream flow rates in order to ensure the long-term protection of salmon habitat.

During the course of the writing of the Phase II, the KRPT has received strong public comment relative to the need for increased enforcement on all lands and waters where new developments affecting the fishery resource occur. To bring about this compliance, the KRPT recognizes and unanimously supports the madatory presence of ADF&G Habitat Division personnel during construction activities impacting the salmon fisheries.

Regional Designation of Natural Salmon Stocks

In any rehabilitation and enhancement program, particularly those involving new hatcheries, the potential for reduction in the genetic variability among wild salmon stocks exists; therefore, it is important that genetic vigor be maintained within the range of natural stocks found in Kodiak waters. These same wild stocks could eventually provide a source of new brood stock for future enhancement programs. The current statewide policy for maintenance of genetic vigor includes the prohibition of artificial production of salmon in designated watershed areas. ADF&G has created strict wild stock protection policies to help safeguard natural salmon stocks (ADF&G 1985). Based on these policies, KRPT will be helping to identify these areas as wild-stock sanctuaries in which no enhancement activity is permitted, except egg collection for brood stock development (ADF&G 1985). Additionally, one of the objectives outlined in the 1991 fishery management plan for the Kodiak National Wildlife Refuge is to establish one or more watersheds to act as fishery gene banks. The ADF&G Fisheries Cover Program is also currently drafting and reviewing a draft "Wild Stock Sanctuaries" policy. The KRPT role in implementing this policy should be determined in 1992.

CHAPTER 3

LONG-TERM STOCK-BUILDING STRATEGIES

This chapter is divided into five sections, with each section addressing the importance of one species of salmon to the Kodiak fisheries as well as their production objectives during the period covered by the plan. Broad regionwide strategies and project descriptions are provided for each management district. The high-priority projects are those that are either ongoing or scheduled for completion in the next five years by ADF&G or KRAA. Low-priority projects will be addressed over the life of the plan. Potential hatchery sites that could be developed by KRAA to augment region-wide production are provided in Appendix A, Table 6.

Sockeye Salmon

The 1992 harvest objective for sockeye salmon in the Kodiak management area is to increase the natural runs to a level that provides an annual harvest of 1.0 million fish (natural stocks, including production from Frazer Lake and Afognak Island fishpasses and the Karluk Rehabilitation Project). During the 1988 season, this goal was surpassed with 2.7 million sockeye salmon harvested from natural runs. The 1970-1988 average sockeye harvest was 1.4 million.

To achieve the annual harvest objectives for sockeye salmon (4.4 million) by the year 2002, an additional 3 million fish must be produced. Strategies to help accomplish this include current management techniques and innovative enhancement programs. Sockeye enhancement technology in Alaska is rapidly moving ahead. Development of improved aquaculture techniques over the past several years has dramatically lessened the incidence of IHN epizootics (Figure 3). New opportunities (e.g., Pillar Creek Hatchery) will provide much-needed local data on advanced hatchery techniques for sockeye production. This hatchery will further serve as an educational tool in instructing students enrolled in fisheries courses at the Kodiak Community College and High School.

There is also the possibility of developing a zero-check smolt program at Kitoi Hatchery. One program method involves under-yearling smolt, or juvenile sockeye salmon that normally migrate to sea as smolts after rearing in freshwater lakes for two or three months. The occurrence of sockeye smolts migrating to sea as under-yearlings or age-0 is not common, but it has been documented at several locations in Alaska and British Columbia. Rapid growth of under-yearling sockeye in estuaries has been observed, and age-0 smolt growth has been nearly equivalent to a year's growth in fresh water.

Successes in sockeye enhancement and rehabilitation programs during the next ten years will largely depend on limnological studies that will increase understanding of the carrying capacities of lakes. This information will result in informed decisions regarding the initiation or continuation of new lake fertilization programs and lake stocking.

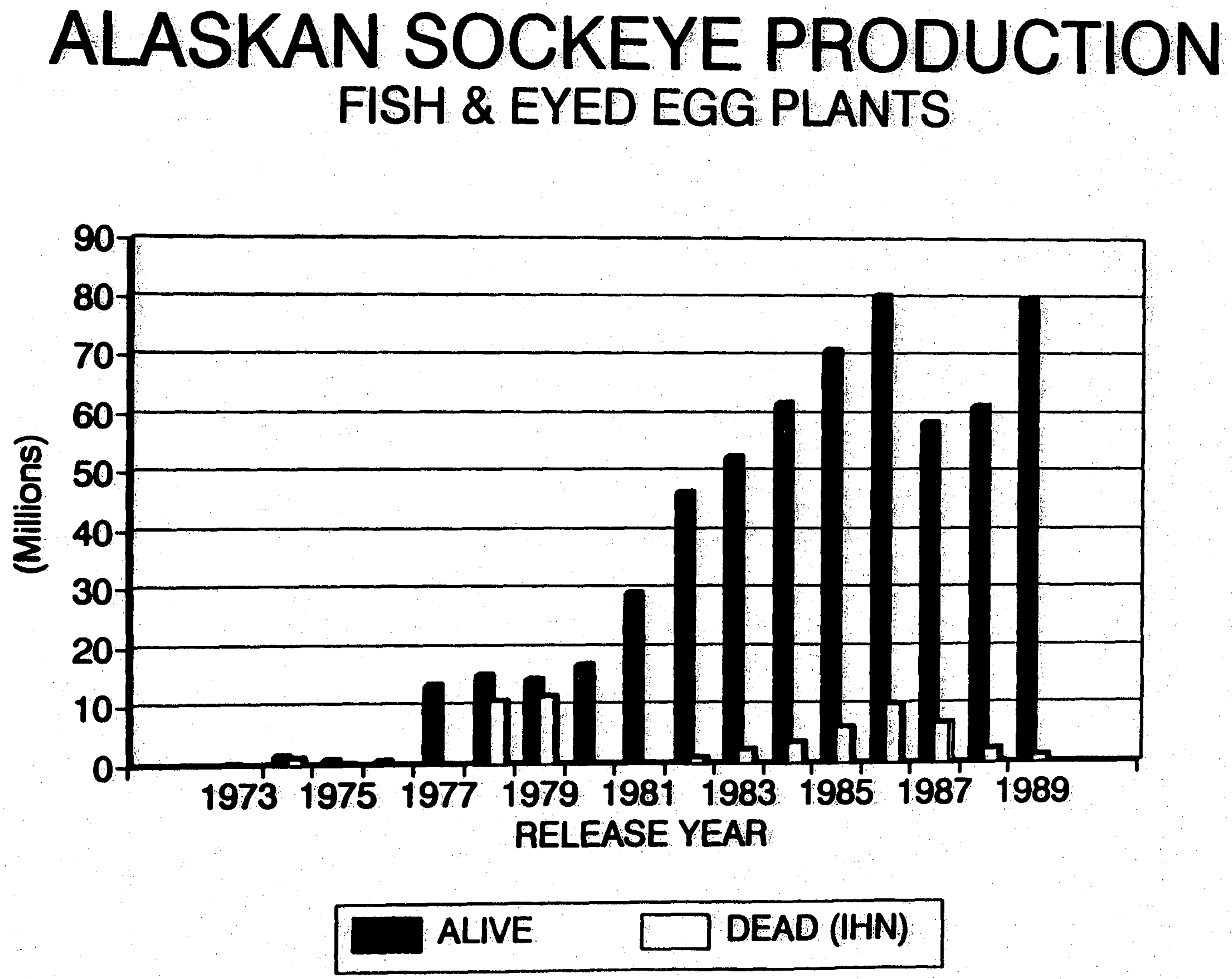

Figure 3. Alaska sockeye salmon production, 1973-1989.

In this 1992 Phase II Revision, KRPT adjusted the natural stock production goal for 2002 to 2.7 million and the supplemental production goal to 1.7 million, for a total of 4.4 million. This is keeping within KRPT's intent of periodically reviewing and updating the plan. Lake fertilization opportunities will complement other enhancement strategies, such as fishpass construction, sockeye incubation, and stream clearance projects. The majority of the sockeye salmon harvested on the west side of Kodiak Island are produced by four major systems: Karluk, Red River, Frazer, and Upper Station. These stocks remain close to shore during their return to natal streams and are harvested in the fixed-gear (set gillnet) or purse seine fisheries. Surplus sockeye salmon are also harvested from minor systems around the Afognak and Eastsiude Kodiak districts.

Kodiak's sockeye stocks are primarily managed by achieving interim escapement goals. The Cape Igvak and North Shelikof fisheries are managed according to management plans that have been approved by the Board of Fisheries. Moreover, the management strategies maintain an adequate population of salmon for acceptable harvest and escapement during most years.

Overall Opportunities in the Region:

While the regional sockeye salmon opportunities (Table 5) presented here are expected to raise overall harvest potentials, they are also intended to safeguard the natural populations. Opportunities aimed at increasing the numbers of sockeye salmon in the Kodiak management area will receive KRPT's highest priority in the Phase II plan. Major sockeye-producing systems will continue to receive priority management status in a predominately mixed-stock fishery. Management plans have already been developed to address escapement goals as well as the fisheries that will probably be affected by them. Stock separation and timing studies to improve in-season management of mixed stocks will have a low priority in this plan. It will be the primary responsibility of ADF&G Division of Commercial Fisheries.

Rehabilitation and Enhancement. High priority opportunities include (1) prioritized candidates for lake investigations that include but are not limited to the following: Afognak, Spiridon Uyak, Malina (two lakes), Miam, Sitkalidak[2], Akalura, Crescent system, Pauls system, Little River, Uganik, Hidden, Portage, Barabara, Kitoi area lakes, Red Fox Bay, Big Waterfall, Little Waterfall, and Buskin. These projects will be pursued according to the priorities established by KRPT. Other systems will be investigated as the opportunities arise (see Table 5); (2) research into development of zero-check sockeye salmon smolts and extended saltwater rearing; (3) construction and maintenance of fish ladders; (4) spawning and rearing habitat improvement, including debris removal, spawning channels, lake fertilization, and fry plants; and (5) extended freshwater rearing of sockey salmon.

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[2] recently investigated and determined not to have enhancement potential.

Table 5. Long-term sockeye salmon projects for Kodiak area by management districts.

District	Priority	Projects
Eastside Kodiak		
	High	Saltery Lake weir
	High	Miam/Summit Lake studies
	Low	Pasagshak weir construction
	Low	Pasagshak River spawning area expansion
	Low	Kaguyak, Kaiugnak Lakes
	Low	Sitkinak Lagoon/Lake
	Low	Stream No. 259422
Afognak		
	High	Afognak Lake studies and fertilization
	High	Afognak Fish Passes
	High	Maintain weirs at Litnik, Pauls, Portage, Waterfall, Malina, and Thorsheim systems
	High	Kitoi Bay Sockeye enhancement
	High	Hidden Lake studies/stocking
	High	Laura and Paul Lakes investigations
	High	Portage Lake prefertilization studies
	High	Fertilization/stocking of Upper Malina Lake
	High	Big and Little Waterfall stocking
	High	Jennifer Lake stocking
	High	Big and Little Kitoi Lakes water quality
	Low	Other studies on prioritized systems
Northeast Kodiak		
	High	Pillar Creek Hatchery
	High	Buskin River weir
Alitak		
	High	Dog Salmon, Upper Station, and Akalura River weirs
	High	Upper Station Lake studies
	High	Frazer Lake limnology, fertilization, and fish pass
	High	Akalura Lake investigations
	Low	Horse Marine fish pass
Northwest/Southwest Kodiak		
	High	Ayakulik and Karluk River weirs
	High	Crescent, Barabara, and Uyak studies
	High	Karluk post fertilization and evaluation studies
	High	Spiridon Lake limnological and stocking evaluations
	High	Mush Lake
	High	Uganik River weir
	High	Little River Lake studies
	High	Ayuakulik (Red River) Lake studies
	Low	Browns Lagoon Lake

Habitat Management. Review of activities that result in habitat alterations (e.g., logging, road construction, mining, etc.) is a high priority. The intent of KRPT is to develop and implement measures to minimize impacts on salmon and their respective fisheries.

Opportunities for Afognak District:

Sockeye Salmon habitat improvement opportunities in Afognak District are very good; however, limnological research will be needed before enhancement plans can be implemented. Success in using long-term management and enhancement strategies in this district will depend on close cooperation with local land managers in the public and private sectors and the ability to work toward mutually agreeable resource-base developments.
Programs identified for this district will directly benefit commercial seine, subsistence, and sport fishermen. Fixed-gear fishermen will experience the indirect benefits from a better distribution of fishing pressure, as other user groups move to noncompetitive locations.

High-priority Rehabilitation and Enhancement. (1) Afognak Lake has excellent potential for the enhancement of sockeye salmon; limnological studies need to continue there. (2) The potential for establishing a sockeye stocking program exists at Hidden Lake; initially, adequate conditions for spawning and/or rearing areas need to be substantiated with additional studies. (3) Laura and Pauls Lakes are potential sites for sockeye enhancement projects, and in order to increase harvestable numbers of this introduced sockeye run, limnology and prefertilization studies need to be initiated to generate adequate baseline data for evaluation. Additionally, ongoing projects need to be continued or project potentials investigated on the the following systems: (4) Upper and lower Malina Lakes, (5) Portage Lake, (6) Little Waterfall, (7) Kitoi Hatchery underyearling production, and (8) Kitoi area lakes.

Low-priority Enhancement. Appropriate studies need to be conducted at other lakes identified and prioritized by KRPT to determine the enhancement potential of these sites.

High-priority Habitat Management. All habitat alteration activities operating in the Afognak District should subscribe to state regulations governing these types of practices. The ADF&G Habitat Division should monitor these activities on a regular basis.

High-priority Research and Management. Adequate funding needs to be provided to maintain and operate the salmon weirs located in the Afognak, Pauls, Laura, Portage, and Thorshiem systems.

Opportunities for Northeast Kodiak District:

Programs aimed at increasing the amount of sockeye salmon available for harvest address the needs of commercial fishermen who have responded to the KRPT survey. Pillar Creek Hatchery has the potential to serve as an underyearling production facility for sockeye salmon smolts.

High-priority Rehabilitation and Enhancement. A sockeye salmon hatchery has been constructed at Pillar Creek as a central outstocking facility to produce 20 million fry. It will provide an education opportunity to local schools and potentially generate an annual run of 25,000 sockeye salmon to Monashka Bay through their production of zero-check smolts.

Opportunities for Alitak District:

Realization of opportunities in this district would especially benefit seine gear and gillnet fishermen. Enhancement efforts for sockeye salmon will proceed cautiously. The Kodiak RPT will review each program on a project-by-project basis in order to minimize problems of mixed-stock management. Management of the fishery will be based on the run strength of Frazer and Upper Station; such factors as commingling of stocks and differential rates of return will be considered.

High-priority Research and Management. Detailed lake studies need to be conducted at Upper Station and Akalura Lake to identify specific sockeye salmon rearing potentials and carrying capacities. Adequate funding is needed to maintain and operate the Dog Salmon and Upper Station Weirs.

High-priority Rehabilitation and Enhancement. Funding to maintain and operate the Frazer Lake fishpass will be needed to assure the continued success of the introduced run. Limnology/fertilization projects need continued funding so that high levels of sockeye salmon production can be maintained.

Low-priority Rehabilitation and Enhancement. During low water an existing falls at Horse Marine Bay delays or impedes the passage of sockeye from reaching the spawning areas. A fishpass project would remedy this problem.

Opportunities for Southwest Kodiak District:

User groups have recently begun to experience the benefits from the combined management and rehabilitation efforts of ADF&G. The Karluk Lake fertilization program is a promising method for increasing sockeye salmon production. The ultimate success of these types of programs depends on the continuation of achieving desired escapements, favorable environmental conditions, and continued evaluation.

High-priority Rehabilitation and Enhancement. The rehabilitation project at Karluk Lake will require post-fertilization funding over the life of the project to fully evaluate work conducted there during the years 1985 to 1990.

High-priority Research and Management. Detailed studies of the Ayakulik system will be conducted to determine rearing and spawning capacities. Adequate funding will be needed to maintain and operate the Ayakulik and Karluk River Weirs.

Opportunities for Northwest Kodiak District:

Projects in this district will benefit the set gillnet and seine gear fishermen.

High-priority Research and Management. A weir needs to be maintained on the Uganik system so that better in-season escapement information on the early spring sockeye run as well as pink, chum, and coho runs can be obtained.

Low-priority Research and Management. A weir needs to be developed on the Little River system for the purpose of developing an escapement data base to be utilized along with limnological data to determine the optimal escapement requirements for the system. A more detailed productivity study of Little River Lake is needed to determine the rearing potential of this sockeye system, which presently receives an indexed estimated escapement of between 10,000 and 20,000 fish.

High-priority Rehabilitation and Enhancement. The Spirodon Lake project needs to receive continued funding in order to realize full implementatiion and to satisfy the requirements of an environmental assessment prepared by USFWS staff at the Kodiak Refuge. Potential systems to consider for stocking are (1) Port Bailey Lakes, (2) Twin Lakes located at the head of Viekoda Bay, (3) a no-name lake located behind Sally Island in the Northeast Arm of Uganik Bay, (4) a no-name lake located northeast of Spiridon Lake, and (5) Browns Lagoon Lake[3].

Opportunities for Eastside Kodiak District:

High-priority Rehabilitation and Enhancement. Miam/Summit Lakes have been identified by the KRPT as high priority in this category through the sockeye salmon opportunity evaluation process.

High-priority Research and Management. A weir is presently located on Saltery Creek so that ADF&G, Commercial Fisheries staff can obtain escapement data for an often underutilized Eastside sockeye salmon run. Current budget cuts could eliminate the weir. Every effort should be made to maintain this management program by identifying long-term sources of funding.

Low-priority Research and Management. Secondarily funding should be provided to maintain and operate the Pasagshak Weir.

Low-priority Rehabilitation and Enhancement. Spawning area expansion should be investigated in the Pasagshak River system.

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[3] investigated in 1991, this system was determined to have no lake-stocking potential for sockeye salmon.

Coho Salmon

The harvest goal for coho salmon for the year 2002 is 543,000. In 1988, 52 percent of that goal was achieved when 303,000 coho salmon were commercially harvested. The 1988 harvest also surpassed the 1992 harvest goal of 122,0001 coho salmon. Recent information collected by ADF&G biologists indicates that there is growing sport and commercial interests in coho salmon. Prior to 1985, an extended closed period during late August and early September was implemented to protect weak sockeye salmon runs bound for the Karluk River. The Karluk River is also a significant contributor to coho salmon harvests on the "West Side," and this commercial fishing closure sometimes resulted in lost opportunities for harvesting migrating coho salmon. This arrangement between user groups and management staff is a trade-off to ensure that short-term economic objectives do not endanger long-term production goals. Stronger sockeye salmon runs in the past few years have allowed mixed-stock fisheries on coho and sockeye salmon. Escapement data are obtained at the Karluk weir, which has been in the same location since 1976. Although sockeye salmon runs have improved, both coho and sockeye salmon require some protection. More harvests occur on even years because of strong pink salmon returns.

A high degree of coho salmon harvests often eliminate the need for a terminal harvest inside Karluk Lagoon. This kind of management response can be expected to occur more frequently as sockeye salmon runs improve for the various systems throughout the region.

The KRPT recognizes the growing sport fish/commercial interests in coho salmon and has placed added emphasis in the five-year plan on identifying and implementing improved management and rehabilitation/enhancement strategies for them. For example, in 1986 enhancement projects contributed to the sport fish and commercial harvests of coho salmon. Approximately 5,500 fish were attributed to efforts at Kitoi Bay Hatchery, and according to the best available estimates, this figure represents only a fraction of the potential supplemental production that these kinds of programs are capable of producing. With recent advances in lake fertilization technology, the potential for coho salmon enhancement in the region is very good. The Kitoi Bay Hatchery 5-year management plan projects more than 200,000 and 800,000 coho salmon smolts and fingerlings, respectively, will be released Kodiak region-wide annually from 1990 through 1995.

Ninety-six percent of the total commercial harvest of coho salmon in 1985 occurred on the natural stocks returning to the Kodiak Management Area. Coho salmon populations in Chiniak and Monashka Bays (General District) could potentially be overharvested by commercial, sport, and subsistence fishermen because of easy public access.

Coho fingerline plants are one possible technique for increasing the number of coho salmon for all user groups. Since 1986 an average of 85,000 coho fingerlings have been planted in nine lakes flowing into Chiniak Bay. This program has proven to be very effective.

Overall Opportunities for Coho Salmon in the Region:

A prioritized list of long-term coho salmon management, research, rehabilitation, or enhancement projects for the Kodiak region are provided in Table 6.

High-priority Management. It will be necessary to direct coho research efforts over a wide range of systems to gain a better understanding of the area-wide opportunities. Evaluating coho escapement into important producer systems such as Pauls Bay, Paramanof Bay, Saltry Cove, and the Buskin River may be very difficult to achieve in the face of ADF&G budget reductions that may result in elimination of weirs. In many areas, weirs are the only accurate way to determine if desired escapement levels are being achieved. Therefore, emphasis will be placed on obtaining in-season escapement data through construction of weirs on important systems. Weirs placed near the terminus of streams provide a means for making more accurate counts of salmon than do aerial surveys; they also greatly improve the ability to manage harvests and achieve desired escapements. Immediate measures should be taken to encourage funding of weirs through the peak of the coho season and insure they remain in place until late September. Moreover, KRPT supports USF&WS research to determine methods to develop optimal coho salmon escapement goals for Kodiak coho salmon systems.

Low-priority Management. Funding for stock separation programs is needed for improved identification of stocks in the commercial fishery to improve management of stocks. Tagging and tag-recovery, scale analysis, and test fishing programs are needed to determine run strength and timing of natural stocks.

High-priority Rehabilitation and Enhancement. To supplement natural stocks of coho salmon and allow annual harvests of 543,000 fish by the year 2002, efforts must be directed toward determining suitable remote release sites for hatchery-produced coho salmon. Programs to produce more coho salmon at the Kotoi Hatchery should be continued and increased. Stream surveys must be conducted to identify coho salmon production opportunities. Candidate lakes to be stocked with sockeye salmon may be stocked with coho salmon if sockeye salmon are not available. Potential sites for developing coho salmon production should not conflict with natural runs, but focus on isolated areas.

High-priority Habitat Management. Coho salmon have special rearing habitat requirements. Shallow pond or marshy areas, often a result of beaver activity, are ideal. Gross disturbances to the habitat can have immediate repercussions on developing coho salmon. Some of the best coho-producing areas are located in the Afognak District, an area where extensive long-term timber harvesting is planned. The KRPT recommends that planning efforts between resource managers and timber interests be undertaken to work out the best long-term guidelines to satisfy the needs of both interests. Close public scrutiny and participation in this effort will be needed to assure that fishery resources are not sacrificed.

Table 6. Long-term coho salmon projects for Kodiak area by management district.

District	Priority	Projects
Afognak		
	High	Little Afognak Lake stocking information studies
	High	Paul-Laura-Gretchen Lakes, Portage Lake, Little Kitoi Lake, Seal Bay Creek, and Waterfall fishpas
	High	Pauls, Portage, Litnik, Waterfall, and Thorsheim weirs
	High	Kitoi Bay Hatchery one-check coho salmon
	High	Hidden Lake stocking
	High	Cold Creek fishpass
	High	Portage Lake habitat
	High	Shuyak Island enhancement studies
	High	Red Fox Bay management for escapement
	Low	Selief Bay site studies
Southwest Kodiak		
	High	Coho monitoring program
	High	Ayakylik River and Karluk weir coho salmon escapement
Northwest Kodiak		
	High	Dry Spruce and Crescent Lakes stocking studies
	High	Uganik River weir
	Low	Brown's Lagoon, Bowmans Creek, Twin Lakes fishpass investigation
	Low	Spruce Island scientific-educational projects
Northeast Kodiak		
	High	Road system coho stocking
	High	Buskin River weir
Alitak		
	High	Operate and maintain weirs on Silver Salmon, Horse Marine, Upper station, Dog Salmon, and Akalura systems (cooperative projects of USFWS and ADF&G)
Eastside Kodiak		
	High	Saltery Creek weir
	High	Pasagshak/Lake Rose Tead rehabilitation and enhancement
	Low	Summit Lake Study

Opportunities for Afognak District:

The Afognak District possesses some of the best habitat in the management district for increasing coho salmon production. Fish survey records predating statehood (i.e., 1959) identified successful rehabilitation and enhancement projects for this species.

High-priority Research and Management. Studies need to be undertaken at Little Afognak Lake and the Danger Bay (Kazakof) area to develop coho salmon lake-stocking information. Coho salmon plants could be made from brood stock raised at nearby Kitoi Bay Hatchery. Red Fox Bay stocks are adequate, but they require careful escapement and habitat monitoring. Funding needs to be continued for the Afognak District's salmon escapement monitoring weirs.

High-priority Rehabilitation and Enhancement. Fish passes at Pauls, Laura, Gretchen, Portage, and Little Kitoi Lakes as well as at Waterfall will require continued sources of funding for maintenance, thereby sustaining production of coho, sockeye, chum, and pink salmon. Plans to produce greater numbers of enhanced coho salmon will be feasible only with adequate funding for upgrading existing facilities over the life of the plan. A fish pass is needed at Cold Creek to assist coho salmon in reaching spawning areas located above falls. Portage Lake is important to the commercial and sport fisheries of Afognak Island. Repairs are needed to maintain the existing fish pass in this system. Large-scale logging in this area may cause long-term negative impacts to these fish runs, making the need for reliable enhancement facilities especially important. Studies need to be continued at Shuyak Island to determine potential enhancement projects for coho salmon. Efforts must be directed towards increasing hatchery coho production programs at Kitoi Hatchery to the projected 1.4 million egg target. Coho salmon brood stock will be monitored at Kitoi Bay Hatchery to develop coho salmon smolts. The stocking of Hidden Lake remains a high priority of KRPT.

Low-priority Management and Research. Further studies are needed at Selief Bay to determine the potential stocking and rearing programs in that area. Baseline data will be developed for Red Fox Bay.

Opportunities for Northeast Kodiak District:

Harvests of coho salmon by each of the user groups in the district have been receiving special attention of fishery managers. In 1984, ten of 11 coho salmon streams between Cape Chiniak and Monashka Bay (adjacent to the road system) received below-average annual escapement; it occurred again during 1985 in three of the 11 streams. Increased sport fishing pressure during 1984 resulted in the first-time Emergency Closure of the aforementioned streams to coho salmon sport fishing between mid-October and the end of December. As this effort increases, regulatory measures will become a necessary management strategy for coho production in the district. Strategies for all fisheries may include reductions in fishing time, enlarged closed-water sanctuaries, or complete closures--especially during years with below-average returns.

Low-priority Rehabilitation and Enhancement. Enhancement of Pillar Creek coho should be accomplished by using the returning natural runs for brood stock. Scientific/educational coho salmon hatchery projects in local schools should be continued and expanded.

Opportunities for Southwest Kodiak District:

While no new opportunities are anticipated for coho salmon enhancement in this district, the fisheries will require close monitoring to prevent excessive harvests of sockeye and coho so that escapement needs continue to be met.

High-priority Research and Management. Operations of Ayakulik River and Karluk weirs must be extended to enumerate coho salmon escapement. The continuation of enumeration and monitoring efforts through postseason aerial surveys by USFWS and ADF&G is encouraqed by KRPT.

Opportunities for Northwest Kodiak District:

Project opportunities in this district will directly benefit all user groups.

High-priority Research and Management. Further studies at Dry Spruce and Crescent Lakes are required to determine the feasibility of a large, interconnected lake system for rearing coho salmon (Kupreanoff Peninsula). A weir on the Uganik River would ensure adequate escapements of coho as well as sockeye, pinks, and chums. The weir is currently operated by USFWS Kodiak Refuge, and its operation needs to be transferred to ADF&G; however a source of funding will be needed. Furthermore, aerial surveys will need to be conducted at Spiridon River.

Low-priority Research and Management. Site investigations should be conducted for potential fish pass locations at Brown's Lagoon, Bowmans Creek, and Twin Lakes.

Opportunities for Alitak District:

High-priority Research and Management. Operation and maintenance of weirs on Silver Salmon and Horse Marine systems will be cooperative done by USF&WS and ADF&G.

Opportunities in the Eastside District:

High-priority Rehabilitation and Enhancement. Pasagshak/Lake Rose Tead system need to be investigated.

Chum Salmon

Although the 1.4 million chum salmon harvested in Kodiak waters in 1988 represents the attainment of the 2002 harvest goal established in the Phase I plan, the average annual harvest is expected to remain near 1.0 million. Site-specific information on the rearing and spawning potential of streams will continue to be required in areas where accelerated stock-building programs are deemed desirable. Should the number of chum salmon grow through increased hatchery efforts during the next 15 years, evaluation programs are recommended to accurately monitor the effects of this supplemental production on natural runs.

Overall Opportunities for Chum Salmon in the Region:

Chum salmon escapement and production goals need to be evaluated and assessed throughout the region. Projects have been prioritized and the enhancement programs at Kitoi Bay Hatchery identified (Table 7).

High-priority Management and Research. Escapement-monitoring projects should be continued in the following districts: Northeast Kodiak, Mainland, Alitak Bay, Eastside, and Northwest Kodiak. Weirs and aerial surveys need to be maintained.

Low-priority Rehabilitation and Enhancement. Investigate the potential of establishing a chum salmon hatchery in conjunction with Terror Lake power house.

Opportunities for Afognak District:

In order to produce sufficient returns by the 1990s, supplemental stock-building programs were phased in at Kitoi Bay Hatchery as early as 1977. To meet the long-term goals of the comprehensive plan, the hatchery will require funds for maintaining its present production level and physical condition of the facilities as well as for upgrading the site.

High-priority Rehabilitation and Enhancement. The success of supplemental programs at Kitoi Bay Hatchery has been well documented (Blackett 1985). Clearly, if the projects planned by KRPT for chum salmon and other species are expected to have a chance of success, funds other than those now provided by the state will be needed. Cooperative efforts between the state and the Kodiak Regional Aquaculture Association are presently being pursued.

Opportunities for Mainland District:

Long-term chum salmon enhancement projects will focus on the Kuliak and Alinchak sections of the Mainland District. Basic research is needed on the many systems in this area. The remoteness of this district will place enhancement efforts for chum salmon near the bottom of the list of projects under consideration. The identification of spawning habitat for salmon rehabilitation and enhancement projects is considered a low-priority project.

Table 7. Long-term chum salmon projects for Kodiak area by management district.

District	Priority	Projects
Afognak		
	High	Kitoi Bay Hatchery upgrade
Mainland		
	High	Escapement-monitoring projects
	Low	Kukak and Alinchak spawning-habitat studies
Northeast Kodiak		
	High	Escapement-monitoring projects
Alitak		
	High	Escapement-monitoring projects
Northwest Kodiak		
	High	Escapement-monitoring projects
Eastside Kodiak		
	High	Escapement-monitoring projects
	High	Information gathering for proposed Old Harbor/Three Saints Bay Hatchery
Southwest Kodiak		
	High	Escapement-monitoring projects

Pink Salmon

At the time strategies were being developed in Phase I for the two-year, odd and even cycles for pink salmon, a working assumption was the continuation of healthy markets for pinks. In this Phase II Revision, KRPT increased the harvest goals for pink salmon in the year 2002 as follows: 24.0 million during even years and 19.0 million during the odd years. These harvest figures represent 80 percent of the total harvest goal for all species of salmon in the Kodiak region for 2002.

The total harvest of pink salmon in 1988 was 14,262,000, which was considerably above the even-year annual average since 1970 of 9,237,000. The KRPT recommends that pink salmon production at Kitoi Bay Hatchery be maintained. Pink salmon returns can be maintained or increased through manipipulation of incubation levels at Kitoi Bay Hatchery; KRAA and

ADF&G are involved in a cooperative effort to expand the capacity at Kitoi through the use of additional rearing net pens, incubators, and building space. Whenever hatchery programs become the principal method of enhancing one or more of a species of salmon for purposes of adding to the overall harvest, there is a risk of over-harvesting the natural runs. This can occur when increasing numbers of supplemental salmon commingle with the natural runs so that accurate separation of stocks is not possible. One method to help reduce this risk is locating the hatchery at a site that does not compromise management strategies for natural runs and by conducting terminal fishery harvests at the hatchery. Kitoi Bay Hatchery is located and managed with this policy in mind. Should the market for pink salmon improve during the next 15 years, additional management activities can be initiated. These will include improved stock-forecasting and separation programs for long-term evaluation programs. Long-term regional projects will be addressed in the following sections (Table 8).

Research and Management Opportunities in the Region:

All salmon weirs need continued maintenance. Assessment of pink salmon production and escapement through aerial surveys and preemergent fry index studies in the spring also need to be continued.

Table 8. Long-term pink salmon projects for Kodiak area, by management districts.

District	Priority	Projects
All districts		
	High	Expansion of Kitoi Bay Hatchery and a new facility
Northwest Kodiak		
	High	Brown's Lagoon fishpass investigation
Eastside Kodiak		
	High	Seven Rivers fishpass investigation
Eastside, Northwest, and Northeast Kodiak		
	High	Hatchery water site investigations
Afognak		
	High	Operation and Maintenance of existing fish passes
	High	Coal Creek investigations

<u>High-priority Rehabilitation and Enhancement.</u> During the next 10 years, projects aimed at improving and increasing the use of existing habitat for pink salmon spawning and development through removal of stream obstructions and debris should be initiated. New site investigations for fish passes at Brown's Lagoon and Seven Rivers should be conducted.

<u>High-priority Research and Management.</u> Fish pass sites investigations should be conducted at Brown's Lagoon, Seven Rivers, Bauman's Creek (Terror Bay), Twin Lakes (Viekoda Bay), and Cold Creek (Afognak).

<u>Chinook Salmon</u>

The Karluk and Ayakulik River (Red River) systems are the only places where chinook salmon runs naturally occur in any significant numbers. There is no chinook production at Kitoi Bay Hatchery. Natural systems throughout Kodiak are producing at near optimal levels. An introduced run of chinook salmon also occurs in the Dog Salmon/Frazer Rivers area and in the Pasagshak River. Few of these fish are available for commercial purposes, and harvests have only incidentally occurred during fisheries targeted on such species as sockeye and pink salmon. Sport fishing for chinook salmon is closed in both the Pasagshak and Dog Salmon Rivers.

The average annual commercial harvest over the recent 10-year period is 5,000. Based on return per spawner and escapement data, the harvest should be at least 15,000. There is the possibility that chinook salmon are being intercepted in other fisheries. In 1988, 22,345 chinook salmon were commercially harvested. This is the fifth consecutive year that the incidental harvest of chinook salmon has exceeded 4,000. The Phase I annual harvest goals of 1992 were set at 3,000 from natural populations and 1,000 from enhancement efforts. Harvest goals for the year 2002 are 15,000 chinook from all sources.

Although sport and subsistence harvests have been low, chinook salmon are a very desireable species to the fishermen. A recent sport fish project has attempted to develop another road-system fishery for trophy chinook salmon at Lake Rose Tead (Pasagshak system). This project failed to produce a fishery, and sport fishing for chinook salmon was closed.

High-priority Rehabilitation and Enhancement Opportunity in the Region:

A zero-check chinook salmon program for the Kodiak road system, specifically for Mill Bay, Potato Patch, and Mission Lakes, need to be developed. Approximately 100,000 chinook salmon smolts from Elmendorf Hatchery were stocked in 1989, 1990, and 1991. Annual stocking efforts are planned for the future.

CHAPTER 4

A PLAN OF ACTION FOR THE NEXT FIVE YEARS

Recommendations for projects in this chapter are based on previously identified high-priority projects, and these projects are scheduled for implementation over the next five years. Because a number of projects identified in this chapter do not have a clearly defined source of funding, by prioritizing the projects KRPT hopes to influence the selection of management and enhancement opportunities during the budget-building process.

Responsibilities for carrying out the recommendations presented in the Phase II Five-Year Plan rests with ADF&G, KRAA, USF&WS, native regional corporations, and the City and Borough of Kodiak, and overlapping areas of authority are expected. Habitat protection, for example, involves USFWS, ADF&G, and National Marine Fisheries Service (NMFS). Enhancement, rehabilitation, and research programs will involve ADF&G, KRAA, and USF&WS. The Karluk Lake fertilization program is a good example of cooperative effort among the aforementioned parties and the Kodiak Island Borough.

Participation in hatchery management and development will take place within ADF&G and KRAA (or any approved PNP facitlity). Each organization, identified as a cooperator, while agreeing to work together, has a mission distinctly its own. USF&WS is responsible for conserving habitats and populations on refuge lands, ADF&G's responsibility and authority for management of the salmon resource and anadromous fish habitat is all encompassing, and KRAA is primarily involved with programs that directly produce more salmon for fishermen. ADF&G's efforts must be reflected in benefits to the state economy as a whole, while KRAA is controlled and directly accountable to its Board of Directors, the majority of whom are commercial fishermen. A free exchange of information and ideas among all the participating parties, focused in the KRPT meeting forum, will ensure that the plan's goals reflect current thinking and needed programs are implemented in a timely manner.

A list of salmon projects oriented by species (Table 9) represents ongoing projects that require continued funding as well as opportunities for new projects that should begin during the next five years. Neither set of recommendations stands much of a chance of implementation without a clearly defined funding source. The KRAA supports the KRPT recommendation that state funding for ADF&G within the Commercial Fisheries Division should continue to be used for weir maintenance, aerial surveys, and stream pre-emergent studies.

Table 9. 5-year salmon projects for Kodiak area, by species and management districts.

SOCKEYE - Ongoing projects (Lead Agency: ADF&G)

Alitak District

Frazer Lake fishpass and fertilization studies.

Upper Station baseline data collection. Red Lake limnological studies (a backup for escapement goals).

Southwest Kodiak District

Karluk Lake post-fertilization studies.

Evaluation of Upper Thumb and Karluk Lake rehabilitation.

Northeast Kodiak District

Pillar Creek Hatchery operation.

Northwest Kodiak District

Spiridon Lake limnological studies.

All Districts

Continuation of escapement monitoring programs using weirs, aerial surveys, and foot surveys.

SOCKEYE - Proposed Projects (Lead Agency: KRAA)

Southwest Kodiak District

Karluk Lake postfertilization project.

Northeast Kodiak District

Pillar Creek Hatchery funding.

Crescent Lake fry stocking.

Northwest Kodiak District

Spiridon Lake fry stocking.

Alitak District

Frazer Lake fertilization project.

Afognak District

Afognak Lake fertilization study.

-Continued-

Table 9 Continued.

Laura and Pauls Lakes habitat and limnological studies.
Red Fox, Hidden, Portage, Little Kitoi, Jennifer, Waterfall Lakes limnological studies.
Malina Lake fertilization and fry stocking.
Hidden Lake fry and pre-smolt stocking.
Waterfall Lake fry and pre-smolt stocking.

COHO - Ongoing projects (Cooperative Lead Agencies: ADF&G/USF&WS/KRAA)

Afognak District
Fishpass operations at Waterfall, Paul and Laura Lakes, Gretchen, and Little Kitoi Lake.
Kotoi lakes stocking and smolt production from Kitoi Bay Hatchery.
Spruce Island/Ouzinkie scientific/educational hatchery.

Northwest Kodiak District
Uganik River Cooperative weir operation.
Dry Spruce and Crescent Lakes put and take stocking.

All Districts
Continuation of escapement monitoring program using weirs, aerial surveys, and foot surveys of streams.
Kodiak road system lake stocking.

COHO - proposed projects (Cooperative Lead Agencies: ADF&G/KRAA)

Afognak District
Cold Creek fishpass project (Afognak logging company--cooperator).

CHUM - ongoing projects (Cooperative Lead Agencies: ADF&G/KRAA/USF&W)

Afognak District
Chum salmon phase-in program for Kitoi Bay Hatchery.
Northwest Kodiak
Uganik weir

-Continued-

Table 9 Continued.

PINK - ongoing projects (Cooperative Lead Agencies: ADF&G/KRAA/USF&W)

All Districts

Continued escapement-monitoring programs (weirs, aerial surveys, and foot surveys of streams).

Continued surveys of additional streams for fish pass improvement.

Northwest Kodiak

Continued escapement-monitoring programs on Uganik weir.

Afognak District

An expansion of the pink salmon production program at Kitoi Bay Hatchery.

Waterfall fish pass operations.

PINK - proposed projects (Cooperative Lead Agencies: KRAA/ADF&G)

Afognak District

Completion of fishpasses at Waterfall Creek.

Completion of Cold Creek fishpass. (Afognak logging company are cooperators).

Eastside Kodiak District

Site survey for a fishpass at Seven Rivers.

Hatchery site selection.

Northwest Kodiak District

Hatchery site selections.

CHINOOK - ongoing projects (Lead Agency: ADF&G)

Northeast Kodiak District

Road-system lake-stocking program.

Current Sources of Funding

A list of funding sources in the following section have been prioritized according to their availability and ease of access; the contact persons have also been provided. As the projects in Phase II continue to be implemented, new sources of funding will be identified.

1. Salmon Enhancement Tax. A two percent (2%) assessment tax on the gross earnings of commercial fishermen derived from salmon is collected and appropriated to the regional aquaculture association to fund the region's rehabilitation and enhancement program. This rehabilitation/enhancement tax requires approval by a majority vote of the eligible interim-use permit and entry permit holders. Contact: Kodiak Regional Aquaculture Association.

2. State of Alaska, Department of Community and Regional Affairs. Both direct grants and loans are being pursued at the time of this writing. Contact person: Mr. Thomas Peterson.

3. State of Alaska, Department of Revenue. The use of the raw fish tax as a regional funding source would require appropriate legislation before it could occur.

4. State of Alaska, Department of Fish and Game. Cost-recovery agreements between the ADF&G and the regional aquaculture associations for harvesting a portion of returns to state hatcheries to pay for operational costs occurred in 1987. Contact person: Dr. Jeffery P. Koenings.

5. Federal Funds. Dingell-Johnson funding is limited to Sport Fish projects and available primarily to state agencies. Contact person: Bill Martin, U.S. Fish and Wildlife Service.

CHAPTER 5

CONTINUATION AND IMPLEMENTATION OF THE PLAN

The Regional Planning Team's Role

Alaska statutes specify three functions of the Regional Planning Team: (1) development of a comprehensive salmon plan, including provisions for both public and private nonprofit hatchery systems (AS 16.10.375); (2) review of private nonprofit hatchery permit applications (AS 16.10.400 [a]); and (3) review of the proposed suspension or revocation of a permit (AS 16.10.430). The remainder of this chapter provides a further elaboration on the responsibilities identified above and also a description of the annual updating process.

Ongoing Planning

Alaska Statute 16.10.375 provides the KRPT with the responsibility for development of a comprehensive salmon plan. Plan development is a constantly evolving process, as opposed to one that is fixed or static. This nature of the planning process gives the KRPT a continuing role in salmon rehabilitation and enhancement planning. The KRPT is responsible for relating actual events to the plan and making the plan responsive to new knowledge, ideas, and changing conditions.

Opportunities have thus far been presented within a 20-year timeframe. Numerous unknowns surround many of these opportunities, and some will never become actual projects. As projects in the five-year action plan become implemented or are determined to be infeasible or undesirable, they will be replaced with new projects for the upcoming five years.

The 20-year plan will be revised as necessary. A procedure for an annual update of the action plan will allow for revision of certain sections. At times, new information and events will require the reevaluation of goals, objectives, district and section targets, or assumptions used for planning.

Annual Update

The Phase II plan is designed to be a working document that provides a framework for increasing salmon production for the Kodiak region; therefore, the five-year action plan will be updated on an annual basis, and an annual report on regional comprehensive salmon planning in Kodiak will be submitted to the Commissioner of ADF&G. For these annual updates, the KRPT will meet at least once a year to discuss (1) reports on current projects; (2) new projects under consideration; and (3) new opportunities that may be investigated as potential future projects.

Each year a statement of progress toward achievement of the goals and objectives in the Phase I plan and a project status report will be incorporated into the annual report. Over time, this annual report will reflect the achievement or non-achievement of the goals and objectives of the Phase I plan.

Criteria for RPT Review of PNP Hatchery Permit Applications

AS 16.10.400(a) provides that a hatchery application must be at least evaluated in the context of its compatibility with the comprehensive salmon plan by the RPT, as well as criteria established by current regulations and statutes. AS 16.10.400(g) identifies conditions that must be satisfied if permits are to be issued by the Commissioner before the regional comprehensive salmon plan is complete.

Part (f) of the same law requires that the commissioner shall classify a stream as suitable for enhancement purposes prior to a permit being issued. There are, however, more than 330 anadromous streams in the Kodiak area. The process of evaluating a stream to determine whether or not it would be suitable for enhancement is very complicated, time consuming, and expensive.

To accomplish a full inventory and classification of all the anadromous streams in the Kodiak area was, therefore, beyond the financial and temporal limits of the plan. Instead, the RPT decided to formally make recommendations to the Commissioner at the time the department initiates the RPT review of a project for rehabilitation or enhancement of the fisheries.

The following criteria are hereby set forth in the Phase II Plan and are consistent with the language and the charge provided in AS 16.10.400(a), (f), (g). In reviewing and making recommendations to the Commissioner on nonprofit hatchery permit applications, the RPT will consider the following criteria in their review. The criteria will also be used to the extent practicable, in their review of other projects.

1. Will it make a significant contribution to the common-property fisheries? (Authority: Section 1, Chapter 111, SLA 1974). The RPT will consider and make its recommendations on each species to be produced if there is a reasonable opportunity for common property harvest consistent with the average Western Region common property fishery exploitation rate for that species. For a site to be suitable for private nonprofit development, there must be capability to generate common property harvest and at the same time provide adequate cost recovery for the facility. Considerations pertinent to determining the potential common property benefits include the following:

(a) Does the application contain significant omissions or error in assumptions? If so, the use of more accurate assumptions might indicate increased hatchery needs and decreased benefits to common property fisheries. Pertinent assumptions might include those relating to interception (harvest) rates in common property fisheries, harvest in the special harvest areas, and survivals of green eggs to adults.

(b) If returns cannot provide the "significant" common property benefit in the traditional fisheries, is there an adequate terminal area where new fisheries could be created for the desired common property benefit without endangering the wild stock?

(c) If the application provides insufficient information for adequate RPT evaluation, the team will request additional information. If they conclude that basic production and harvest assumptions are not realistic, they will recommend that changes in the proposed projects be incorporated by the applicant.

<u>2. Does it allow for continued protection of wild stocks?</u> (Authority: Section 1, chapter 111, SLA 1974) (AS 16.400(g) and AS 16.10.420/10). Any judgment as to the acceptability of impacts on natural stocks from an enhancement project should be made on only on the actual and potential size of the affected wild stocks, but also on the extent of benefits from enhancement and alternative enhancement opportunities in the area that may have less impact on natural stocks. Considerations include the following:

(a) Can management or harvest strategies be developed to allow harvest of enhanced returns while protecting natural stocks?

(b) Is there a segregated area for hatchery harvest that will provide adequate cost recovery without impacting wild stocks?

(c) Does the affected stock actually or potentially support a commercial, sport, and/or subsistence fishery?

(d) Does the affected stock have unique characteristics or are there special circumstances (e.g., a unique early run of coho)?

(e) What is the degree of risk and the probable degree of loss to the natural stock?

<u>3. Is the proposed project compatible with the Comprehensive Plan?</u> (Authority: Section 1, chapter 111, SLA 1974) (AS 16.10.375, AS 16.10.400(g)). The goals and objectives of the Comprehensive Plan, Phase I, are directed toward substantial public benefits. Phase II identifies ongoing and proposed projects that are compatible with management strategies for the wild stocks. Thus, the goals and objectives of Phase I and the recommendations in Phase II provide a basis for evaluating all projects.

The project should also be compatible with management concerns and guidelines set forth in the plan and with specific recommendations concerning strategies and projects. The RPT, in its recommendation to the commissioner, will take all of those factors into consideration in determining the project's compatibility with the comprehensive plan.

<u>4. Does it make the most appropriate use of the site's potential?</u> (Authority: AS 16.10.400(g), AS 16.10.430(b)). A number of very good opportunities for further enhancement

programs exist in the Kodiak management area. If the plan goals and objectives, as well as substantial public benefits, are to be achieved, enhancement sites must be developed to their fullest potential with appropriate species using the best available technology.

In most instances, investigation will show one strategy to be far more effective than the others. Within a given strategy, it will be extremely important that the proposed project will develop the site appropriately and to its full potential. Given technical feasibility, the RPT's determination of the appropriate development of a site will be based on such factors as the magnitude of its water supply, harvest potentials, manageability, and potentials to address user needs.

The applicant, in his application and presentation to the RPT, should demonstrate adequate plans for the site and the capabilities to carry them out. If the applicant does not show adequate planning and documentation, the RPT cannot judge the proposed project's ability to satisfy any criteria or determine in general whether the proposed hatchery would result in substantial public benefit as required under AS 16.10.400(g), AS 16.10.430(b), and the Mission Statement of the plan (Phase I).

An applicant should document to the RPT an ability to develop the site properly and to its full potential. This documetation should include the following: (a) plans for implementation and full development of long- and short-term production goals and objectives; and (b) an adequate description of facility plans for incubation and rearing.

The RPT will formulate a recommendation based on its review of the application and forward it to the commissioner within 14 days of the date when the application is considered. The RPT's recommendation should not be construed as denoting the decision to be made by the Commissioner. The ADF&G staff as well as concerned members of the public also provide reviews and recommendations to the Commissioner. The Commissioner may uphold or reject the recommendations of the RPT after reviewing all the merits and potential problems associated with the proposal.

Since the RPT need adequate review time prior to considering an application, it will generally require that applications and attendant materials be received by the RPT members at least two weeks before the meeting at which the application is to be considered. It may also request additional information during the initial review if the information in the application is inadequate. A representative from the corporation making the application will be expected to make a presentation of the proposal at the RPT meeting.

Alaska statutes specifically grant the RPT an opportunity to review a permit suspension or revocation; however, revocation by the Commissioner would occur only as a very last, unavoidable course of action. It is far more desirable to identify problems early and attempt to remedy them. Existing procedures provide for an annual evaluation of operating hatcheries. The annual report supplies information on the hatchery's past performance, while the annual management plan provides a mechanism for monitoring and modifying hatchery operations on a year-to-year basis. These documents are subject to standard departmental review. RPT review of annual reports and annual management plans is a part of ongoing planning and is also the logical extension of review of hatchery applications. Actual hatchery performance will show whether it contributes to the fishery as planned. This departmental and RPT review allows for monitoring or ongoing performance.

If the department has determined that a hatchery's performance is inadequate and that a permit suspension or revocation is being considered, the Commissioner will notify the RPT, and the RPT will be provided with an opportunity to make a recommendation on the proposed action. In evaluating any PNP operation that is referred to the RPT by the Commissioner, the RPT will use the specific performance criteria in their review, evaluation, and recommendation to the Commissioner. The criteria are established in 5 AAC 40.860 of the 1986 edition of the "Alaska Statutes and Regulations for Private Nonprofit Hatcheries." The RPT, in this evaluation, will also consider any mitigating circumstances that were beyond the control of the hatchery operator. The reader is referred to Appendix C for a detailed listing of project review criteria used during an initial review by the RPT of rehabilitation and enhancement projects.

In addition to the fish culture information provided in the annual report for each PNP hatchery, one additional tool is needed for evaluation of performance. The RPT may recommend mandatory tagging of hatchery-released salmon of all species for at least several cycles in order to measure contributions to the fishery as well as to provide valuable information for management. This tagging may, of course, be accompanied by an adequate program for tag recovery.

Contribution to the fishery will be the ultimate measure of hatchery performance. However, it is not easy to define this criterion in measurable terms or to delineate what actions should be taken if the criterion is not met. Furthermore, the build-up of production at any facility may be slow, so that the ultimate success or failure cannot be determined for many years. As experience with hatchery operations is gained, the performance criteria should be reviewed and refined as needed.

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APPENDIX A

Tables

Figure

Table 1. Estimated salmon harvests and values by gear type in the Kodiak Management area, 1970-1991.

Year	Total Harvest[a]	Total Value[b]	Average Purse Seine	Average Beach Seine	Average Set Net
1970	13,949,000	$21,658,000	$41,880	$10,470	$21,083
1971	6,376,000	4,973,000	13,397	2,919	3,015
1972	3,890,000	3,909,000	9,233	647	1,451
1973	1,001,000	2,094,000	5,075	251	852
1974	3,323,000	4,808,000	15,993	4,406	4,828
1975	3,187,000	3,831,000	13,300	5,600	3,849
1976	12,484,000	16,976,000	43,017	11,035	14,481
1977	7,977,000	21,000,000	48,382	12,434	19,351
1978	16,942,000	32,000,000	72,158	15,731	25,495
1979	12,420,000	25,000,000	48,906	18,839	23,000
1980	19,157,000	31,000,000	69,117	7,710	21,578
1981	13,057,000	33,000,000	75,257	17,312	26,231
1982	10,892,000	16,230,000	31,868	10,549	30,554
1983	7,082,000	14,530,000	32,832	5,886	19,338
1984	13,678,000	26,202,000	72,018	12,577	26,777
1985	9,898,000	20,782,000	45,303	6,451	31,296
1986	15,956,959	39,106,000	92,933	9,517	69,644
1987	7,745,000	28,113,000	71,170	12,780	38,000
1988	18,711,000	94,075,000	228,000	41,000	115,000
1989[c]	26,209,000	54,114,000	130,000	30,000	100,000
1990	12,123,000	53,407,000	123,000	10,292	72,414
1991	23,723,000	31,489,000	65,442	4,518	46,662
Average for previous decades:					
1970-80	**8,155,100**	**$13,624,900**	**$31,134**	**$8,233**	**$11,741**
1980-89	**14,307,200**	**$36,682,600**	**$87,273**	**$15,980**	**$48,170**
Average for previous 5 years:					
1986-90	**16,278,800**	**$55,697,800**	**$133,872**	**$21,921**	**79,669**

[a] Includes total commercial harvest, test fishery, and Kitoi cost-recovery harvests in number of fish.

[b] Ex-vessel value based on in-season prices; it may exclude values associated with dock deliveries and postseason settlements.

[c] Actual harvest limited by PWS oil spill in 1989; harvest figures for 1989 include actual & projected harvest of wild stocks & actual harvest of hatchery stocks from cost-recovery fishery. 1989 total value is estimated by expanding average in-season prices for actual wild harvest & in-season bid price for hatchery harvest. 1989 ex-vessel value was estimated using 1988 gear levels & proportional harvest.

Table 2. Kodiak Management Area summary of limited entry permit activity, 1975-1991.

Year	Purse Seine		Beach Seine		Set Gillnet		Total		Percent
	Fishable	Fished	Fishable	Fished	Fishable	Fished	Fishable	Fished	Fished
1975	468	280	26	8	229	116	703	404	56
1976	394	325	23	17	187	140	604	482	80
1977	378	312	32	22	186	142	596	476	80
1978	388	345	32	24	188	152	608	521	86
1979	385	340	34	28	184	154	603	522	87
1980	387	360	35	29	187	158	609	547	90
1981	387	325	35	30	187	169	609	524	86
1982	386	338	34	28	187	169	607	535	88
1983	383	342	35	27	188	174	606	543	90
1984	384	298	31	25	188	168	607	491	81
1985	384	272	35	21	188	169	607	467	77
1986	385	288	35	15	187	175	607	478	79
1987	386	298	35	18	188	173	609	489	80
1988	387	323	35	21	188	180	610	523	86
1989[a]	388	4	35	1	189	187	612	92	15
1990	389	354	35	21	190	185	614	560	91
1991	388	348	35	17	189	185	612	550	90
17-year average (1975-88)	**391**	**322**	**33**	**22**	**190**	**162**	**614**	**507**	**83**

[a] 1989 effort levels not included in average totals because of extensive fishery closures caused by the presence of oil from Exxon Valdez spill.

Table 3. Kodiak area historical salmon harvests by species 1948-1988[a].

Year	Chinook	Sockeye	Coho	Pink	Chum	Total
1948	1,000	1,260,000	32,000	5,958,000	331,000	7,582,000
1949	1,000	892,000	54,000	4,928,000	700,000	6,575,000
1950	2,000	921,000	41,000	5,305,000	685,000	6,954,000
1951	2,000	470,000	48,000	2,006,000	422,000	2,948,000
1952	1,000	631,000	36,000	4,554,000	984,000	6,206,000
1953	3,000	392,000	39,000	4,948,000	490,000	5,872,000
1954	1,000	329,000	56,000	8,325,000	1,140,000	9,851,000
1955	2,000	164,000	35,000	10,794,000	480,000	11,475,000
1956	1,000	306,000	54,000	3,349,000	660,000	4,370,000
1957	1,000	234,000	35,000	4,691,000	1,152,000	6,113,000
1958	2,000	288,000	21,000	4,039,000	931,000	5,281,000
1959	2,000	330,000	15,000	1,800,000	734,000	2,881,000
1960	2,000	362,000	54,000	6,685,000	1,133,000	8,236,000
1961	1,000	408,000	29,000	3,296,000	519,000	4,883,000
1962	1,000	785,000	54,000	14,189,000	795,000	15,824,000
1963	--	407,000	57,000	5,480,000	305,000	6,249,000
1964	1,000	478,000	36,000	11,862,000	932,000	13,309,000
1965	1,000	346,000	27,000	2,887,000	431,000	3,692,000
1966	1,000	632,000	68,000	10,756,000	763,000	12,220,000
1967	1,000	284,000	10,000	188,000	221,000	704,000
1968	2,000	760,000	56,000	8,761,000	750,000	10,329,000
1969	2,000	604,000	35,000	12,493,000	537,000	13,671,000
1970	1,000	917,000	66,000	12,045,000	919,000	13,949,000
1971	1,000	478,000	23,000	4,333,000	1,541,000	6,378,000
1972	1,000	222,000	14,000	2,486,000	1,165,000	3,883,000
1973	1,000	167,000	4,000	512,000	318,000	1,001,000
1974	1,000	409,000	14,000	2,635,000	248,000	3,329,000
1975	--	137,000	25,000	2,945,000	85,000	3,187,000
1976	1,000	641,000	24,000	11,078,000	740,000	12,485,000
1977	1,000	623,000	28,000	6,252,000	1,072,000	7,977,000
1978	3,000	1,072,000	49,000	15,004,000	814,000	16,942,000
1979	2,000	632,000	141,000	11,287,000	358,000	12,420,000
1980	1,000	651,000	139,000	17,290,000	1,076,000	19,157,000
1981	1,000	1,289,000	122,000	10,337,000	1,345,000	13,094,000
1982	1,000	1,205,000	344,000	8,076,000	1,266,000	10,892,000
1983	4,000	1,232,000	158,000	4,603,000	1,085,000	7,082,000
1984	5,000	1,951,000	230,000	10,884,000	649,000	13,678,000
1985	5,000	1,843,000	284,000	7,335,000	431,000	9,898,000
1986	4,000	3,155,000	168,000	11,504,000	1,126,000	16,304,000
1987	5,000	1,793,000	192,000	5,073,000	682,000	7,747,000
1988	22,000	2,698,000	303,000	14,262,000	1,426,000	19,010,000
1989[b]	5,000	2,629,000	141,000	22,649,000	836,000	26,259,000
1990	18,810	5,248,000	293,700	5,983,810	577,740	12,122,150
1991	22,200	5,704,000	324,900	16,642,800	1,029,100	23,723,000

-Continued-

Table 3. Continued

Year	Chinook	Sockeye	Coho	Pink	Chum	Total
48-year avg	2,864	1,007,950	89,710	7,392,270	786,422	9,279,216
Odd-year average (21 years) pink:				5,848,700		
Even-year average (22 years) pink:				8,864,810		

[a] Data source: for the period 1948-1991, harvest data was derived from fish ticket information summarized by ADF&G.

[b] The 1989 harvest data shown is unique from all other years in that the total harvest by species in this table is the summation of the actual harvests that occurred and the projected harvest that would have occurred if there had not been restrictions placed on the 1989 fisheries because of the presence of oil-contaminated waters in the Kodiak area caused by the Exxon Valdez oil spill that occurred on April 24, 1989; harvest dat for 1989 is not included in the average harvest totals.

Table 4. Optimal sockeye salmon fry-stocking potential in the Kodiak area[ab].

LAKE NAME	TYPE PROJECT	EUPHOTIC VOLUME	OPTIMAL FRY	RUN TIMING	CATCH POTENTIAL
Afognak	Rehab	46.1	2,489,400	Early	44,809
Akalura	Rehab	45.1	2,435,400	Late	43,837
Barabra	Rehab	4.4	237,600	Early	4,277
Buskin	Rehab	11.6	626,400	Early	11,275
Crescent	Enhanc	5.6	302,400	Early	9,072
Hidden	Enhanc	19.6	1,058,400	Early	31,752
Jennifer	Enhanc	5.8	313,200	Late	9,396
Laura	Rehab	40.1	2,165,400	Late	38,977
L.Kitoi	Enhanc	4.5	243,000	Late	7,290
Little R	Rehab	12.2	658,800	Early	11,858
Malina	Rehab	21.1	1,139,400	Early	20,509
Portage	Rehab	11.1	599,400	Early	10,789
Red Fox	Enhanc	1.7	91,800	Early	2,754
Spiridon	Enhanc	211.6	11,426,400	Late	342,792
Summit	Enhanc	1.6	86,400	Early	2,592
Uganik	Rehab	11.1	599,400	Early	10,789
Uyak	Enhanc	2.8	151,200	Late	4,536
Waterfall	Enhanc	8.3	448,120	Early	13,446
TOTALS			**25,072,200**		**620,750**

Rehabilitation = 10,951,200
Enhancement = 14,121,000

[a] Stocking potential is estimated at 54,000 fryi per euphotic volume unit (EV); harvest estimated at 100% for enhancement lakes and 60% for rehabilitation lakes; fry to adult survival estimated at 3%.

[b] Source: Lorne White (Kodiak Area Biologist) and Steve Honnold (Fishery Biologist), ADF&G, Fisheries Rehabilitation, Enhancement, Development (FRED) Division.

Table 5. Historical harvest summary of subsistence fisheries in the Kodiak area, 1962-1990[a].

	Permits								
Yr	Issued	Returned	%	Chinook	Sockeye	Coho	Pink	Chum	Total
1962	74	13	17.6	zero	zero	433	397	20	850
1963	74	15	20.3	zero	297	576	836	195	1,904
1964	43	9	20.9	6	332	184	88	71	681
1965	67	7	10.5	2	19	318	244	12	595
1966	48	13	27.1	zero	295	331	334	393	1,353
1967	84	29	34.5	2	1,306	571	894	344	3,117
1968	132	28	21.2	zero	658	433	529	45	1,665
1969	242	30	12.4	1	481	338	620	30	1,470
1970	213	49	23.0	1	959	939	797	265	2,961
1971	267	131	49.1	5	3,442	1,720	1,276	472	6,915
1972	329	176	53.5	11	3,633	1,531	2,516	2,729	10,420
1973	400	149	37.3	7	4,453	2,289	1,393	1,166	9,308
1974	367	90	24.5	1	1,909	846	1,094	128	3,978
1975	508	90	17.7	1	1,141	922	947	221	3,232
1976	536	243	45.3	4	4,338	962	2,275	370	7,949
1977	739	451	61.0	54	8,119	2,508	2,849	317	13,847
1978	860	539	62.7	50	7,239	3,699	2,747	572	14,307
1979	1,085	697	64.2	111	10,376	3,840	3,300	333	17,960
1980	1,239	756	61.0	67	13,746	4,407	2,755	566	21,541
1981	1,166	733	62.9	44	12,756	3,729	2,278	470	19,277
1982	1,276	993	77.8	110	16,615	7,192	3,558	667	28,142
1983	1,307	1,082	82.8	111	15,526	6,283	2,536	800	25,256
1984	1,240	1,061	85.6	265	17,620	5,808	1,877	720	26,290
1985	1,476	1,196	81.0	172	16,231	8,873	2,756	855	28,887
1986	1,244	1,049	84.3	91	14,451	7,087	2,371	605	24,605
1987	1,124	969	86.2	162	11,562	6,149	2,195	1,061	21,129
1988	1,098	663	60.4	108	10,152	4,094	1,271	366	15,991
1989	2,800	687	--	39	11,979	3,577	1,453	328	17,376
1990	2,900	1,177	--	131	17,920	8,638	1,605	655	28,949
Total				**1,556**	**207,585**	**88,277**	**47,791**	**14,776**	**359,955**
Avg.	**791**[b]			**54**	**7,158**	**3,044**	**1,648**	**509**	**12,413**
Percent of Total				**0.4%**	**57.7%**	**24.5%**	**13.3%**	**4.1%**	**100%**

[a] In 1989 and 1990 subsistence permits were mailed to all eligible applicants; in 1990 approximately 20% of the 2,900 (580) permits mailed were "returned to sender" by reason they were undeliverable--these names were removed from the list of permitees.

[b] Excludes data from 1989 and 1990 when subsistence permits were mailed to eligible applicants.

Table 6. Potential fish hatchery site in the Kodiak management area.

District	Bay	Site No.	Stream No.	Description/ salmon species
Northwest Kodiak	Viekoda	1	253-321	anadromous system pink and coho
Northwest Kodiak	Viekoda	2	253-322	anadromous system accessible to only coho stock
Northwest Kodiak	Uganik	1	253-XXX	nonanadromous stream inaccessible steep gradient
Northwest Kodiak	Uganik	2	253-133	intertidal cataract prevents anadromous access
Eastside Kodiak	Ugak	1	259-422	anadromous system natural pink stock

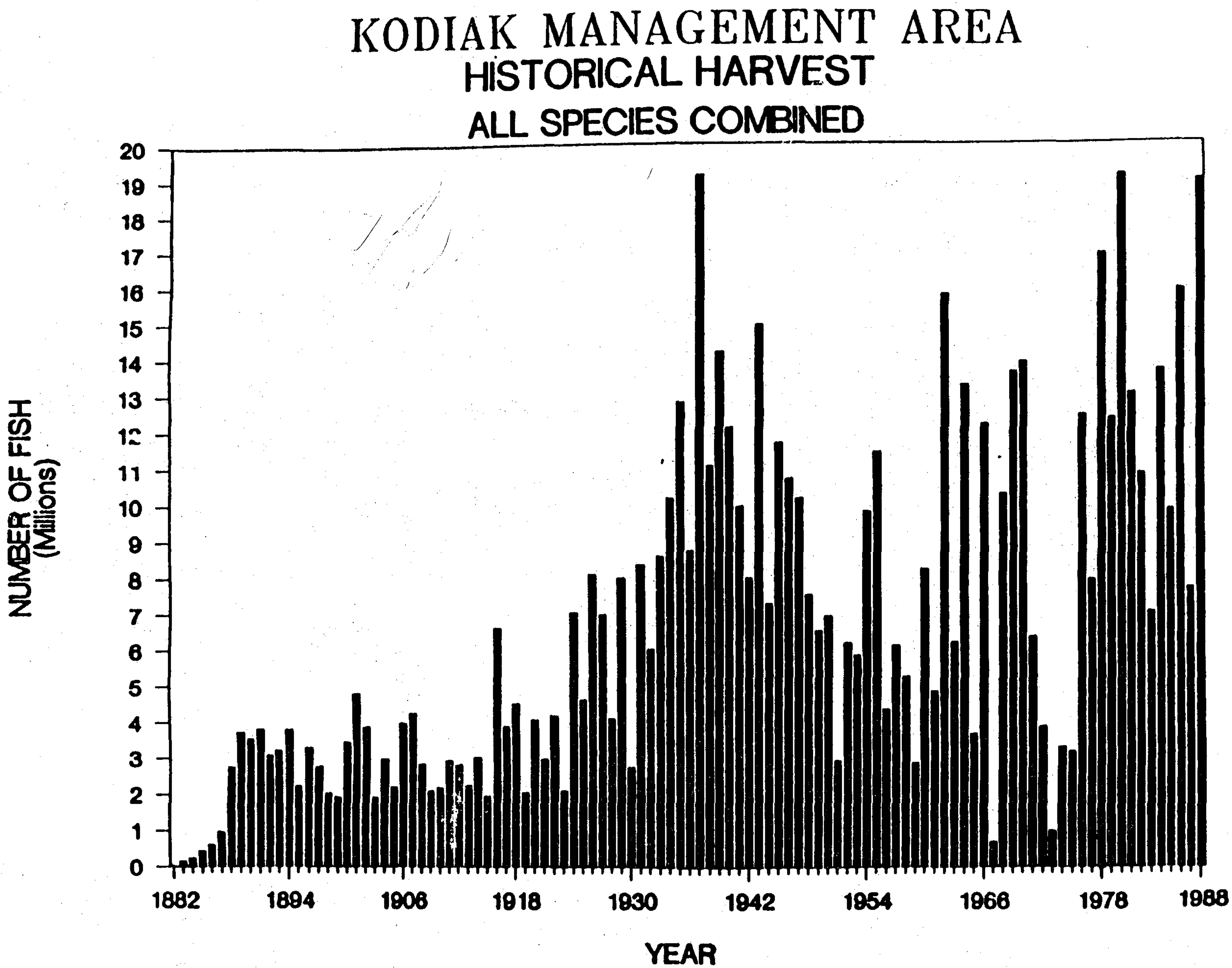

Figure 1. Historical harvest profile of all salmon species combined for the Kodiak area, 1982-1988.

APPENDIX B

PROJECT REVIEW CRITERIA
PHASE II PLANNING - KODIAK

FRED PROJECT REVIEW CRITERIA

FISHERY CONCERNS:

1. Is supplemental salmon production needed and desirable?

   a. What is the socioeconomic impact on local residents and fishermen?

   b. Do the public and user groups want a hatchery in that location?

   c. Will the hatchery fulfill a substantial portion of the region's 20-year salmon goals?

SITE LOCATIONS:

1. Can the hatchery be constructed?

   a. Is the land available for reasonable purchase or lease, and will the landowners consent to construction?

   b. What is the likelihood of site and construction permit applications being approved or disapproved.

   c. Is the site area suitable and of sufficient size for hatchery construction?

   d. Will the site require special biological and/or engineering studies and surveys (i.e., land, soil, water, and organisms)?

   e. Will the hatchery be compatible with existing and future development in the area (i.e., potential habitat conflicts)?

2. Can the hatchery be operated and maintained?

   a. How accessible and logistically difficult will the hatchery be to operate (i.e., access by road, air, or sea and distance from supply point)?

   b. Protected and deep water bay for vessel docking and supply?

   c. Winter access and supply problems (i.e., bay ice conditions)?

d. Is the beach suitable for amphibious aircraft and landing craft (i.e., surf and wind protection, tidal changes,beach slope, and stability)?

e. Can electrical and fueling requirements be met?

f. Can personnel (including families) and support service be provided?

g. Is the site capable of the type of hatchery (incubation and rearing systems) that would be needed?

3. Is the water supply adequate and suitable?

a. Adequate flow year around for intended operations?

b. Are water quality and seasonal temperature regimes suitable for intended operation?

c. Are exclusive water rights available, and can water quality be maintained to hatchery standards?

d. Are prime and secondary back-up water sources available?

e. Is gravity surface flow available, or will well field development and pumping be required?

f. What is the anticipated pipeline size, length, head, and route?

g. Anticipated hazards to the pipeline and intake?

h. Will future land/habitat uses conflict with quality or quantity of the water supply?

i. What is the probability of disease transmission in the water supply (i.e., virus shed by salmonids)?

4. Can brood fish be obtained and held?

a. Are local brood fish stocks available and in sufficient number at the right time?

b. Is brood fish disease history known, and are disease problems anticipated?

c. Are brood fish stocks genetically and biologically suitable and matched to hatchery water conditions (incubation and rearing schedules?

d. Can brood fish be protected from the fishery and held in estuary or other holding area for ripening?

5. Can hatchery fry production be reared?

   a. Is the estuary suitable for saltwater rearing pens (i.e., protected from seas, sufficient depth, salinities, temperature, fouling organisms, etc.)?

   b. Can rearing be accomplished with land-based facilities (water and facility requirements)?

6. What is the capacity of the estuary and bay for additional salmon rearing?

   a. Are food organisms abundant and available at time of release?

   b. Will abundance of predatory and competitor species severely limit survival of hatchery fish?

   c. Are estuarine and bay conditions suitable for good fry survival?

   d. Will hatchery fish displace or decrease wild salmon fry (compete and prey upon wild fry)?

7. Can adult returns of hatchery fish be readily evaluated?

   a. Will returning fish be mixed with other hatchery stocks and/or wild stocks?

   b. What type and quantity of evaluation effort will be required to assess hatchery operation and goal achievement?

<u>FEASIBILITY CONCERNS</u>:

Is the hatchery feasible?

1. Are cost/benefit ratios and Net Present Value (NPV) acceptable and justifiable?

2. Are there specific or special economic impacts, benefits, and costs involved?

3. If constructed, will the hatchery distract from other worthwhile or perhaps more feasible projects and facilities for the region?

CRITERIA FOR FISHPASSES

FISHERY CONCERNS:

Same as for hatcheries with the frequent addition of increased need for regulation enforcement in remote areas as a salmon run is increased and additional escapement is required.

SITE CONCERNS:

1. Can the fish pass be constructed?

Same as for hatcheries with additional engineering requirements on high and low water flows and velocity, rock competence and fracture zones (geomorphology), fishpass location (protection) and salmon entrance, and passage capability. Each site requires specialized studies to determine the best engineering design for a specific location and target species.

2. Can the fish pass be operated and maintained?

Many of the same criteria as for hatcheries, especially during the construction stage, but less restrictive and demanding once built.

Fish passes require only seasonal operation and maintenance before, during, and after salmon migration. Larger fishpasses with salmon diversion weirs and manual water control structures require manned operation. Smaller installations require only opening, maintenance, spot-checking operation, and end-of-season closure.

Manned facilities require construction, operation, and maintenance of field living quarters, equipment, and seasonal logistical support of personnel.

3. Is the water supply adequate and suitable?

Many of the same water quantity and quality concerns for hatcheries are also important for fishpasses. Fishpasses require adequate flow for efficient salmon attraction and passage. Salmon are attracted to the area of greatest flow. Falls close to a fishpass entrance will tend to attract salmon to the falls rather than the fishpass unless diversion weirs are operated.

High water flows are of more concern for fishpasses than most hatcheries. Fishpasses can be flooded-out by high flows or permanently damaged by debris and ice during floods. Weirs and other associated fishpass structures have a high risk of wash-out and damage by debris at a falls.

Low water flows require either self-controlling or manual water control diversion to the fishpass.

4. Will wild salmon naturally use the fishpass and establish upstream spawning?

Some systems and stocks will require a hatchery and fry or egg transplants to establish new spawning area. Brood-stocks, therefore, become a consideration for fishpasses, as well as for hatcheries.

Natural stock below the falls may be sufficient to extend spawning range and use the fishpass without assistance. Stocks that are genetically programmed to spawn downstream or in site-specific areas (i.e., intertidal pink salmon, chum salmon that spawn in spring areas, etc.) may be slow to use a fishpass or may not extend spawning range.

Increased escapements are usually necessary to increase salmon density below the fishpass and, in turn, increase range extension upstream and salmon passage. Salmon passage through a fishpass is to some extent density related.

5. Is the upstream spawning and rearing area adequate?

The quality and quantity of spawning and rearing area above the falls area needs to be assessed to determine potential production capability. Biological evaluation of egg-to-fry survival may be required as part of this assessment.

6. Will emigrant fry or smolts survive to reach salt water?

Fry and/or smolt survival at falls requires assessment. Substantial mortality might occur at high vertical drop-offs on underlying rock. A series of falls may have greater mortality risk than a single fall.

7. What is the capacity of the estuary and bay for additional salmon rearing?

Same considerations as for hatchery fish releases.

8. Can adult returns of fish produced by a fish pass project be readily evaluated?

Both escapement and catch assessment is required. Counts at the fishpass and on spawning areas, in addition to commercial catch information, are a minimum evaluation effort. Frequently, mark and recovery projects are needed. Evaluation concerns for fishpasses are the same as for hatcheries; further evaluation to improve fishpass effectiveness passage is often required.

FEASIBILITY CONCERNS:

1. Is the fishpass feasible?

Same as for hatcheries. Normally, benefits are high for dollars spent on fishpasses, but the return on investment is usually more limited than for a hatchery and may also take longer to realize.

SPORT FISH PROJECT REVIEW CRITERIA

1. Fishery Status
   - Is it a depressed fishery?
   - Has the fish population been decimated or eliminated?

2. Habitat Assessment
   - Lakes should be five acres in size or large, at least eight feet deep.
   - Predator/competitor concerns must be identified.
   - Available spawning area should be identified/estimated.
   - Water quality characteristics.
     - D.O., Temp., Alkalinity, Conductivity
     - Morphodaphic Index-richer lakes are stocked prior to poorer lakes.

3. Access
   - Will it create new fisheries (has to have the potential)?
   - Accessible to the fishing public, anything you can hike to from the Kodiak road system within two hours would be a priority over fly-in.

4. Effect on Management
   - New sport fish projects should not complicate commercial fisheries management plans.

5. Lake Stocking Guidelines
   - ADF&G guidelines should be adhered to with any new projects.

6. Genetics Consideration
   - Donor stocks would have to be taken from as close to the area as possible.

COMMERCIAL FISHERIES PROJECT REVIEW CRITERIA

Regarding supplemental production (enhancement):

1. What are the potential effects on management plans with the placement of a hatchery?

2. What effects will the proposed production, by species, have on present management schemes?

3. What effects will the hatchery stocks (and their harvest) have on natural stocks in the area?

4. Can returns be harvested to provide "significant" common property benefits in traditional fisheries?

5. Is there an adequate terminal area where new fisheries could be created to affect the desired common property benefit?

6. Does the hatchery as proposed allow for the continued protection of natural stocks?

   a. Can management or harvest strategies be developed to allow harvest or enhanced returns while protecting natural stocks?

   b. Is there a segregated area for hatchery harvest that will provide adequate cost recovery without impacting wild stocks?

   c. Does the affected wild stock actually or potentially support a commercial, sport, and/or subsistence fishery?

   d. Does the affected stock have unique characteristics or are there special circumstances (e.g., an unique early run of coho)?

   e. What is the degree of risk and the probable degree of loss to the natural stocks?

7. Does the hatchery proposal make the most appropriate use of the site's potential?

Ref./File#: ________
Date: ______________

KODIAK REGIONAL PLANNING TEAM

FISHERIES REHABILITATION AND/OR ENHANCEMENT
NEW PROJECT SOLICITATION FORM

This form is to be used by Fish and Game and other government agency personnel and the public to identify opportunities that may be worthy to pursue to help rehabilitate and/or enhance the fisheries.

PROJECT DESCRIPTION:

1. WHAT: (Give a brief description of the project):

2. WHERE (be specific as to project location):

3. BENEFITS TO USER GROUPS:

4. COST ESTIMATE OF PROJECT (IF KNOWN):

____

____

____

____

____

____

5. SUBMITTED BY:

Name: ______________________ Date: ______________

Address: ____________________ Phone: _____________

____________________________ Occupation: __________

6. ADF&G COMMENTS:

____

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7. COMMERCIAL FISH MANAGEMENT COMMENTS:

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8. SPORT FISH MANAGEMENT COMMENTS:

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9. HABITAT PROTECTION COMMENTS:

10. FRED MANAGEMENT COMMENTS:

11. REMARKS:

Ref./File #:_______
Date:_______________

POTENTIAL PROJECT VERIFICATION FORM

NAME:___________________________________ Date:_______________

LATITUDE:_______________________________ SURVEYED BY:_____________

LONGITUDE:____GE

ODETIC MAP NO:____

LOCATION:____AE

RIAL SURVEY

NOTES:____

____

TRAILS:____

____

PROJECT WILL PRIMARILY BENEFIT:________________________________

____

AVAILABLE ESCAPEMENT DATA:

Year	Pink	Chum	Coho	Sockeye	King	Steelhead

____Other Species Present:____

____

____

APPENDIX C

Elements of the Benefit/Cost Analysis

Steps for undertaking the projects identified in this plan will incorporate variables such as the facilities and equipment, cost of operations, and the financing.

Feasibility of a Project

In determining the feasibility of a project, the team may consider the four following questions:

1. Are benefit/cost ratios and Net Present Value acceptable?
2. What special economic impacts, benefits, and costs are involved?
3. If a hatchery or other facility is constructed, will it detract from other more worthwhile projects in the region?
4. Will the cost for an annual hatchery or other facility operation and maintenance decrease funding available for other projects in the region?

Costing a Project

The cost of a project can generally be segregated into three major categories, depending upon the nature and the scope of the task. These are as follows:

Facility and Equipment:

- Site section, including studies of alternative areas.
- Site acquisition.
- Construction costs, including planning fees.
- Equipment acquisition.

Operations:

- Cost of labor, utilities, fish feed, personnel, and maintenance costs.
- Administrative.
- Project evaluation costs.

Financing:

- Available funding sources.

- Current interest rates.

Economic benefits to most groups directly affected by specific projects are easier to identify. However, the benefits of an enhanced fishery to sport and personal use fishermen are, again, very subjective and therefore difficult to assign a dollar value. The dollar impact to this group may not vary significantly from project to project and, when compared to the total economic benefit/cost ratio, will not have a significant effect on the overall analysis.

Economic Benefits to Commercial Fishermen and Processors

The economic benefits to these two groups can be expressed in dollar terms throughout the analysis of two major components; the anticipated increase product available for catch and the dollar value of the catch increase. Regardless of the nature of the project, however, the amount of product available depends on the annual adult salmon rate of return and the annual catch rate, expressed in terms of pounds of product.

Variables to Consider in Determining the Product Value

The value of the caught product includes a scrutiny of the following variables:

1. Type of product;

2. Anticipated market price, including the effect of world supply and demand on the market price; and

3. Cost of catching and processing the product.

In order to prepare a benefit/cost analysis for hatchery stock development, a form is available from ADF&G which provides in detail the variables required to determine the quantity of catchable product, value of the catch, impact multipliers, and cost information relating the development of fish hatcheries. For further information, contact ADF&G, FRED Division in Kodiak.

APPENDIX D

LIST OF TERMS

ADF&G - Alaska Department of Fish and Game

allocation - To apportion, through regulation, salmon harvest to various user groups (i.e., subsistence, sport, or commercial fishermen).

aquaculture - Culture of husbandry of salmon (or other aquatic fauna/flora).

brood stock - Salmon contributing eggs and milt for supplemental culture purposes.

commissioner - Principal Executive Officer of the Alaska Department of Fish and Game.

commissioner approval - Formal acceptance of a salmon development plan or other RPT products by the Commissioner.

comprehensive salmon production plan - A statutory-mandated, strategic plan, spanning 20 years, for perpetuation and increase of salmon resources on a regional basis.

criteria - Accepted measures or rules for evaluation of program and project proposals and operations.

depressed stock - A stock which is currently producing at levels far below its historical levels.

enhancement - Strategy designed to supplement the harvest of naturally produced salmon species by using artificial or semi-artificial production systems or to increase the amount of productive natural habitat. Procedures applied to a salmon stock to supplement the numbers of harvestable fish to a level beyond what could be naturally produced. This can be accomplished by artificial or semi-artificial production systems. It can also be an increase of the amount of productive habitat in the natural environment through physical or chemical changes.

escapement - Salmon which pass through the fisheries to return upstream to a spawning ground or used as broodstock in a hatchery.

ex-vessel price - Price paid to the commercial fishermen for their catch.

eyed egg - The stage in which pigmentation of the eyes of the embryo becomes visible.

fecundity - The number of eggs per adult female salmon (or other fish).

fingerling - The stage of salmon life between fry and smolt.

fishpass - A fish ladder to enable salmon to get past a barrier to reach spawning grounds.

five-year action plan - The section of phase II planning that recommends projects for implementation within the next five years.

FRED - Division of Fisheries Rehabilitation, Enhancement and Development, Alaska Department of Fish and Game.

fry - The stage of salmon life from emergence from gravel until it doubles its emergence weight.

goals - Broad statements of what the Planning Team, with input from the user groups, hopes to see accomplished within the 20-year life of the plan.

green egg - The stage of salmon egg development form ovulation until the eye becomes visible, at which time it becomes an eyed egg.

incidental catch - Harvest of a salmon species other than the desired species from which the fishery is managed. Fish of another species and/or stock caught during harvest of specific species and/or stock.

instream incubator - A device, located adjacent to a stream, that collects water from the stream and is used to incubate and hatch salmon or trout eggs.

mixed stock fishery - Harvest of salmon at a location and time during which several stocks are intermingled. Harvest of more than one stock at a given location and/or period.

natural production - Salmon which spawn, hatch, and rear without human intervention (i.e., in a natural stream environment).

phase II plan - An analytical document or process that addresses salmon production development by geographic unit, project, and site and makes recommendations concerning both long- and short-range opportunities (usually 20-year and 5-year timeframes).

plan (The Plan) - Comprehensive Salmon Plan.

plan amendment - Analyzing and evaluating a planning document with the option of changing the plan.

plan content outline - A document that defines topics and gives guidance and shape to comprehensive salmon plans.

plan development - Composing, drafting, revising, and finalizing a planning document.

plan maintenance - Process through which the RPT reviews and comments on existing plans to preserve, continue, and expedite planned salmon production.

plan update - The process and results of RPT review and changes of a plan document.

PNP - Private nonprofit: level and/or operational status of a private sector organization without profit motives.

present condition - the average catch for the last five years.

private nonprofit hatchery permit application - A request presented by a private nonprofit corporation to the Department of Fish and Game for a permit to operate a private nonprofit hatchery.

private sector - That group active in salmon resource development which is not employed by government.

production - Perpetuation or increase of the salmon resource through maintenance, rehabilitation, or enhancement programs and techniques. The comprehensive salmon plan addresses stock perpetuation and increase through appropriate balance and integration of program and techniques within reason.

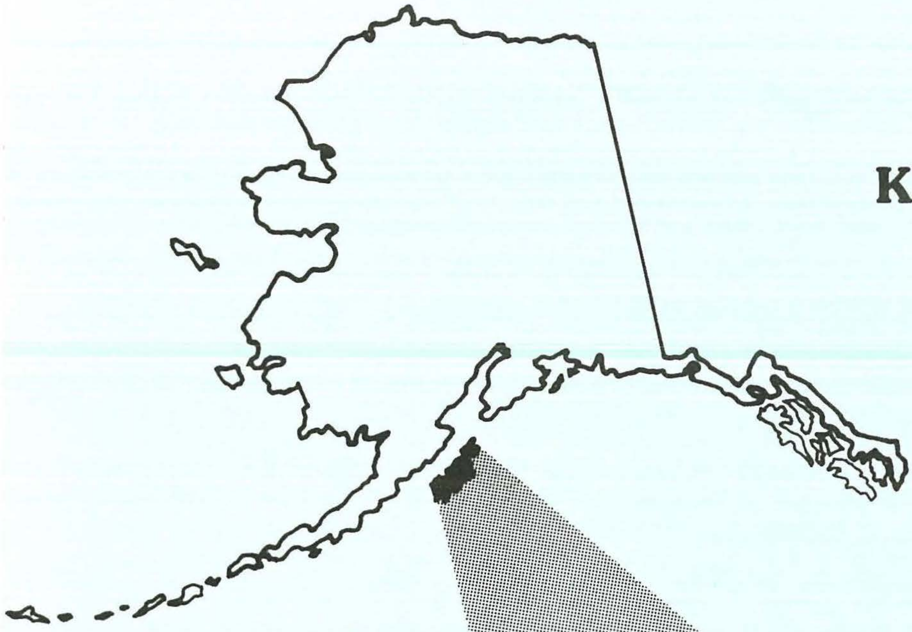
project - A unit of work having a beginning, middle, and end that functions according to defined performance criteria.

projected status - Continuation of the present condition without additional supplemental production.

public sector - That group active in salmon resource development that is employed by government.

recent 22-year average - The historical catch for the years 1970-1991 (see Appendix A, Table 1, page 42).

regional aquaculture association (RAA) - A statutory-based nonprofit corporation comprised of representatives of fisheries user groups organized for the purpose of producing salmon.



Developed By
KODIAK REGIONAL PLANNING TEAM

KODIAK REGIONAL COMPREHENSIVE SALMON PLAN

1982 - 2002

16.4.1

KODIAK REGIONAL COMPREHENSIVE SALMON PLAN

1982 - 2002

KODIAK REGIONAL PLANNING TEAM

STATE OF ALASKA

BILL SHEFFIELD, GOVERNOR

DEPARTMENT OF FISH AND GAME

OFFICE OF THE COMMISSIONER

P.O. BOX 3-2000
JUNEAU, ALASKA 99802
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April 13, 1984

Mr. Hank Eaton
Chairman
Kodiak Regional Planning Team
Box 1423
Kodiak, AK 99615

Dear Mr. Eaton:

This letter is to inform the members of the Kodiak Regional Planning Team (KRPT) and you, as the chairman, of my formal approval of the final draft of the Kodiak Regional Comprehensive Salmon Plan, 1982-2002.

Prior to the submittal of the plan for my consideration, I have been informed that it was subject to a public review and comment period which was extended to allow additional time for comment. A review by the Alaska Department of Fish and Game (ADF&G) technical staff was also conducted simultaneously. Since then, the plan has undergone a process of review and comment by all division directors within ADF&G who are responsible for managing, enhancing, and protecting Alaska's fishery and its habitat.

I am confident that the KRPT has been responsive to the comments and suggestions resulting from the reviews mentioned above.

Based on the efforts of the KRPT in preparing the plan and comments I have received on the quality of these efforts, I believe that a viable and responsible document has been produced.

I offer my congratulations and appreciation to you and all members of the team for cooperating with the department and me in producing a comprehensive salmon plan for the Kodiak region.

Sincerely,

Don W. Collinsworth

Don W. Collinsworth
Commissioner

cc: Members, KRPT
ADF&G Division Directors

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SECTION 1.0

INTRODUCTION TO THE PLAN

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1.0 INTRODUCTION TO THE PLAN

1.0 INTRODUCTION TO THE PLAN

1.1 INTRODUCTION

This document is the comprehensive plan for the management, rehabilitation, and enhancement of the Kodiak Region's salmon resources during the next twenty years.

This introductory section discusses the history of legislation for the management, rehabilitation, and enhancement of the salmon fishery, outlines the geographical area of interest, describes the formation of the fishermen in the Kodiak Region into a Regional Aquaculture Association, and describes the work of the Regional Planning Team in preparing this document.

1.1.1 Legislative Background

The salmon in the State of Alaska are a valuable resource. Due to fluctuations in the salmon fisheries in the 1960s, the State Legislature in 1971 recognized that action was required to rehabilitate and enhance the state's salmon fishery. On this basis, it created the Division of Fisheries Rehabilitation, Enhancement and Development (F.R.E.D.). One of the major responsibilities of this division of the Alaska Department of Fish and Game (ADF&G) is to "develop and continually maintain a comprehensive, coordinated state (regional) plan for the orderly present and long-range rehabilitation, enhancement and development of all aspects of the state's fisheries for the perpetual use, benefit and enjoyment of all citizens and to revise and update this plan annually."

Recognizing the need for private sector involvement in the rehabilitation and enhancement efforts, the legislature, in 1974, passed the private non-profit (PNP) hatchery statutes (AS 16.10.375.550). It was the intent of the act to "... authorize the private ownership of salmon hatcheries by qualified non-profit corporations for the purpose of contributing by artificial means to the rehabilitation of the state's depleted and depressed salmon fishery."

In 1977, the legislature concluded that it was important to gain regional input from organized fishermen's groups and the public. Therefore, it amended AS 16.10.375 to recognize the importance of regional planning. A portion of the statute states, "Subject to plan approval by the Commissioner, comprehensive salmon plans shall be developed by Regional Planning Teams consisting of department personnel and representatives of the appropriate qualified regional associations formed under Section 380 of this chapter."

1.1.2 Kodiak Regional Aquaculture Association

In 1982, the Kodiak Fisheries Advisory Committee concluded that it was important that a comprehensive regional salmon plan be developed for the Kodiak Region and that a qualified regional aquaculture association be formed. This request was implemented by ADF&G and approved by the legislature in the form of a $100,000 planning grant to be administered by the F.R.E.D. Division. The purpose of the grant was to develop a comprehensive regional salmon plan and to form a regional aquaculture association. The formation of the regional aquaculture association began in late 1982 and concluded with a formal request for certification being forwarded to the Commissioner of the Alaska Department of Fish and Game in May, 1983. The association drafted its by-laws, elected a nine-member Board of Directors, and participated in the review of the draft comprehensive salmon plan.

1.1.3 Geographic Area of Interest

While the characteristics of the Kodiak Region will be discussed in much greater detail in the following chapters, certain features of its location and characteristics need to be mentioned to set an appropriate context for review of the plan.

The Kodiak Region consists of the entire Kodiak management area, which includes the Kodiak Island Archipelago and the south and east slopes of the Alaska Peninsula from Cape Douglas, at the beginning of Shelikof Strait, to the southern entrance of Imuya Bay near Kilokak Rocks.

1.1.4 The Regional Planning Team (RPT)

In 1982, the Kodiak Advisory Committee appointed three members to the Kodiak Regional Planning Team. The RPT has six voting members, three representing the Kodiak public and three representing the Alaska Department of Fish and Game. Public members of the RPT are: Chairman, Hank Eaton, Kodiak; Don Vinberg, Kodiak; Leon Francisco, Kodiak. ADF&G members of the RPT are: Paul Pedersen, Commercial Fisheries Division; Pete Murray, Sport Fish Division; Roger Blackett, F.R.E.D. Division. All ADF&G representatives are from the Kodiak office. Other ADF&G participants are Lonnie White, Tim Joyce, Ken Manthey of the Kodiak office and Jerry Madden and Kevin Duffy from the private non-profit office in Juneau. To facilitate the planning process, a consultant, Leonard Lane Associates, Inc., was hired by the F.R.E.D. Division of the Alaska Department of Fish and Game. It was the consultant's responsibility to coordinate all planning activities and serve as the principal writer of the plan.

Meetings were held by the team on a regular basis. These team meetings were also attended by additional members of the Alaska Department of Fish and Game's Kodiak Regional Office. Public involvement in the planning process was formally handled through the efforts of the RPT. The Kodiak Regional Aquaculture Association was formed during the latter stages of the planning process and participated in the review of this draft plan. It is anticipated that the second phase of the planning process will continue under the auspices of the Kodiak Regional Aquaculture Association. The association will be responsible for appointing the public members to the RPT.

1.2 APPROACH TO THE PLAN

The comprehensive salmon plan for the Kodiak Region is being developed in two phases. Phase I of the planning process, which is represented by this document, is the creation of a long-range plan. This plan sets a framework for a Phase II Plan which will develop specific projects. The Phase I Plan includes a review of all relevant information regarding the salmon fishery in the Kodiak Region. This information is contained in historical records and in on-going data developed primarily by the Alaska Department of Fish and Game. The data were synthesized and analyzed in order to establish the status of the fishery.

Based upon the status of the fishery and a combination of both natural runs and current supplemental production, the RPT estimated the demands that would be placed on the resource during the life of the plan. They were able to develop goals and objectives required to fill the "gap" between what would be produced through natural runs and current supplemental production and what the RPT felt would be required to support the future demands on the fishery.

The plan is intended to undergo constant modifications during its life span as objectives are achieved or deemed unattainable. Additionally, technological advances in fisheries fields will provide new opportunities for the rehabilitation and enhancement of the salmon resource.

1.3 PUBLIC PARTICIPATION

Public participation in the planning process was part of the plan development through the structure of the planning team, use of a questionnaire, and finally, public comment on this draft plan.

The public members of the RPT were individuals nominated at a meeting of the Kodiak Fisheries Advisory Committee. These individuals have a long history of fishing activity in the region. They also represented a diversity in the major gear groups.

The RPT developed a questionnaire which was distributed to all user groups. The numerical results obtained from the questionnaire are contained in Appendix IV along with a copy of the questionnaire. Trends which were developed from the data are contained in Section 4 of the plan.

This is the public review draft of the plan. Comments will be reviewed, and appropriate action regarding changes in the plan will be discussed and taken into account by the RPT when they develop the final draft.

1.4 APPROVAL AND AUTHORITY OF THE PLAN

The responsibility for and authority to develop the plan is vested by the Commissioner of Fish and Game in the RPT. The RPT is directly responsible for developing the draft plan and soliciting public input.

The draft will then be revised accordingly and forwarded to the Commissioner of the Alaska Department of Fish and Game for review and approval. Upon approval by the Commissioner, the plan will be printed in final form and transmitted to the legislature. Once this is completed, the plan will become the official guideline for salmon enhancement and rehabilitation efforts in the Kodiak Region.

1.5 EFFECTIVE LIFE OF THE PLAN

To develop a meaningful plan it is necessary to identify a period of time that serves as a framework within which specific targets can be set. The general guidelines for this planning effort indicate that the plan should address a period of from 18 to 22 years. The RPT selected a period of 21 years, covering the last two decades of this century, 1982 through 2002.

It is possible within this time framework to:

(1) complete a single action,
(2) complete a series of dependent actions, and/or
(3) initiate an action which may not be complete before the termination of the 21-year period.

It should be emphasized that the plan is a living document which is expected to undergo modifications during its "life span." These adjustments cannot be unilateral. Rather, they must arise from the same organized and cooperative effort that created this document. Therefore, the plan is the initial effort in a general planning approach which will continue indefinitely.

1.6 ASSUMPTIONS

Certain assumptions have governed the development of the plan and are essential to the accurate understanding of its contents.

1. The plan uses the best data available and the most accepted interpretation of that information.

2. The plan assumes a regular, if not constant, reassessment of information and requirements and the subsequent modification of plan elements.

3. The plan assumes the continuation of close cooperation between the user groups and the state toward the end of providing an optimum sustainable harvest of the salmon resource.

4. The team feels that there will be more fishing pressure on the amount of available fish due to:

   (a) More efficient harvest and processing techniques.

   (b) A strong feeling that fishermen will want a reasonable net profit on a sustained basis.

5. Prices will continue to fluctuate during the plan period.

6. Economic viability must be maintained. In order to maintain the economic viability of the fishing industry in Kodiak, the amount of harvestable fish will have to increase as follows:

   (a) Pink Salmon: An increase to 18,500,000 fish in an even year and 13,500,000 fish in an odd year by the year 2002.

   (b) Sockeye Salmon: An increase to 1.9 million harvestable fish by the year 2002.

(c) Chum Salmon: An increase to 2 million harvestable fish by the year 2002.

(d) Coho Salmon: An increase to 507,000 harvestable fish by the year 2002.

(e) Chinook Salmon: An increase to 7,000 harvestable fish by the year 2002.

7. In order to achieve the Target 2002 status for natural runs, the RPT assumed within ± 20 percent that the factors affecting survival will remain approximately the same as those for the previous 5-year period. (For planning purposes this period was deemed to be more representative than the previous 10-year and 20-year periods.)

8. The market will show a continued increase in the amount of frozen product and a decrease in the amount of canned product.

9. There will be a continued trend toward vertical integration in the industry, i.e., fishermen owning the cannery for which they fish, thereby affecting prices and demand.

10. Land status will affect enhancement efforts over the plan period primarily due to Native Land Claims Settlements and the prohibition of construction and operation in the Kodiak Wildlife Refuge area.

11. Alaska marketing and processing techniques will need to be revised in order to compete in the world market in terms of quality of product. It is assumed that processors and fishermen will concentrate on quality.

12. There will be continuing oil exploration activities in the region that may affect the salmon fishery.

13. There is a strong possibility of more private hatcheries being developed in the region, provided early attempts are successful.

14. Markets will continue to be analyzed, and the return on investment data will be compared against the cost of building enhancement facilities and rehabilitation projects.

15. Public funds for rehabilitation and enhancement, as well as construction in the public and private sector, will be decreasing. Additionally, existing facilities may not continue to be operated by the State. However, an exception could be state loans made to viable private non-profit associations that can show a return on their investment.

16. There will continue to be a limited entry program that can withstand the test of the courts. While there may be a slight increase in the number of permits, it will not be significant.

17. The "Alaska limit", in terms of size of boats, will be retained for the Kodiak fleet.

18. Management and regulation will be a mitigating factor on how much of the resource can be harvested.

19. Sport fish harvest effort will increase due to an increase in anglers and improved angler access.

20. Processor capacity will continue to increase with the expected increased harvests.

21. Subsistence and personal use fisheries will continue to increase in terms of specific species in specific areas.

With the context of the development of the plan thus established, Chapter 2 will explore the conditions which prevail in the region as they relate to the present condition of the salmon resource and the potential of this resource.

SECTION 2.0

REGIONAL PROFILES

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2.0 REGIONAL PROFILE

2.1 PROJECT LOCATION

The Kodiak Region includes the Kodiak Island Archipelago and the south and east slopes of the Alaska Peninsula from Cape Douglas, at the beginning of Shelikof Strait, to the southern entrance of Imuya Bay near Kilokak Rocks. The Kodiak Island Archipelago includes Kodiak, Afognak, Raspberry Islands, and the smaller outlying islands.

The Kodiak Archipelago is within the boundaries of the Kodiak Island Borough. The land area within the borough is approximately 4,900 square miles, with Kodiak Island, the largest island in the state, accounting for about 3,600 square miles of the total.

The majority of the Alaska Peninsula portion of the region bordering Shelikof Strait is not within an organized borough. A small section near Cape Douglas is located in the Kenai Peninsula Borough.

The Kodiak Region, as defined for the plan, coincides with the Kodiak ADF&G Commercial Fish Management area for salmon.

2.2 OVERVIEW OF THE NATURAL ENVIRONMENT

Within this section, those elements of the natural environment which exhibit clear and potentially significant relationships to one or more phases in the annual life cycle of the salmon of the Kodiak-Shelikof Strait area, will be highlighted.

2.2.1 Kodiak Archipelago/Alaska Peninsula

The Kodiak Region is part of the south central region of Alaska which includes many areas draining into the Gulf of Alaska. The Kodiak Archipelago is separated from the Alaska Peninsula by Shelikof Strait.

Kodiak Island is the largest island in the state and it has approximately 900 miles of coastline. The coastline of the archipelago facing the Gulf of Alaska, is extremely irregular with many islands and fjords which have branching arms. Chiniak Bay has several offshore islands which protect the Municipality of Kodiak from direct impact from the Gulf's storms. Ugak and Kiliuda Bays also indent the coastline. Sitkalidak Island is the largest island on this outer coast. The southwestern coast is relatively smooth with only Alitak Bay indenting Kodiak Island.

The northwest side of the island along Shelikof Strait is characterized by the long narrow fjords, Uyak, Spiridon, Uganik and Viekoda Bays. It is on this northern shore that the Karluk River, once considered North America's most productive salmon river, empties into the strait.

Afognak Island is located northeast of Kodiak Island. Its eastern shore is separated from Shuyak Island by Shuyak Strait. Major bays are Kazakof (Danger) Izhut, Tonki, Perenosa, Foul, Paramanof, Malina, and Afognak Bays. Between Kodiak and Afognak Islands lie a number of smaller islands, the largest of which is Raspberry Island. Kupreanof Strait separates the Raspberry Islands and Kodiak Island. Whale Pass and Shuyak Strait are known for their strong tide currents.

The portion of the Alaska Peninsula along Shelikof Strait is a rugged, diversified area of narrow, steep-walled fjords, gently curving bays, wide and long beaches and intricate coves. The ice-shrouded Aleutian Range rises from the coast to elevations exceeding 4,000 feet, and numerous glaciers may be found in the area. The coastline north of Hallo Bay continues in a large sweeping arc that includes the eastern most promontory of the Alaska Peninsula, Cape Douglas. Major bays from north to south are Hallo, Kukak, Kaflia, Kuliak, Missak, Kinak, Amalik, Dakavak, Katmai, and Kasvik. All of these are in the Katmai National Monument. Major bays from south of the monument are Alinchak, Puale, Portage, Wide, and Imuya Bays.

2.2.2 Major Mountain Systems

Two mountain ranges define the watersheds of the Kodiak Region. The Aleutian Range dominates the southern coast of the Alaska Peninsula. Rounded ridges rise from 1,000 to 4,000 feet in altitude, creating an abrupt and rugged coastline. The drainage divide between the Bering Sea and the Pacific Ocean is generally within ten miles of the southern coastline along the highest ridges.

The Kodiak Mountains form the Kodiak Archipelago. Kodiak Island has a rugged northeast-trending divide with summit altitudes between 2,000 and 4,000 feet. Afognak Island has its highest elevations (2,400 feet) on the northern side. Much of the island is mountainous. Only a few icy remnants of past glacial systems remain on the archipelago and do not contribute significantly to the drainage systems. However, on the Alaska Peninsula portion of the region, large areas of the upper zones are covered by snow fields and glaciers.

2.2.3 Surface Waters

Major river systems, creeks, and lakes are considered from two perspectives: their roles in the hydrology of the Kodiak Region drainage basins and their roles in the annual production of salmon. This section deals only with physical aspects and later sections will examine salmon support capacities.

The Kodiak Region contains at least 335 streams that produce anadromous fish. Kodiak Island has at least

1,000 lakes of four hectares or larger and has 299 known anadromous streams.[1] Afognak Island has many fish producing lakes. On the Alaska Peninsula portion of the region, there are many streams. Some of these systems have important lakes.

Streams in this region are typically short and often fairly steep. On the Kodiak Archipelago most rivers flow in fairly direct courses from the higher ridges to the nearest bays. Therefore, drainage systems are relatively simple and of small area. These small watersheds, when precipitation is heavy, cause localized flooding of short duration.

On Kodiak Island, streams are mostly swift, clear, and less than ten miles long. Major rivers are the Karluk, Ayakulik (Red River), and Dog Salmon Rivers. Karluk Lake (12 miles long and one mile wide) is the largest lake on the island. Other large lakes are South Olga Lakes (Upper Station), Akalura, Red, Frazer, Spiridon, and Uganik Lakes.

On Afognak streams are also short, and the major ones drain lakes such as Afognak, Big Kitoi, Laura, Pauls, Upper and Lower Malina and Portage Lakes.

On the Alaska Peninsula, small, single lakes and streams constitute many separate drainages. Dakavak Lake is the largest lake draining into Shelikof Strait. The Swikshak River, a braided system, is the only major drainage whose headwaters are in the Kenai Peninsula Borough. Other streams, which are extensively braided

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1 Van Hulle, Frank and John B. Murray, "Sport Fish Investigations of Alaska, Inventory and Cataloging." Vol. 19. July 1, 1977 to June 30, 1978. Sport Fish Division, Alaska Department of Fish and Game.

and have unstable beds, are the Katmai, Big, Ninagiak Rivers and Hallo, Soluka, and Kialagvik Creeks. The area also contains many unnamed streams.

2.2.4 Climate

The climate within the Kodiak Region is maritime and influenced by the warm Japanese current which swings along the Alaskan coast. Temperatures are mild with wet, cool summers and relatively warm winters. Snow occurs during winter months, however, snow depths are not usually excessive at low elevations.

Meteorological records since 1956 indicate appreciable variation in yearly precipitation throughout the Kodiak Archipelago. Average annual rain fall is approximately 56.41 inches in Kodiak City. However, records also tend to indicate a general persistence of an east-west precipitation gradient with maximum precipitation concentrated near Shearwater Bay along the Pacific coast of Kodiak Island and minimum precipatation on the Shelikof Strait side near Larsen Bay and the Karluk River. The total monthly precipitation is fairly uniform throughout the year, although intensive storms in the Gulf of Alaska during the fall can bring prolonged and heavy rain. Sustained extreme wind speeds range from 50 to 75 knots. Gusts as high as 100 knots are also experienced. Frequency of fog is approximately 10% of the time in the Kodiak Archipelago.

Table 2.2-1 provides weather information for selected sites within the Kodiak Region.

Table 2.2-1:

CLIMATE DATA - KODIAK CITY

Month	Temperature °F Average	High	Low	Precipitation in Inches Average	Min.	Max.
January	30.4	54	-8	5.01	0.24	15.77
February	31.4	56	-12	4.59	1.41	12.43
March	32.1	57	-6	3.85	1.36	8.12
April	36.9	64	7	3.81	1.13	6.15
May	43.2	80	20	4.35	1.00	11.89
June	49.7	86	30	4.12	1.42	11.78
July	54.1	82	37	3.54	1.01	8.09
August	54.9	83	36	4.30	1.68	11.13
September	50.0	71	26	6.11	1.20	12.60
October	40.7	61	10	6.29	1.56	14.53
November	34.8	54	0	5.41	0.19	14.79
December	29.9	54	-1	5.03	1.21	12.19
TOTAL PRECIPITATION IN INCHES:				56.41	13.41	139.47

U.S. National Climate Center, NOAA, 1982.

2.2.5 Seismicity and Volcanism

The Kodiak Region is situated on the edge of the North Pacific Plate, a zone of tremendous seismic activity which encircles the Pacific Ocean. The southern Alaska Peninsula, adjoining the Aleutian Chain and the Kodiak Archipelago, constitute one of the most active seismic areas in the world. During Russian times, settlements at Three Saints Bay were destroyed by tsunami and earthquakes in 1788 and 1792. Since 1867 there have been at least two dozen major earthquakes and in the 20th century two reported tsunami. The historic 1964 earthquake and resultant tsunami completely destroyed Kaguyak and Old Harbor, while heavy damage was suffered in Kodiak, Afognak, Ouzinkie and several other coastal villages.

The subsidence and uplift, which is associated with the more severe of these events, can make dramatic and long term changes in the land forms and, therefore, in the character of the related surface waters. It is safe to assume that seismic activities will continue to occur with some regularity and that the results will be locally important.

Another facet of this physically active region is the presence of volcanos along the southern Alaska Peninsula. Eleven volcanic centers are found in the Kodiak Region of the peninsula. Five have probably had no historic activity. The Katmai volcanos have been included in a national monument. An explosive eruption from Mount Katmai, with vast pumice and ash deposits, caused extensive damage to buildings and crops on the Kodiak Archipelago in 1912. This pumice and ash had an effect on many salmon streams of Afognak Island and the northern portion of Kodiak Island. During the last sixty years, lava flows have occurred at Novarupta in

1912 and five times from Mount Trident since 1953. Nineteen recorded eruptions have occurred on Mount Katmai, Novarupta, Mount Mageck, and Mount Martin since 1912.

Volcanic activity could occur at any time. Eruptions of large magnitudes could have very significant impacts on the southern Alaska Peninsula, as well as areas of the Kodiak Archipelago.

2.2.6 Geology and Soils

The geology and soils are complexly interwoven and play a part in stream characteristics. In the mountainous areas of the Kodiak Archipelago a combination of high precipitation, steep topography, considerable exposed bedrock, a lack of aquifers, and thin soils causes runoff to be almost the highest in the state. However, on the lowlands, major streams transport water across relatively porous and permeable glacial and alluvial sediments where water is lost by seepage, consequently recharging the ground water system.

Turbidity of stream water can be the result of glacial flour from glacial abrasion. Many streams, which originate from glaciers on the peninsula portion, are silt laden, however, on the Kodiak Archipelago very few streams are so affected. Some sands, silts, clays, and volcanic ash can be picked up during flood stages and transported by a stream. Ash deposits on the archipelago and on the peninsula are a predominant surface feature over most of the slopes and valleys. In bog areas, water may become high in organic content, acidity and color levels. This brown water can significantly inhibit light penetration.

Oil and gas seeps have been recognized on the southern Alaska Peninsula. Studies do not rule out the possibilities of producing oil, however volcanic activity makes this area less conducive to petroleum development.[2]

2.2.7 Wildlife

The Kodiak Region is unique in its wildlife, especially on the Kodiak Archipelago. Brown bear, weasel, fox, and land otter are native to the islands. Black bear, wolves, wolverines, moose, and barren ground caribou do not inhabit Kodiak Island. Successful transplants of beaver, Sitka black-tailed deer, Roosevelt elk, and mountain goat have been made to the archipelago. A small number of Dall sheep, after an initial transplant, still exist. Feral reindeer occur on Kodiak Island.

On the Alaska Peninsula wolves, fur bearing animals such as beavers, river otter, red and arctic fox, and lynx are found. There are no Sitka black-tailed deer, Dall sheep, elk, nor mountain goat on the southern Alaska Peninsula. Barren ground caribou and moose use the north side of the peninsula more than the Pacific side. The coast is inhabited by several species of marine mammals. The wolverine has been identified by the Bureau of Sports Fish and Wildlife as being an endangered species, needing protection within the Katmai National Monument.

Many of these species are significant as game species and are sought in sport and subsistence hunting. This results in regular access to some areas of the watersheds.

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2 U.S. Department of Interior, "Proposed Katmai National Park Final Environmental Statement", 1974, (page 47).

Other wildlife such as birds and smaller terrestrial mammals occur in the region. Some of the wildlife species use streams and lakes as significant parts of their habitat requirements. In this context they influence the habitat of the stream or lake and may act directly on the salmon resources. This interaction with salmon resources may be as direct as the predatory character of the feeding brown-grizzly bears or somewhat indirect, such as the habitat alteration created by beaver dams.

Marine mammals in the bays and straits must be considered, as some are recognized as salmon predators. Sea lions are found throughout the area. Tugidak Island has what may be the largest population of harbor seals in the world.

2.2.8 Vegetation

The Kodiak Archipelago has two distinct forms of vegetation. On Afognak, Shuyak, and neighboring islands and on the northeast end of Kodiak Island, a dense forest of Sitka spruce occurs. Since these forests are relatively new to the area (800 to 1,000 years), the forest is slowly expanding south. The valleys may contain growths of cottonwood, black birch, and alder.

Most treeless areas support a thick cover of grass, although low brush and tundra vegetation such as mosses, sedges, and heathers grow in such spots.

The Alaska Peninsula area includes white spruce in the foothills, with alder, willow, cottonwood, and black birch throughout. There are essentially no commercially valuable timber stands in the southern Alaska Peninsula area, although significant amounts of commercially valuable timber occur on Afognak Island and the northeast end of Kodiak Island.

2.2.9 Fish

2.2.9.1 Salmon

Five species of salmon (sockeye, coho, chinook, pink, and chum) are harvested in the subsistence, sport, and commercial fisheries on the Kodiak Archipelago and southern Alaska Peninsula. These five species are the focal point of this plan. There are, however, other fish resources of value in the region.

2.2.9.2 Non-Salmon Anadromous and Freshwater Species

Rainbow trout (steelhead), Dolly Varden, and stickleback may be anadromous or may be exclusively freshwater on a site-by-site basis. Freshwater species on the Kodiak Archipelago include Arctic grayling and rainbow trout.

All fishes along the Shelikof Strait side of the Alaska Peninsula are from groups known to tolerate salinity and to be capable of marine dispersal. This includes the Dolly Varden char.

2.2.9.3 Non-Salmon Marine Species

Within the region herring and halibut are harvested on a commercial basis. Efforts continue in an attempt to develop a viable groundfish industry with a potential of a large resource harvest.

2.2.9.4 Shellfish

Shellfish play an extremely important role in the region, with major harvests of tanner, king, and dungeness crab, as well as shrimp and scallops. Swikshak Beach on the Alaska Peninsula, has razor clams which have been certified safe for human consumption.

2.2.10 Summary

The natural environment of the Kodiak Region has many features which directly affect the salmon resource and encourage human activity, resulting in an indirect effect on the salmon resource.

The Kodiak Region provides a wide variety of habitats for the salmon resource. The southern portion of the Alaska Peninsula borders on Shelikof Strait, where migration patterns show that salmon generally move from east to west in the strait.

The major mountain range on the Kodiak Archipelago has few glaciers. However, with the season's snow pack, there is usually sufficient water storage to sustain waterflow in streams year around. Most streams in the region depend upon annual precipitation to maintain their flow regimes. On the Alaska Peninsula, in many cases, the large glacier systems provide sufficient water to maintain flows year around.

The surface waters of the Kodiak Archipelago are less variable in terms of length than those in other parts of Southcentral Alaska. Generally rivers and streams are less than ten miles long and frequently are swift, coming from steep gradients. This makes their investigation, assessment, and understanding easier in comparison with surface waters in other parts of the state, which often have rivers with broad courses, covering large flood plains. However, with these clearly defined channels, it makes the system more vulnerable to a single altering factor. On the Alaska Peninsula some streams have unstable beds and are extensively braided, making it more difficult to assess the environment for salmon.

The major rivers and lakes are found on Kodiak Island along the west coast. On the north end of Afognak Island are several clusters of lakes which drain into Little Waterfall Bay, Discovery Bay, and Perenosa Bay. On the Alaska Peninsula, major rivers drain many different watersheds, and there are few lakes which drain to the Shelikof Strait side.

The climate plays a very active role in the Kodiak Region and its salmon fishery. The intensive periods of rain, in combination with snowmelt during warm trends, often result in flooding, which scours the stream channels when salmon eggs are buried there. With low flow and an extremely cold period, anchor ice may appear on streams causing egg mortality.

As it has in the past, seismic activity can have a permanent effect on the salmon resource, by causing changes in spawning grounds through alterations in river systems and by upthrusting or or causing the subsiding of land along the coastline.

Recurring full-scale volcanic activity has caused wide spread stream blockage, high turbidity, and excessive sedimentation of streams.

Other geological activity may also influence the salmon resource. Porous and permeable glacial and alluvial sediments can lead to seepage which lowers the stream flow during dry periods. Turbidity of water can be the result of glacial flows or can be caused by suspension of sands, clays, silts, and volcanic ash picked up during flood stages. Bog areas can cause high acidity, organic content, and color levels, the latter inhibiting light penetration.

The major interaction between wildlife and the salmon resource occurs where management of one or more species of wildlife produces limitations or impacts on the salmon resource.

The regional vegetation is of concern in planning the salmon resource primarily in the area where mature Sitka spruce can be harvested. When timber harvest occurs, habitat conditions change.

The relevance of other fish species to the planning effort is two-fold. Some species compete for habitat and food, while others are considered predatory. Some species provide a viable alternative harvest for fishermen, decreasing emphasis on utilization of the salmon resource.

2.3 OVERVIEW OF THE HUMAN ENVIRONMENT

Human activities can produce an effect on the salmon resource. These activities may be indirect to a greater extent than those of the natural environment. The action or results may appear to have nothing to do with the salmon resource, however, the results of the action may significantly affect the potential of an area to support salmon.

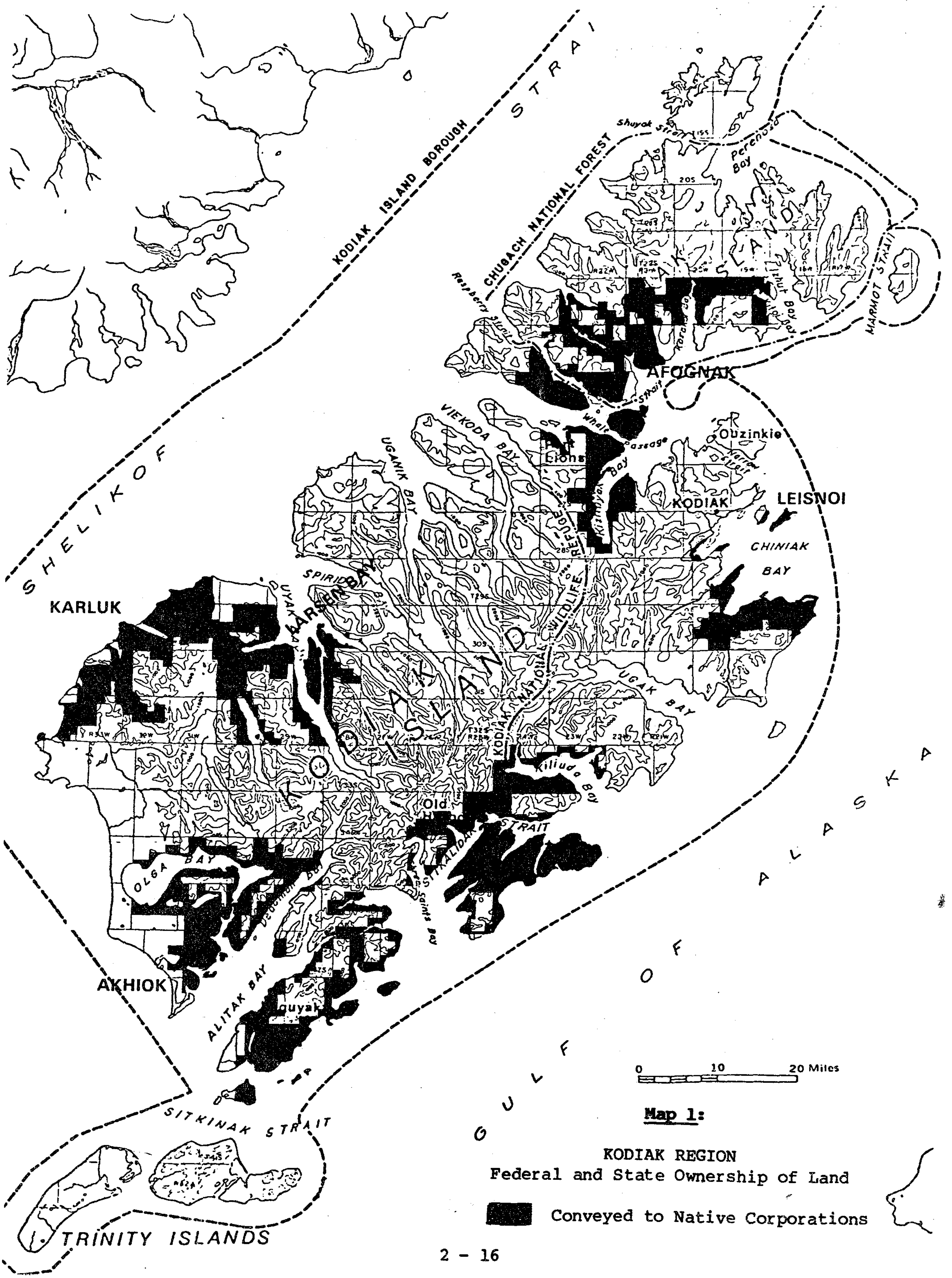
2.3.1 Land Status and Use

Much of the effectiveness of planning can be dependent upon who owns the property in question, what their actions are apt to be, and what uses may be implemented on the property.

2.3.1.1 Land Status

The land within the Kodiak Region is in federal, state, borough, municipal, Native village and regional corporation, and individual ownership. In addition, there are ongoing programs and legislative actions which continue to transfer parcels of land among these various owners. In some cases, to add to the complexity, there are two or more overlapping claims to the same property.

Much of the Kodiak Region is federally owned, with a great portion of Kodiak Island situated within these boundaries of the Kodiak Wildlife Refuge. Portions of the peninsula are in the Katmai National Monument. For lands with federal and state ownership, there is a stability of status and a known set of operational and management policies. Alteration of these policies is open to public input and should be in the public interest. Federal and state ownership of land is shown in on Map 1.



Map 1:

KODIAK REGION
Federal and State Ownership of Land

Land which is held in some generalized status category by government or individual, has a much less certain future.

The coastal zone has been recognized because of its importance to coastal communities. Various state and federal programs have been instituted to assure its preservation. In Alaska much attention is given to this issue through the Coastal Zone Management Program, the U.S. Army Corps of Engineers' 404 Wetland Permit Program, and the Critical Habitat Designations. The Kodiak Island Borough has drafted a plan for much of its coastal zone.

2.3.1.2 Land Use

Direct impacts can be expected when there are projects to develop the land and/or to exploit the natural resources. It is generally true that the magnitudes of these impacts increase in proportion to the scale of the project. The location and character of the project play large roles in determining what these impacts will be.

Power projects may alter habitat significantly. Within the Kodiak Region the only power project is at Terror Lake on Kodiak Island. The area altered will be in the Terror and Kizhuyak River drainages. However, the indirect impacts may be greater and longer lasting.

Although there are known deposits of sub-surface minerals in the Kodiak Region, only minor production has occurred. Much of the production from the region was in the form of beach placers along the western shore. If large, commercial deposits of sub-surface minerals are located, the actual disruption caused by the extraction and the effect of the exposed terrain can be significant.

Offshore from the Kodiak Archipelago, recoverable reserves of oil and gas are believed to exist. Leases to explore the Outer Continental Shelf in the Western Gulf of Alaska are scheduled within the time scope of the plan. A sale in Lower Cook Inlet and the northern part of Shelkikof Strait has been proposed, thus raising the possibility of gas and oil development on both sides of Kodiak Island. The impact on the coastal habitat by such exploration and possible production with onshore development has been the subject of numerous studies and several environmental impact statements.

There is a strong tendency to look for the damage, caused by major development, and to overlook potential benefits which could be derived from nominal modifications. Major projects should be reviewed as early as possible to consider what features could serve to maintain and enhance the salmon resource.

Indirect impacts are often overlooked and may involve less planning to minimize negative impacts. Development can result in increased residential and industrial growth. This growth, coupled with increased uses and number of users, can alter habitat and impact salmon.

2.3.2 Population

According to the 1980 census, only 3.0% of the state's population resides in the Kodiak Region. These people live within the Kodiak Island Borough. The Alaska Peninsula portion has been uninhabited for a number of years.

The Kodiak Island Borough has grown from 9,409 residents to 12,714 residents, a 26% population growth since 1970 (see Table 2.3-1). This gain was due to fishing, its largest industry, which has expanded significantly over the decade.

Six villages within the region represent 10% of the population, with the remainder residing in Kodiak and on the road system. During the last thirty years, the population of theses villages has increased at a much slower rate than the population of the City of Kodiak. All of the villages, with the exception of a few people who still live at the Afognak village site and the village of Ouzinkie on Spruce Island, are on Kodiak Island. None of the villages are on the current road system. Access to all is by boat or airplane.

To the year 2000, forecast is for steady population growth in the Kodiak urban area at a rate of about 2.7% annually and a cumulative increase of 100% over the forecast period.[3]

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3 Growth of the Alaskan Economy: Future Conditions Without the Proposal, ISER, 1979.

Table 2.3-1:

POPULATION DATA

	1970 [a]	1982 [b]
Kodiak Island Borough	9,409	12,714
Kodiak City	3,798	5,873
Kodiak Military Base	3,052	3,018
Outside Kodiak City Limits	-----	2,559
Akhiok	115	103
Larsen Bay	126	180
Old Harbor	290	355
Ouzinkie	160	233
Port Lions	227	291
Karluk	98	102

(a) 1970 Census

(b) Kodiak Island Borough data

2.3.3 Description of the Economic Sector

The Kodiak Region's primary industry is fishing and fish processing. As in most other parts of Alaska, the region's fishing industry has been traditionally reliant on salmon, supplemented by catches of halibut and herring. While salmon remains a very important fishery, the addition of large scale king crab, tanner crab, dungeness crab, and shrimp fisheries, and more recently, groundfish, have served to make this area's seafood processing industry a diversified year-around operation.

Most processing takes place in Kodiak, however, several salmon processing plants are located elsewhere on the island. None operate on the Alaska Peninsula portion of the region.

Tourism is currently a minor economic activity in the Kodiak Region, however, it is an industry with potential for expansion. Kodiak Archipelago and the Shelikof shore of the Alaska Peninsula are "off the beaten track" for tourists.

The military has been a factor in the region's economy since World War II, however, it plays a much less dominant role in the economy today. The U.S. Coast Guard, which has a major base on Kodiak, has an impact because it is a major civilian employer and acts as a support for fishing and fish processing, Kodiak's primary industry.

To date, the timber industry has not been a major economic factor in the region. In 1982, two lumber mills near the City of Kodiak cut 2,950,000 board feet of timber that is processed and sold locally as rough cut lumber. The demand for this lumber is increasing. Within the last five years, 110,000,000 board feet of timber has been cut on Afognak Island and shipped to

Japan. With much of the timber lands now in private hands, timber harvest may increase during the plan period.

A minor element in the economy is cattle ranching. Currently six or seven ranches support about 2,000 cattle. An approved slaughterhouse facility at Woman's Bay provides meat to Kodiak and occasionally to Anchorage.

2.3.4 Employment and Labor Force

Fish processing is the largest employer of the Kodiak labor force. The average annual employment for manufacturing, which is almost entirely fish processing, was 3,660. This represents almost 64% of the non-agricultural wage and salary employment in the region.

Fishing employment within the Borough of Kodiak peaks in July during the salmon harvest. While seasonal employment declines in the winter months, these declines are less pronounced than the statewide seasonal patterns. This is due to shellfish harvesting and processing activities during that period of the year.

While the volume of fish harvested fluctuates from year to year, the overall employment level has increased. This is due to exploitation of a wider variety of fish and a generally improved catch level. However, it is difficult to predict future employment levels in this industry. With generally improved management practices, fish enhancement, new technologies in the fish processing industry, and marketing efforts by the State, fish processing employment is expected to hold its own and perhaps even grow moderately in the future. While utilization of groundfish species may increase, it will be a number of years before this has any large impact on employment.

After fishing, government provides the largest employment. The federal government, including the U.S. Coast Guard, is a significant element in this employment. Government is the slowest growing economic sector and the Coast Guard Station, the chief public employer, is not expected to expand its operations. Thus, the public sector employment is expected to decline from 33% to 23% of total employment by the year 2,000.

The basic employment categories - timber, fishing, fish processing, and agriculture - are projected to grow by about 75%, accounting for about 40% of all employment growth to the year 2,000.[4] Trade and services exhibit the fastest growth rate, together generating about 36% of all new jobs. These categories provide 75% of the Kodiak area's growth.

The remaining sectors of construction, transportation, finance, insurance, real estate, and mining comprise a minor share (10%) of the employment and will probably maintain this share through the forecast period.

The petroleum industry will have only minor impacts in terms of employment. Most employment would be on site, and most of the secondary employment increases would go to current residents.

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4 Alaska Consultants, Inc. "Northern and Western Gulf of Alaska, Local Socioeconomic Baseline" prepared for BLM, Outer Continental Shelf Office, 1979.

2.3.5 Economic Outlook for the Region

The economic outlook for the Kodiak Region is dependent upon the influence of the fisheries industry and potential oil and gas development. Without such oil and gas development, the region is expected to continue its moderate growth, much as it has experienced over the last ten years. Several factors lead to this pattern. One of the most important is the availability of land on which to develop new projects. Another is the limited entry fisheries program. This system has been hotly contested in the Kodiak area, however, the limiting of salmon fishing gear is a fact. Kodiak currently has a single basic industry which is fishing and seafood processing. When problems develop in this area, it is felt within the attendant retail and wholesale trade, as well as the services industry.

Fisheries activities should gradually increase despite lower quotas on many of the more valuable shellfish species. It is anticipated that better scientific understanding and improved resource management practices will enhance and stabilize yields, allowing more efficient use of gear, plant and labor force. Efforts continue to establish a viable groundfish industry and as technology and markets improve, this could be a significant influence on the economy.

Tourism has only slight to moderate significance in relation to the total economy of the region and should continue to grow on a modest basis. Promoting the region's historical and recreational assets and improved visitor facilities should attract increased numbers of tourists, conventioneers, and vacationers. Sport fishing and hunting attract the most visitors, with hunting of brown bear with or without a guide, the main attraction. However, the majority of the hunting guides allowed to work in this area are not residents of the region. As the population increases in other parts of Southcentral Alaska and favorite fishing and hunting spots become overused, a spill-over effect may occur to the lesser exploited areas of the Kodiak Region.

Major portions of the forests of the Kodiak Archipelago have been transferred from the Chugach National Forest to private owners through the Alaska Native Land Claims Settlement Act. It is expected that the forest products industry could become a significant element in the economy. Since the timber is Native owned, it is anticipated that new employment opportunities for Native corporation shareholders will become available and that service and support related activities in the region will benefit.

Another element in the economic future, cattle ranching and meat processing, has some potential for expansion, providing a greater portion of the meat market within the state.

The government sector of the economy is expected to experience some growth as a result of the general expansion of the community of Kodiak. The Kodiak Coast Guard base is anticipated to remain at or around current strength in the future, unless major new developments such as oil and gas exploration take place. A University of Alaska fisheries technology center is being developed and may provide additional employment.

The federal hiring freeze may affect federal government expansion in the region. However, as the economy grows, it is expected that local government will respond by providing increased education and general services.

The investment plans of the Native regional corporation, Koniag, Inc., and the various village corporations, could be an important role in the future economy.

The major economic factor on the horizon is the proposed Western Gulf OCS oil and gas leases. An unknown, but significant economic impact would occur in the region, either as direct salary and wages to local workers, or as dollar infusions throughout the economy through service and support related activity.

2.3.6 Summary

Human environment impacts on the salmon resource differ from impacts by the natural environment. Potential problems can be recognized and minimized through plan modification. In dramatic cases threats to the resource can be mitigated if not eliminated.

The ownership and status of much of the land within the region is in the public domain because it is either held by the state or federal government. The short and long-term policies governing these lands facilitate the planning for salmon enhancement by adding a degree of predictability. These lands are afforded some protection, can serve multiple resource functions, and are dedicated to serving public interest.

Land use development and alteration could have significant impact on the salmon resource that would affect planning of projects. Anticipated projects such as exploration and possible production of oil and gas, may lead to development of support and supply facilities, crude oil terminal sites, and onshore production treatment facilities. As progress toward OCS leasing and subsequent exploration begins, assessment of the impact on salmon habitat needs to start at the earliest possible time to determine the potential effects of resource development on the habitat.

The total population growth of the region appears to have stabilized and a major influx can only be expected when oil and gas exploration and possible production begins. A large increase in the number of people in the area will cause loss of salmon habitat in some areas and pressure on the salmon resource, especially with reference to sport fish.

The Kodiak Region's growth and prosperity is tied to its primary industry, fishing and fish processing. Other sources of economic strength include the continued presence of the U.S. Coast Guard plus some probable expansion in forest products, tourism, and recreational activities. The investment plans of the Native regional and village corporations may also be a factor in the future growth of both Kodiak and other communities in the region.

It is expected that employment opportunities and the labor force will continue to have seasonal fluctuations. New opportunities for employment may arise from development of such industries as timber, oil and gas, and groundfish.

2.4 SALMON FISHERY

The story of the man/salmon relationship in the Kodiak Region has been one of increased participation, harvest, management, and regulation.

2.4.1 Overview

The salmon resource in the Kodiak Region is utilized by three user groups: subsistence and personal use fishery, sport fishery, and commercial fishery. Some aspects of the salmon fishery are important to all user groups or play a role in the relationship between these user groups.

2.4.1.1 Historical Perspective

The earliest use of salmon in the Kodiak Region came from Native harvest on a relatively small scale as a basic food for existence.

In the 18th century Russian explorers discovered and reported great runs of salmon at the Karluk River, which the Natives knew about and used long before Russian arrival. Undoubtedly the Russians utilized the salmon from an early date, although limited data exists to indicate the extent of their operations. However, in several seasons around 1827, 300,000 sockeye salmon were prepared as "yukola" (dried without salting or smoking).

No large commercial use seems to have been made of the region's salmon until Alaska was purchased by the United States in 1867. Commercial use of salmon centered on the Karluk River and Lagoon. For a 46 year span (1882 through 1927) a yearly average of 1,706,000 sockeye was harvested from this great salmon stream. Commercial fishing spread by the 1890s to other sockeye producing areas such as Alitak and Olga Bays, Ayakulik (Red River), Uganik Bay, and Afognak Island streams.

Sockeye was the preferred species prior to 1900. Pink salmon were dried by natives for winter use and moderate numbers were salted for San Francisco markets. Chum salmon were also dried for subsistence use.

By the turn of the century, commercial use of chinook and coho salmon was established. It was not until 1908 that quantities of pink salmon were harvested commercially. Pink salmon harvests rapidly increased about 1919 and became dominant in the catch around 1924.

Traps were used as early as 1896, however, the major gear used were hand-hauled drag nets. Steam power was introduced in 1896, reducing manual labor by half. Gear restrictions began by the early 1920s, and it was not until the 1930s that the present structure of commercial gear users was in place: purse seine, set net and beach seine. Traps were legal and as many as 33 were used to commercially harvest salmon. With the coming of statehood in 1959, traps were eliminated in the region.

The sport fishery began to develop particularly with the increase in military personnel during and after World War II.

As more and more use of the salmon resource developed, increased efforts to manage the resource were made by the fishery managers: the U.S. Bureau of Fisheries until 1940 and the U.S. Fish and Wildlife Service from 1940 until 1960 when the State of Alaska began management of its fisheries. Programs such as establishment of escapement goals and forecasts have become management tools which help to ensure the continuation of the resources in a viable condition.

2.4.1.2 The Salmon

All five species of salmon return to the Kodiak Region. The complexity of the fishery and its management comes from many factors. One is the difference in the life cycle of each species. There is considerable variation in the amount of time that will pass between the period when eggs are deposited and the time the product of these eggs will return as mature adults. Although the chinook salmon may have a seven-year return period, they and the sockeye salmon normally have a 4 to 6-year return pattern. The chum and coho salmon generally are considered to have a 4-year cycle. The pink salmon have the shortest cycle of 2 years. However, the 2-year cycle of pink salmon is further divided into the dominant and non-dominant year. The even-year cycle is dominant.

There are pronounced differences in the number of each species which occur in the region. The commercial species in greatest abundance is the pink salmon. Both chum and sockeye rank nearly the same in the recent 20-year period, 1963 through 1982. Fourth is the annual harvest of coho salmon, and chinook salmon experienced the smallest harvest.

The annual run of each species is different and the total annual return within species is made up of different distinct runs spread out over several weeks and months. General run timing for the Kodiak Region is shown on Table 2.4-1.

Table 2.4-1:

GENERAL SALMON RUN TIMING INFORMATION
KODIAK AREA

Species	Present Bays and Estuaries	Present Freshwater	Peak of Spawning
Chinook Salmon	3/15 - 7/01	6/01 - 9/15	8/10 - 9/01
Sockeye Salmon	5/01 - 9/15	5/15 - 12/15	8/01 - 10/15
Coho Salmon	7/01 - 11/15	8/15 - 1/15	10/15 - 12/15
Pink Salmon	7/01 - 9/01	7/15 - 10/01	8/01 - 9/15
Chum Salmon	6/15 - 9/01	7/15 - 10/01	8/01 - 10/01

2.4.1.3 User Group Definition and Development

Three groups of fishermen have been recognized, based on the reason why they fish. The subsistence fisherman represents the continuation of Man's earliest use of the salmon resource. Today's context of what constitutes subsistence fishing is the subject of discussion and definition. However, the concept is based on the premise that fish caught are consumed by those who catch the fish or are traded for some other life sustaining necessity. A personal use concept is being discussed and defined.

Sport fishing is an ever increasing factor in the salmon fishery. Although the salmon are captured for recreation, the fish which are caught are consumed by the fishermen representing a quasi-subsistence use.

The commercial fishery is the largest harvester and has the longest, clearly quantifiable record of active involvement with the salmon resource. There is a substantial range in the size of commercial fish operations. However, all of the commercial fishermen are harvesting the salmon resource for the primary purpose of sale to the processor, with the ultimate goal of serving a large national and international market. A small fraction of the individual commercial fisherman's catch is diverted to his own table to fill a quasi-subsistence function.

Commercial fishermen define themselves according to the type of gear used in fishing. The greatest number of permit holders are the purse seine fishermen. The second largest group are the set gillnet fishermen, and the third group is comprised of the beach seine fishermen.

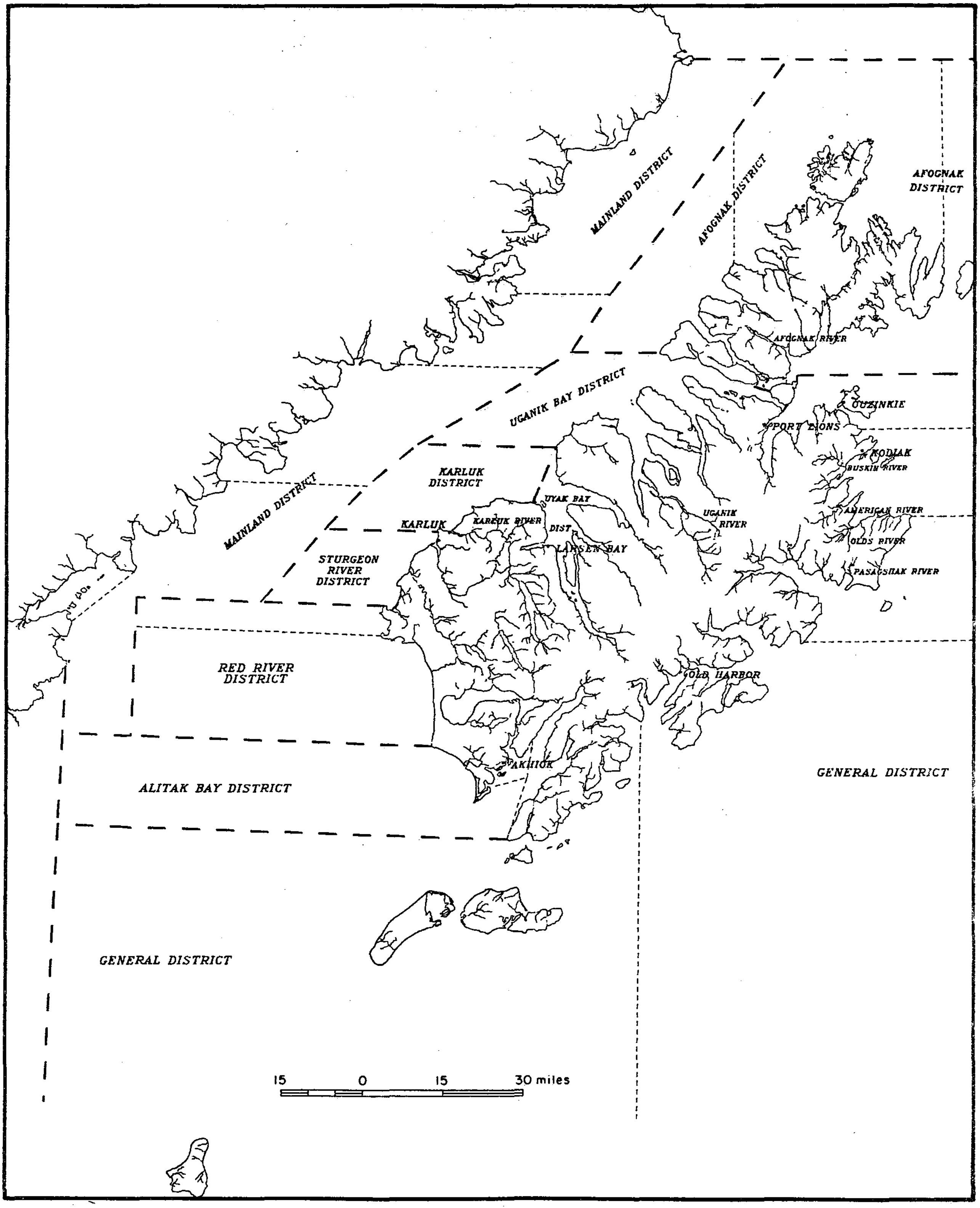
2.4.1.4 Fisheries Management

A management structure regulates how the needs of resource management and enhancement and resource harvest will be achieved. The agency with jurisdiction is the Alaska Department of Fish and Game, operating under the policies of the Alaska Board of Fisheries.

For purposes of administration and management, the ADF&G has created districts within the Kodiak Region shown on Map 2.

Map 2:

KODIAK REGION COMMERCIAL FISHING DISTRICTS



2.4.2 Subsistence Fishery

Subsistence fishing, the oldest category of salmon use, is the user group which is least defined. A permit system has been in effect since statehood. Recently the concept of subsistence fishing has come under scrutiny and has been subjected to new and generally expanded definition. It appears criteria will continue to be defined in years to come.

2.4.2.1 Regulations

The general trend for the past twenty years has been a general tightening in subsistence regulations. Participation has expanded because of public awareness.

All waters in the Kodiak Management Area are open to subsistence fishing except for a few areas. Subsistence fishing is open year around except that registered purse seine permit holders cannot take fish for subsistence purposes with commercial gear. Fish may be taken only by seines and gillnets.

The number of permits has dramatically increased in the 20-year period (1963 to 1982) from 74 in 1962 to a high of 1,277 in 1982. Not all permits are returned, consequently statistics for this document were calculated from data received from an average of 48% of the permit holders. In addition, there is undoubtedly subsistence fishing conducted without a permit which adds an unknown to the actual number of salmon taken for subsistence purposes.

2.4.2.2 Catch Analysis

The total catch reported by subsistence fishermen averaged 17,394 salmon a year, in the 5-year period from 1977 through 1981. *

Sockeye salmon is the most sought after species. The annual catch in the 5-year period has averaged 10,447, with a high of 13,746 in 1980. There has been a dramatic increase in the sockeye taken, with three times as many sockeye taken in 1980 as in 1976. Sockeye salmon contributed 66% of the total subsistence harvest in 1981.

Coho salmon is the second most harvested species, contributing an average of 20% to the total subsistence catch. There has been a steady increase in pressure on the coho runs.

The pink salmon harvest has remained fairly constant with an average of 2,786 fish taken in each of the years. Pink salmon contribution to total subsistence catch has steadily decreased during these years, from 21% in 1977 to 12% in 1981.

Chum and chinook salmon do not show a significant contribution to subsistence fishing. In 1981, chum contributed only 3% of the total subsistence take, and chinook salmon contributed less than 1%.

The average number of salmon caught per reported permit was 28 fish during the 5-year period. The trend has been stable within this period.

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* Data for 1982 are incomplete.

Salmon are taken for subsistence throughout the region. The Buskin and Afognak Rivers provide the most salmon for subsistence users. Other important locations for subsistence are the Uganik River, Chiniak Bay, Moser Bay, Karluk River, and Old Harbor. The Mainland District provides the fewest salmon for the subsistence fishery.

2.4.2.3 Economic Assessment

It is difficult to make an assessment of the economic impact of this fishery. Its main economic benefit is to the individual subsistence fisherman in the form of reduced household expenses.

2.4.3 Sport Fishery

2.4.3.1 Introduction

Sport fishing effort in the Kodiak Region has continued to increase since the first major pressure by military personnel in the 1940s.

Interest was sufficiently great by 1953, resulting in the organization of a sportsmen's club, the Kodiak Conservation Club, an unofficial volunteer project of the military. Its emphasis was on steelhead enhancement, however, it does show that sportsmen were concerned and dedicated to ensuring that a sport fishery would be available. Today, the Kodiak Island Sportsman Association and the Kodiak Rod and Gun Club are active sport fishermen's organizations.

After statehood, inventories and catalogues of lake and stream systems, used by fresh water and anadromous species, were conducted on the Kodiak Archipelago. Greater emphasis on this research in the last ten years has provided information for establishing priorities, formulating policies, and planning within the area.

2.4.3.2 Fishing Pressure

The sport fishing effort has increased annually since statehood, and it seems likely to do so for many years to come. A review of 1973-1978 sport fish license sales indicated a 73% increase in license sales over that 7-year period.

Starting in 1977, an annual angling survey has been conducted by a series of mail questionnaires which provides an estimate of state and regional angler use. This survey confirms the dramatic continuing upward trend in sport fish effort in the Kodiak Region. During the 5-year period, 1977-1981, the total number of anglers increased 44%, and the days they fished increased 35.5%.

Angling effort in Cook Inlet is the fastest growing in the state. As more and more pressure is placed on the salmon resource by sportsmen in that area, a spill-over effect may be felt in the Kodiak Region. Sport fishermen may choose to fly or take the state ferry to the Kodiak area, where the chances of catching more fish per angler-hour are greater.

2.4.3.3 Catch Analysis

The sport catch of salmon within the Kodiak Region has been assessed since 1977 by the postal survey (see Table 2.4-2).

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5 Murray, Pete, Area Sport Fish Biologist, letter dated December 23, 1982.

Table 2.4-2:

ESTIMATED SPORT FISH CATCH, 1977-1982

Year	Chinook	Coho	Land Locked Coho	Sockeye	Pink	Chum	Steel-head
1977	483	4,716	229	1,255	14,519	1,645	232
1978	350	4,927	90	1,776	17,739	1,287	162
1979	752	11,522	373	2,436	15,871	500	318
1980	327	12,692	628	2,178	18,669	525	671
1981	724	10,584	-	1,620	12,259	637	313
1982	1,120	13,329	712	3,055	18,850	1,324	258

Not included in the survey is the narrow coastal belt along Shelikof Strait on the Alaska Peninsula. Sport fishing is generally rated low because of remoteness, lack of easy access, and inclement weather. There are several species of sport fish present in many of the streams and lakes. However, the fishery has not been developed and sport fishing here is considered insignificant.

On the Kodiak Archipelago, sport fishing is primarily for freshwater salmon, char, and trout. The saltwater salmon troll fishery is minor. Most of the sport fishery centers along the 129 miles of road system. Of all remote rivers, the Karluk River receives the most sport fishing pressure.

The majority of the salmon are caught in fresh water. A 4-year average, 1977 through 1980, shows 90% of the chinook, 75% of the coho, 79% of the sockeye, 57% of the pink, and 40% of the chum are caught in fresh water. The Buskin and Pasagshak Rivers account for much of the freshwater sport fishing. In 1980, 50% of the total pink, 36% of the coho, and 28% of the sockeye catch came from the Buskin River. The Pasagshak River provided 34% of the total coho, 21% of the sockeye, 16% of the pink, and 14% of the chum salmon catch. Fishing pressure on these systems has increased rapidly. For example, the Buskin River salmon fishery has increased from 11,072 man-days of effort in 1978 to 19,403 man-days in 1981. On Pasagshak River, the increase was from 3,403 man-days in 1977 to 4,434 man-days in 1981.

A sport fishery occurs on land-locked coho salmon in freshwater lakes on the Kodiak road system. These lakes are stocked with coho fingerlings in an ongoing program. These salmon do not reproduce and are placed in lakes for sport fishing effort. Table 2.4-2 shows the increased contribution these land-locked coho make to the sport fishery. The Karluk River is the scene of the majority of the chinook salmon fishery.

The saltwater salmon fishing generally takes place shoreside. Caught in salt water, from the shore, are 65% of the coho, 87% of the pink, and 90% of the chum salmon. Chinook and sockeye salmon are caught either by boat or from shoreside, however, fishermen showed no consistent preference.

2.4.3.4 Economic Assessment

Several small commercial enterprises function in support of the recreational fishery and thereby generate revenue, ultimately attributed to the presence of salmon. Since the majority of the fishery is reached by road, the economic impact is not great on aircraft and boat charters. In comparison to the commercial fisheries, the overall impact of the sport fishery is not large.

2.4.4 Commercial Fishery

2.4.4.1 Introduction

The commercial fishery in the region has been developed chronologically to show its progression over nearly one-hundred years.

Commercial use of salmon in the Kodiak Region began in Russian times, possibly as early as 1827 when sockeye salmon were dried for food. Commercial catch data for sockeye salmon were recorded beginning in the early 1880s. Data for coho and chinook salmon began in the late 1890s.

The high catch of sockeye salmon (4,826,000 fish) was made in 1901. Pink and chum salmon catch data begin around 1910.

The first closure of waters within the Kodiak Region was in 1918 when the Karluk River and Lagoon and all tributary waters were closed to commercial fishing. Fishing was permitted 100 yards outside the mouth of the Karluk River where it broke through the spit into Shelikof Straits. Although all commercial fishing was restricted to 500 yards beyond a stream mouth in 1921, the Karluk River remained an exception with the continuation of the 100 yards boundary.

Beginning in the 1920s commercial catches of pink salmon consistently were higher than sockeye salmon. Counting weirs were established at the Karluk River in 1921, Olga and Akalura Lakes in the Alitak District in 1923, and at Ayakulik (Red) River in 1929. Investigations of the Karluk River system began during this decade and have continued ever since.

The Executive Order of 1924, known as the White Act, began the era of more regulation of the salmon fishery. In the Kodiak Region counting weirs were used to be certain the take of salmon would not exceed 50% of the total run. Use of purse seine and floating traps for the capture of salmon were prohibited in the Kodiak Region. The act specified certain waters for the exclusive use of one gear type. For the first time several bays and waters along the shores of Kodiak Island were closed to commercial fishing. Closure times for commercial fishing were set and methods for emergency orders, openings, and closures were outlined.

From 1922 to 1933 beach seines, gillnets and stationary traps were the only legal gear types in the Kodiak Region. In 1933 purse seining was allowed. The record odd year pink catch was made in 1937 at 16,788,000.

In 1946 purse seining near the Karluk River was prohibited within 500 yards of the beach.

In 1958 fish traps were prohibited as a means of commercial fishing in the Kodiak Region's waters. In 1960 the management of the fisheries passed from the U.S. Fish and Wildlife Service to the State of Alaska's Department of Fish and Game.

During the 1970s, additional controls on commercial fishing came into existence. In 1971, the Division of Fisheries Rehabilitation, Enhancement and Development (F.R.E.D.) was established. That same year the Commercial Fisheries Entry Commission was formed to oversee the limited entry permit system, which came into effect in 1973. In 1971, the record chum salmon catch of 1,541,000 was established for the Kodiak Region.

In 1980, the even year pink salmon record catch for the Kodiak Region was established at 17,291,000. In 1983, the record catch of coho salmon was established at 344,000.

2.4.4.2 Regulations

Regulations govern who can fish, what gear can be used, and when and where fishing takes place.

Permits to commercially fish for salmon in the Kodiak Region must be secured through the Commercial Fisheries Entry Commission. The number of permanent permits issued, since inception of the commission in 1972, is 595. These permits are distributed among the gear types with 376 purse seine permits, 34 beach seine permits, and 186 set net permits. This number is not likely to increase significantly.

Areas are reserved in certain districts for specific gear types. Although times of openings are generally set, special openings and closures can be invoked at short notice when warranted by run stengths.

2.4.4.3 Purse Seine Fishery

As of 1983, there are 376 permanent and 10 interim purse seine permits. An average of 92% of these permits have been fished over the recent 5-year period 1978 through 1982. However, there is no specific trend on how permits are used: 87% were used in 1981 and 96% in 1980, which was the highest for the 5-year period.

Pink salmon composed the majority of the purse seine catch, averaging 87% of their overall catch during the 5-year period from 1977-1981.* By coincidence, purse seiners took about 87% of the total pink salmon harvest for the same period of time. Chum salmon are second in number of fish harvested by purse seine, averaging about 8% of the harvest. However, sockeye salmon were the second most valuable fish, economically, to the purse seine fleet.

The areas open to purse seine fishing are shown on Map 3.

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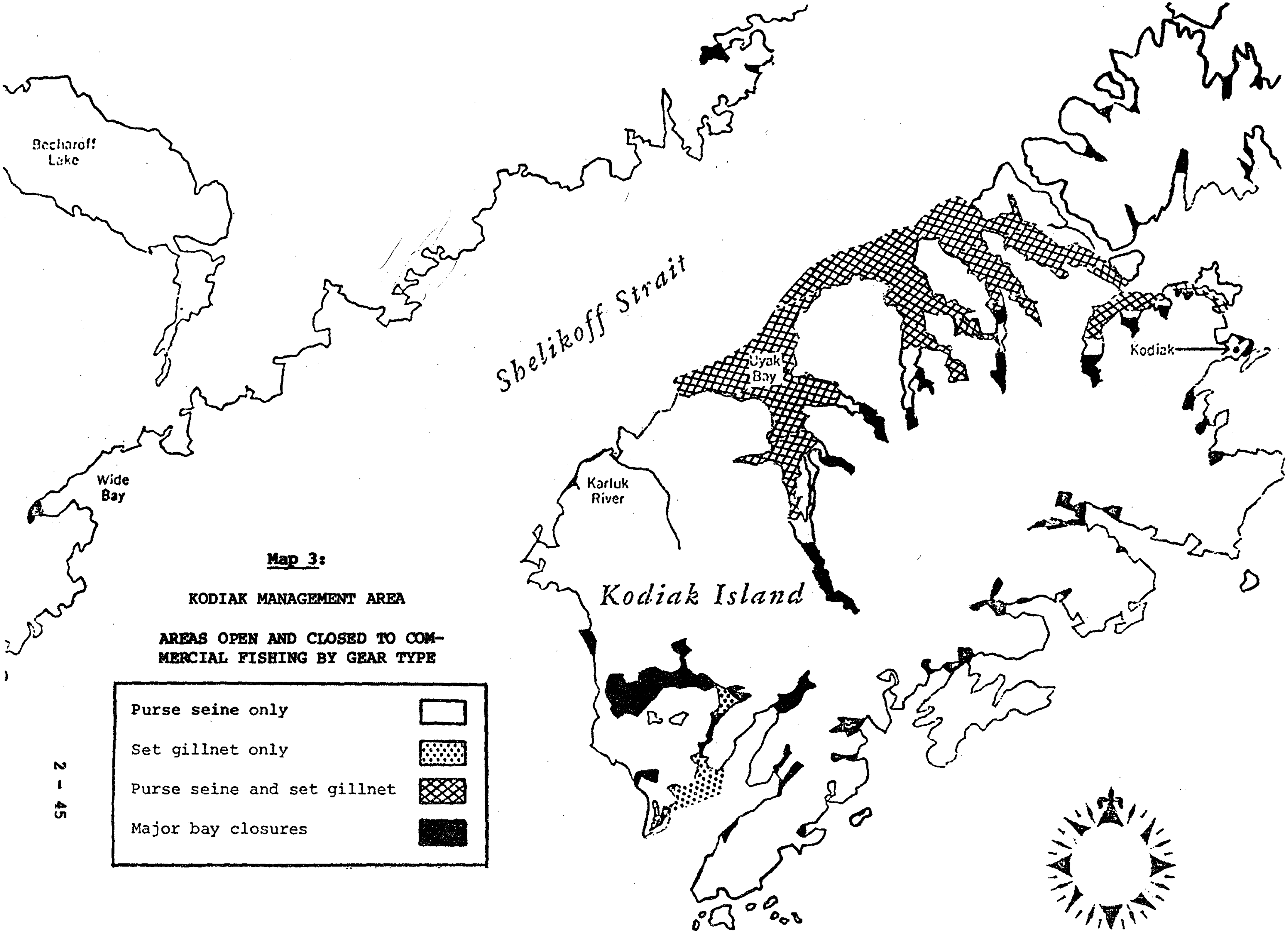
* Data not available for 1982. Therefore, the most recent 5-year period for which data are available was used.



Map 3:

KODIAK MANAGEMENT AREA

AREAS OPEN AND CLOSED TO COMMERCIAL FISHING BY GEAR TYPE

2.4.4.4 Beach Seine Fishery

As of 1983, there are 34 permanent and 1 interim beach seine permits. An average of 84% of the permits were used during the present 5-year period of 1978-1982. The trend is toward more utilization of existing permits. Pink salmon are the dominant species fished and provided the most income to beach seiners over the 5-year period of 1977-1981.* However, in 1979 the sockeye catch provided more income. Pink salmon provided 91% of the catch, but only 1% of the total pink harvest. In this 5-year period, coho and chum salmon were the other important species with coho catch averages a bit higher than chum salmon catches.

Economically, during the same period, the average income derived from coho and chum salmon was nearly the same. However, during 1979 and 1980, the value of the coho catch in dollars was nearly twice that of the chum value. Most beach seining is done from one specific site every year. Regulations do not require specific sites and exclude beach seining only from closed areas and restricted areas reserved for set gillnets.

2.4.4.5 The Set Gillnet Fishery

The number of permits for set gillnets is 186 permanent and 1 interim permit in 1983. An average of 86% of these have been used during the 5-year period from 1978-1982. The trend has been toward more utilization of permits.

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* Data not available for 1982. Therefore, the most recent 5-year period for which data are available was used.

The most important species is the pink salmon averaging 77% of the set net fishery catch during the 5-year period 1977-1981.* However, the set net fishery catch is only 11% of the total pink harvest. Sockeye salmon were the second most economically valuable fish and second in catch for this gear type.

Exclusive set gillnet areas have been designated in the Moser/Olga Bay area. Other areas which are open to the set gillnet fishery are shown on Map 3.

In most cases, tideland leases have been obtained from the State Division of Lands for areas where fish migrate. For sites in the Kodiak National Wildlife Refuge, a cabin site permit is secured from the U.S. Fish and Wildlife Service.

2.4.4.6 Harvest Summary

Table 2.4-3 depicts the high consecutive year averages for the history of the Kodiak Region commercial salmon fishery by species. Because of the 2-year period necessary to catch both the high and low years of the pink salmon cycle, increments of 2 years were selected. Calculated were the 32, 30, 28, 26, 24, 22 and 20-year averages.

The highest single year on record for each species in the total harvest is also shown on this figure. They are plotted to show the relationship to the long-term averages.

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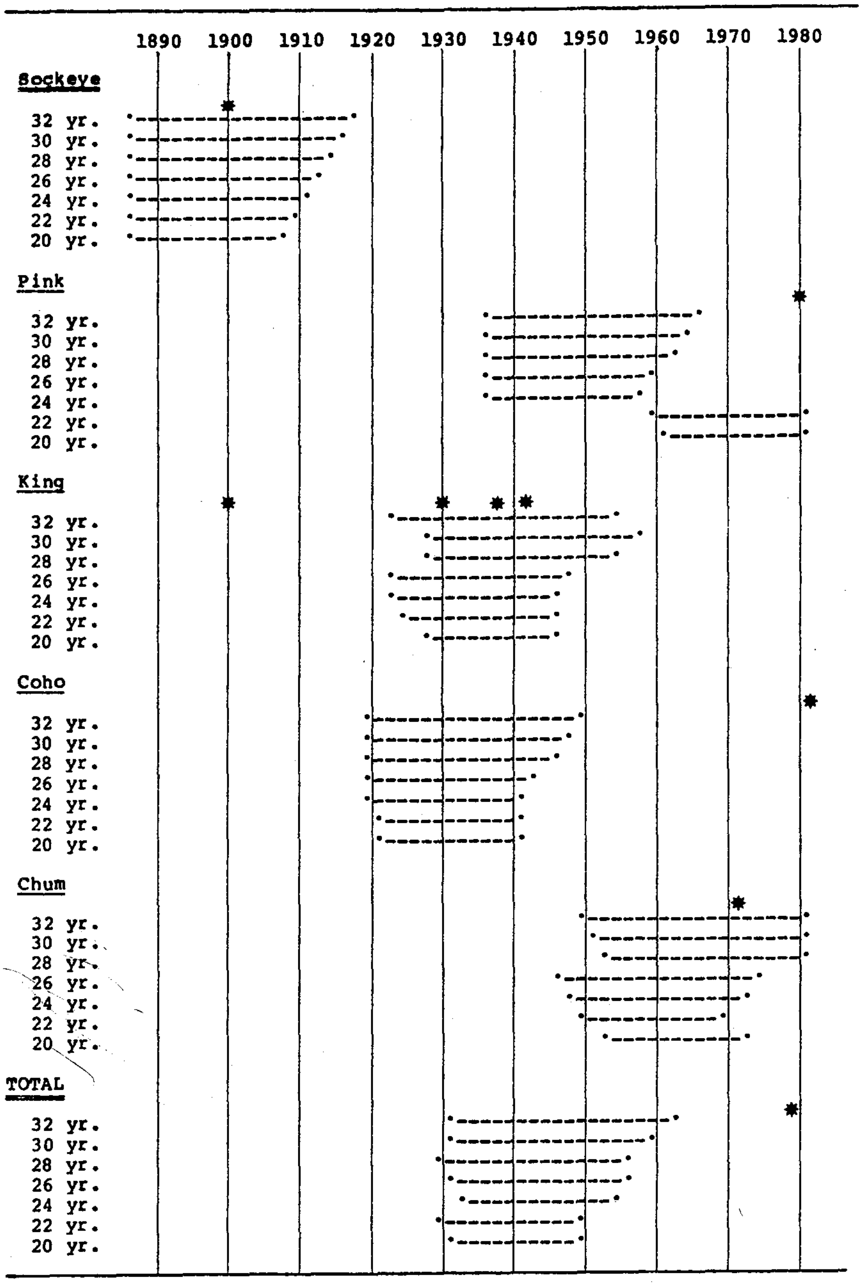
* Data not available for 1982. Therefore, the most recent 5-year period for which data are available was used.

The long-term high consecutive year averages for sockeye occurred near the turn of this century, when the Karluk River was in its most productive years. It should be noted that the 20 and 22-year highs for the pink salmon have occurred within the past 20 and 22 years. The highest consecutive 20-year averages for the catch of all species of salmon occurred between 1930 and 1949.

Table 2.4-3:

AVERAGE HIGH CONSECUTIVE YEAR COMMERCIAL CATCHES



✱ highest single year

2.4.4.7 Economic Catch Analysis

The price paid to fishermen for their catch (ex-vessel prices) varies by species and gear type from year to year (Table 2.4-4). The fluctuations are the result of a variety of causes. The trend of prices per pound of salmon was decidedly upward during the 1970s, but no trend has been established in the early 1980's.

Pink salmon, the most abundant species in the Kodiak Region, have provided the largest percentage of income to all gear types, although it is not the highest value per pound (Tables 2.4.-5 and 2.4-6). The ex-vessel values to the fishermen and the average gross earnings by gear type are not available for 1982.

Table 2.4-4:

AVERAGE GROSS EARNINGS BY GEAR TYPE
(Rounded to Nearest Dollar)

Year	Gear Type	Amt. of Gear	Chinook	Sockeye	Coho	Pink	Chum	Total
1971	Purse Seine	338	7	1,922	68	7,149	4,251	$13,397
	Beach Seine	16	1	113	9	2,434	362	$ 2,919
	Set Net	132	2	1,346	37	1,189	441	$ 3,015
1972	Purse Seine	385	9	884	56	4,052	4,232	$ 9,233
	Beach Seine	50	0	90	2	435	120	$ 647
	Set Net	219	0	376	17	586	472	$ 1,451
1973	Purse Seine	373	13	1,398	12	1,359	2,293	$ 5,075
	Beach Seine	54	0	33	2	165	51	$ 251
	Set Net	219	0	397	2	343	110	$ 852
1974	Purse Seine	268	12	3,558	101	10,147	2,175	$15,993
	Beach Seine	10	1	601	0	3,649	155	$ 4,406
	Set Net	99	5	1,941	23	2,544	315	$ 4,828
1975	Purse Seine	283	3	715	1,711	10,376	495	$13,300
	Beach Seine	10	1	177	1,290	4,081	51	$ 5,600
	Set Net	116	1	1,376	16	2,286	170	$ 3,849
1976	Purse Seine	341	19	5,967	140	32,092	4,799	$43,017
	Beach Seine	18	5	382	826	9,353	469	$11,035
	Set Net	145	3	4,382	64	9,569	463	$14,481
1977	Purse Seine	344	36	7,240	306	26,680	14,120	$48,382
	Beach Seine	25	2	232	1,482	8,765	1,953	$12,434
	Set Net	143	8	8,145	121	9,223	1,854	$19,351
1978	Purse Seine	375	86	13,923	661	46,681	10,807	$72,158
	Beach Seine	31	19	1,415	2,504	10,121	1,672	$15,731
	Set Net	158	40	10,131	179	13,514	1,631	$25,495
1979	Purse Seine	401	55	6,465	1,821	36,941	3,624	$48,906
	Beach Seine	31	8	1,541	3,164	13,476	650	$18,839
	Set Net	169	19	11,769	1,085	9,243	890	$23,006
1980	Purse Seine	372	9	4,668	1,597	53,652	9,191	$69,117
	Beach Seine	33	2	616	277	6,492	323	$ 7,710
	Set Net	169	14	7,299	409	12,606	1,250	$21,578
1981	Purse Seine	325	54	17,012	1,657	43,434	16,137	$78,294
	Beach Seine	30	6	1,358	2,447	21,320	1,579	$26,710
	Set Net	169	22	15,891	571	16,696	2,870	$36,049

Source: ADF&G Kodiak Management Area Finfish Annual Report

Table 2.4-5:

VALUE TO FISHERMEN - EX-VESSEL
(In 1,000 Dollars)

Year	Chinook	Sockeye	Coho	Pink	Chum	Total
1971	3.0	829	28	2,612	1,501	$ 4,973
1972	4.0	427	25	1,710	1,742	$ 3,909
1973	5.0	610	5	591	882	$ 2,094
1974	4.0	1,152	29	3,008	616	$ 4,808
1975	0.8	364	63	3,242	160	$ 3,831
1976	7.0	2,677	72	12,499	1,712	$ 16,967
1977	13.0	3,661	160	10,716	5,171	$ 19,721
1978	39.0	6,866	354	20,704	4,362	$ 32,325
1979	25.0	4,629	1,012	16,793	1,624	$ 24,083
1980	5.0	2,990	672	22,303	3,641	$ 29,613
1981	21.0	8,255	708	17,577	5,777	$ 32,339

Source: ADF&G Kodiak Management Area Finfish Annual Reports

Table 2.4-6:

EX-VESSEL PRICES PER POUND
(Average)

Year	Chinook	Sockeye	Coho	Pink	Chum
1971	0.22	0.27	0.18	0.15	0.13
1972	0.22	0.31	0.20	0.19	0.19
1973	0.50	0.57 * 0.50**	0.21 * 0.19**	0.29 * 0.26**	0.33 * 0.22**
1974	0.50	0.44	0.25	0.26	0.29
1975	0.52	0.44	0.31	0.26	0.25
1976	0.51	0.66	0.35	0.28	0.27
1977	1.09 * 1.15**	0.88 * 0.83**	0.65 * 0.74**	0.42 * 0.38**	0.52 * 0.78**
1978	1.00	1.00	0.85	0.37	0.60
1979	0.88	1.20	0.90	0.29	0.57
1980	0.62	0.85	0.70	0.40	0.45
1981	0.81	1.11	0.70	0.44	0.52
1982	0.50	.90	0.70 *** 0.25****	0.23	0.45

* Seine
** Set Net
*** Frozen
**** Canned

Source: ADF&G Kodiak Management Area Finfish Annual Report

Sockeye salmon, the highest value-per-pound species, are significantly more abundant than chinook and coho salmon which are also high value fish. The total value in dollars of the catch fluctuates more than the catch level in numbers of fish, because prices per pound and total weight differences affect the value to the fishermen.

The majority of the processors are located in Kodiak, with a few located in remote bays on Kodiak Island. No processors are located on the Alaska Peninsula at present. The bulk of the salmon are canned. There is an increase in freezing capacity by larger processors, as well as by small mobile units.

The salmon fishery contributes heavily to the fishing industry in the Kodiak Region. The ex-vessel price paid in the recent 5-year period of 1976 to 1980 totalled $122.7 million. However, in the preceding 5-year period, from 1971 to 1975, ex-vessel values were only $19.6 million (Table 2.4-7). For comparison, Table 2.4-8 shows the average earnings during the first year of statehood, 1960. These were direct payments to the fishermen and do not include the additional multiplier effect.

Table 2.4-7:

TOTAL CATCH AND ITS VALUE
AND THE AVERAGE EARNINGS BY GEAR TYPE
FOR 1971 TO 1981

Year	Catch	Total Value In Dollars	Average Earnings Purse Seine	Average Earnings Beach Seine	Average Earnings Set Net
1971	6,376,000	4,973,000	13,397	2,919	3,015
1972	3,890,000	3,909,000	9,233	647	1,451
1973	1,001,000	2,094,000	5,075	251	852
1974	3,323,000	4,808,000	15,993	4,406	4,828
1975	3,187,000	3,831,000	13,300	5,600	3,849
1976	12,484,000	16,976,000	43,017	11,035	14,481
1977	7,977,000	19,721,000	48,382	12,434	19,351
1978	16,942,000	32,325,000	72,158	15,731	25,495
1979	12,420,000	24,083,000	48,906	18,839	23,000
1980	19,157,000	29,613,000	69,117	7,710	21,578
1981	13,094,000	32,339,000	78,294	26,710	36,049

Table 2.4-8:

1960 (FIRST YEAR OF STATEHOOD)
AVERAGE EARNINGS BY GEAR TYPE
(Rounded to Nearest Dollar)

Gear Type	Chinook	Sockeye	Coho	Pink	Chum	Total
Purse Seine	8	611	126	7,577	1,670	$ 9,992
Beach Seine	20	797	67	3,710	700	$ 5,294
Set Net	1	845	20	1,768	247	$ 2,881

Ex-Vessel Value to Fishermen = $3,794,000 in actual 1960 dollars.

2.5 REGIONAL PROFILE SUMMARY

The plan must address a very valuable resource in the context of a complex natural and human environment. Careful consideration must be taken of both human and natural factors that contribute variables to the salmon fishery. All of these factors must be addressed because of the effects on the economy of the salmon resource.

SECTION 3.0

STOCK STATUS

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3.0 STOCK STATUS

3.1 INTRODUCTION

In the Kodiak Region, the present stock status concerns mainly wild stocks. However, on Afognak Island at Kitoi Bay, there are hatchery returns of pink salmon. The contribution of these pink salmon to the fishery in that area is significant, and it appears that it will continue to be a factor. Additionally, there is a small rehabilitation hatchery at Karluk Lake, and there are nine fishpasses supporting runs of pink, coho, and sockeye salmon. Chinook salmon have been successfully introduced into two systems.

Resource data available on the Kodiak Region are substantial. A synopsis of these data presents the stock status of each of the five species of Pacific salmon. Two different time periods have been used. To establish the high historic annual average, the consecutive 20-year high period was used to determine the annual average. The other time period used was the past 20 years, 1963 - 1982. These time periods give a consistent basis for forecasting for the life of this plan, a 21-year period, 1982 - 2002. These data present a perspective on the salmon resources which can be used for assessment of the goals and objectives of this plan.

3.2 STATUS OF WILD STOCKS

3.2.1 Methods for Determining Wild Stock Status

The Alaska Department of Fish and Game is the agency responsible for collecting data which contributes to assessment of the status of wild stocks in the Kodiak Region. Secondary sources may make interpretive manipulations of these data as is done in this plan. The primary source of information, however, is the Alaska Department of Fish and Game.

3.2.1.1 Commercial Harvest Reports

Because of the various federal agencies responsible for Alaska's fisheries since the first commercial exploitation in the 1880s, there has not been a consistent method of data collection. However, it is possible to gain a fair idea of the numbers of fish caught from the 1880s to 1927 for Shelikof Strait (Mainland), Alitak Bay, Red River district, Karluk River district, the northwest coast of Kodiak Island district (Cape Uyak to Whale Passage), Afognak Island district, Marmot Bay district, and the east coast of Kodiak Island district.[6] Federal area reports and ADF&G area management reports contain valuable harvest information from the mid-1930s through 1982. In recent years, particularly with the advent of fish tickets and limited entry, the count of commercially caught fish has become more accurate.

Catch data need to be modified with the various factors that influence them. Increases and decreases in runs are influenced by the number of participants in the fishery, the effectiveness of the gear being fished, the number of openings, the weather during open periods, and human factors such as price disputes.

The commercial fishery is regularly the largest part of the total catch. Data from this catch provide the best numbers with which to construct the strength of the stocks during a given period.

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6 Rich, Willis H. and Edward M. Ball, "Statistical Review of the Alaska Salmon Fisheries, Part II: Chignik to Resurrection Bay", Bulletin of the United States Bureau of Fisheries, Vol. XLVI, 1930, p. 643-712.

3.2.1.2 Sport Fish Harvest Reports

The second major user in the Kodiak Region is the sport fishermen. During the fishing season, a creel census is taken to help define the catch being taken by sport fishermen. These data are further defined by a mail questionnaire that solicits data on effort expended and the catch. The Sport Fish Division of ADF&G annually publishes a statewide harvest report which includes the Kodiak Region.

3.2.1.3 Subsistence Harvest Reports

Reports on subsistence fishing for the Kodiak area have been kept for the past twenty years. Because of the small portion of the catch clearly attributed to this group, it has relatively little impact on the stock status picture. As has been indicated, subsistence use has been the subject of much discussion and definition.

3.2.1.4 Escapement Monitoring

Escapement monitoring adds another valuable piece of information for estimating the overall stock strength. When coupled with harvest data, these data can bring the analysis another step closer to the assessment of the total run's strength. In addition, because it is system specific, it provides the best data on individual stocks and their relative strength.

3.2.1.5 Management Reports

An annual management report is prepared for the Kodiak Management Area by the Commercial Fisheries Division of ADF&G. This report contains a synthesis of salmon harvest and economic data. In addition to the current year's report, tables and figures present a brief historical context in which current information can be assessed.

3.2.1.6 Stock Status Reports

The ADF&G is preparing stock status reports dealing with the important Kodiak Region salmon stocks.

3.2.2 Historical Trends

Over the 100 years (1883-1982) that the salmon fishery has been documented in the Kodiak Region, annual harvests of salmon averaged 6.3 million fish per year. It should be noted that pink salmon catches were not consistently recorded until 1908, although small quantities were packed prior to that time.

Pink salmon dominate the 100-year commercial harvest with an annual average of 4.3 million fish (69%). The contribution of other species are: 1.5 million sockeye (24%); 373,000 chum (5.9%); 62,000 coho (1%); and 1,600 chinook salmon (less than one-hundredth of one percent).

In the past twenty years (1963-1982), salmon production in the Kodiak Region has increased from the 100-year average of 6.3 million to 9.2 million. The even-year average is 11.6 million; the odd-year average is 6.8 million. The annual average contributions of the species for the past twenty years has been: 7.8 million pink (84.8%); 597,000 sockeye (6.5%); 743,000 chum (8%); 64,000 coho (0.7%); and 1,200 chinook salmon (less than one-hundredth of one percent).

From a statewide perspective, Kodiak Region salmon average 18.6% of the annual Alaska production for the 20-year period of 1962-1981. On a species basis, pink salmon accounted for 25.3%, chum 11.4%, sockeye 4.3%, coho 2.4%, and chinook 0.2%.

3.2.3 Pink Salmon

3.2.3.1 Life History

Pink salmon have the shortest life cycle of the Pacific salmon, returning to spawn in their second year. Some streams on the average produce equally well on odd and even-year cycles while others on the average produce much stronger returns on only one cycle year, specifically the even-numbered years in the Kodiak Region.

The return rate for natural spawning pink salmon is generally three returning adults for each spawner. The returning adults which are harvested, averaged over the recent period, 3.8 pounds (3.6 pounds in even years and 3.9 pounds in odd years).

3.2.3.2 Historical Production

Through 1927, the records show that more pink salmon were harvested on the even years. This was undoubtedly because the commercial fishermen were targeting on sockeye destined primarily for Karluk, Red River, and Olga Bay systems. Pink salmon were taken incidentally to the sockeye fishery every year, but only the Red and Karluk Rivers produce large numbers of pink salmon on the even years, hence the larger incidental harvest on even years. Once sockeye were decimated to a large degree, pink salmon were actively sought in the 1930s, and it appears that through 1946 the odd-year cycle was actually stronger than the even-year cycle. From 1946 to the present, the even-year pink salmon run has been dominant with relatively strong returns on both cycles since 1976.

The highest commercial harvest on record for the Kodiak Region occurred in 1980 with 17,291,000 pink salmon. The highest long-term average catch of pink salmon has been in the 20-year period (1963-1982) with an average annual catch of 7,839,000 fish. The average even-year catch was 10,004,000 and the odd-year catch was 5,674,000. It is clear that the current pink salmon fishery in the Kodiak Region is stronger than it was in historic times.

3.2.3.3 Stock Status

Run strengths in the 5-year period 1977-1981 averaged 16,031,000 pink salmon. The escapement counts were estimated to be 4,001,000.

The majority of the pink salmon escapement is contained in 35 of the major river systems. They account for 60% to 85% of the total escapement.

Uganik and Uyak districts have produced pink salmon catches as high as 3.7 million since 1960. Terror, Uganik, and Uyak Rivers are the major producers. The Karluk, Sturgeon, and Red River districts produce large catches in even years and very few pink salmon in odd-year cycles. Major pink salmon systems are Karluk, Sturgeon, and Ayakulik (Red) Rivers. In the Alitak district, Humpy, Deadman, and Dog Salmon Rivers are major producers. In the Afognak district, Waterfall and Portage Rivers - with their fishpasses - and the Afognak River are the best producers. The Mainland district is not a major pink salmon producer. The variability of fishing effort in this district has contributed to fluctuating pink catches in the 1960s and 1970s. The General district is characterized by many smaller streams which produce pinks.

Optimum escapement figures for pink salmon systems in the Kodiak Region are not defined for each system. Desired escapement for many major producers has been determined from studying past escapement/return figures.

3.2.4 Sockeye Salmon

3.2.4.1 Life History

Sockeye salmon in Kodiak Region are generally considered five and six years old at spawning. This species is considered to be a lake-rearing fish, however, spawning sockeye have been observed in systems with no lakes. Generally they will spawn in the streams that are tributaries of a lake and upon emergence will move into the lake. They will spend one or more years in the lake before migrating to sea. In some instances, sockeye salmon may become land-locked, precluding the marine portion of their development. These are known as kokanee and are found in a few locations in the Kodiak Region. The IHN virus is common among wild stocks. Although it can be devastating in hatchery stocks, its toll on wild stocks is unknown.

The return rate for natural spawning sockeye is generally considered to be two or three adults to one spawner. In the recent 20-year period, the average weight of harvested sockeye has been 5.9 pounds.

3.2.4.2 Historical Production

The abundance of sockeye salmon, as measured by the size of the commercial fishery catch, has varied substantially. The single highest catch of record was 4,826,000 in 1901. The highest long-term average catch was for the 20-year period from 1888-1907, when the commercial catch annually averaged 3,185,000.

The average annual catch for the 20-year period 1963-1982 was 597,000. It is evident that the sockeye fishery in the Kodiak Region has an annual yield far below the historic long-term average.

3.2.4.3 Stock Status

Run strengths for the 5-year period 1977-1981 averaged 2,236,000 sockeye salmon. The escapement counts for sockeye are estimated to be 1,383,000.

There are more than thirty sockeye salmon systems in the Kodiak area. Four river systems are identified as the major producers of sockeye: Karluk River, Ayakulik (Red) River, Dog Salmon River (Frazer Lake), and Olga Creek (Upper Station). Approximately 80% of the sockeye, migrating along the west and southwest side of Kodiak Island in June, are bound for these systems.

Historically, the Afognak Island district produced sockeye catches in excess of 100,000 in some years prior to 1930. In the Uganik district, the Uganik River and Little River are sockeye producers. The Alitak district has historically been a sockeye producing district. The four systems, Upper Station, Akalura, Horse Marine, and Silver Salmon, reportedly produced average annual catches of over 400,000 up until 1927. Since the 1950s, the district averaged less than 100,000 fish. The former barren Frazer Lake is beginning to contribute good catches in this district. The Mainland district has no major sockeye systems. The vast majority of the sockeye catches in this district are fish destined for the Chignik River.

3.2.5 Chum Salmon

3.2.5.1 Life History

Chum salmon are generally considered to have a four-year life cycle, although some return in three years or in five years. This species spawns in the side channels of large systems, particularly where there are upwelling springs. Emerging chum fry move quickly into estuarine environments.

The adults return in a ratio estimated to be three adults to one spawner. In the recent 20-year period, the average weight of harvested chum salmon has been 8 pounds.

3.2.5.2 Historical Production

The single highest annual catch of chum salmon in the Kodiak Region was 1,541,000 fish in 1971. The highest long-term average annual catch was during the 20-year period from 1953-1972, when the average was 780,000 chum salmon. For the recent 20-year period, (1963-1982), the average annual catch is 743,000. These numbers make it evident that the chum salmon fishery over the past 20 years in the Kodiak Region has an annual yield near this historic long-term average. However, the past 5-year average is 917,000, above the historic highest long-term annual average.

3.2.5.3 Stock Status

The run strengths in the 5-year period 1977-1981 averaged 1,614,000 chum salmon. The escapement is estimated at 681,000 chum salmon.

The main runs of chum salmon occur on the east side of Kodiak Island where there are many small streams which produce chum, especially in Kiliuda Bay. Other producers are the Sturgeon River and the Kukak river, the latter in the Mainland district.

3.2.6 Coho Salmon

3.2.6.1 Life History

Most coho salmon spend one or two years in fresh water and migrate to sea in the spring of the second or third year. One and one-half years are spent at sea before adults return in the summer or fall. In the recent 20-year period, the average weight of harvested coho salmon has been 7.8 pounds.

3.2.6.2 Historical Production

The highest commercial catch on record of coho salmon was 344,000 in 1982. This was due to increased effort on coho, combined with an excellent coho return. The highest long-term annual average was the 20-year period of 1922-1941 with an annual average harvest of 136,000 coho salmon. The average annual catch for the 20-year period (1963-1982) was 64,000. It is evident that the coho fishery is far below the historic high levels for this period. However, during the past 5-year period, the annual average is 159,000 fish which is above the historic high levels. This 5-year average includes the highest annual catch ever made.

3.2.6.3 Stock Status

Recent run strengths (1977-1981) averaged 151,000 coho salmon. Escapement estimates are at 49,000 coho salmon, but are known to be incomplete.

Many of the Kodiak systems have runs of coho. The largest consistent coho fishery in recent years occurred at the Karluk River and in the Afognak Island and Shuyak Island areas. Fishing effort on coho has increased in recent years.

3.2.7 Chinook Salmon

3.2.7.1 Life History

Of the five Pacific salmon species, the chinook salmon has the longest life cycle, and it may be as long as seven years. However, returning adults that spawn are generally four to five or six years old. The fry typically spend one year in fresh water, and the remainder in salt water.

In the recent 20-year period, the average weight of harvested chinook salmon has been 22.5 pounds.

3.2.7.2 Historical Production

The highest annual commercial catches of chinook salmon occurred in 1900, 1930, 1936, and 1941, when 6,000 fish were harvested. The highest long-term average catch was in the 20-year period from 1927-1946 with an average of 3,000 fish. The average annual catch for the past 20 years (1963-1982) has been 1,200 fish. It is evident that the chinook salmon fishery in the Kodiak Region is far below the historic high levels due to closures. The chinook salmon fishery continued to be at a low level (1,600 fish) during the past 5-year period (1978-1982).

3.2.7.3 Stock Status

In the past 5-year period, the run strength has averaged 14,400 fish. Escapement levels are estimated to be at 12,800 chinook salmon. The Karluk and Ayakulik (Red) Rivers are the only natural chinook salmon runs in the Kodiak Region. The escapement levels for chinook salmon are at record highs. Therefore, the total run strengths are considered excellent.

3.2.8 Summary

The status of wild stocks in the Kodiak Region has been examined in several different ways. Table 3.2-1 summarizes the various methods by which catch and escapement data have been examined. The historical high 20-year period, the recent 20-year period (1963-1982), and the past 5-year period (1977-1981 for escapement) have been calculated. It should be noted that the annual sport fish catch for all five species for the past five years would add an average of 28,000 salmon to these commercial catches. The subsistence catch has averaged 6,200 fish annually for the past 20 years. The average annual catch was 15,000 fish in the past 5-year period. When interpreting data as presented in this section, some qualifications must be kept in mind. The commercial fishery is stable as far as the number of participants. Gear has become noticeably more efficient in recent years. The gear efficiency may in part offset the decreasing amount of time available to the commercial fisherman.

Table 3.2-1:

HISTORICAL COMMERCIAL CATCH PERSPECTIVES
(number of fish)

	Pink	Sockeye	Chum	Coho	Chinook	Total
Highest Single Year	17,291,000 (1980)	4,826,000 (1901)	1,541,000 (1971)	344,000 (1982)	5,000 (1900, 1930, 1936, 1941)	19,152,000 (1980)
Highest Consecutive 20 Years (Annual Average)	7,839,000 (1963-1982)	3,185,000 (1888-1907)	780,000 (1953-1972)	136,000 (1922-1941)	3,000 (1927-1946)	10,075,000 (1930-1949)
Recent 20-Year Annual Average (1963-1982)	7,839,000	597,000	743,000	64,000	1,200	9,244,000
5-year Avg. Est. Run Strength (1977-1981)	16,031,000	2,236,000	1,614,000	151,000	14,000	20,046,000
5-year Avg. Est. Escapement (1977-1981)	4,003,000	1,383,000	681,000	55,000	13,000	6,135,000
1982 Commercial Catch	8,076,000	1,205,000	1,266,000	344,000	1,000	10,892,000

3.3 STATUS OF SUPPLEMENTAL PRODUCTION

3.3.1 Introduction

It has been clear for some time that demands on the salmon resource have been increasing, and that natural salmon fluctuations can result in economic instability for fishermen and individuals in support industries, loss of recreational opportunities, and subsistence hardship. This result was deemed to be undesirable, and several official actions were taken to give assistance to the resource. The most notable of these were the establishment of the F.R.E.D. Division of ADF&G and the regional aquaculture associations.

In the following sections, there will be a discussion of supplemental production techniques that are viewed as useful at one or more locations in the Kodiak Region (see Map 4) and descriptions of contributions to the overall stock strength that are now being made through supplemental production.

3.3.2 Methods of Supplemental Production

3.3.2.1 Hatchery

Hatcheries are used as a production base for salmon rehabilitation and enhancement programs because they are roughly eight times more efficient in converting eggs to fish than the natural environment.[7] The efficiency of hatchery production shortens the time required to rehabilitate depleted stocks. Because of initial investment, hatcheries may appear to be an expensive means of supplemental salmon production. However, there is generally a direct relationship

7 ADF&G, "Annual Report, Division of Fisheries Rehabilitation, Enhancement and Development, 1981," p. 39.

between the cost of a hatchery fish and the life stage at which the hatchery releases the fish. More specifically, the longer the hatchery holds fish, the more dollars it invests in each individual fish. However, this fact is mitigated by the improved survival which is attained with fish that are more fully developed in a hatchery. Short term rearing can double marine survival and substantially increase hatchery benefit and feasibility.

There is currently one production hatchery in the Kodiak Region at Kitoi Bay. It is owned and operated by the state through its F.R.E.D. Division. It has been in pink salmon production since 1976, although it was a research facility prior to that and provided incubation facilities for sockeye eggs and fry for Frazer Lake and lakes on Afognak Island. Today, small numbers of chum salmon are being propagated to build a brood stock. Stocks of chinook, coho, and rainbow trout for the sport fishery are also being developed.

3.3.2.2 Lake Stocking

When rearing area is a limiting factor in salmon production, lakes can be used as natural nursery areas. Some lakes are under-utilized, while others have rearing habitat which is inaccessible due to a barrier. Chinook, coho, and sockeye are the species best adapted to this procedure.

A number of factors need to be considered before lake stocking is selected. The lake must be located where a harvest is feasible. An available and acceptable brood stock is needed. Pre-stocking studies are required to select suitable lakes, thus ensuring that stocked fry will grow and survive to migrate to sea in sufficient numbers. Careful determination of stocking density and timing is crucial to success.

Two lakes in the Kodiak Region have been stocked with chinook salmon fry. These are Lake Rose Tead and Frazer Lake. Sockeye fry and eggs were also planted in Frazer Lake and a number of lakes near Kitoi Bay. These runs are now self-sustaining.

3.3.2.3 Stream Planting

The technique of stream stocking may be advisable when there is a stream with too few salmon to make it probable that the stream will rehabilitate itself within an acceptable time frame. This assumes that the small numbers of salmon are due to overfishing or catastrophic weather conditions, not an absence of habitat. Streams may have areas of under-utilized habitat which could serve as a natural rearing area.

There are at least five different approaches, or a combination of these, to implement this technique. They are identified by the stage of life at which the fish are released. With artifical spawning and natural incubation, green eggs can be seeded in the stream. A second possibility with artificial spawning and partial natural incubation is to plant eyed eggs in the stream. The third choice is to depend on artificial spawning and incubation and natural rearing by releasing unfed fry into the stream. A fourth alternative depends on artificial spawning and incubation and partial natural rearing by releasing fed fry or fingerlings into the stream. The fifth choice is to depend entirely upon artificial spawning, incubation, rearing, and releasing of smolts into the stream.

The Karluk Lake system has been the site for planting eyed eggs for several years. The F.R.E.D. Division has been re-establishing sockeye in the Upper Thumb River portion of the Karluk Lake system. An incubation facility is now in place, and eggs are planted at the eyed stage before winter conditions make it impossible to work in the creeks. Plants of eyed eggs have also been used in Frazer and Laura Lakes to establish sockeye runs. Pink salmon plants of eyed eggs were made in Izhut Bay streams.

3.3.2.4 Lake Fertilization

Addition of nutrients to lakes which serve as nurseries for rearing salmon, particularly sockeye, may increase the quality and quantity of phytoplankton and subsequently zooplankton, the major sources of food for rearing fish. Past studies have shown a clear and strong correlation between the availability of food to juvenile salmon, their size at out-migration, and their survival to adults.

Results of lake fertilization have varied. Some systems have shown a negative benefit, while others have experienced up to 20-fold increases in returning adults. The majority of cases do show some positive benefit.

The ADF&G has guidelines for lake fertilization. The first stage, pre-fertilization study, calls for a detailed study of the physical, biological, and chemical status of the lake. This study should encompass at least one full year's cycle. The study should draw conclusions about the rate and frequency of fertilizer application. The second stage is the application of the fertilizer in one or more sessions as prescribed by the study. The third and final stage is the evaluation of the effort in a post-fertilization study. The assessment of the effects of the application must be related to the overall physical/chemical condition of the lake, growth of juvenile salmon, and the contribution of the effort to the salmon fishery.

Pre-fertilization studies have been conducted on Karluk, Thumb, and O'Malley Lakes, all on the Karluk Lake system.

3.3.2.5 Spawning Channels

The construction of artificial spawning channels is an effort to both increase and enhance the spawning habitat. It permits some control of factors such as water flow, substrate, sedimentation, and predation so that egg-to-fry survival rates are improved. Past experience indicates that there is a strong incentive to explore application of this technique because the egg-to-fry survival in streams may be 10 to 15 percent, while it may increase to 35 to 80 percent with the introduction of spawning channels.

To implement this technique, there must be a controllable water source, the proper terrain, and sufficient salmon stock to utilize the completed project.

3.3.2.6 Habitat Modification - Stream Clearance

Stream clearance, as a means of rehabilitating salmon runs, is at the other end of the complex enhancement spectrum of hatcheries and artificial production. Because of its simplicity, the concept is one that is generally supported by user groups. There are, however, some attendant risks which should be considered. Complete removal of a barrier may cause a velocity barrier, scour downstream gravels, or eliminate pooling areas in a stream. Therefore, selective removal of a portion of the barrier, sufficient to allow passage of fish upstream without substantially altering the flow or downstream conditions, is the desirable level of effort.

The costs in terms of time and equipment vary from site to site. Therefore, if the cost is relatively small, the number of fish to benefit can be smaller and still have a good benefit/cost ratio. The cost of stream clearance is usually high in the Kodiak Region because of the remote locations of projects, usually accessible only by aircraft.

In the evaluation of a potential stream clearance project, assessment should be made of the unutilized spawning or rearing habitat that will be made available, the portion of the barrier to be removed, and the availability of a sufficient spawning population to make use of the new habitat.

Stream clearance has been conducted in the Kodiak Region as funds have permitted. An increase in beaver populations in recent years has created numerous small dams that block salmon migrations on Kodiak Island. Driftwood jams and beach deposits frequently block salmon streams in the Kodiak area.

3.3.2.7 Habitat Modification - Fishpass

The construction of a fishpass (fish ladder or steep pass) is a structured and permanent form of habitat modification. Much of the ultimate success of an individual fishpass will depend on a thorough preconstruction analysis, including estimation of high and low water flows. Thought must be given to the effects on fish species other than the salmon it is designed to benefit. Past experience over a broad range of conditions substantiates the fact that a well placed fishpass can yield a high benefit/cost ratio.

One of the most successful fishpasses provides access to Frazer Lake on Kodiak Island. There are eight other fishpasses in the region, all on Afognak

Island. The five lake and stream systems are Little Kitoi, Seal Bay, Waterfall (three fishpasses open up spawning grounds); Portage, and Pauls Lake (two passes between three lakes). Most of these open spawning area used by pink and coho salmon with some use by sockeye. All major salmon runs on north Afognak Island are served by fishpasses.

3.3.2.8 Habitat Modification - Predator/Competitor Control

This technique is more a modification of the biological habitat than the physical one. It is the process of trying to improve conditions for salmon stocks at any one or a number of different stages in their life cycle by taking direct action on species who prey upon young salmon or compete for food, spawning habitat, or rearing area.

Historically, the most common means was to eliminate Dolly Varden char from salmon streams.

No predator/competitor control is currently taking place in the Kodiak Region. However, plans are underway for controlling stickleback in the Karluk Lake area.

3.3.3 Summary of Supplemental Production

The overall enhancement and rehabilitation program in the Kodiak Region is still in a stage of growth where it is not producing what it is eventually expected to produce. The assignment of numbers of additional fish attributed to supplemental production can be made for the past three years at Kitoi Bay Hatchery. However, it is difficult to calculate numbers of fish produced by other techniques.

In 1982, 321,000 pink salmon returned to the hatchery. In 1981 at Kitoi Bay Hatchery, more than 797,000 pink salmon returned, and at least 663,000 were taken in a commercial fishery near the hatchery. In 1980, 360,000 pinks returned, and an estimated 125,000 were commercially harvested. The egg-take for 1982 at Kitoi Bay Hatchery was 85.7 million pink; 275,000 chinook; and 145,000 chum eggs. At Karluk Lake, 13.8 million sockeye eggs were taken. In 1983, 72 million pink salmon fry were released from the Kitoi hatchery.

Returns of salmon into the Frazer Lake system were recorded as 437,876 in 1982. An additional 54,000 salmon from Frazer Lake were estimated to have been caught in the commercial fisheries. Returns of chinook salmon to the Pasagshak River systems occurred in 1981 and 1982.

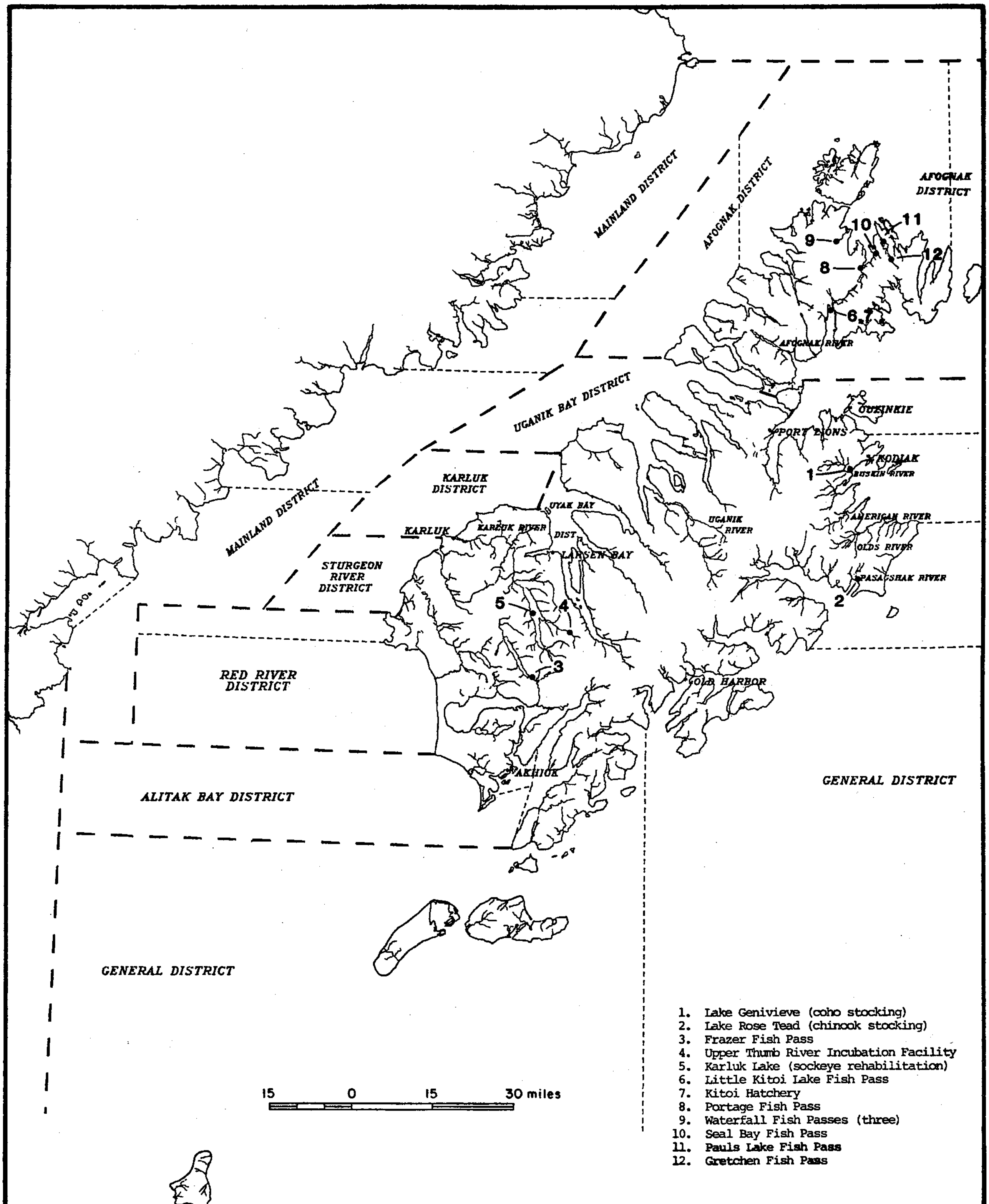
3.4 THE SUMMARY OF SALMON PRODUCTION STATUS

The history of the salmon resource in the Kodiak Region is a long one. Current data show the past 20-year status of the runs has fluctuated from a record high in 1980 to a record low in 1967. The past four years have shown a decided increase in the size of runs. This increase has come from efforts to obtain the proper escapements, to supplement the wild stocks, to implement the 200-mile limit, and weather conditions favorable to survival. The present status, outlined in the following chapters, is one that should offer encouragement about the progress which is possible.

The following chapters will develop goals, objectives, and strategies, to lead to a larger salmon resource, which is based on the full potential of the Kodiak Region, and which can be subjected to a greater harvest without jeopardizing its continuity.

Map 4: KODIAK MANAGEMENT AREA

CURRENT SUPLEMENTAL PRODUCTION SITES



1. Lake Genivieve (coho stocking)
2. Lake Rose Tead (chinook stocking)
3. Frazer Fish Pass
4. Upper Thumb River Incubation Facility
5. Karluk Lake (sockeye rehabilitation)
6. Little Kitoi Lake Fish Pass
7. Kitoi Hatchery
8. Portage Fish Pass
9. Waterfall Fish Passes (three)
10. Seal Bay Fish Pass
11. Pauls Lake Fish Pass
12. Gretchen Fish Pass

Table 3.4-1:

COMMERCIAL CATCH DATA

Historical Catch of the Kodiak Area Salmon
in Numbers of Fish by Species to the Nearest 1,000 Fish
1882 - 1982

YEAR	CHINOOK	SOCKEYE	COHO	PINK	CHUM	TOTAL
1882		59,000				59,000
1883		189,000				189,000
1884		282,000				282,000
1885		469,000				469,000
1886		646,000				646,000
1887		1,004,000				1,004,000
1888		2,781,000				2,781,000
1889		3,755,000				3,755,000
1890		3,593,000				3,593,000
1891		3,846,000				3,846,000
1892		3,126,000				3,126,000
1893		3,245,000				3,245,000
1894		3,830,000				3,830,000
1895		2,247,000	8,000			2,255,000
1896		3,329,000				3,329,000
1897		2,786,000	2,000			2,788,000
1898		2,033,000	19,000			2,052,000
1899	1,000	1,935,000	32,000			1,968,000
1900	5,000	3,450,000	32,000			3,487,000
1901	4,000	4,826,000		2,000		4,832,000
1902	3,000	3,868,000	35,000			3,906,000
1903	1,000	1,826,000	120,000	10,000		1,957,000
1904	3,000	2,875,000	103,000	5,000		2,986,000
1905	2,000	2,142,000	87,000			2,231,000
1906	4,000	3,980,000	24,000			4,008,000
1907	4,000	4,232,000	38,000			4,274,000
1908	3,000	2,488,000	74,000	286,000		2,851,000
1909	4,000	1,915,000	52,000	154,000		2,125,000
1910	2,000	1,955,000	44,000	215,000		2,216,000
1911	1,000	2,686,000	28,000	230,000	6,000	2,945,000
1912	1,000	2,246,000	17,000	547,000	25,000	2,836,000
1913	1,000	1,663,000	28,000	590,000	4,000	2,286,000
1914	1,000	1,255,000	32,000	1,726,000	13,000	3,027,000
1915	1,000	1,664,000	51,000	252,000	20,000	1,988,000
1916	1,000	3,376,000	50,000	2,182,000	29,000	6,638,000
1917	1,000	3,646,000	30,000	225,000	16,000	3,918,000

continued on next page

Table 3.4-1: continued

COMMERCIAL CATCH DATA

Historical Catch of the Kodiak Area Salmon
in Numbers of Fish by Species to the Nearest 1,000 Fish
1882 - 1982

YEAR	CHINOOK	SOCKEYE	COHO	PINK	CHUM	TOTAL
1918	2,000	1,894,000	78,000	2,467,000	82,000	4,523,000
1919	2,000	1,619,000	104,000	283,000	60,000	2,068,000
1920	2,000	1,958,000	89,000	1,977,000	55,000	4,081,000
1921	1,000	2,858,000	46,000	68,000	25,000	2,998,000
1922	1,000	1,097,000	120,000	2,766,000	224,000	4,208,000
1923	2,000	1,090,000	78,000	929,000	39,000	2,138,000
1924	1,000	1,408,000	121,000	5,435,000	118,000	7,083,000
1925	2,000	1,693,000	93,000	2,674,000	212,000	4,674,000
1926	1,000	3,015,000	174,000	4,607,000	325,000	8,122,000
1927	4,000	1,155,000	152,000	5,297,000	418,000	7,026,000
1928	3,000	1,592,000	291,000	1,535,000	726,000	4,147,000
1929	3,000	712,000	144,000	6,108,000	1,058,000	8,025,000
1930	5,000	466,000	229,000	1,651,000	419,000	2,770,000
1931	2,000	1,183,000	170,000	6,840,000	184,000	8,379,000
1932	2,000	1,058,000	52,000	4,710,000	237,000	6,069,000
1933	1,000	1,428,000	91,000	6,574,000	536,000	8,630,000
1934	3,000	1,829,000	86,000	7,642,000	662,000	10,222,000
1935	2,000	1,614,000	63,000	10,781,000	382,000	12,842,000
1936	5,000	2,658,000	163,000	5,648,000	329,000	8,803,000
1937	2,000	1,882,000	134,000	16,788,000	346,000	19,152,000
1938	3,000	1,966,000	133,000	8,398,000	640,000	11,140,000
1939	4,000	1,786,000	64,000	11,741,000	641,000	14,236,000
1940	3,000	1,318,000	163,000	9,997,000	674,000	12,155,000
1941	5,000	1,730,000	208,000	7,601,000	445,000	9,989,000
1942	3,000	1,281,000	106,000	6,093,000	565,000	8,048,000
1943	2,000	1,991,000	61,000	12,480,000	454,000	14,988,000
1944	2,000	1,818,000	45,000	4,956,000	507,000	7,328,000
1945	4,000	2,041,000	79,000	9,045,000	559,000	11,728,000
1946	1,000	839,000	71,000	9,546,000	298,000	10,754,000
1947	1,000	994,000	72,000	8,857,000	295,000	10,119,000
1948	1,000	1,260,000	32,000	5,958,000	331,000	7,582,000
1949	1,000	892,000	54,000	4,928,000	700,000	6,575,000
1950	2,000	921,000	41,000	5,305,000	685,000	6,954,000
1951	2,000	470,000	48,000	2,006,000	422,000	2,948,000
1952	1,000	631,000	36,000	4,554,000	984,000	6,206,000
1953	3,000	392,000	39,000	4,948,000	490,000	5,872,000

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Table 3.4-1: continued

COMMERCIAL CATCH DATA

Historical Catch of the Kodiak Area Salmon
in Numbers of Fish by Species to the Nearest 1,000 Fish
1882 - 1982

YEAR	CHINOOK	SOCKEYE	COHO	PINK	CHUM	TOTAL
1954	1,000	392,000	56,000	8,325,000	1,140,000	9,851,000
1955	2,000	164,000	35,000	10,794,000	482,000	11,477,000
1956	1,000	306,000	54,000	3,349,000	660,000	4,370,000
1957	1,000	234,000	35,000	4,691,000	1,152,000	6,113,000
1958	2,000	288,000	21,000	4,039,000	931,000	5,281,000
1959	2,000	330,000	15,000	1,800,000	734,000	2,881,000
1960	2,000	362,000	54,000	6,685,000	1,133,000	8,236,000
1961	1,000	408,000	59,000	3,926,000	519,000	4,883,000
1962	1,000	785,000	54,000	14,189,000	795,000	15,824,000
1963		407,000	57,000	5,480,000	305,000	6,249,000
1964	1,000	478,000	36,000	11,862,000	932,000	13,309,000
1965	1,000	346,000	27,000	2,887,000	431,000	3,692,000
1966	1,000	632,000	68,000	10,756,000	763,000	12,220,000
1967	1,000	284,000	10,000	188,000	221,000	704,000
1968	2,000	760,000	56,000	8,761,000	750,000	10,329,000
1969	2,000	604,000	35,000	12,493,000	537,000	13,671,000
1970	1,000	917,000	66,000	12,045,000	919,000	13,949,000
1971	1,000	478,000	23,000	4,333,000	1,541,000	6,376,000
1972	1,000	220,000	17,000	2,690,000	1,164,000	4,093,000
1973	1,000	167,000	4,000	512,000	318,000	1,002,000
1974	1,000	415,000	13,000	2,646,000	248,000	3,323,000
1975		136,000	24,000	2,943,000	84,000	3,187,000
1976	1,000	630,000	23,000	10,906,000	718,000	12,277,000
1977	1,000	624,000	25,000	6,274,000	1,071,000	7,994,000
1978	3,000	1,072,000	49,000	15,004,000	814,000	16,942,000
1979	2,000	632,000	141,000	11,288,000	358,000	12,420,000
1980	1,000	651,000	139,000	17,291,000	1,076,000	19,157,000
1981	1,000	1,289,000	122,000	10,337,000	1,345,000	13,094,000
1982	1,000	1,205,000	344,000	8,076,000	1,266,000	10,892,000

Sources:

Data prior to 1934: Historical Salmon Catches of Alaskan Commercial Fisheries, ADF&G, Juneau, 1980.

Data after 1934: Kodiak Management Area Annual Report, 1982.

SECTION 4.0

TARGET 2002 STATUS

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4.0 TARGET 2002 STATUS

4.0 TARGET 2002 STATUS

4.1 BACKGROUND OF THE TARGET 2002 STATUS

After examination of projected natural run data, the RPT concluded that significant shortfalls would exist by the year 2002 between the needs of the fishermen, projected natural runs, and current supplemental production. Therefore, it was concluded that production of more fish in the Kodiak management area was required in order to provide the basis for continuing the economic viability for all participants in the salmon fishery in the region.

To reach a determination of what a future required harvest level might be, the RPT closely examined catch and ex-vessel price data for each user group and determined trends that were occurring in the fishery. One of the major assumptions of this plan is that there will be an increase in commercial catch due to better equipment, gear, and technological improvements during the plan period. Additionally, there will be increased harvest from sport fishermen along the Kodiak road system. The RPT found that the ex-vessel value to fishermen was generally increasing from the period 1972-1981. However, in 1982, there was a dramatic decrease in ex-vessel prices paid to fishermen. It does not appear that the same set of circumstances, which contributed to the low 1982 prices, will occur in 1983. However, the objectives set for each species in the plan take into account that there will be price fluctuations from year to year. Additionally, the RPT acknowledged the continued requirement for the fishery to support future harvests by subsistence users and users who are identified under the new category of personal use.

4.2 QUALIFICATION OF THE TARGET 2002 STATUS

The continued achievement of catch objectives in the salmon fishery in the Kodiak Region required that the RPT examine the relationship between what user groups seek from the resource and the ability of the resource to continue to respond to this pressure. The establishment of the target goals expressed what the RPT determined to be the user group needs. After these user group needs were determined, the RPT examined the ability of the natural resource plus current supplemental production to meet these needs in terms of a "projected status". The difference between the user group needs and the projected status was determined to be the "gap" that must be filled. The identification of supplemental production projects and the number of salmon they may produce, is the methodology recommended by the RPT to respond to harvest pressure.

The RPT also felt that the target goals could be sustained in the Kodiak Region with the addition of the supplemental production outlined in Section 6.

The projects outlined in Section 6 were felt by the RPT to provide for an orderly expansion of the resource, as well as provide for the continued gathering of additional data in order to better understand the resource base.

The RPT also felt that limited entry legislation will remain in force, and the number of limited entry permit holders will not significantly change during the plan period. However, the number of participants in the sport fishery will continue to increase. In spite of this increase, the RPT felt that due to the geographical location of Kodiak and the limited road system throughout the management area, it is not expected that this user group will present a major "pressure" on the total fishery during the plan period. Past data indicate that approximately 80% of the harvest and effort in the sport fishery occurs on the Kodiak road system, primarily impacting coho salmon.

The future number of participants in the subsistence fishery will be determined by qualifications established by the Alaska Board of Fisheries. In 1982, 1,277 permits were issued for subsistence fishing. Approximately 30,000 salmon are taken annually in this fishery. This number excludes commercial fish taken for personal use which, based upon questionnaire data, the RPT estimates to be approximately 14,000 fish. This does not represent a major fishing pressure in the Kodiak Region during the plan period, however, strategies and specific projects will need to provide salmon in certain locations to support subsistence use.

4.3 QUESTIONNAIRE DATA

The final element examined prior to establishing target goals was public input data. In February, 1983, the RPT designed and sent questionnaires to commercial permit holders, commercial crew members, subsistence permit holders, and sport fish license holders in the Kodiak Region. The objective of this task was to obtain a representative sample of preferences for the type of fish these groups would like to catch in the future, problems they were currently experiencing, and preferred methods of rehabilitation and enhancement. The questionnaire was designed to provide the RPT with overall trends and a feel for the "general direction" in which each of these groups would like to proceed in the development of further rehabilitation and enhancement programs in the Kodiak Region.

The complete questionnaire data is contained under separate cover and available upon request at the Kodiak office of the Alaska Department of Fish and Game. The data is divided by commercial permit holders, commercial crew, sport fishermen, and subsistence fishermen. The summary of the data is as follows.

COMMERCIAL PERMIT HOLDERS

The RPT sent 607 questionnaires to commercial permit holders in the Kodiak Region. The breakdown was:

1. Purse seiners - 381
2. Set netters - 185
3. Beach seiners - 34

The RPT received 214 responses for a 35% return.

The general findings from the commercial permit holders were:

1. 85% of those surveyed commercially fished in the Kodiak Region in 1982.

2. In 1982, the majority (63%) of those sampled were not satisfied with their fishing income. This dissatisfaction primarily related to the prices received for salmon in the Kodiak Region in 1982. These prices were some of the lowest in recent years. However, 81% of those sampled were satisfied with their income during the period 1979-1981, when prices were higher. In neither case were they dissatisfied with the number of fish available for harvest.

3. The majority of those sampled need to gross between $30,000 and $150,000 from all sources to cover their fishing and living expenses. These data fell into two groupings. One group needed to gross between $30,000 and $70,000. A second group needed to gross between $80,000 and $150,000.

4. Most of those sampled have licensed commercial fishing boats, and 60% of those boats appeared to be paid for, because the respondents stated they were not financing their boats. Tying closely to this was the average total investment in their fishing gear. The majority of respondents have a total investment of between $100,000 and $200,000 in fishing gear. The RPT noted that the total investment figure ties closely to the financial requirements of between $30,000 and $150,000, which respondents say they need to make in any given year.

5. More than 25% of the respondents fish in multiple fisheries. These include salmon, crab, halibut, and herring.

6. The majority of respondents in terms of "species that they prefer to fish", responded in the following manner:

   (1) First choice was sockeye salmon.

   (2) Second choice was pink salmon.

   (3) Third choice was chum salmon.

7. In response to the question of which species they would like to see increased, there was a one-to-one tie to those which they prefer to fish. The order of preference was: (1) sockeye, (2) pink, and (3) chum. There was also a strong preference for coho salmon. The RPT concluded that the preference for coho salmon will vary depending upon the purse seiners' pink salmon season.

8. More than 50% of the respondents take fish home for personal use. In terms of the choice they like to take home for personal use and numbers of fish they take home, the data indicated: (1) sockeye and (2) coho.

   This is also the same preference for species that is reflected in the data obtained from the subsistence permit holders.

9. The majority of those sampled prefer to fish in the General District. This ties closely to the fact that the majority of responses were from purse seine permit holders. However, this is a minor conflict with the preference to fish for sockeye salmon and the respondents' first choice to see sockeye salmon runs increased. However, it ties closely to the respondents' second choice, which was pink salmon, as the species that the respondents preferred to see increased.

10. To the question: "in which districts do you wish to have salmon stocks increased?", commercial permit holders responded as follows:

    (1) Alitak District. This was the first choice and ties directly to the preference to see an increase in sockeye salmon.

    (2) General District. This was the second choice and ties closely to the second choice of species the respondents would like to see increased, which were pink salmon.

    (3) Karluk District. Again, this ties closely to the first choice of species that the respondents would like to see increased, which are sockeye salmon.

11. Problem areas identified in the commercial fishery were as follows:

    (1) Markets/prices.

    (2) Overcrowded fishing areas. (The strike in Kodiak, causing a short season, could be the reason for overcrowded fishing areas in 1982.)

    (3) Lack of enforcement.

12. In terms of increasing salmon runs and benefits from the resource, the commercial fishermen preferred that the following activities take place:

    (1) Stocking previously unproductive lakes.

    (2) Fertilizing lakes.

    (3) Clearing streams of logs and boulders.

    (4) Building hatcheries.

Items #1 and #2, stocking previously unproductive lakes and fertilizing lakes, relate directly to the preference that commercial fishermen indicated for fishing for sockeye salmon, as well as their choice for the the "number 1" species to be enhanced. Item #4, building hatcheries, relates directly to increasing pink salmon runs.

COMMERCIAL CREW MEMBERS

The RPT sent out 100 questionnaires (a 5% sample) to the commercial crew permit holders listed in the Kodiak Region. Sixteen responses were received for a 16% return. This was the lowest return of any of the groups sampled. The data from the returns were not sufficient in the RPT's mind to draw any major conclusions. However, certain statements can be made regarding desires of this group. They are as follows:

1. All commercial crew permit holders sampled fished in the Kodiak Region.

2. The majority were satisfied with their total earnings in 1982. However, more than 50% of them stated that they were not satisfied with their earnings from salmon fishing in 1982. The majority of those sampled were satisfied with their earnings from fishing for the period 1979-1981.

3. The majority of those sampled said they needed between $4,000 and $25,000 to cover their fishing and living expenses in any given year.

4. All stated that they must participate in multiple fisheries in order to cover fishing and living expenses.

5. The majority of those sampled prefer to fish for sockeye, coho, and chum salmon. This ties closely to the "number 1" preference (sockeye) of the commercial permit holders.

6. The majority of those sampled take some of their catch home, and they prefer to take home sockeye, coho, and chinook salmon. Most respondents stated they take sockeye home. This ties closely to the data contained in the commercial permit holder information.

7. Major problems seen by this group were:

   (1) Markets/prices.

   (2) Lack of enforcement.

8. As is the case with commercial permit holders, crew members would like to see the following rehabilitation and enhancement projects taking place in the Kodiak Region during the next twenty years:

   (1) Stocking previously unproductive lakes.

   (2) Building hatcheries.

   (3) Fertilizing lakes.

SUBSISTENCE PERMIT HOLDERS

The RPT sent out 150 questionnaires to subsistence permit holders in the Kodiak Region. This represents a 12% sample. There were 50 total responses for a 33% return. The general trends from the data are:

1. Set gillnets were utilized by 94% of the respondents in the Kodiak Region.

2. The preference in terms of the types of fish they like to eat are:

   (1) First choice is sockeye.

   (2) Second choice is coho or chinook. Inasmuch as they get very few chinook salmon, the RPT felt that the primary second choice was coho salmon.

3. The majority of subsistence salmon caught by the respondents were sockeye salmon. Sockeye had a better than a four-to-one ratio in terms of catch to the next closest species, which was coho salmon.

4. An adequate 1982 subsistence catch was reported by 65% of the respondents.

5. The Buskin beach area was fished with set gillnets by 72% of the respondents. The balance of the respondents fished primarily the Afognak/Litnik area. The remainder fished in 19 different locations throughout the Kodiak Region.

6. The preferred fish for subsistence is the sockeye salmon, followed by coho. It should be noted that these are also two of the top preferences for the sport fishermen, and the sockeye salmon is the "number 1" preference for the commercial fishermen.

7. Major problems listed by subsistence fishermen were:

   (1) Overcrowding. The feeling of the RPT is that this primarily takes place in the Buskin beach area.

   (2) Restrictive regulations.

   (3) Lack of access to fishing areas.

8. The rehabilitation and enhancement activities favored by the subsistence fishermen are as follows:

   (1) Stock previously unproductive lakes.

   (2) Construct spawning channels.

   (3) Build fish ladders.

   Based upon these priorities, the subsistence fishermen have indicated a strong preference for sockeye salmon enhancement. This ties closely to the "number 1" preference of fish in terms of what they like to eat, as well as the "number 1" fish they prefer to catch.

SPORT FISH LICENSE HOLDERS

Utilizing the mailing list developed by Mike Mills of the Sport Fish Division, the RPT sent out 266 sport fish questionnaires. There were 74 responses for a 36% return. A summary of the information contained in the data is:

1. The majority of those responding fished on the Kodiak road system. The primary areas were the Buskin River/Buskin beach; Pasagshak River; and American River.

2. Total days fished per year was 23 days. This corresponded closely to the data contained in a Statewide Postal Survey conducted by Mike Mills which showed an average of 21 days fished by sport fishermen in Alaska.

3. Most of the anglers (89%) fish from the shore in the Kodiak Region.

4. The "number 1" preference in terms of fish was coho salmon.

5. The majority of respondents release a substantial number of fish they catch.

6. The majority of respondents are satisfied with their catch and do not need to catch their limit in a single day to be satisfied. Furthermore, 79% of the respondents stated that they were satisfied with one or two fish, regardless of species, in a day's fishing.

7. Although the "number 1" preference for sport fishermen in terms of catch is coho salmon (primarily because this is what they can catch on the road system), their "number 1" preference for species to be enhanced is chinook salmon, followed by coho salmon and sockeye salmon.

8. The three most important problems seen by sport fishermen are:

   (1) Overcrowding of fishing areas.

   (2) Lack of enforcement.

   (3) Lack of boat slips.

9. In terms of rehabilitation and enhancement preferences by the sport fishing group, the first three choices were as follows:

   (1) Stock previously unproductive lakes.

   (2) Fertilize lakes.

   (3) Build hatcheries.

Stocking of previously unproductive lakes and fertilizing of lakes, primarily relate to the sport fishermen's choice for more coho salmon. Building hatcheries relates directly to their choices for increased coho salmon and chinook salmon, which would be available to them along the Kodiak road system.

SUMMARY

From general trends in the data contained in the questionnaires, the following points can be made:

1. All three gear groups prefer to have sockeye salmon enhanced.

2. The major rehabilitation and enhancement activities they would like to see are: (1) stocking previously unproductive lakes, (2) fertilizing lakes, and (3) building hatcheries. These activities relate directly to their desire to increase sockeye runs for all user groups, increase pink runs in the General District for commercial permit holders, and increase coho and chinook runs along the road system for sport fishermen.

3. The most important problems as seen by groups in the area are: (1) overcrowding of fishing areas, and (2) lack of enforcement.

4.4 TARGET 2002 STATUS

Based upon the assumption that a greater amount of salmon would be required to meet harvest demands, the RPT established a target towards which the efforts of the plan would be directed. After considerable review of historic and current trends and levels of harvest, a target goal of 22,950,000 salmon of all species available for harvest in the even years by the year 2002, and 17,950,000 in the odd years, was adopted. This mark was developed for harvestable fish by species as follows:

		Even Year	Odd Year
Pink Salmon	-	18,500,000	13,500,000
Sockeye Salmon	-	1,900,000	1,900,000 *
Chum Salmon	-	2,000,000	2,000,000
Coho Salmon	-	543,000	543,000
Chinook Salmon	-	7,000	7,000
TOTAL:		22,950,000	17,950,000

These figures are based upon the following assumptions:

- The current natural runs will be maintained at the present levels.
- Expected fluctuations of $\pm$ 20% could occur.
- That necessary funds will be available from the "Fisheries Enhancement Loan Program" for the supplemental production projects required to achieve the target goals.
- Enough is known about the technical and biological limitations of salmon production to identify target goals for each species.

The next section, entitled "Gap Analysis" examines the "gap" between the projected status and target goals.

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* Potential exists to increase this number even further by lake enrichment projects.

SECTION 5.0

GAP ANALYSIS

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5.0 GAP ANALYSIS

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5.0 GAP ANALYSIS

5.1 INTRODUCTION

To conduct this analysis, the RPT felt it was necessary to define the "gap" with its qualifying elements. Based upon this analysis, it would then be possible to identify many of the variables which could affect the magnitude of such a "gap". Consideration could then be given to the means for closing that "gap" and the economic and biological implications of that closure.

5.1.1 Definition of Terms

The RPT developed a series of definitions to relate to terms used in projecting the number of salmon available to close the "gap" or to arrive at the Target 2002 goals and the "gap" figures. The terms are as follows:

(1) Recent 21-Year Average: This is the historical catch for the years 1962-1982. Historical commercial catch data is listed in Section 3 in Table 3.4-1, entitled "Commercial Catch Data - Historical Catch of the Kodiak Area Salmon in Numbers of Fish by Species to the Nearest 1,000 Fish 1882-1982."

(2) Present Condition: The average catch for the previous five years, 1978-1982.

(3) Projected Status (natural stocks only): The continuation of the present condition without additional supplemental production. This number is represented by a single figure (expected fluctuation of ± 20%) which the RPT felt takes into account the factors that could impact the natural runs during the plan period.

(4) Target 1992 Goal: The desired magnitude of the salmon resource by the year 1992, as a result of both natural and supplemental production.

(5) Target 2002 Goal: The desired magnitude of the salmon resource by the year 2002, as a result of natural and supplemental production.

(6) Gap: The required increase of salmon needed from the projected status to meet the Target 1992 and 2002 goals.

5.1.2 Perspective on "Gap"

The RPT felt that the number of fish required to fill the "gap" was achievable. This determination was made as a result of analyzing the goals established for each species for 1992 and 2002, as well as the validity of the assumptions made by the RPT. The RPT also felt that the efforts to close the gap will need to be carefully coordinated due to interrelationships of salmon stocks in the region and factors (such as increased commercial harvest) associated with any project aimed at increasing salmon production.

The potential of each of the five species of salmon to contribute to closing this gap will vary. Not only are the absolute levels of catch for the five species widely separated now, but their respective reproductive rates are markedly different. The perspective is complicated even more by the increase in survival and harvest rates of salmon produced by hatcheries as compared to natural stocks.

A final point is that the number of fish required to close the "gap" varies between the five species, and the increase of one species in total numbers may have an effect on the capability of another species to reach its potential.

Opportunities to increase salmon above present levels and to improve the management of the fishery exist. Each of these opportunities, which is part of a long-range strategy, will have to be assessed thoroughly before they are implemented. Phase II, which will look at specific projects, is anticipated to include a thorough project-by-project analysis which will take into account the previously listed interrelationships.

The RPT felt that the long-term strategies to close the "gap" would involve the entire range of rehabilitation and enhancement methods. The particular rehabilitation and enhancement method utilized during the plan period to enhance salmon stocks will be closely examined in the planning stage. This examination will include an evaluation of the benefit/cost of each project.

The "gap" represents not only an additional quantity of fish, but also the need for more data about the salmon resource.

In the last analysis, the RPT felt the reason for planning to close the "gap" is to increase wild stocks, while also developing the ability to produce more harvestable salmon on a sustained basis through artificial means. Both artificial and wild stocks will be managed on an optimum sustained yield basis. Although harvest policies applied to the increased resource are outside the jurisdiction of the RPT, it is clearly the intent of the plan that the resource benefit all user groups.

5.1.3 Structure of the Analysis

The structure of the "gap" analysis involves the following elements:

(1) The first element involves a review by the RPT of the recent 21-year average (1962-1982). From this review the RPT decided that it would be appropriate to develop a high mean and a low mean for this period, in order to take into account the environmental fluctuations that had affected the natural runs. Furthermore, this would also enable the RPT to project a "status" through 1992 and 2002 which would also take into account environmental fluctuations.

(2) Secondly, the RPT developed a present 5-year average (1978-1982). This present 5-year average was utilized by the RPT for the "high" projections of the natural stocks. It was felt that the present 5-year average was more representative than the last 21-year average.

(3) Table 5.2-1, entitled "Present Condition of Natural Runs", outlines the odd-year and even-year recent 20-year average and present average by species. The table also sets forth the odd-year and even-year escapements, as well as the odd-year and even-year total runs based upon the recent 20-year average and the present 5-year average.

(4) The RPT's analysis identified activities required to reach the 1992 goals.

(5) The RPT's analysis identified activities required to reach the Target 2002 goals.

(6) The final element of the overall analysis was a summary of the implications of the "gap" closure.

5.2 THE PRESENT CONDITION

The beginning of this analysis was to define a point against which future actions may be referenced. Table 5.2-1, entitled "Present Condition of Natural Runs", indicates what has been accepted as this starting point. The present condition table includes the recent 1962-1982 averages and the present condition. The present condition is defined as the average catch for the past five years (1978-1982), which the RPT felt was a more representative base period for the projections of natural stocks than the recent 1962-1982 averages. The table also shows recent 1962-1982 averages, illustrated with a low-mean and high mean-figure. Low-mean is defined as the average of the lowest eleven years between the years 1962 and 1982. High-mean is defined as the average of the highest eleven years between 1962 and 1982.

The general pattern that has been established during the previous years by state management will be continued during the life span of this plan, thereby lending the element of continuity to the harvest management practices.

The total run in Table 5.2-1, including commercial, sport, and subsistence catch during the present period (1978-1982) was 23,400,000 fish for the even years and 18,300,000 fish for the odd years. The total escapement averages for all species combined for the even years was 7,900,000 and for the odd years was 5,400,000. During the present period, it was assumed that all fish were a combination of natural stocks and production from the Kitoi Hatchery. The species composition of the present condition is also shown on Table 5.2-1.

TABLE 5.2-1:

PRESENT CONDITION OF NATURAL RUNS

Species	Recent 1962-1982 Averages Low-Mean	Recent 1962-1982 Averages High-Mean	Present 5-Yr. Average 1978-1982
CATCH:			
Pink - Odd Year	2,173,000	9,170,000	10,812,000
Pink - Even Year	8,758,000	14,078,000	13,457,000
Sockeye	353,000	837,000	970,000
Chum	399,000	1,063,000	972,000
Coho	20,000	103,000	159,000
Chinook	1,000	2,000	2,000
Total Catch:			
- Odd Year	2,946,000	11,175,000	12,915,000
- Even Year	9,531,000	16,083,000	15,560,000
ESCAPEMENT: (1)			
Pink - Odd Year	835,000	2,224,000	3,129,000
Pink - Even Year	2,250,000	3,898,000	5,623,000
Sockeye	585,000	1,222,000	1,448,000
Chum	136,000	564,000	737,000
Coho (2)	21,000	47,000	61,000
Chinook	2,000	6,000	8,000
Total Escapement:			
- Odd Year	1,579,000	4,063,000	5,383,000
- Even Year	2,994,000	5,737,000	7,877,000
TOTAL RUN:			
Pink - Odd Year	3,008,000	11,394,000	13,941,000
Pink - Even Year	11,008,000	17,976,000	19,080,000
Sockeye	938,000	2,059,000	2,418,000
Chum	535,000	1,627,000	1,709,000
Coho (2)	41,000	150,000	220,000
Chinook	3,000	8,000	10,000
Total Run All Species:			
- Odd Year	4,525,000	15,238,000	18,298,000
- Even Year	12,525,000	21,820,000	23,437,000

(1) Escapements are department estimates based upon a combination of aerial surveys, foot surveys, and weir counts.

(2) Does not represent total run. Only a portion of the coho escapement is counted.

Table 5.2-2:

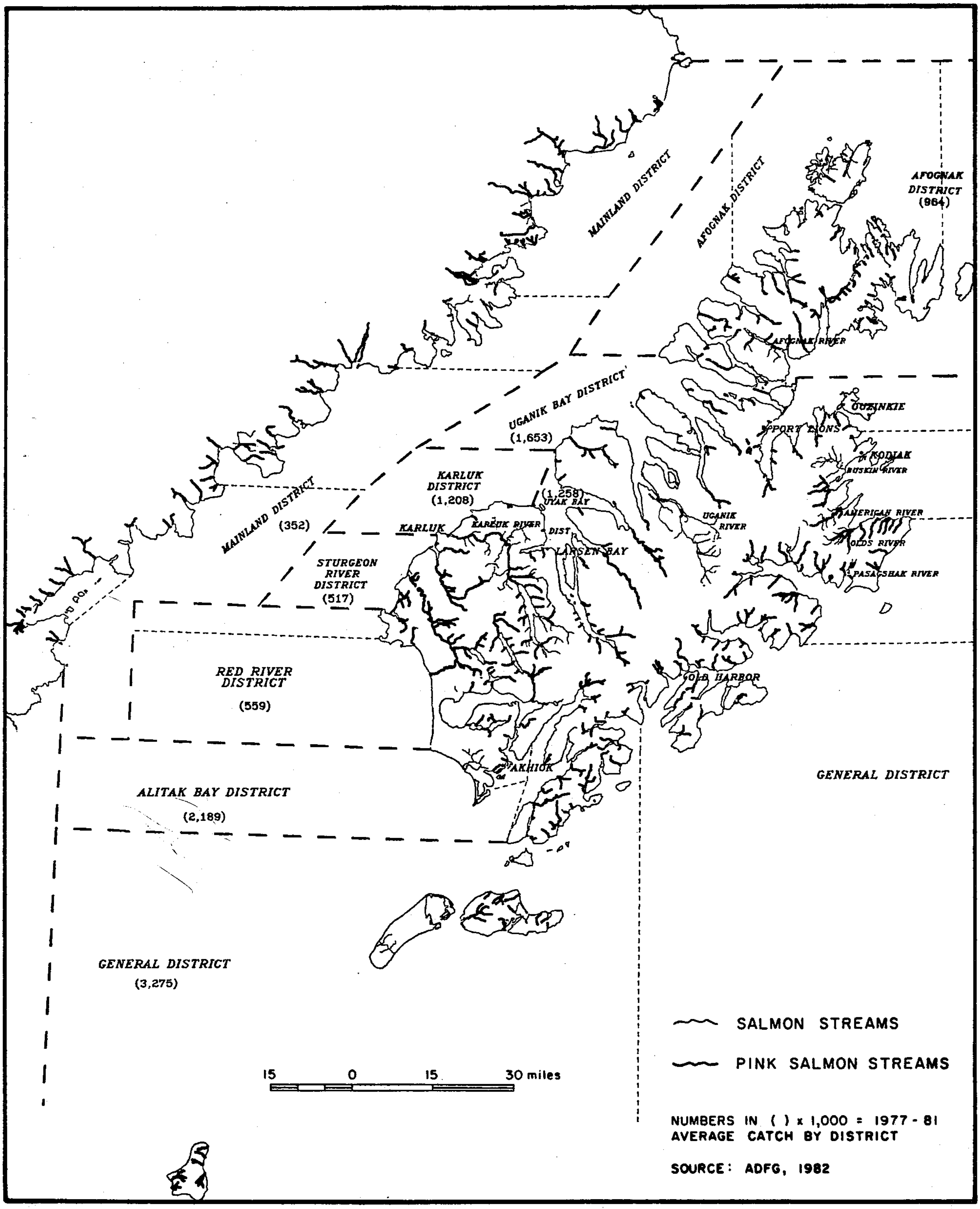
5-YEAR AVERAGE CATCH (1977-1981) PER DISTRICT PER SPECIES

(number of fish)

District	Chinook	Sockeye	Coho	Pink	Chum	Total
Alitak	200	232,000	10,000	2,189,000	59,000	2,490,200
Red River	300	155,000	2,000	559,000	3,000	719,300
Sturgeon	0	16,000	3,000	517,000	3,000	539,000
Karluk	0	37,000	7,000	1,208,000	6,000	1,258,000
Uyak	200	76,000	6,000	1,258,000	45,000	1,385,200
Uganik	200	83,000	9,000	1,653,000	75,000	1,820,200
Afognak	100	43,000	40,000	964,000	32,000	1,079,100
General	400	31,000	19,000	3,275,000	394,000	3,719,400
Mainland	100	181,000	2,000	352,000	301,000	836,100

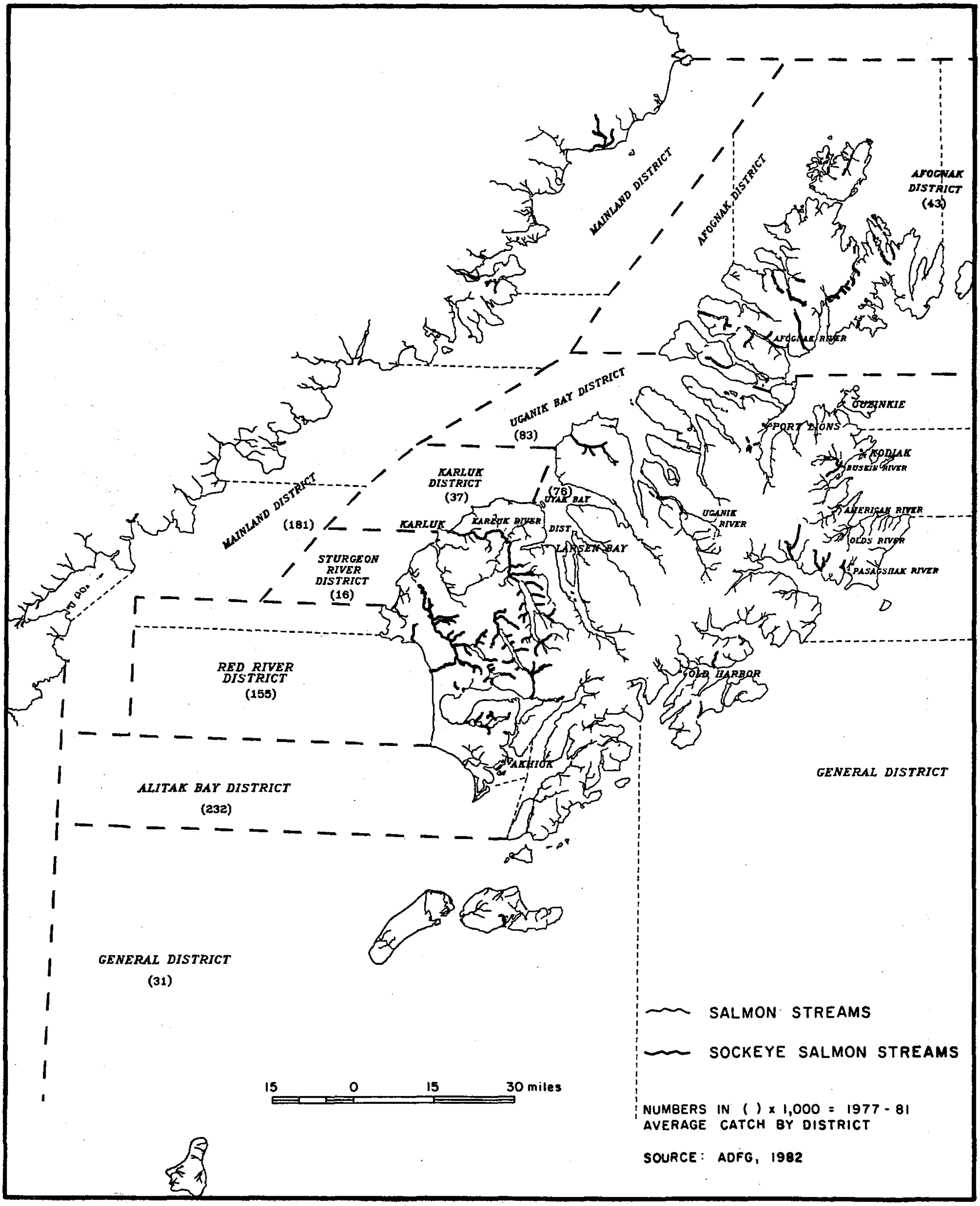
Map 5: KODIAK MANAGEMENT AREA

PINK SALMON DISTRIBUTION AND CATCH DATA



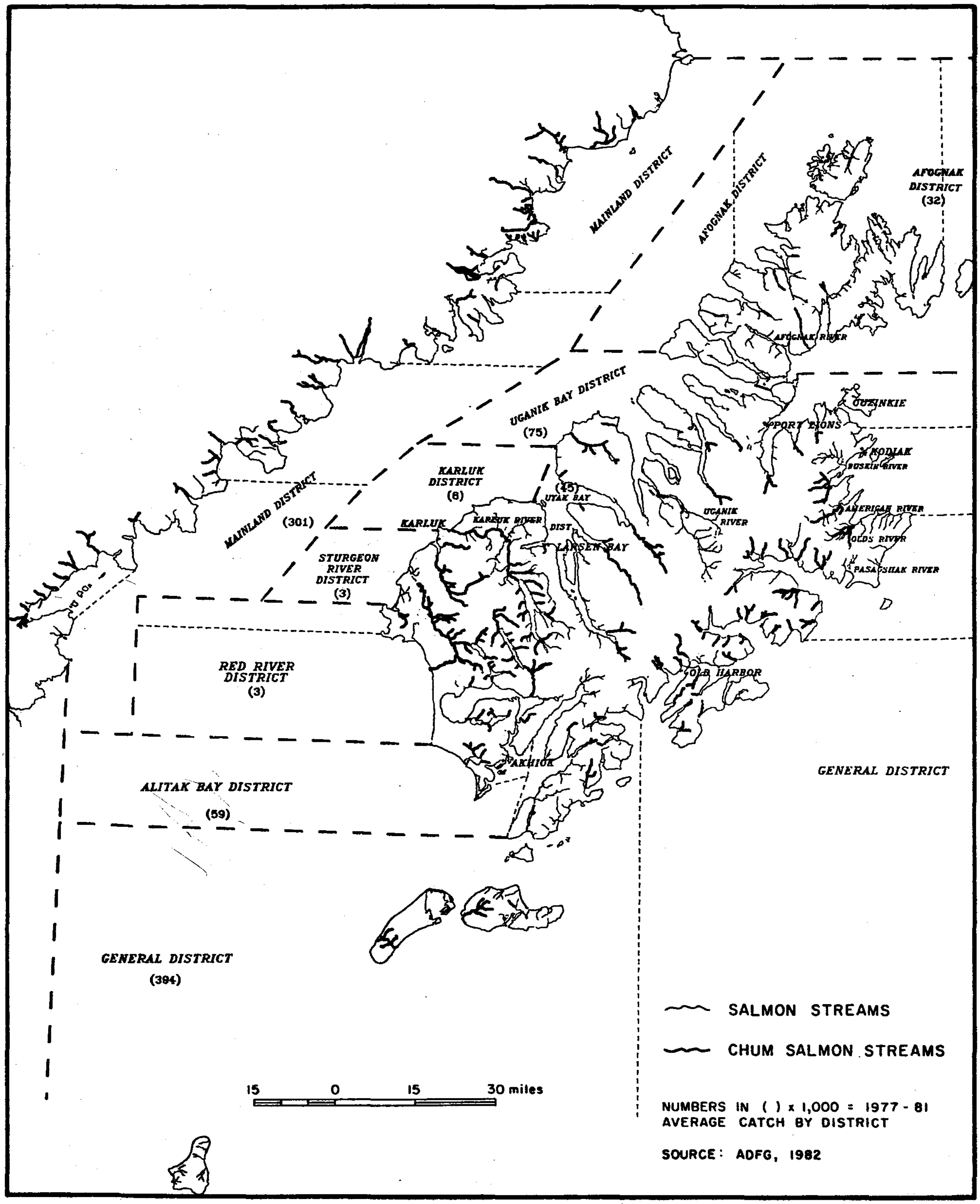
Map 6: KODIAK MANAGEMENT AREA

SOCKEYE SALMON DISTRIBUTION AND CATCH DATA



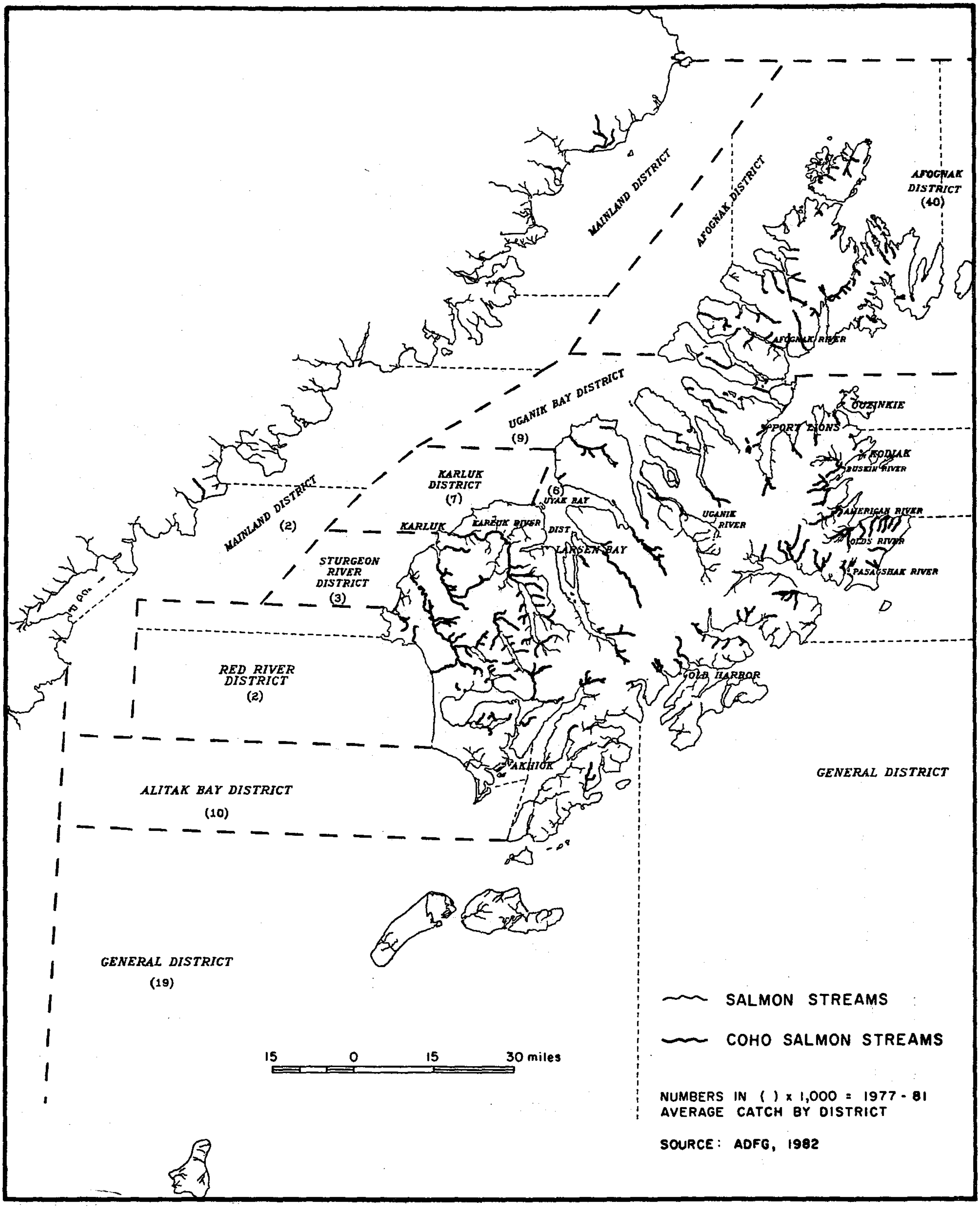
Map 7: KODIAK MANAGEMENT AREA

CHUM SALMON DISTRIBUTION AND CATCH DATA



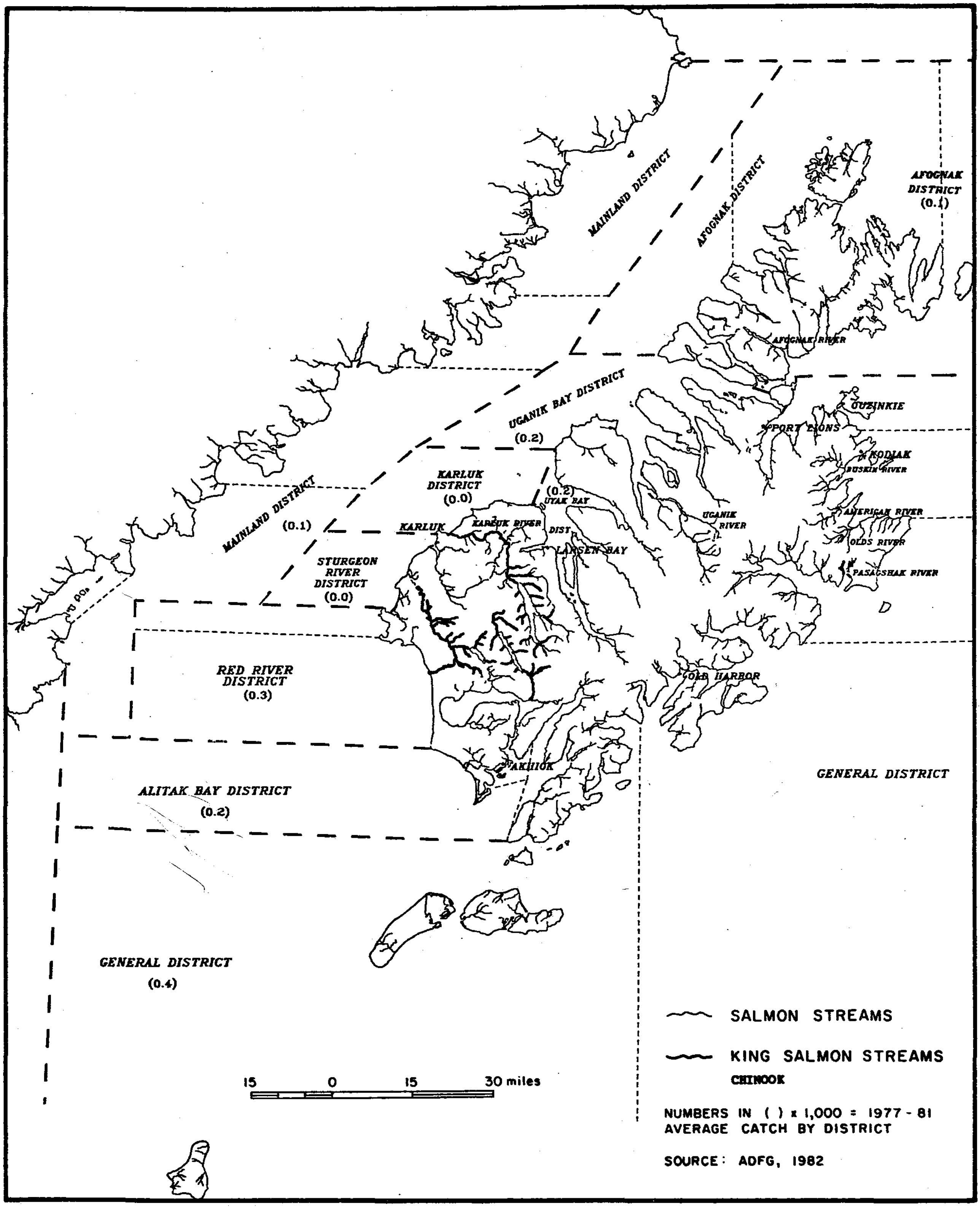
Map 8: KODIAK MANAGEMENT AREA

COHO SALMON DISTRIBUTION AND CATCH DATA



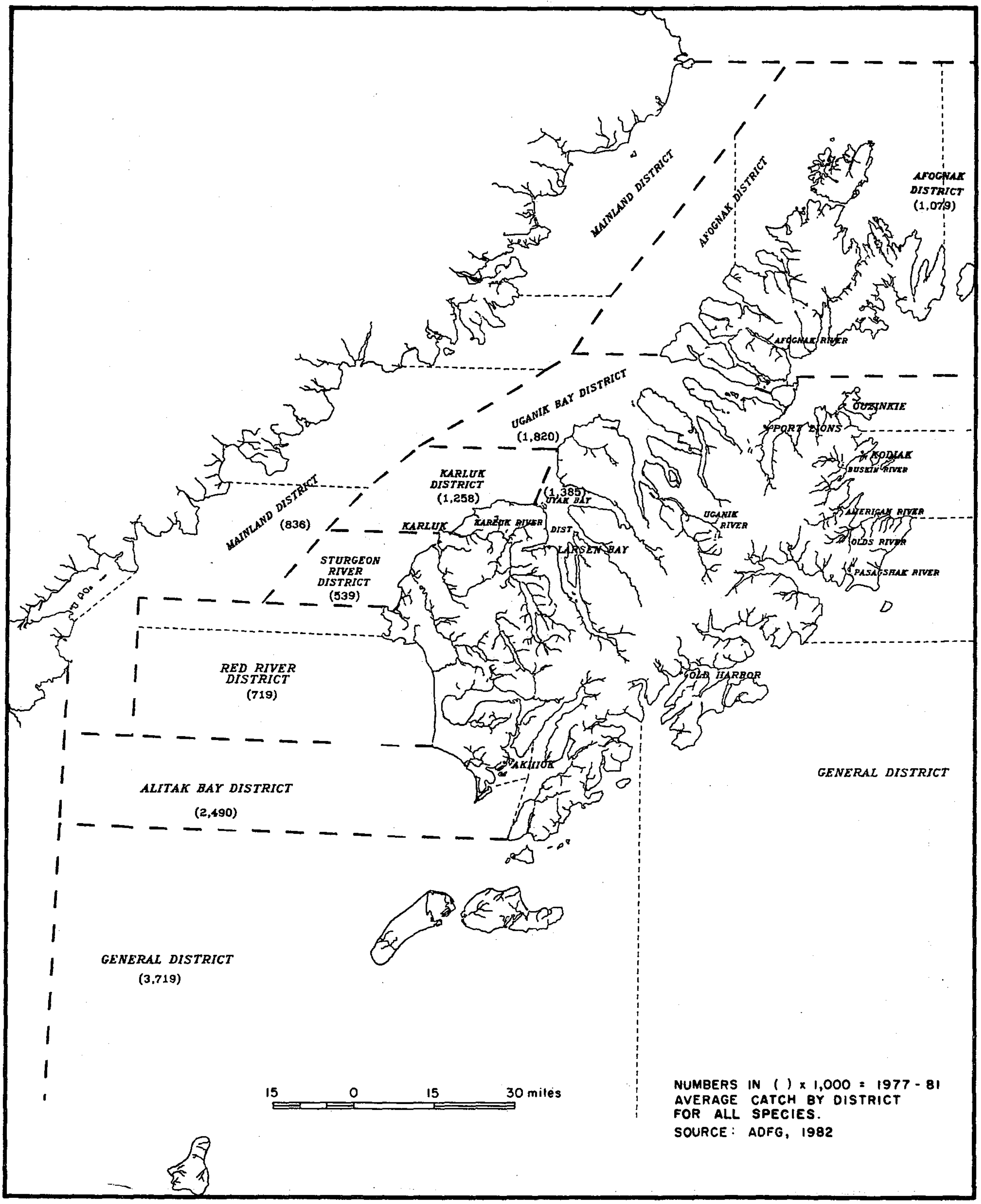
Map 9: KODIAK MANAGEMENT AREA

CHINOOK SALMON DISTRIBUTION AND CATCH DATA



Map 10: KODIAK MANAGEMENT AREA

5-YEAR AVERAGE CATCH BY DISTRICT FOR ALL SPECIES
(1977-1981)



5.3 TARGET 1992 and 2002 GOALS

The RPT recognized 1992 as a half-way point in the plan and 2002 as the final point.

Tables 5.3-1 and 5.3-2, entitled "Projected 1992 Status" and "Projected 2002 Status", show the target goals established by the RPT for each species for the years 1992 and 2002. The tables also show the supplemental production required to achieve these target goals.

By 2002, the RPT anticipates that the continued maintenance of natural run strength and increased supplemental production will achieve the 2002 target goals as set forth in Table 5.3-2

5.3.1 Projected 1992 Status

The projected 1992 status assumes that Kitoi Bay Hatchery is phased into chum salmon production. By 1992, Kitoi Bay Hatchery would have the capability of producing for harvest 67,000 chum salmon, 1,301,000 pink salmon, 2,000 coho salmon, and 1,000 chinook salmon. In addition to Kitoi Bay Hatchery, a single new hatchery of 100 million egg capacity is expected to be in operation and producing 794,000 pink salmon for harvest by 1992. A private non-profit hatchery of 20 million egg capacity is also assumed to be in production. This hatchery would produce 298,000 pink salmon for harvest. The combined supplemental production of these facilities by 1992 would produce the following numbers of fish for harvest: 67,000 chum salmon, 2,393,000 pink salmon, 2,000 coho salmon, and 1,000 chinook salmon. (See Appendix V, Support Material for Supplemental Production.)

Table 5.3-1:

PROJECTED 1992 STATUS

Species	Natural Runs	Supplemental Production: Kitoi Hatchery(1)	Supplemental Production: New Hatcheries(2)	Target 1992 Goals
CATCH				
Pink - Odd Year	6,200,000	1,301,000	1,092,000	8,593,000
Pink - Even Year	11,200,000	1,301,000	1,092,000	13,593,000
Sockeye	1,000,000			1,000,000
Chum	900,000	67,000		967,000
Coho	120,000	2,000		122,000
Chinook	3,000	1,000		4,000
Total Catch:				
- Odd Year	8,223,000	1,371,000	1,092,000	10,686,000
- Even Year	13,223,000	1,371,000	1,092,000	15,686,000
ESCAPEMENT				
Pink - Odd Year	2,800,000	71,000	144,000	3,015,000
Pink - Even Year	5,800,000	71,000	144,000	6,015,000
Sockeye	1,900,000	0	0	1,900,000
Chum	732,000	52,000	0	784,000
Coho	56,000	-- (3)	0	56,000
Chinook	8,000	-- (3)	0	8,000
Total Escapement:				
- Odd Year	5,496,000	123,000	144,000	5,763,000
- Even Year	8,496,000	123,000	144,000	8,763,000
TOTAL RUN				
Pink - Odd Year	9,000,000	1,372,000	1,236,000	11,608,000
Pink - Even Year	17,000,000	1,372,000	1,236,000	19,608,000
Sockeye	2,900,000	0	0	2,900,000
Chum	1,632,000	119,000	0	1,751,000
Coho	176,000	2,000	0	178,000
Chinook	11,000	1,000	0	12,000
Total Run All Species:				
- Odd Year	13,719,000	1,494,000	1,236,000	16,449,000
- Even Year	21,719,000	1,494,000	1,236,000	24,449,000

(1) Kitoi Hatchery only - Assuming a 50/50 split between pink and chum salmon.
(2) Two new hatchery facilities (100 and 20 million egg capacity.)
(3) Brood stock: Coho 299, Chinook 100.

Table 5.3-2:

PROJECTED 2002 STATUS

Species	Natural Runs	Supplemental Production: Kitoi Hatchery	Supplemental Production: New Hatcheries (1)	2002 Goals
CATCH				
Pink - Odd Year	6,200,000	739,000	6,561,000	13,500,000
Pink - Even Year	11,200,000	739,000	6,561,000	18,500,000
Sockeye	1,000,000	0	900,000	1,900,000
Chum	900,000	758,000	342,000	2,000,000
Coho	161,000	2,000	380,000	543,000
Chinook	4,000	1,000	2,000	7,000
Total Catch:				
- Odd Year	8,265,000	1,500,000	8,185,000	17,950,000
- Even Year	13,265,000	1,500,000	8,185,000	22,950,000
ESCAPEMENT				
Pink - Odd Year	2,800,000	71,000	576,000	3,447,000
Pink - Even Year	5,800,000	71,000	576,000	6,447,000
Sockeye	1,900,000	0	294,000	2,194,000
Chum	732,000	52,000	24,000	808,000
Coho	75,000	-- (2)	36,000	111,000
Chinook	8,000	-- (2)	-- (2)	8,000
Total Escapement:				
- Odd Year	5,515,000	123,000	930,000	6,568,000
- Even Year	8,515,000	123,000	930,000	9,568,000
TOTAL RUN				
Pink - Odd Year	9,000,000	810,000	7,137,000	16,947,000
Pink - Even Year	17,000,000	810,000	7,137,000	24,947,000
Sockeye	2,900,000	0	1,194,000	4,094,000
Chum	1,632,000	810,000	366,000	2,808,000
Coho	236,000	2,000	416,000	654,000
Chinook	12,000	1,000	2,000	15,000
Total Run All Species:				
- Odd Year	13,780,000	1,623,000	9,115,000	24,578,000
- Even Year	21,780,000	1,623,000	9,115,000	32,518,000

(1) Also includes projects such as stocking barren lakes and lake fertilization.
(2) Broodstock: Coho 200
Chinook - Kitoi 100
New hatcheries 135

5.4 "GAP" DEFINITION

The "gap" is defined as the difference between the target catch goals, minus the natural catch. The total "gap" in harvest by 2002 will be "closed" by supplemental production (six new hatcheries), as well as other rehabilitation and enhancement projects, producing a contribution to the total run of 9,685,000 fish.

Table 5.4-1, entitled "Total Gap", sets forth the total "gap" to be closed by the year 2002.

Table 5.4-1:

TOTAL GAP

Species	Natural Runs 2002	Target Goal 2002	Total Gap
CATCH:			
Pink - Odd Year	6,200,000	13,500,000	7,300,000
Pink - Even Year	11,200,000	18,500,000	7,300,000
Sockeye	1,000,000	1,900,000	900,000
Chum	900,000	2,000,000	1,100,000
Coho	161,000	543,000	382,000
Chinook	4,000	7,000	3,000
Total Catch:			
- Odd Year	8,265,000	17,950,000	9,685,000
- Even Year	13,265,000	22,950,000	9,685,000
ESCAPEMENT:			
Pink - Odd Year	2,800,000	3,447,000	
Pink - Even Year	5,800,000	6,447,000	
Sockeye	1,900,000	2,194,000	
Chum	732,000	808,000	
Coho	75,000	111,000	
Chinook	8,000	8,000	
Total Escapement:			
- Odd Year	5,515,000	6,568,000	
- Even Year	8,515,000	9,568,000	
TOTAL RUN:			
Pink - Odd Year	9,000,000	16,947,000	
Pink - Even Year	17,000,000	24,947,000	
Sockeye	2,900,000	4,094,000	
Chum	1,632,000	2,808,000	
Coho	236,000	654,000	
Chinook	12,000	15,000	
Total Run All Species:			
- Odd Year	13,780,000	24,518,000	
- Even Year	21,780,000	32,518,000	

5.5 IDENTIFIED ACTIVITIES

The management practices currently employed in the Kodiak Region are expected to remain the same during the plan period. Based upon these management practices, it is anticipated that the natural salmon stocks will remain relatively stable, with only modest increases in coho and sockeye salmon (see Tables 5.3-1 and 5.3-2 for increase by species).

The RPT anticipates that at least two hatcheries, in addition to Kitoi, and several site specific projects will contribute salmon to the harvest and therefore, to the run by 1992. These two facilities include one with an anticipated 100,000,000 egg capacity and one hatchery with a 20,000,000 egg capacity. Approximately 2,463,000 additional salmon may be anticipated to be added to the runs from these two facilities and the Kitoi hatchery (see Table 5.5-1).

Table 5.5-1:

PROPOSED SUPPLEMENTAL PRODUCTION FACILITIES
IN OPERATION BY 1992

	Salmon for Harvest by 1992					
Facility	Pink	Chum	Sockeye	Coho	Chinook	Total
Kitoi Hatchery	1,301,000	67,000	0	2,000	1,000	1,371,000
New Hatchery (1)	794,000	0	0	0	0	794,000
Private Hatchery (1)	298,000	0	0	0	0	298,000
Total	2,393,000	67,000	0	2,000	1,000	2,463,000

(1) Number of hatcheries.

Lake fertilization could also substantially increase sockeye and coho salmon. Throughout the period from 1982-1992, it is expected that research will identify more improvement opportunities which will have to be evaluated as they occur.

5.5.1 Projected 2002 Status

The major distinction of enhancement activities during the period 1992-2002, is the strong emphasis placed on a combination of state and private non-profit hatcheries, anticipated to be in operation and contributing approximately 9,685,000 fish to the total (see Table 5.5-2).

Table 5.5-2:

**PROPOSED SUPPLEMENTAL PRODUCTION FACILITIES
IN OPERATION BY 2002**

	Salmon for Harvest by 2002					
Facility	Pink	Chum	Sockeye	Coho	Chinook	Total
Kitoi Hatchery	739,000	758,000	0	2,000	1,000	1,500,000
New Hatcheries (4)	6,561,000	0	0	0	0	6,561,000
New Hatchery (1)*	0	342,000	0	380,000	2,000	724,000
New Hatchery (1)**	0	0	900,000	0		900,000
Total	7,300,000	1,100,000	900,000	382,000	3,000	9,685,000

* Combined with rearing and lake stocking projects.

** Combined with sockeye enhancement and lake enrichment projects.

(1) Number of hatcheries.

(4) Number of hatcheries.

By 2002, Kitoi Hatchery production will be half chum and half pink salmon, resulting in annual expected harvests of 758,000 chum and 739,000 pink salmon. At least four hatcheries of 100 million egg capacity will need to be in operation to produce 6.5 million more pink salmon for harvest by 2002. Production of 342,000 additional chum, 380,000 more coho, and 2,000 chinook salmon will require a fifth hatchery with 75 million egg capacity in conjunction with an ambitious rearing, natural lake stocking, and evaluation program. Additional production of 900,000 sockeye for harvest requires at least one more hatchery of 100 million egg capacity in conjunction with sockeye enhancement and lake enrichment projects. The combined supplemental production of salmon for harvest from these facilities by 2002 is expected to be 7,300,000 pink, 1,100,000 chum, 900,000 sockeye, 382,000 coho, and 3,000 chinook salmon. (See Appendix V for simulated production schedules.)

Some of the major emphasis in the management of the fisheries, occuring during this period, will be to protect the hatchery brood stocks, managing to take pressure off the natural runs, and more refined management in the area of stock separation. The RPT felt that more research will have to be accomplished in the area of stock separation to respond to this fisheries management requirement. Additional emphasis will be placed on:

- Assessment of coho escapements
- Assessment of escapement goals
- Research and evaluation of lake stocking densities and salmon production
- Pre-stocking studies on lake and stream systems

In order to meet plan goals the RPT also recognized that additional protection activities will be required. Close coordination between Fish and Wildlife Protection and ADF&G is necessary. This activity was also recognized by the public as being of importance.

5.6 SUMMARY IMPLICATIONS OF "GAP" CLOSURE

Undertaking this ambitious program requires commitment, and its eventual success will have significant implications for the salmon fishery in the Kodiak Region. Some of these implications can only be assumed at this time. However, an awareness of their potential should properly temper the progress of work outlined in the plan. Assuming there is not a large scale increase in the number of fishermen, there should be more fish available to satisfactorily meet the anticipated increase in sport, subsistence, and commercial fishing pressure. This increase in fish will provide a good economic return for the fishermen, as well as the support industries in the Kodiak Region.

One of the results of this program would be to introduce more stability into the fishery, making it less subject to some of the fluctuations that have marked its history; thus helping it achieve a steady growth in the future.

A secondary effect of this stability would be a stronger position for the "support" industries and associated businesses which are an integral part of the commercial and sport fishery.

The Kodiak commercial salmon fishery is part of a large international market which is subject to supply-and-demand pressures. Should efforts locally and internationally create an excess supply, salmon prices and overall conditions of the industry locally would be adversely affected. Fluctuations in the market throughout the next twenty years will require that this plan be updated.

The RPT also recognizes that there must be a commitment to monitor and assess the effects of new fish on the existing salmon stocks. It is entirely possible that any new project may decrease the existing natural stock directly associated with it. The project may then represent some net gain which can only be measured against those specific "costs" that it exacts. This commitment also requires the funding and staffing of projects and programs at a level that allows them to function effectively. This commitment is important to understand at a time when public funds for rehabilitation and enhancement, as well as construction in the public and private sector, is expected to decrease during the plan period. Additionally, existing facilities may not continue to be operated by the State. However, an exception could be State loans made to viable private non-profit associations that can show a return on their investment.

The next two chapters discuss the goals, objectives, and the strategies that are required to support the gap analysis.

SECTION 6.0

GOALS AND OBJECTIVES

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6.0 GOALS AND OBJECTIVES

6.0 GOALS AND OBJECTIVES

6.1 INTRODUCTION

The overall goal of the plan for the Kodiak Region is improved fisheries in the 20-year period. This is expressed in a series of goals and objectives. These goals are to increase the salmon available for harvest by the various user groups, the collection and evaluation of new data regarding the production of salmon in the Kodiak Region, and the potential revision and expansion of some management practices. Tying the goals together are three basic principles. These are:

1. The salmon resource needs to be maintained at an optimum sustainable yield.
2. The most effective management can only come with the attainment of the most complete information base.
3. The prudent harvest of salmon to the greatest extent possible is a positive benefit to the user groups and ultimately to the Kodiak Region and the state.

6.1.1 Production/Harvest Goals

These goals are expressed in numbers of salmon available to harvest by the user groups. Inasmuch as many specific projects have not yet been identified, the objectives are only identified in terms of being able to contribute to an increased harvest.

6.1.2 Research/Data Gathering Goals

There are a number of efforts that need to be expanded, but will not directly result in more salmon. However, the RPT feels that these will lead to a stronger and more precise harvester/manager/resource relationship so that the harvest will be as efficient as possible. Surveys of the habitat will help to clarify the manner and extent to which the salmon resource of the region utilizes available habitat. Broadening the group of systems to which escapement monitoring is applied, and increasing the effort will further develop understanding of the resource. Expansion of stock separation studies (including use of coded-wire tagging techniques) should also provide a basis for refining the application of harvest pressure. Overall, additional knowledge is a prerequisite to the achievement of the greater harvests that are sought by all user groups.

6.1.3. Policy/Management Goals

One of the major goals of the plan is to support adequate funding of proposed research, data gathering, and production projects. Additionally, as a matter of policy, the plan will continuously be re-examined in the context of new information.

The RPT also supports all efforts to continue and improve the coordination between appropriate federal and state agencies and private non-profit associations actively involved in salmon enhancement.

6.1.4 Relationship of the Goals to the Target 2002 Status

The RPT established a harvest target for the year 2002 of 22,950,000 fish in an even year and 17,950,000 fish in an odd year. In Section 5 that target harvest was examined in the context of known projects and the production and harvest which might be expected from them. The results of that examination revealed a total gap of 9,685,000 salmon in an even and odd year. The projected catch composition by species for the even and odd years by the year 2002, are as follows:

TOTAL CATCH - 2002

	Even Year	Odd Year
Pink	18,500,000	13,500,000
Sockeye	1,900,000	1,900,000
Chum	2,000,000	2,000,000
Coho	543,000	543,000
Chinook	7,000	7,000
TOTAL	22,950,000	17,950,000

The catch composition in the years 1992 and 2002 were derived from calculations based upon the number of fish projected to be available for harvest from natural runs and supplemental production.

6.2 PRODUCTION/HARVEST GOALS AND OBJECTIVES

There are three broad goals relating to the harvest and production of salmon. The first two can be discussed in terms of specific numbers and objectives. The third cannot at this stage of the planning process be stated in terms of specific objectives.

GOAL: Maintaining the present condition as a base and increasing and stabilizing through identified projects, the runs of all salmon species to the point that they will support a catch of 15,686,000 fish in an even year and 10,686,000 fish in an odd year by 1992.

GOAL: Maintaining the present condition as a base and increasing and stabilizing through identified projects, the runs of all salmon species to the point that they will support a catch of 22,950,000 million fish in an even year and 17,950,000 fish in an odd year by 2002.

GOAL: Pursuing new enhancement opportunities considering habitat conservation measures and, through implementation of feasible projects, increase runs of all salmon species to the point that they will support an annual harvest of an additional 9,685,000 fish in even years and odd years.

The supporting objectives are detailed on the following pages.

6.2.1 PINK SALMON

In keeping with the character of pink salmon runs in the Kodiak Region, a distinction has been made between the even and odd-year runs.

OBJECTIVES 1992:

Objective: To maintain the natural stocks of pink salmon at a level that would allow a harvest from natural stocks of 11,200,000 fish in even years and 6,200,000 fish in odd years.

Objective: To produce, through supplemental production, an additional 2,393,000 returning pink salmon to be available for harvest.

Objective: To have 1,301,000 returning pink salmon produced for harvest by the Kitoi hatchery.

Objective: To have 1,092,000 returning pink salmon produced for harvest by new hatcheries.

OBJECTIVE 2002:

Objective: To have, in addition to the Kitoi hatchery, 6,561,000 pink salmon produced for harvest annually by new hatcheries.

6.2.2 COHO SALMON

OBJECTIVES 1992:

Objective: To increase the natural stocks of coho salmon to a level that would allow a harvest from natural stocks of 161,000 fish annually.

Objective: To have 2,000 returning coho salmon available for harvest from Kitoi hatchery production.

OBJECTIVE 2002:

Objective: To increase the natural stocks through supplemental production of coho salmon to a level that would allow a harvest of 543,000 fish annually.

6.2.3 CHUM SALMON

OBJECTIVES 1992:

Objective: To maintain the natural stocks of chum salmon at a level that would allow a harvest from natural stocks of 900,000 fish annually.

Objective: To have 67,000 returning chum salmon available for harvest from Kitoi hatchery production by 1992.

OBJECTIVES 2002:

Objective: To maintain the natural stocks of chum salmon to a level that would allow a harvest of 900,000 fish annually.

Objective: To have 1,100,000 chum salmon available for harvest annually by a combination of the Kitoi and new hatchery efforts.

6.2.4 SOCKEYE SALMON

OBJECTIVE 1992:

Objective: To Increase the natural stocks of sockeye salmon to a level that would allow a harvest of 1,000,000 fish annually.

OBJECTIVES 2002:

Objective: To maintain the natural stocks* of sockeye salmon at a level that allows a harvest from natural stocks of 1,000,000 fish annually.

Objective: To produce, through supplemental production techniques, an additional 900,000 sockeye salmon available for harvest annually.

Objective: To implement additional supplemental programs to enhance the sockeye salmon runs by the year 2002.

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* Natural stocks include production from the Frazer Lake Afognak fishpasses and the Karluk Rehabilitation Project.

6.2.5 CHINOOK SALMON

OBJECTIVES 1992:

Objective: To maintain the natural stocks of chinook salmon at a level that would allow a harvest from natural stocks of 3,000 fish.

Objective: To have 1,000 chinook salmon, produced by the Kitoi hatchery, available for harvest annually.

OBJECTIVES 2002:

Objective: To have 7,000 chinook salmon available for harvest annually from all sources by 2002.

Objective: To have 2,000 chinook salmon for harvest produced annually by new hatcheries by 2002.

6.3 RESEARCH/DATA GATHERING GOALS AND OBJECTIVES

The expression of goals and objectives in this section relates to research efforts that are important to the achievement of harvest objectives.

Objective: To initiate a comprehensive program to survey fish habitat (including stream surveys and inventories) throughout the Kodiak Region.

Objective: To increase the data base for improved fisheries management.

Objective: To further define salmon migratory routes within the Kodiak Region.

Objective: To improve forecasting techniques to determine salmon run strengths.

Objective: To continue efforts to increase the efficiency of hatchery facilities and the benefits associated with hatchery operation.

Objective: To initiate site investigation work for rehabilitation and enhancement efforts.

Objective: To evaluate and recommend feasible rehabilitation and enhancement projects for increasing salmon in the region.

6.4 POLICY/ISSUE GOALS

The RPT will assume an active role in the support, maintenance, and further development of salmon planning and project implementation in the region.

GOAL: Continuously review and evaluate progress in accomplishing goals and objectives identified in this plan.

GOAL: Maximize public participation in the salmon planning and project implementation process.

GOAL: Evaluate all projects in terms of user group benefits and economic feasibility.

GOAL: Monitor land uses effecting the salmon habitat and when necessary, through the Kodiak Regional Aquaculture Association, propose legislation and/or ordinances designed to protect the natural salmon production systems from incompatible land activities.

SECTION 7.0

STRATEGIES

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7.0 PROJECTS AND STRATEGIES

7.1 INTRODUCTION

This chapter will describe the strategies, and in some cases projects, which may be utilized to attain the goals and objectives set forth in Section 6. The basic strategies involved in improving salmon production are supplemental enhancement and rehabilitation strategies, research, and improved management strategies. The utilization of these strategies will vary according to species and natural conditions.

Inasmuch as they are easily identifiable at this stage of the planning process, a number of projects are included in the sport fishing area.

Planning in the Kodiak Region is in the beginning stages. Therefore, the strategies are necessarily broad in nature and will be finalized as the planning process continues.

As a final note, the planning team does not have the authority to allocate resources. It can only make recommendations to the Commissioner. The authority to allocate fisheries resources is vested in the Alaska Board of Fisheries by AS 16.251-255.

7.2 ENHANCEMENT AND REHABILITATION PROJECTS AND STRATEGIES

Enhancement and rehabilitation involves the building of stocks to production levels beyond their former capabilities and restoration of depressed stocks to higher levels of availability. Numerous projects fall into these categories. They include such things as construction of new hatcheries, hatchery expansion, lake and stream stocking, fishpass installation, stream improvement and clearance, and lake fertilization.

7.2.1 Projects

Project: To upgrade the Kitoi Hatchery by providing the following:

(1) A cold water pipeline for chum salmon production.

(2) Increasing rearing capacity.

(3) Construct brood stock holding facilities.

Project: Investigate sites for hatcheries, fishpasses, and lake stocking/fertilization projects.

Project: Contruct hatcheries and fishpasses in feasible locations during the 20-year period in order to meet the plan's goals and objectives.

Project: Conduct stream clearance and habitat improvement projects during the course of the plan in selected locations.

7.2.2 Strategies

Strategy: Increase production of coho, sockeye and chinook salmon through a combination of lake fertilization, predator-competitor control, and stocking of lakes and streams.

Strategy: Encourage private non-profit hatchery construction in order to expand the number of fish available for harvest.

Strategy: Protect the habitat for salmon while increasing utilization of existing habitat for salmon spawning and rearing.

Strategy: Develop plans and policies, in conjunction with the U.S. Fish and Wildlife Service, for the Kodiak National Wildlife Refuge, which will allow enhancement and rehabilitation projects on refuge lands.

7.3 RESEARCH AND IMPROVED MANAGEMENT STRATEGIES

Management strategies are generally developed in order to maintain and improve the salmon run, through the achievement of appropriate escapement for each stock and optimum utilization of salmon that are surplus to escapement needs. Harvest management strategies are required for both wild and supplementally-produced stocks.

Management strategies specifically work toward the attainment of more knowledge of run size, stock composition, timing, escapement rates, and optimum escapement levels. Increasing the knowledge in these areas will improve the harvest in the Kodiak Region.

7.3.1 Strategies

The following eight strategies are designed to maintain and improve salmon runs by providing additional knowledge on various aspects of the salmon stocks in the region:

Strategy: To establish a number of research project on specific stock and management problems in the region.

Strategy: To assess the habitat area and quality for optimizing salmon escapements, as well as for spawning and rearing capacities.

Strategy: To undertake a number of projects that will increase the assessment of salmon escapement for all species.

Strategy: To initiate catch sampling projects to determine sex, age, and size composition of salmon caught during specific time periods for the major salmon stocks of the region.

Strategy: To improve methods of recording salmon harvest data in order to get more specific information on actual catch by area.

Strategy: To continue studies on salmon stock separation within mixed stock fisheries by scale analysis and tag/recovery methods.

Strategy: To undertake projects that further define the time at which specific stocks of salmon pass through the fisheries.

Strategy: To manipulate the fishing effort to harvest hatchery fish instead of weak natural runs.

7.4 SPORT FISHING PROJECTS

The sport fishery on Kodiak Island has developed to the point where specific projects can be identified at this stage of the planning process.

The overall strategy is to increase the number of man-days of additional recreational fishing both near the City of Kodiak and on the Kodiak road system.

7.4.1 Projects

Project: Kodiak Road System Coho Enhancement

This project will provide a harvest of 2,500 coho salmon, which will result in an estimated 7,500 man-days of additional recreational fishing near the City of Kodiak. Eight roadside lakes would be stocked with coho fingerlings (weight equals 500/lb, Little Kitoi Lake origin) for natural rearing and volitional emigration. Adult coho would be harvested in the marine areas adjacent to the lakes.

Project: Smolt Plants

Smolt Plants are also a possible technique to increase the number of coho salmon to various user groups. Monashka Creek, Sargent Creek, and Russian Creek appear suitable for this type of coho production. However, further investigations will be required before smolt plants are conducted in these areas.

Project: Kodiak Road System Chinook Salmon Development

This project will provide a harvest of 1,000 chinook salmon, which will result in an estimated 5,000 man-days of additional fishing effort on the Kodiak road system. Buskin

River and Saltry River would be stocked with chinook fingerlings (weight equals 500/lb, Ayakulik River origin) for natural rearing and volitional emigration. Adult chinook would be harvested in the rivers and in adjacent marine areas.

Project: Lake Rose Tead Chinook Salmon Introduction

The objective of this experimental project is to produce a population of trophy size fish and 5,000 man-days of recreational effort on the Kodiak road system. The project is an existing project and involves stocking Lake Rose Tead with chinook fingerlings (weight equals 500/lb, Chignik origin) for natural rearing and volitional emigration.

SECTION 8.0

APPENDICES

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APPENDIX I

GLOSSARY

GLOSSARY

ADF&G - Alaska Department of Fish and Game

enhancement - Procedures applied to a salmon stock to supplement the numbers of harvestable fish to a level beyond what could be naturally produced. This can be accomplished by artificial or semi-artificial production systems. It can also be an increase of the amount of productive habitat in the natural environment through physical or chemical changes.

escapement - Salmon which pass through the fisheries to return upstream to a spawning ground or used as brood stock in a hatchery.

ex-vessel price - Price paid to the commercial fishermen for their catch.

fishpass - A fish ladder to enable salmon to get past a barrier to reach spawning grounds.

F.R.E.D. - The Division of Fisheries Rehabilitation, Enhancement, and Development, Alaska Department of Fish and Game.

goals - Broad statements of what the Planning Team, with input from the user groups, hopes to see accomplished within the 20-year life of the plan.

incidental catch - Fish of another species and/or stock caught during harvest of specific species/and or stock.

mixed stock fishery - Harvest of more than one stock at a given location and/or period.

natural production - Salmon which spawn, hatch, and rear without human intervention.

optimum sustained yield - Number of salmon that can be harvested and still sustain the population at a maximum level of production and vitality.

present condition - The average catch for the last five years, 1978-1982.

projected status - Continuation of the present condition without additional supplemental production.

recent 21-year average - The historical catch for the years 1962-1982.

rehabilitation - Procedures applied to a depressed natural stock which increase it to historical abundance.

residual gap - The required increase in salmon needed from the "projected status" to meet the "Target 1992" and "Target 2002" goals.

RPT - Regional Planning Team

run strength - Total run of salmon, including escapement, plus catch.

salmon:

chinook salmon - *Oncorhynchus tshawytscha* or king salmon.

chum salmon - *Oncorhynchus keta* or dog salmon.

coho salmon - *Oncorhynchus kisutch* or silver salmon.

pink salmon - *Oncorhynchus gorbuscha*, humpy or humpback salmon.

sockeye salmon - *Oncorhynchus nerka* or red salmon.

stock - Salmon of a single species that are produced from a single geographic location and are of the same genetic origin.

supplemental production - Salmon produced by other than natural spawning using enhancement and/or rehabilitation methods.

Target 1992 Goal - The desired magnitude of the salmon resource by 1992 as a result of natural and supplemental production.

Target 2002 Goal - The desired magnitude of the salmon resource by 2002 as a result of natural and supplemental production.

total run (run strength) - Number of salmon returning in a year for a stock or area (escapement plus harvest number).

user group - Identification by method and/or reason for the harvest of salmon (commercial, sport, or subsistence).

wild stock - Stocks which have not been rehabilitated or enhanced.

APPENDIX II

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APPENDIX III

COMMERCIAL CATCH DATA

COMMERCIAL CATCH DATA

Historical Catch of the Kodiak Area Salmon
in Numbers of Fish by Species to the Nearest 1,000 Fish
1882 - 1982

YEAR	CHINOOK	SOCKEYE	COHO	PINK	CHUM	TOTAL
1882		59,000				59,000
1883		189,000				189,000
1884		282,000				282,000
1885		469,000				469,000
1886		646,000				646,000
1887		1,004,000				1,004,000
1888		2,781,000				2,781,000
1889		3,755,000				3,755,000
1890		3,593,000				3,593,000
1891		3,846,000				3,846,000
1892		3,126,000				3,126,000
1893		3,245,000				3,245,000
1894		3,830,000				3,830,000
1895		2,247,000	8,000			2,255,000
1896		3,329,000				3,329,000
1897		2,786,000	2,000			2,788,000
1898		2,033,000	19,000			2,052,000
1899	1,000	1,935,000	32,000			1,968,000
1900	5,000	3,450,000	32,000			3,487,000
1901	4,000	4,826,000		2,000		4,832,000
1902	3,000	3,868,000	35,000			3,906,000
1903	1,000	1,826,000	120,000	10,000		1,957,000
1904	3,000	2,875,000	103,000	5,000		2,986,000
1905	2,000	2,142,000	87,000			2,231,000
1906	4,000	3,980,000	24,000			4,008,000
1907	4,000	4,232,000	38,000			4,274,000
1908	3,000	2,488,000	74,000	286,000		2,851,000
1909	4,000	1,915,000	52,000	154,000		2,125,000
1910	2,000	1,955,000	44,000	215,000		2,216,000
1911	1,000	2,686,000	28,000	230,000	6,000	2,945,000
1912	1,000	2,246,000	17,000	547,000	25,000	2,836,000
1913	1,000	1,663,000	28,000	590,000	4,000	2,286,000
1914	1,000	1,255,000	32,000	1,726,000	13,000	3,027,000
1915	1,000	1,664,000	51,000	252,000	20,000	1,988,000
1916	1,000	3,376,000	50,000	2,182,000	29,000	6,638,000
1917	1,000	3,646,000	30,000	225,000	16,000	3,918,000

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COMMERCIAL CATCH DATA continued

Historical Catch of the Kodiak Area Salmon
in Numbers of Fish by Species to the Nearest 1,000 Fish
1882 - 1982

YEAR	CHINOOK	SOCKEYE	COHO	PINK	CHUM	TOTAL
1918	2,000	1,894,000	78,000	2,467,000	82,000	4,523,000
1919	2,000	1,619,000	104,000	283,000	60,000	2,068,000
1920	2,000	1,958,000	89,000	1,977,000	55,000	4,081,000
1921	1,000	2,858,000	46,000	68,000	25,000	2,998,000
1922	1,000	1,097,000	120,000	2,766,000	224,000	4,208,000
1923	2,000	1,090,000	78,000	929,000	39,000	2,138,000
1924	1,000	1,408,000	121,000	5,435,000	118,000	7,083,000
1925	2,000	1,693,000	93,000	2,674,000	212,000	4,674,000
1926	1,000	3,015,000	174,000	4,607,000	325,000	8,122,000
1927	4,000	1,155,000	152,000	5,297,000	418,000	7,026,000
1928	3,000	1,592,000	291,000	1,535,000	726,000	4,147,000
1929	3,000	712,000	144,000	6,108,000	1,058,000	8,025,000
1930	5,000	466,000	229,000	1,651,000	419,000	2,770,000
1931	2,000	1,183,000	170,000	6,840,000	184,000	8,379,000
1932	2,000	1,058,000	52,000	4,710,000	237,000	6,069,000
1933	1,000	1,428,000	91,000	6,574,000	536,000	8,630,000
1934	3,000	1,829,000	86,000	7,642,000	662,000	10,222,000
1935	2,000	1,614,000	63,000	10,781,000	382,000	12,842,000
1936	5,000	2,658,000	163,000	5,648,000	329,000	8,803,000
1937	2,000	1,882,000	134,000	16,788,000	346,000	19,152,000
1938	3,000	1,966,000	133,000	8,398,000	640,000	11,140,000
1939	4,000	1,786,000	64,000	11,741,000	641,000	14,236,000
1940	3,000	1,318,000	163,000	9,997,000	674,000	12,155,000
1941	5,000	1,730,000	208,000	7,601,000	445,000	9,989,000
1942	3,000	1,281,000	106,000	6,093,000	565,000	8,048,000
1943	2,000	1,991,000	61,000	12,480,000	454,000	14,988,000
1944	2,000	1,818,000	45,000	4,956,000	507,000	7,328,000
1945	4,000	2,041,000	79,000	9,045,000	559,000	11,728,000
1946	1,000	839,000	71,000	9,546,000	298,000	10,754,000
1947	1,000	994,000	72,000	8,857,000	295,000	10,119,000
1948	1,000	1,260,000	32,000	5,958,000	331,000	7,582,000
1949	1,000	892,000	54,000	4,928,000	700,000	6,575,000
1950	2,000	921,000	41,000	5,305,000	685,000	6,954,000
1951	2,000	470,000	48,000	2,006,000	422,000	2,948,000
1952	1,000	631,000	36,000	4,554,000	984,000	6,206,000
1953	3,000	392,000	39,000	4,948,000	490,000	5,872,000

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COMMERCIAL CATCH DATA continued

Historical Catch of the Kodiak Area Salmon
in Numbers of Fish by Species to the Nearest 1,000 Fish
1882 - 1982

YEAR	CHINOOK	SOCKEYE	COHO	PINK	CHUM	TOTAL
1954	1,000	392,000	56,000	8,325,000	1,140,000	9,851,000
1955	2,000	164,000	35,000	10,794,000	482,000	11,477,000
1956	1,000	306,000	54,000	3,349,000	660,000	4,370,000
1957	1,000	234,000	35,000	4,691,000	1,152,000	6,113,000
1958	2,000	288,000	21,000	4,039,000	931,000	5,281,000
1959	2,000	330,000	15,000	1,800,000	734,000	2,881,000
1960	2,000	362,000	54,000	6,685,000	1,133,000	8,236,000
1961	1,000	408,000	59,000	3,926,000	519,000	4,883,000
1962	1,000	785,000	54,000	14,189,000	795,000	15,824,000
1963		407,000	57,000	5,480,000	305,000	6,249,000
1964	1,000	478,000	36,000	11,862,000	932,000	13,309,000
1965	1,000	346,000	27,000	2,887,000	431,000	3,692,000
1966	1,000	632,000	68,000	10,756,000	763,000	12,220,000
1967	1,000	284,000	10,000	188,000	221,000	704,000
1968	2,000	760,000	56,000	8,761,000	750,000	10,329,000
1969	2,000	604,000	35,000	12,493,000	537,000	13,671,000
1970	1,000	917,000	66,000	12,045,000	919,000	13,949,000
1971	1,000	478,000	23,000	4,333,000	1,541,000	6,376,000
1972	1,000	220,000	17,000	2,690,000	1,164,000	4,093,000
1973	1,000	167,000	4,000	512,000	318,000	1,002,000
1974	1,000	415,000	13,000	2,646,000	248,000	3,323,000
1975		136,000	24,000	2,943,000	84,000	3,187,000
1976	1,000	630,000	23,000	10,906,000	718,000	12,277,000
1977	1,000	624,000	25,000	6,274,000	1,071,000	7,994,000
1978	3,000	1,072,000	49,000	15,004,000	814,000	16,942,000
1979	2,000	632,000	141,000	11,288,000	358,000	12,420,000
1980	1,000	651,000	139,000	17,291,000	1,076,000	19,157,000
1981	1,000	1,289,000	122,000	10,337,000	1,345,000	13,094,000
1982	1,000	1,205,000	344,000	8,076,000	1,266,000	10,892,000

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Data after 1934: Kodiak Management Area Annual Report, 1982.

APPENDIX IV

SUPPORT MATERIAL
FOR SUPPLEMENTAL PRODUCTION

Supplemental Production Facilities

Facility	Salmon for Harvest: Pink	Chum	Sockeye	Coho	Chinook	Total
			BY 1992			
Kitoi Hatchery	1,301,000	67,000	0	2,000	1,000	1,371,000
New Hatchery (1)	794,000	0	0	0	0	794,000
Private Hatchery (1)	298,000	0	0	0	0	298,000
Total	2,393,000	67,000	0	2,000	1,000	2,463,000
			BY 2002			
Kitoi Hatchery	739,000	758,000	0	2,000	1,000	1,500,000
New Hatcheries (4)	6,561,000	0	0	0	0	6,561,000
New Hatchery (1)a/	0	342,000	0	380,000	2,000	724,000
New Hatchery (1)b/	0	0	900,000	0	0	900,000
Total	7,300,000	1,100,000	900,000	382,000	3,000	9,685,000

a/ combined with rearing and lake stocking projects.

b/ combined with sockeye enhancement and lake enrichment projects.

PROJECTED 1992 STATUS (1,000's)

Species	Natural Runs	Supplemental Production: Kitoi Hatchery	Supplemental Production: New Hatcheries	Target 1992 Goals
		HARVEST		
Pink - Odd yr	6,200	1,301	1,092	8,593
Pink - Even yr	11,200	1,301	1,092	13,593
Sockeye	1,000	0	0	1,000
Chum	900	67	0	967
Coho	120	2	0	122
Chinook	3	1	0	4
Total Odd:	8,223	1,371	1,092	10,686
Total Even:	13,223	1,371	1,092	15,686
		ESCAPEMENT		
Pink - Odd yr	2,800	71	144	3,015
Pink - Even yr	5,800	71	144	6,015
Sockeye	1,900	0	0	1,900
Chum	732	52	0	784
Coho	56	- a/	0	56
Chinook	8	- b/	0	8
Total Odd:	5,496	123	144	5,763
Total Even:	8,496	123	144	8,763
		TOTAL RUN		
Pink - Odd yr	9,000	1,372	1,236	11,608
Pink - Even yr	17,000	1,372	1,236	19,608
Sockeye	2,900	0	0	2,900
Chum	1,632	119	0	1,751
Coho	176	2 a/	0	178
Chinook	11	1 a/	0	12
Total All Species:				
Odd yr:	13,719	1,494	1,236	16,449
Even yr:	21,719	1,494	1,236	24,449

a/ 299 Coho Broodstock
100 Chinook Broodstock

PROJECTED 2002 STATUS (1,000's)

Species	Natural Runs	Supplemental Production: Kitoi Hatchery	Supplemental Production: New Hatcheries & Projects	Target 2002 Goals
HARVEST				
Pink - Odd yr	6,200	739	6,561	13,500
Pink - Even yr	11,200	739	6,561	18,500
Sockeye	1,000	0	900	1,900
Chum	900	758	342	2,000
Coho	161	2	380	543
Chinook	4	1	2	7
Total Odd:	8,265	1,500	8,185	17,950
Total Even:	13,265	1,500	8,185	22,950
ESCAPEMENT				
Pink - Odd yr	2,800	71	576	3,447
Pink - Even yr	5,800	71	576	6,447
Sockeye	1,900	0	294	2,194
Chum	732	52	24	808
Coho	75	- a/	36	111
Chinook	8	- a/	- b/	8
Total Odd:	5,515	123	930	6,568
Total Even:	8,515	123	930	9,568
TOTAL RUN				
Pink - Odd yr	9,000	810	7,137	16,947
Pink - Even yr	17,000	810	7,137	24,947
Sockeye	2,900	0	1,194	4,094
Chum	1,632	810	366	2,808
Coho	236	2 a/	416	654
Chinook	12	1 a/	2 b/	15
Total All Species:				
Odd yr:	13,780	1,623	9,115	24,518
Even yr:	21,780	1,623	9,115	32,518

a/ 200 Coho Broodstock
100 Chinook Broodstock

b/ 135 Chinook Broodstock

NEW HATCHERIES
SUPPLEMENTAL PRODUCTION (2002)

Broodstock Requirements:

Pink Salmon

Harvest Goal: 6,561,000	
Broodstock	576,000
Holding Mortality (10%)	57,600
Stock For Eggs	518,400
Females (50%)	259,200
Females x 1,700 Eggs	440,640,000
Eyed Eggs (90%)	396,576,000
Fry (90%)	356,918,400
Adults (2%)	7,138,368
Harvest (92%)	6,562,368
Broodstock	576,000

Sockeye Salmon

Harvest Goal: 900,000	
Broodstock	294,000
Holding Mortality (10%)	29,400
Stock For Eggs	264,600
Females (50%)	132,300
Females x 2,500 Eggs	330,750,000
Eyed Eggs (85%)	281,137,500
Fry (85%)	238,966,875
Stream/Lake (25%)	59,741,719
Smolt (10%)	5,974,172
Adults (20%)	1,194,834
Harvest (75%)	900,834
Broodstock	294,000

Chum Salmon

Harvest Goal: 342,000	
Broodstock	24,000
Holding Mortality (10%)	2,400
Stock For Eggs	21,600
Females (50%)	10,800
Females x 2,100 Eggs	22,680,000
Eyed Eggs (90%)	20,412,000
Fry (90%)	18,370,800
Adults (2%)	367,416
Harvest (93.5%)	343,416
Broodstock	24,000

Coho Salmon

Harvest Goal: 380,000

Broodstock	36,000
Holding Mortality (10%)	3,600
Stock For Eggs	32,400
Females (50%)	16,200
Females x 3,200 Eggs	51,840,000
Eyed Eggs (90%)	46,656,000
Fry (90%)	41,990,400
Smolts (10%)	4,199,040
Adults (10%)	419,904
Harvest (91.4%)	383,904
Broodstock	36,000

Chinook Salmon

Harvest Goal: 2,000

Broodstock	135
Holding Mortality (10%)	13.5
Stock For Eggs	121.5
Females (50%)	61
Females x 7,200 Eggs	439,200
Eyed Eggs (90%)	395,280
Fry (90%)	355,752
Smolt (20%)	71,150
Adults (3%)	2,135
Harvest (93.7%)	2,000
Broodstock	135

POTENTIAL KITOI HATCHERY PRODUCTION BY 1992 AND 2002 BY PHASING CHUM INTO 50% CAPACITY a/

		Chum	Pinks
By 1992:			
	Return	119,000	1,372,000
	Broodstock b/	52,000	71,000
	Harvest	67,000	1,301,000
By 2002:			
	Return	810,000	810,000
	Broodstock b/	52,000	71,000
	Harvest	758,000	739,000

a/ Based upon assumptions and simulated production schedule.

b/ Broodstock includes 6,000 pink escapement for Kitoi Creek and assumed holding mortality of 10% for both pink and chum salmon.

KITOI HATCHERY PRODUCTION OF
50% EACH PINK AND CHUM SALMON

Assumptions:

1. Hatchery capacity 100 million eggs.

2. Survival rates:
   Egg-take to eyed-egg 90%
   Eyed-egg to fry 90%
   Fry to adult (partial rearing) 2.0%

3. Eggs/female:
   Pinks 1,700 and chum 2,100

4. Sturgeon chum broodstock egg-takes:
   1983-84 0.5 million
   1985-86 1.0 million

5. Chum salmon interception before broodstock established is 10% (10% of return to Kitoi harvested).

6. Broodstock holding mortality is 10% for both species.

7. Ocean age of returning chum salmon is 80% age .3 and 20% age .4.

8. New cold-water pipeline for chum incubation constructed in 1984 and completed in 1985.

9. Maximum use of chum returning to Kitoi for broodstock until 1991.

SIMULATED PRODUCTION SCHEDULE FOR 50% PINK/CHUM AT KITOI HATCHERY

Year of Operation	Activity	Species	Broodstock Total	No. Females	Egg Take (millions)	Fry Release (millions) Year	No.	Adult Return Year	No.	Adult Year	Harvested No.
1983	Existing Production	Pinks	135,000	58,800	100.0	1984	81.0	1985	1,600,000	1985	1,466,000
	Chum Development Sturgeon River	Chum	350	250	0.5	1984	0.40	1987	6,480	1987	648
								1988	1,620		
1984	New Pipe Construction	Pinks	135,000	58,800	100.0	1985	81.0	1986	1,600,000	1986	1,466,000
		Chum	350	250	0.5	1985	0.40	1988	6,480	1988	810
								1989	1,620		
1985	New Pipe Complete	Pinks	134,000	58,200	99.0	1986	80.2	1987	1,600,000	1987	1,472,000
		Chum	952	476	1.0	1986	0.81	1989	12,960	1989	1,458
								1990	3,240		
1986	Last Egg Take	Pinks	134,000	58,200	99.0	1987	80.2	1988	1,600,000	1988	1,474,000
	Sturgeon River	Chum	952	476	1.0	1987	0.81	1990	12,960	1990	1,620
								1991	3,240		
1987	First Chum Egg Take	Pinks	127,517	55,235	93.9	1988	76.1	1989	1,521,000	1989	1,403,000
	Kitoi	Chum	5,832	2,916	6.1	1988	4.9	1991	79,056	1991	30,238
								1992	19,764		

SIMULATED PRODUCTION SCHEDULE FOR 50% PINK/CHUM AT KITOI HATCHERY (cont'd)

Year of Operation	Activity	Species	Broodstock Total	No. Females	Egg Take (millions)	Fry Release (millions) Year	No.	Adult Return Year	No.	Adult Year	Harvested No.
1988	Chum Brood Development	Pinks	125,577	54,353	92.4	1989	74.8	1990	1,497,000	1990	1,381,000
	Continues	Chum	7,290	3,645	7.6	1989	6.2	1992	99,202	1992	66,584
								1993	24,801		
1989		Pinks	117,553	50,706	86.2	1990	69.8	1991	1,396,000	1991	1,325,000
		Chum	13,122	6,561	13.8	1990	11.2	1993	178,564	1993	150,983
								1994	44,641		
1990		Pinks	115,611	49,823	84.7	1991	68.6	1992	1,372,000	1992	1,301,000
		Chum	14,580	7,290	15.3	1991	12.4	1994	198,288	1994	190,547
								1995	49,572		
1991	First Year Chum at	Pinks	70,706	29,412	50.0	1992	40.5	1993	810,000	1993	739,294
	Capacity	Chum	52,382	23,810	50.0	1992	40.5	1995	648,000	1995	645,190
								1996	162,000		
1992		Pinks	70,706	29,412	50.0	1993	40.5	1994	810,000	1994	739,294
		Chum	52,382	23,810	50.0	1993	40.5	1996	648,000	1996	757,618
								1997	162,000		
1993		Pinks	70,706	29,412	50.0	1994	40.5	1995	810,000	1995	739,294
		Chum	52,382	23,810	50.0	1994	40.5	1997	648,000	1997	757,618
								1998	162,000		

PRIVATE NON-PROFIT HATCHERY

BY 1992

Pink Salmon

20,000,000	Eggs Taken
18,000,000	Eggs Eyed (90%)
16,200,000	Fry Reared & Released (90%)
324,000	Adults Produced (2%)
26,000	Broodstock
298,000	Harvest

Broodstock Requirement:

11,765	Females x 1,700 eggs = 20,000,000
23,530	Males & Females at 50:50
2,353	Holding Mortality at 10%
25,883	Broodstock

ASSUMPTIONS FOR NEW PINK SALMON HATCHERY - KODIAK

1. 100 million egg capacity
   50 million fry rearing capacity

2. Female fecundity 1,700, 50% sex ratio

3. Survivals:

Broodstock	90%
Eyed Egg	90%
Fry	90%
Adult	2.2%

4. Harvest interception 50% of returning fish during broodstock development.

5. Initial broodstock 8,000 (4,500 females)

SIMULATED PRODUCTION SCHEDULE FOR A NEW PINK SALMON HATCHERY
WITH 100 MILLION EGG CAPACITY, KODIAK

Year of Operation	Activity	Broodstock No. Total	Broodstock No. Females	Egg Take (millions)	Fry Release (millions) Year	Fry Release (millions) No.	Adult Return Year	Adult Return No.	Adults Harvested
1986	Construction	-	-	-	-	-	-	-	-
1987	Operation Broodstock Development	8,000	4,500	7.65	1988	6.20	1989	136,323	68,162
1988	"	8,000	4,500	7.65	1989	6.20	1990	136,323	68,162
1989	"	76,161	30,081	51.14	1990	41.42	1991	911,274	763,626
1990	"	76,161	30,081	51.14	1991	41.42	1992	911,274	793,626
1991	Operation @ Capacity	117,648	58,824	100.00	1992	81.00	1993	1,782,000	1,664,352

Full capacity production by 1993 at 1,782,000 pinks.
Harvestable pinks 1,664,352 per year.
Average weight 3.8 lbs/fish.
Total weight harvestable fish/yr 6,324,538.
Average (1979-1982) ex-vessel price/lb 37¢.
6,324,538 lbs x $0.37 = $2,340,079 ex-vessel value (annual).

3 hatcheries x 1,664,352 = 4,993,056 pink salmon for harvest.
4 hatcheries x 1,664,352 = 6,657,408 pink salmon for harvest.

HYPOTHETICAL
COMPARISON OF HATCHERY AND
NATURAL SOCKEYE SALMON PRODUCTION

HATCHERY	NATURAL
1 Male:1 Female	1 Male:1 Female
2,500 Eggs	2,500 Eggs
2,125 Eyed Eggs (85%)	-
1,806 Fry (85%)	750 Fry (30%)
452 Fry Emerge to Lake (25%)	188 Fry Emerge to Lake (25%)
45 Smolt (10%)	19 Smolt (10%)
9 Adults (20%)	3.8 Adults (20%)
4.5 Adults Harvest (50%)	1.9 Adults Harvest (50%)
4.1 Adults Egg Take (90%)	1.7 Adults Spawn (90%)
4.1:2 Return/Spawner	1.7:2 Return/Spawner

( ) Survival Rate

In this comparison, the natural system cannot sustain a 50% harvest and maintain a viable population. A hatchery, releasing fry into the natural lake, could maintain the population and 50% harvest and still have surplus fish.

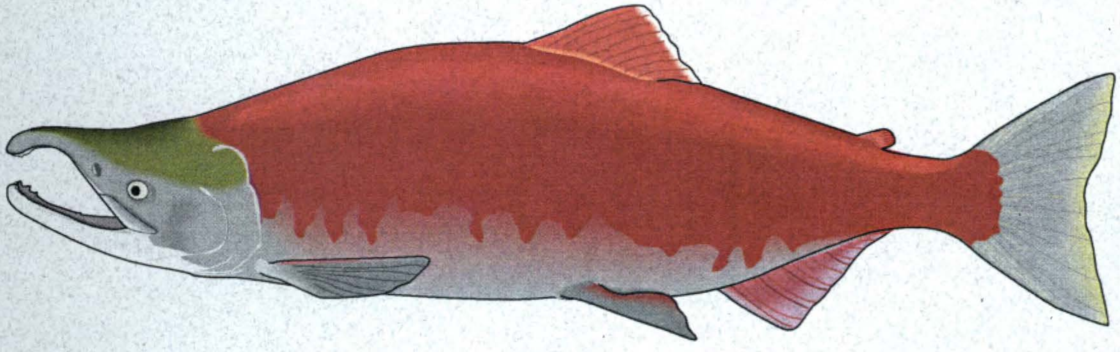
With a fishery harvesting 20% of the adults returning to the natural system, only 2.7 sockeye would be available to spawn (2.7 fish per parent pair) and would probably maintain the population.

To maintain viable natural sockeye stocks, harvest rates generally should not be expected to exceed 20% of the adult fish returning.

When escapement reaches the habitat capacity (spawning and rearing area), then the harvest can be increased on the surplus fish. For example, a 500,000 sockeye return to Frazer Lake can provide a 100,000 harvest (20%) and a 400,000 escapement. If the return is greater than this, then the harvest can be increased to maintain the escapement at 400,000 (system capacity estimate).

The Hatchery Program and Protection of Wild Salmon in Alaska: Policies and Regulations

Compiled by
Steven G. McGee



Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
P.O. Box 25526
Juneau, Alaska 99802-5526

Tony Knowles, Governor
January 1995

16.4.1

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Foreward

The hatchery program in Alaska was initiated in the early 1970s to contribute to the rehabilitation of the state's depleted and depressed salmon fisheries. From the beginning, this program was intended to supplement and enhance, not supplant, wild stock production. For this reason, numerous policies and regulations were developed to guide hatchery development and operations, and serve as safeguards for the maintenance of wild stocks. As evidenced by dramatic increases since 1975 in harvests of wild and enhanced salmon in Alaska's commercial fisheries (Figure 1), the growth of the salmon enhancement program has not adversely impacted Alaska's wild stocks. Alaska's constitution, unique among states, mandates the sustained yield management of its fish and game resources, and wild populations of salmon are given added protection under state statute.

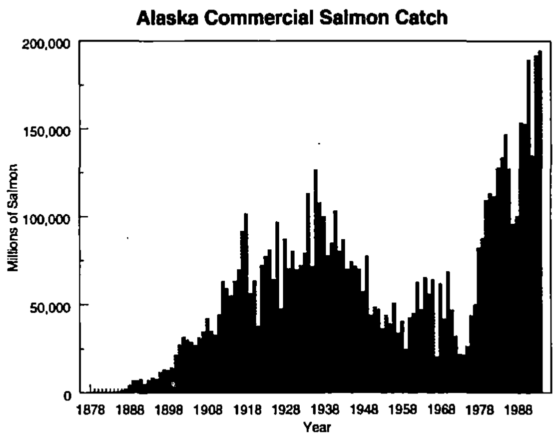

Figure 1. Combined salmon harvests (wild + hatchery), 1878-1994.

The hatchery program in Alaska was developed under a sound scientific framework with the protection of wild stocks in mind. Many of these protections, developed in concert with the hatchery program, were included in the policies and regulations that form the basis for this report. In addition, Alaska's habitat is largely intact; cultural eutrophication and agricultural diversion of water supplies rare; and the deleterious effects of logging and hydropower development relatively minor. Coupled with sound inseason escapement-based management of largely mixed stock commercial fisheries, Alaska's fishery resources have reached record harvests of over 190 million fish.

Introduction

Beginning with the inception of Alaska's hatchery program in the early 1970s, policies, statutes, and formal regulations have been instituted to guide hatchery development and protect Alaska's wild stocks of salmon. These include the department's ***Genetic Policy***; ***Background of the Genetic Policy of the Alaska Department of Fish and Game***; ***Regulation Changes, Policies and Guidelines for Alaska Fish and Shellfish Health and Disease Control***; ***Salmon Escapement***

Goal Policy; and ***Policy and Requirements for Fish Resource Permits***. It also includes selected statutes and administrative regulations for Private Nonprofit (PNP) Salmon Hatcheries, and Alaska Board of Fisheries regulations on ***Transportation, Possession, and Release of Live Fish*** and ***Policy for the Management of Mixed Stock Salmon Fisheries***. These documents, included in this report, form the scientific framework for building the hatchery program, and for the protection of wild salmon in Alaska.

The department also operates and staffs state-of-the-art fish pathology and genetics laboratories that support these respective policies through diagnostic services and field research.

As evidenced by the fact that Alaska's salmon harvests have grown from a modern-day low in the mid-1970s to an all-time high (see Figure 1), the development of the salmon enhancement program during the same time period has been successful in supplementing, not supplanting, wild stock production. For this to occur, rigorous genetic and fish health policies were carefully developed as the scientific framework to guide the program.

The department's ***Genetic Policy*** was initially formalized in 1975 following legislative approval of the PNP hatchery program and was revised in 1978. The current edition was revised in 1985 by a review team consisting of scientists from the department, PNP organizations, the University of Alaska, and the National Marine Fisheries Service. This team reviewed and updated genetic guidelines established in the mid-1970s to steer aquaculture efforts in the state; the original policy represented a consensus of opinion at the time, and was intended to be reviewed periodically to ensure the guidelines maintained consistency with current knowledge. Protection of wild stocks remains the principal objective of the policy. The ***Background of the Genetic Policy of the Alaska Department of Fish and Game*** was completed in 1989 to discuss the basis for the policy and to demonstrate that the policy's objectives had been achieved.

The department's ***Regulation Changes, Policies, and Guidelines for Alaska Fish and Shellfish Health and Disease Control*** was formally completed in 1988 by the State Pathology Review Committee. This multi-agency group worked from 1985 through 1987 to develop proposed changes in state regulations, new policies, and recommendations for maintaining adequate finfish and shellfish health in Alaska. Its goal was to prevent dissemination of infectious diseases in fish and shellfish within and from outside the state without creating impractical constraints for aquaculture and other fisheries enhancement or rehabilitation projects. This document includes the department's sockeye salmon culture policy which has been recently updated and is available under separate cover (McDaniel et al. 1994).

The ***Salmon Escapement Goal Policy*** was formally approved in 1992 to establish the basis and mechanisms for setting escapement goals for wild salmon stocks. The policy further supports the department's mandate to manage fishery resources on a sustained yield basis. This mandate was also adopted by the Alaska Board of Fisheries in its ***Policy for the Management of Mixed Stock Salmon Fisheries*** (5 AAC 39.220). This regulation makes conservation of wild stocks, and sustained yield, the highest priority when allocating salmon resources.

The ***Policy and Requirements for Fish Resource Permits*** was approved in 1994 to replace an outmoded policy statement on departmental Collection and Scientific and Educational Permits implemented in 1983. The new Fish Resource Permit Policy was developed by a departmental committee to provide a more detailed explanation to the public on the various types of permits required for the collection and/or transportation of live fish in any life stage used for scientific, educational, propagative, or exhibition purposes. The permit requirements are scaled by egg numbers; the more eggs taken, the greater the risk to wild stocks and the more constraints added to the permits.

Selected statutes and regulations governing the permitting, operation, and management of the state's hatchery program are discussed below. Specific regulations for the Transportation, Possession, and Release of Live Fish (5 AAC 41.001 - 41.100) have also been included in this report. The fish transport regulations establish a permit system and requirements for inspections of fish, reporting and control requirements for specific fish diseases, and prohibits the importation of live fish into the state for purposes of stocking or rearing in the waters of the state.

Until recently, the hatchery program has concentrated on the enhancement of wild stock production rather than on wild stock restoration. However, hatchery production can also be used in several ways to assist in the restoration of naturally spawning salmon stocks. Hatcheries can be used (1) to supplement the production of naturally spawning stocks of fish; (2) as a management tool to divert fishing pressure from wild stocks; (3) as a subject of research designed to understand both the effects of environmental parameters and the activities of man on the survival of fish; and in extreme cases, (4) to prevent the immediate extinction of unique wild stocks.

The following sections describe (1) the approach taken by Alaska to plan its salmon enhancement program, particularly the involvement of the private sector in the program as a government-private sector joint venture; (2) the current magnitude of the hatchery and nonhatchery-related enhancement programs in the state; and (3) the regulatory mechanisms now in place to guide and control the further development of Alaska's salmon enhancement program.

Regional Planning

The PNP hatchery program was initiated along with requirements for developing long-term Regional Comprehensive Salmon Plans to guide fisheries enhancement in Alaska (Figure 2). The responsibility for these plans rests with the commissioner of the Alaska Department of Fish and Game (ADF&G) through Regional Planning Teams (RPTs) composed of personnel from the department's fisheries divisions and representatives from fishermen's organizations (regional aquaculture associations). In regions where no association has been formed, planning core groups representing ADF&G, fishermen, and local governmental agencies have been established to develop the plans.

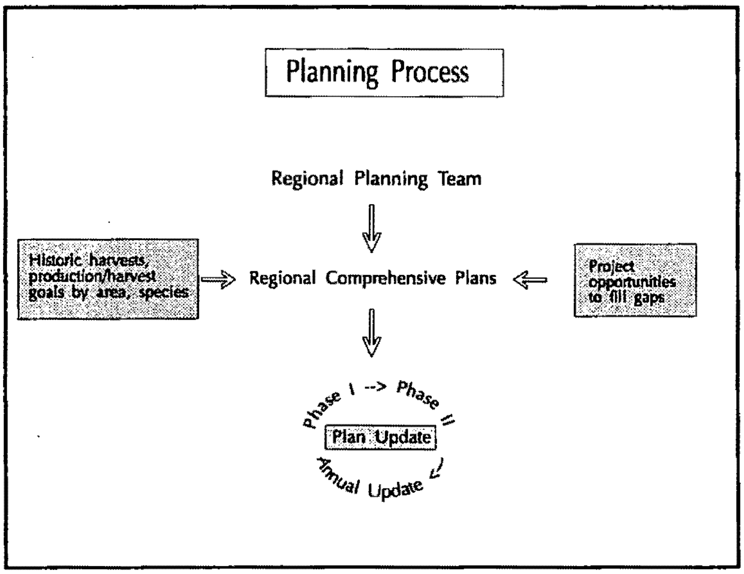

Figure 2. Planning process.

Regional comprehensive planning progresses in stages. Phase I sets the long-term goals, objectives, and strategies for the region. Phase II identifies potential projects and establishes criteria for evaluating the enhancement and rehabilitation potentials for the salmon resources in the region. And in some regions, a third planning phase has been instituted to incorporate Board of Fisheries-approved allocation and fisheries management plans with hatchery production plans.

In addition to the development of comprehensive salmon plans, the RPTs also review all PNP hatchery applications, proposed alterations of existing permits, annual management plans for each hatchery operating in the region, and statutorily mandated annual reports from each permitted hatchery in the region. Each RPT develops criteria for its review, comment, performance evaluation, and analysis of enhancement projects.

Hatchery Production

Hatcheries have played a major role in the enhancement and development of fisheries in Alaska. The state now operates 6 hatcheries (down from a high of 19 in 1987), and oversees the operation of 33 facilities operated by PNP corporations. Over recent years, the operation of 13 state-owned hatcheries has been contracted to the private sector. The success of this joint government-private

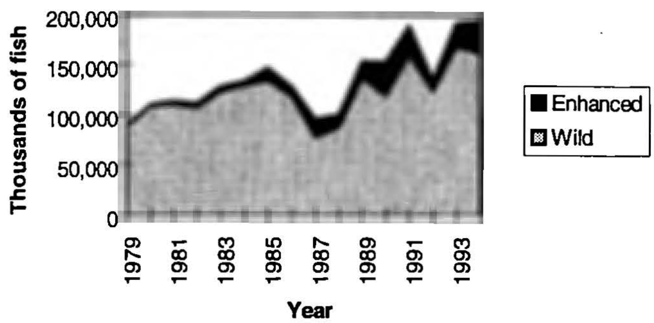

Figure 3. Historical statewide commercial common property salmon harvest.

sector program can be measured in the gradual withdrawal of state operations and the growing involvement of the private sector.

Contributions of adult salmon from hatchery releases to commercial fisheries in Alaska grew from a few thousand in the mid-1970s to a high of over 34 million in 1990. Hatchery production in 1994 will meet or exceed the 1990 level. Hatcheries work well as a salmon enhancement tool; however, there are inherent concerns and documented benefits from the hatchery program. Alaska's salmon enhancement program, particularly the use of hatcheries, has been closely reviewed through its initial 25 years of success in the production of fish. Historical contributions of enhanced salmon to common property fisheries are shown in Figure 3. On a statewide basis, the overall percentage of enhanced salmon has never exceeded 25% of the total harvest. However, for some species in some areas (e.g., pink salmon in Prince William Sound) enhanced fish now make up a majority of the harvest (Figure 4). In such situations, ADF&G has tried to ensure sufficient marking of hatchery releases to enable inseason evaluation of the mix of wild and hatchery-produced fish in the commercial fisheries. The department also operates a statewide tag recovery laboratory to support the hatchery program by aiding inseason identification of hatchery fish in mixed stock fisheries.

Regulation of Hatcheries

Alaska Statutes (AS) 16.10.400 - 16.10.480 address the application process for PNP hatchery permits. This process is also described in detail in regulations 5 AAC 40.100 - 40.990. The following description explains these statutes and regulations in a paraphrased format. The application process is shown in Figure 5.

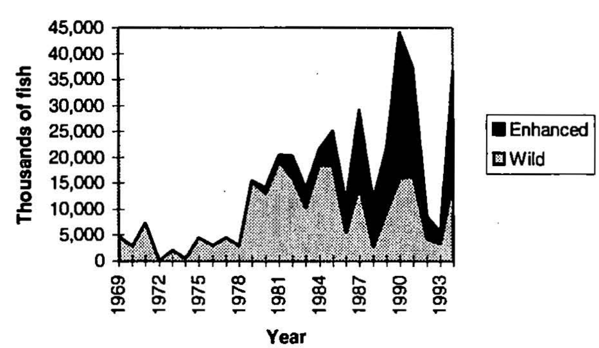

Figure 4. Historical pink salmon harvest in Prince William Sound.

AS 16.10.400 allows the commissioner of ADF&G to issue a permit, subject to restrictions imposed by statute or regulation, to a nonprofit hatchery corporation for the construction and operation of a salmon hatchery after the permit application has been reviewed by the regional planning team.

A hatchery permit is nontransferable. A public hearing is required at least 30 days before the issuance of a permit, and the hearing must be held in a central location in the vicinity of the proposed facility.

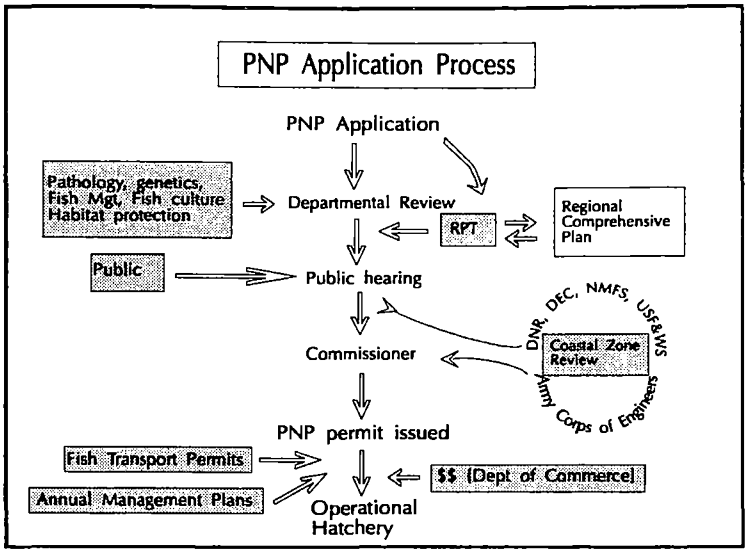

Figure 5. PNP application process.

The commissioner may place conditions on a PNP permit. This includes a provision that donor stock eggs must be from the department or from a source approved by the department. This action is supported by Board of Fisheries regulations 5 AAC 41.001 - 41.100 for the fish transport permit (FTP) process. 5 AAC 41.005 states that no person may transport, possess, export from the state, or release into the waters of the state any live fish unless that person holds an FTP issued by the commissioner and that person is in compliance with all conditions of the permit and the provisions of the rest of the regulations in the chapter. The FTP process is diagramed in Figure 6. 5 AAC 41.030 states that the commissioner will only issue an FTP if it is the department's determination that the proposed transport, possession, or release of fish will not adversely affect the continued health and perpetuation of native, wild, or hatchery stocks of fish. All fish transport permit applications are reviewed and signed (recommending either approval or denial) by the ADF&G Principal Pathologist and the ADF&G Principal Geneticist, as well as the region's regional supervisors for the fisheries divisions, the Chief of Technology and Development and, finally, the commissioner. The potential for disease and genetic impacts are primary considerations throughout the review process.

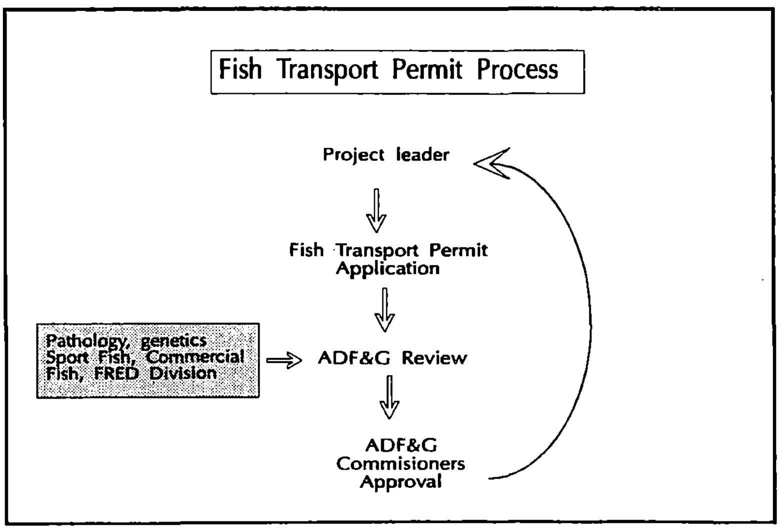

Figure 6. FTP process.

Additional PNP permit conditions may be included: No placement of salmon eggs or resulting fry into waters of the state except as designated in the permit; restrictions on the sale of eggs or resulting fry; no release of salmon before departmental approval; destruction of diseased salmon; and departmental control over where salmon are harvested by hatchery operators. The hatchery must be located in an area where reasonable segregation from natural stocks occurs but, when feasible, in an area where returning hatchery fish pass through traditional salmon fisheries.

The commissioner may alter, suspend, ar revoke a PNP permit if the operator fails to comply with the terms and conditions of the permit within a reasonable period following notification. The commissioner may also alter the permit or initiate termination of the operation if it is found not to be in the best interest of the public.

Regulation of Harvest

Fish released by hatchery operators are available to the people for common use in the same way as natural stocks until they return to the location established by the department for hatchery harvest (Figure 7). According to AS 16.10.440 (b), the Board of Fisheries may, after a permit has been issued, amend by regulation the terms of the permit relating to the source and number of eggs, the harvest by hatchery operators, and the locations designated by the department for harvest by the operator (i.e., the hatchery special harvest area). In addition, AS 16.05.730 requires fisheries to be managed consistent with sustained yield of wild fish stocks. With approval by the Board of Fisheries, such fisheries may also be managed for sustained yield of enhanced fish stocks. Conservation of wild salmon stocks consistent with sustained yield is accorded the highest priority among competing uses in the Board of Fisheries' policy for the management of mixed stock salmon fisheries (5 AAC 39.220).

Regulation of Brood Stock

The department is required by statute to provide assistance before and after permit issuance, within the limits of time and resources. AS 16.10.445 reinforces that the department shall approve the source and number of salmon eggs used by hatchery operators. Salmon eggs shall first be taken from stocks native to the area in which the hatchery is located. The sale of salmon and salmon eggs by operators is addressed in AS 16.10.450. After the operator uses

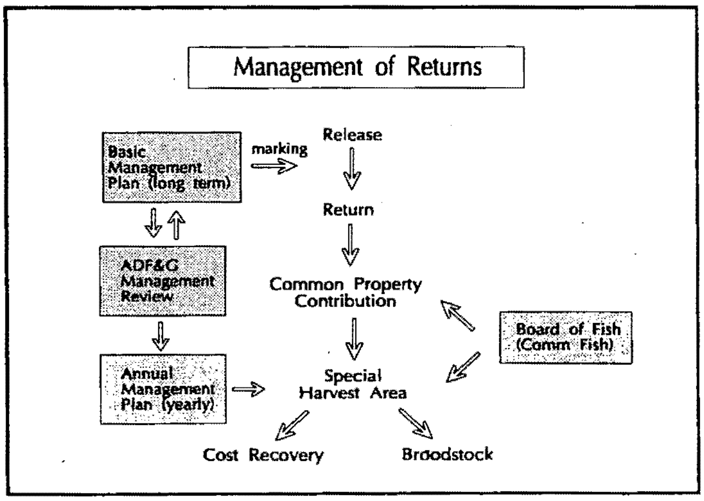

Figure 7. Management of returns.

funds from such sales for debt service and reasonable operating costs, any remaining funds must be passed along to the region's respective regional aquaculture association who will use it on fisheries activities for the area. Also, any fish returning to hatcheries and sold for human consumption must be of comparable quality to fish harvested by commercial fisheries in the area, and must be sold at prices commensurate with the local market.

The department may inspect the hatchery facility at any time the facility is operating. Each facility is inspected at least every other year, and each brood stock is examined for disease prior to its use in a hatchery.

An annual report must be filed with the department by December 15 of each year that contains information on hatchery returns, numbers of eggs taken, and numbers of fry or smolt released.

PNP Permit Process

The permit application procedures for a PNP hatchery, the regional comprehensive salmon planning process, and general provisions for the permitting and operation of PNP hatcheries are described in regulations 5 AAC 40.100 - 40.990. Permit application procedures include pre-application assistance, a management feasibility analysis, the permit application form and fees, determination of acceptance by the department for formal review, regional planning team review, a provision for requesting additional information, completeness determination by the commissioner (this includes 6 major criteria), and a provision for reconsideration. The departmental review of all PNP hatchery permit applications includes review by the 2 fisheries divisions, the Habitat Division, the Principal Pathologist, and the Principal Geneticist. A public hearing and full review by other state and federal agencies through the coastal zone consistency review process are also required.

Regulations 5 AAC 40.800 - 40.990 address the following issues: nontransferability of permits, preference rights to potential hatchery locations for the regional aquaculture associations, basic management plans for each hatchery, hatchery inspection requirements, annual management plan requirements, notice and review of permit alteration requests, provisions for performance review by the department and regional planning team, requirements for reporting of mortalities, details on the concept of surplus salmon eggs, notice on report coordination with the Department of Commerce and Economic Development, and definitions.

Hatchery Management Plans

A basic management plan (BMP) is developed as part of the actual PNP permit. The BMP includes a complete description of the facility, including the special harvest area, brood stock development schedules and descriptions of brood stock, and hatchery stock harvest management. Where deemed necessary by the management divisions, marking and evaluation programs for hatchery-produced fish are required in the hatchery permit and BMP. Such programs are usually optional unless the fisheries management divisions specify the need for special inseason management capability during the permit or permit alteration process. Representative numbers of most species are routinely coded-wire-tagged at most facilities; other (e.g., otolith) mass marking techniques are being developed.

When a permitted hatchery becomes operational, an annual management plan (AMP) is developed for each year of operation (Figure 8). Specific plans for egg takes, cost recovery harvests, fry and smolt releases, marking and recovery, and any other operations are included and approved in this plan. AMPs are developed by the department in conjunction with the operator and are reviewed by the fisheries management divisions and regional planning team before approval by the commissioner. The PNP permitting process is rigorous and thorough, and usually takes 1–2 years to complete.

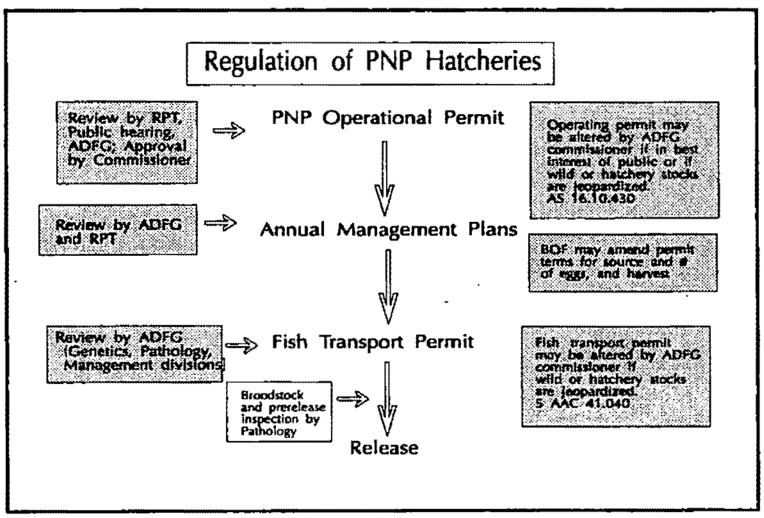

Figure 8. Regulation of PNP hatcheries.

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SECTION A

Genetic Policy

Alaska Department of Fish & Game

GENETIC POLICY

by

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INTRODUCTION

Alaska's valuable salmon industry relies on production from wild systems and, increasingly, on fish produced by aquaculture programs. The importance of maintaining healthy wild stocks and implementing successful enhancement activities underlies the need for an effective genetic policy. The genetic guidelines created to steer Alaska's aquaculture efforts were established in the mid-70's and have been reviewed to ensure that they reflect current knowledge, and goals. A revised genetic policy has been established that contains guidelines, supporting information and recommendations.

The genetic policy contains restrictions that will serve to protect the genetic integrity of important wild stocks. Certainly in Alaska where wild stocks are the mainstay of the commercial fishery economy, it is necessary to protect these stocks through careful consideration of the impacts of enhancement activities. Another important aspect of the genetic policy is the orientation towards increasing the productivity of enhancement programs in the state. Adherence to the guidelines will help maintain adequate genetic variability ensuring that the enhanced stock will be able to adapt to changing environmental conditions. The policy also includes considerations for selective breeding for desirable characteristics.

Due to the limited amount of information available on the genetic impacts of salmon enhancement on wild stocks, much of the basis for these guidelines is theoretical or based on work done with other species. Consequently, the most important considerations used in writing the guidelines are presented as a mechanism for illustrating the intent of the policy. An understanding of the rationale behind the policy is imperative to its effective application to individual cases under the very diverse conditions found in Alaska.

The importance of the genetic guidelines will continue to increase as aquaculture activities expand their production. This policy represents a consensus of opinion and should continue to be periodically reviewed to ensure that the guidelines are consistent with current knowledge. By doing so, we will be able to meet the goal of greater fish production through enhancement while maintaining healthy wild stocks.

POLICY STATEMENT

I. Stock Transport

A. Interstate: Live salmonids, including gametes, will not be imported from sources outside the state. Exceptions may be allowed for trans-boundary rivers.

B. Inter-regional: Stocks will not be transported between major geographic areas: Southeast, Kodiak Island, Prince William Sound, Cook Inlet, Bristol Bay, AYK and Interior.

C. Regional: Acceptability of transport within regions will be judged on the following criteria.

1. Phenotypic characteristics of the donor stock must be shown to be appropriate for the proposed fish culture regions and the goals set in the management plan.

2. No distance is set or specified for transport within a region. It is recognized that transplants occurring over greater distances may result in increased straying and reduce the likelihood of a successful transplant. Although the risk of failure affects the agency transporting the fish, transplants with high probability of failure will be denied. Proposals for long distance transport should be accompanied by adequate justification for using nonlocal stock.

II. Protection of Wild Stocks

A. Gene flow from hatchery fish straying and intermingling with wild stocks may have significant detrimental effects on wild stocks. First priority will be given to protection of wild stocks from possible harmful interactions with introduced stocks. Stocks cannot be introduced to sites where the introduced stock may have significant interaction or impact on significant or unique wild stocks.

B. Significant or unique wild stocks must be identified on a regional and species basis so as to define sensitive and nonsensitive areas for movement of stocks.

C. Stock Rehabilitation and Enhancement

1. A watershed with a significant wild stock can only be stocked with progeny from the indigenous stocks.

2. Gametes may be removed, placed in a hatchery, and subsequently returned to the donor system at the appropriate life history state (eyed egg, fry or fingerling). However, no more than one generation of separation from the donor system to stocking of the progeny will be allowed.

D. Drainages should be established as wild stock sanctuaries on a regional and species basis. These sanctuaries will be areas in which no enhancement activity is permitted except gamete removal for broodstock development. Use of such reservoirs for broodstock development should be considered on a case-by-case basis, and sliding egg take removal schedules applied to such systems should be conservative.

E. *Fish releases at sites where no interaction with, or impact on significant or unique wild stocks will occur, and which are not for the purpose of developing, rehabilitation of, or enhancement of a stock (e.g., release for terminal harvest or in landlocked lakes) will not produce a detrimental genetic effect. Such releases need not be restricted by genetic concerns.*

III. *Maintenance of Genetic Variance*

A. *Genetic diversity among hatcheries*

1. *A single donor stock cannot be used to establish or contribute to more than three hatchery stocks.*

2. *Off-site releases for terminal harvest rather than development or enhancement of a stock need not be restricted by III.A.1, if such release sites are selected so that they do not impact significant wild stocks, wild stock sanctuaries, or other hatchery stocks.*

B. *Genetic diversity within hatcheries and from donor stocks*

1. *A minimum effective population (N_e) of 400 should be used for broodstock development and maintained in hatchery stocks. However, small population sizes may be unavoidable with chinook and steelhead.*

2. *To ensure all segments of the run have the opportunity to spawn, sliding egg take scales for donor stock transplants will not allocate more than 90% of any segment of the run for broodstock.*

GUIDELINES AND JUSTIFICATIONS

I. Stock Transport

A. Interstate: It is generally accepted that population of salmonids which have existed over many generations in a given watershed have evolved traits that make them best adapted for survival in that environment. The greater the distance that a population is transferred from its native environment or the greater the difference in environmental conditions between the donor and transplant stream, the less likely the genetic characteristics of the population will fit the new environment. If the fitness of the population is indeed reduced in the new environment, then the probability of the transplant succeeding would be affected. In addition, interbreeding of a transferred stock with indigenous stocks could transfer gene traits that would reduce the fitness of the native populations. In many states, discrete stocks cannot be identified because excessive movement and interbreeding have already occurred. The State of Alaska, therefore, desires to protect and develop local stocks by restricting the movement of live fish or eggs into the state. There are, however, several trans-boundary rivers penetrating British Columbia, Canada, that flow into the state of Alaska. In some instances, donors from these stocks might fit a well-designed management plan.

B. Inter-regional: The environment can vary greatly from one region to another in a state as large as Alaska. For similar reasons given in I.A. above, the transfer of fish from one region to another is restricted. Consideration may be given to regional border areas, especially when no suitable donor stock is available within a region.

C. Regional: Although it is recognized that indigenous stocks are best for donor stock development, there have been numerous successful transplants, especially if the environment at the new site is similar to that of the donor stock and distance between the sites is not great. There is insufficient scientific data to predict how far or how diverse the environment must be before a negative impact will occur. However, it is believed that within a region site matching opportunities may be available. As site matching characteristics decrease and transplant distance increases within the regional borders greater justification is required for the proposed transplant. The following should be considered when selecting a donor stock:

1. Matching: Phenotypic characteristics of the donor stock should be matched to the environment at the site and to the management goals. Water chemistry and temperature profiles should be considered. Island stocks should be matched to other islands or to short rivers of comparable characteristics where possible. Time of spawning and fry emergence should be matched or compensated with the hatchery temperature required. Any deviations should be addressed and justified in the permit application or the annual management plan.

2. Migration Routes: The probable migration routes and potential user groups should be identified. The applicant must determine a probable migration route based on the migration route of the proposed stock and characteristics (topography) of the transplant site. Coded wire tagging of hatchery releases can determine the accuracy of migration route predictions as well as assess possible impact on local stocks.

II. Protection of Wild Stocks

A. Prevention of detrimental effects of gene flow from hatchery fish straying and interbreeding with wild fish.

Straying of hatchery fish released at the hatchery or off-station can potentially impact the fitness of wild fish populations through interbreeding of wild and hatchery fish. This assumes that hatchery and wild fish are adapted to different environments and either would presumably be less fit in the environment of the other and that hybrids would be less fit for either environment. Wild stocks have presumably been rigorously adapted to their native environment. Because of the large number of loci involved in the adaptation, many "successful" combinations of genetic information are possible along with the enormous number of "unsuccessful" combinations. Hybridization between discrete populations may produce a stock that has reduced fitness and therefore reduced production. Hatchery fish have been subjected to selection pressure for survival within artificial culture regimes, and may also have been originally derived from another stock adapted to totally different conditions than the impacted wild stock. Continued influx of hatchery fish together with the return of hybrids may alter the wild gene pool, reduce stock fitness, and thus threaten the survival of the wild population.

An alternative perspective is that hatchery strays will have little genetic impact on wild stocks. The influx of new genetic material through straying is a natural process in the development and expansion of salmon populations. If adaptation of the natural population is indeed very specific and selection is intense, then selection will favor and maintain the genetic complex of the wild populations. If adaptation is less specific and less intensive, then the genetic impacts from gene flow are insignificant. It is true that some straying occurs among adjacent wild populations and in most cases has occurred for a long enough time that such populations are quite similar genetically. However, situations in which transplanted stocks are involved are not analogous, as transplanted stocks would be less similar and gene flow would have a more profound effect. It is also true that the impact of introgression into the wild gene pool of genes from fish transplanted from a radically different environment may be limited by natural selection. Again the situations of concern do not necessarily lie near this extreme; hybrids and strays may be fit enough to dilute or replace the wild genome. Inherent homeostatic mechanisms for gene expression may compensate for some genetic influx.

The magnitude of straying relative to the size of the wild run is the most important criterion, as massive spawning by hatchery strays may jeopardize a wild population by displacement on spawning habitat and superimposition of redds, as well as, genetic influx. A conservative management approach dictates avoiding release sites where large numbers of hatchery strays can be expected to interact with significant or unique wild stocks. This approach can be achieved by spatial or temporal isolation of the hatchery and wild stock.

B. <u>Regional designation of significant and unique wild stocks</u>.

The magnitude of salmon populations varies between watersheds from intermittent runs maintained by straying to hundreds of thousands of fish. In evaluating the impacts of salmon enhancement projects, consideration must be given to the potential of detrimental effects from straying and intermingling with wild populations and possible resultant loss of wild production. Such consideration must take into account the benefits of the enhancement activity and the significance of the wild stocks impacted. Designation of criteria for runs of fish that are considered significant would greatly expedite the evaluation process. However, "significance" must be defined not only by the magnitude of the run, but also in the context of local importance and utilization. A small sockeye salmon stock near a village in southeast Alaska may be "significant", whereas the same size population may be too small to be considered a manageable entity in Bristol Bay. Because local utilization is an important concern, a regional planning group such as the Salmon Enhancement Regional Planning Teams, should consider what criteria will be used to determine significant stocks within a region and recommend such stock designations.

C. Stock rehabilitation and enhancement.

1. A watershed with significant wild stocks can only be stocked with progeny from the indigenous stocks. Rehabilitation of a watershed implies that there is insufficient production in habitat that formerly maintained a stock of some magnitude. Unless the indigenous stock has gone to extinction, use of an exogenous stock has potential for genetic damage noted in II.A. This damage will be exacerbated by the imprinting and homing of the transplanted stock to the impacted watershed, and potential displacement of wild

juveniles by the exotics stocked in the rearing habitat.

Enhancement of habitat not naturally accessible to salmon involves stocking eyed eggs, fry, or fingerlings, thus gaining production from this unutilized habitat. Where the inaccessible habitat is located above barriers on watersheds that maintain significant natural populations, stocking nonindigenous populations again has potential for genetic impacts noted in II.A., exacerbated by imprinting and homing of the transplanted stock to the watershed. For both rehabilitation and above barrier stockings, use of the indigenous stock alleviates these concerns.

2. When enhancing a stream using the indigenous stock, the fish used for stocking shall not be removed from the wild system to a hatchery for more than one generation.

Hatchery incubation and rearing select for a limited set of biological and behavioral traits which are not necessarily the most suitable for survival in the wild environment. Because of this potential for such selection, the transfer of hatchery fish to rehabilitate or enhance stocks in depleted or underutilized watersheds runs the risk of altering the genetic character of the wild stock, even if the indigenous stock was the original donor stock for hatchery population. By restricting the separation between the transfer to the hatchery and the stocking to no more than one generation (e.g., eggs taken in a given year are cultured to fry or fingerling release at the hatchery; eggs or fish from the returns to the hatchery of this donor transplant are used for stocking), the risk of negative effects due to selection in the hatchery are minimized.

D. Establishment of wild stock sanctuaries.

As noted in preceding sections, there is concern that hatchery culture of salmon through their freshwater (and in some cases, initial estuarine) life history phases may select for a limited set of biological traits that are not suitable for wild populations. Loss of genetic variability through intensive inbreeding for domestication and desired traits has often resulted in detrimental genetic effects in agronomy and agriculture, such as reduced resistance to disease or adverse environmental conditions. Original wild strains can provide the genetic variability needed to outbreed domestics and alleviate inbreeding depression. Because there is potential for detrimental impacts due to reduction of genetic variability, there is a need to preserve a variety of wild types for future broodstock development and outbreeding for enhancement programs. Designation of watersheds where hatcheries or hatchery plants are not allowed would allow wild stocks within these watersheds to be subjected to natural selection only, within the life history phases cultured at hatcheries. These watersheds would be "gene banks" of wild-type genetic variability.

III. Maintenance of Genetic Variance

A. Genetic diversity among hatcheries.

There is general agreement that by introducing and maintaining a wide diversity of wild donor stock populations into the hatchery system that the prospects for long term success of the hatchery program in Alaska will be enhanced. Diversity tends to buffer biological systems against disaster, either natural or man-made. Developing and maintaining hatchery broodstock from a wide variety of donors will buffer the hatchery system against future catastrophes. Agricultural crop production in the U. S. provides a prime example of the dangers of genetic uniformity.

In an effort to increase yield, plant breeders have come to rely on a few highly productive strains. In 1970 approximately 15% of the corn production in the United States was lost to corn blight. The corn blight responsible, a mutant of the normal blight causing fungus, did not attack all strains. Only one strain of corn was vulnerable, but that strain of corn was grown by nearly every farmer in the country. Breeders were able to recover from the corn blight epidemic by replacing Texas cytoplasm with normal cytoplasm. Recovery was rapid because adequate genetic variability was available. There are other examples.

How does this relate to salmonid culture? Salmonid stocks apparently differ in levels of disease resistance, temperature tolerance, acid tolerance, and in their response to artificial selection. It seems imprudent to assume that conditions similar to those found in agriculture will not occur in aquaculture. In addition, the ability to genetically improve hatchery broodstock performance in the future will depend on the availability of genetic variability such as is found among wild salmonid stocks. A hatchery system with a variety of diverse broodstocks will be a valuable resource.

Genetic diversity does not guarantee protection from disaster, but uniformity seems to invite catastrophe. Local failures are inevitable within the hatchery system. It seems prudent to provide the system with a level of insurance by developing and preserving diversity among hatcheries.

Off-site releases for terminal harvest, whether for the commercial fishery or for a put and take sport fishery should have no adverse genetic effect if they are released at sites selected so that they do not impact significant wild stocks, wild stock sanctuaries or other hatchery stocks. The success of this type of release from a genetic standpoint depends on the ability to manage and harvest the return. If returns can not be harvested, increased straying may result which might lead to an impact on wild stocks at a greater than expected distance from the release site.

B. <u>Genetic diversity within hatcheries and from donor stocks</u>.

There is a general consensus among geneticists that fitness (reproductive potential) is enhanced by heterozygosity (genetic variability). Any loss of genetic variation will be accompanied by a concomitant reduction in fitness. Genetic variation allows a population to adapt to a changing environment or to adapt to and colonize a new environment. Available genetic variation determines how rapidly a population will respond to either artificial or natural selection. On the other hand, selection, inbreeding and random genetic drift will reduce genetic variability in a population.

Natural selection, that is selection for fitness, is a continuing process and should not be so intense that it has a significant effect in reduction of genetic variation, unless the population is in a new and quite different environment. Artificial selection on the other hand can be very intense, but can either be avoided or designed to assure that possible negative effects to fitness are offset by increased production efficiency due to the selection program, and by more efficient culture techniques. Inbreeding due to the deliberate mating of related individuals can be easily avoided in salmon hatcheries. Undoubtedly, in hatcheries and possibly in natural stocks the most important cause of loss of genetic variation is random genetic drift. In hatcheries reduction of genetic variation caused by inbreeding and genetic drift can easily be avoided by using adequate numbers of spawners.

Random genetic drift in general refers to fluctuations in gene frequency that occur as a result of chance. Such fluctuations occur, especially in small populations, as a result of random sampling among gametes. The amount of change but not the direction of change, can be predicted. The rate of this change is related inversely to effective population size (N_e). The smaller the effective population size the greater the fluctuation in gene frequencies. In small populations random genetic drift can result in inadvertent loss of genetic variability which may significantly reduce the fitness of the population.

Effective population size (N_e) is defined as the size of an idealized population that would lose genetic variability at the same rate as the sample population. An idealized population is one in which there is no mutation or selection, there are equal numbers of males and females, mating is random, etc. Obviously it is very unlikely that any natural population will meet all criteria for an idealized population.

Breeding structure of a population can profoundly affect the rate at which genetic variability is lost. However, we can determine the effective breeding size (N_e) for breeding structures and obtain the rate of inbreeding (ΔF) as

$$\Delta F = 1/2N_e$$

so the consequences of breeding structure can be related to the loss of variation.

Many breeding structure variations can influence the effective population size. Four seem likely to operate in a salmon hatchery population: (1) numbers of males and females in the breeding population; (2) unequal numbers in successive generations; (3) nonrandom distribution of offspring among families; and (4) overlapping generations. These are discussed in greater detail in Appendix A.

Any of these variations in breeding structure may have a marked effect on N_e. Although it may be impossible to control or even to measure variation in family size it is important to keep in mind the relationship to effective population size. Breeding plans that would aggravate or increase the variation of family size should be avoided. The effect of overlapping populations is to increase the effective population number, in that individuals mating in different years contribute to greater diversity. For example, it would take a larger number of pink salmon each year to maintain $N_e = 400$ than it would sockeye salmon.

The factor having the greatest potential effect in the hatchery and over which we have most control is sex ratio. As the formula indicates (Appendix A) the effective population size is affected most by the numbers of the least frequent sex. It is important to consider this in the breeding plan. In salmon, because a male can be used to fertilize the eggs of a large number of females, there is a temptation to do so. This temptation should be moderated by the necessity to maintain an effective population size which will assure that adequate genetic variation is maintained in the population. A minimum effective population (N_e) of 400 should be maintained. At this size the rate of inbreeding will be 0.125 percent per generation which should not have a significant effect on the long term fitness of the population.

In some cases, for example with chinook and steelhead, small population size may be unavoidable. In such cases a plan should be developed to offset the effects of small population size by infusion of genes from a source outside the hatchery population, such as the original donor source. Help in designing these breeding plans can be obtained from the Principal Geneticist, FRED Division, Alaska Department of Fish and Game.

While developing hatchery stocks from wild donor sources it is important that the genetic variability in the donor stock be protected. Cropping of the early or late run segments of a donor stock can change the timing of that run, which will reduce genetic variability of the population and may be detrimental to the stock's prospects for long term survival. To prevent such selection, sliding egg take scales for donor stock transplants should allocate no more than 90% of any segment of a run for broodstock.

RESEARCH

The necessity for much of this policy arises from our ignorance of the genetics of wild salmon populations and the effects of their domestication in hatcheries. The policy is based more on extrapolation from other disciplines such as agriculture than from first-hand knowledge of our resource. As a result, the policy is a somewhat conservative interpretation of these data in order to assure the long-term viability of salmon populations. The Committee has identified several areas in which specific knowledge would clarify this policy and contribute to the effectiveness of salmon enhancement. The Committee encourages cooperative research efforts among the university, state, federal and private sectors directed toward the general areas listed below.

1. Development of performance profiles of hatchery stocks and potential for genetic improvement. Information about stocks kept in culture will be useful in several ways. If taken in a standard manner, the data will be useful in determining the extent of variability in the species and will aid in the choice of stock to be used for outplanting or transplanting. The information will also be helpful in maximizing the production of a particular facility.

2. Potential for genetic improvement of cultured stocks. A sequel to the cataloging of the variability within and among stocks will be to experimentally assess the potential for genetic improvement by selective breeding. To do this, it is necessary to determine the heritabilities for traits of interest, that is the part of the phenotypic variability present in a population which results from genetic (heritable) causes as opposed to environmental causes. Traits such as size of adults, age of return and various timing parameters are particularly interesting to industry.

Application of artificial selection is responsible for the enormous advances that have been made in agriculture; the potential also exists in aquaculture.

3. Assessment of the effect of introgression of genes from hatchery fish into wild populations. To examine this effect, one must first have an estimate of the rate of straying and the factors that influence straying. Such factors might include transplant distance, run strength, source of the hatchery stock and year-to-year environmental differences. By using a genetically marked stock, one can monitor the flow of "hatchery genes" into other populations. Because the effect of such introgression may develop over time, it is necessary that such an experiment be conducted over several generations. For this kind of study, it may be necessary to develop a means for marking fish cultured at production levels.

   The second part of this problem is to establish the impact of introgression. A range of potential interactions is possible ranging from introgression between two unrelated stocks to the introgression of fish subject to the selective pressures of a hatchery back into the wild stock from which they were derived. Research to examine these effects could best be done in an experimental hatchery where hybrid stocks could be produced and all releases marked. Port sampling and stream walking would be necessary to evaluate survival, straying and other phenotypic effects.

4. The effects of inbreeding and maintenance of inbred lines. Accompanying the artificial propagation of a species is the potential for inbreeding, loss of genetic variability and increased homozygosity. Information pertinent to the extent of inbreeding depression that results from various levels of inbreeding is necessary in determining adequate effective population sizes. This is especially important for species

for which a large effective population size is difficult to maintain. In addition, this information would permit a judgement on the efficacy of enhancing very small remnant populations. This work could be done both by performing crosses designed to accomplish some level of inbreeding, and by the maintenance of small randomly breeding populations. In both cases, it is important to keep careful controls.

APPENDIX A

Appendix A

The relationship of breeding structure, effective population size, and rate of inbreeding.

Breeding structure can profoundly affect effective breeding size (N_e) of a population. We can, at least in theory, determine the effective breeding size for many breeding structures and obtain the rate of inbreeding (ΔF) as

$$\Delta F = 1/2N_e$$

directly relating variation in breeding structure to loss of genetic variation.[1/]

The following demonstrates the consequence of some breeding structures to effective population size.

Number of males and females: Unequal numbers of males and females in the breeding population reduce effective population size. Sex ratio is related to effective population number (N_e) as

$$N_e = 4N_mN_f/(N_m + N_f)$$

where N_m and N_f refer to the total number of males and females respectively. The effective population size is strongly influenced by the number of the least frequent sex.

Unequal numbers in successive generations: If the numbers of breeding individuals is not constant in successive generations the mean effective number is the harmonic mean of the number in

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1/ See D.S. Falconer. 1981. Introduction to Quantitative Genetics. Longman Inc., New York.

each generation. Over generations the effective number is approximately,

$$1/N_e = 1/t(1/N_1 + 1/N_2 + 1/N_3 + \ldots\ldots 1/N_t).$$

The generation that has the smallest number will have the largest effect.

Nonrandom distribution of offspring among families: When there is large variation in family size the next generation is made up of the progeny of a smaller than expected number of parents. This can be related to loss of genetic variation through effective population number as

$$N_e = 4N/(V_k + 2)$$

where V_k refers to the variance in family size. When variation of family size V_k is equal to 2, then $N_e = N$. When the number of males and females are unequal, the variance of family size may be unequal in the two sexes and

$$N_e = 8N/(V_{km} + V_{kf} + 4)$$

where V_{km} and V_{kf} are the variance of family size for males and females respectively.

Overlapping generations: In species other than pink salmon generations are not discrete, they are overlapping. When generations overlap the effective population size is

$$N_e = 4N_cL/(V_{km} + 2)$$

where L is the generation time and N_c is the number of individuals born in a year, that is the cohort size. The cohort size N_c is related to the total number (N_t) by $N_c = N_t/E$ and E is the mean age at death. As before V_{km} is the variation of family size.

The effect of unequal sex ratio and unequal numbers in successive generations on population size can be easily estimated. On the other hand it will be difficult or perhaps impossible to estimate the variance of family size. Nevertheless, we should keep in mind the relationships of family size and overlapping generations. Overlapping generations will in general increase the effective population number in that individuals mating in different years contribute to greater diversity. Variance of family size can radically reduce effective population size. Procedures that contribute to variance of family size or separation of year classes should be avoided.

SECTION B

Background of the Genetic Policy of the Alaska Department of Fish and Game

Background of the Genetic Policy of the Alaska Department of Fish and Game

by
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Number 95

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INTRODUCTION

The salmon industry of Alaska is dependent on production of salmon from wild populations. In the early 1970s, a system of public and private nonprofit hatcheries was created for the rehabilitation and enhancement of salmon populations. This came about largely because of several years of very low returns of salmon to many areas of Alaska. This depression of wild stocks was coupled with increases in knowledge of incubation and rearing requirements of salmon. However, the importance of the wild stocks of salmon to the state economy was recognized as paramount. It was also understood that the development and operation of a hatchery system could, if not done with care, have a detrimental impact on wild salmon populations. There has never been any intent to replace wild populations with hatchery fish. The intention is to augment wild production and, perhaps, even reduce fishing pressure on wild systems. A provisional genetic policy was developed in 1975 by the Department of Fish and Game (ADF&G) to protect wild stocks from enhancement activities. It has been revised twice (1978 and 1985). The revisions have extended the policy by developing guidelines that provide for the application of genetic principles to the development and management of broodstock for the hatchery system. The revisions also clarify the rationale for the policy guidelines, and reduce ambiguity in the policy. Protection of wild stocks remains the principal objective of the genetic policy.

Our goal is to discuss the genetic policy and the genetic principles on which it is based. We also will discuss some of the problems encountered in trying to implement the policy. Finally, we will review the policy in an attempt to determine if, in its present form, it achieves the objectives for which it was developed.

PROBLEM

Genetic impacts to wild, indigenous fish stocks becomes a possibility when man decides to (a) transport fish from one locale and release them in another, and (b) when man decides to create by artificial means (hatcheries) fish to supplant those produced by nature. It is important to recognize that to conduct these activities does not automatically mean that genetic impact to wild stocks will follow. The attention man gives to preventing impact will determine whether any impact ensues. While not a topic for discussion here, it should be mentioned that the most clearly demonstrable genetic impact to wild salmon has been produced by commercial harvest.

What are the potential genetic hazards to wild fish populations brought by transport associated with enhancement? There are two. The first hazard is with the effects of gene flow between fish stocks. Gene flow occurs naturally between local stocks of the same species, but our concern is that fish released either at a hatchery or off-station may stray and interbreed with local wild stocks. If these stray fish are poorly adapted to the environment, the fitness of the local stocks potentially can be impacted. It is presumed that wild stocks have been adapted by natural selection to their native environment. Interbreeding with hatchery fish or transplanted wild fish, because these have adapted to a different environment, could reduce the fitness of the local stock. Although we are primarily interested in protection of wild fish stocks, the same dangers exist for hatchery broodstocks.

The second area of concern is with maintaining adequate genetic diversity both within and between fish populations. There are two components to the diversity in a species. There is the variation within each stock and also the diversity among stocks.

Both of these components are important to the long-term well-being of the species.

GENETIC CONCERNS

The science of Population Genetics has been developed over the past 70 years. It is true that there is little, if any, direct information on the genetic impacts of salmon enhancement on wild salmon stocks. However, there is a large body of theoretical and experimental work; the experimental work has been based on a wide variety of plants and animals other than fish. We have applied that body of knowledge to the development of the genetic policy.

What We Know

Genetic Variability and Fitness:

Our approach to policy development has been based on principles of population genetics theory. Population genetics deals with diversity, phenotypic diversity but, especially, with that portion of diversity that is caused by differences in genotype among individuals. A great deal of effort in population genetics is expended in determining the amount of genetic variation that exists both within and between natural populations. Genetic variability is the raw material which allows a population to adapt to its environment. Genetic variation, in addition, seems to increase the physiological stability of individuals and populations. In addition to genetic variability, a central factor in salmon population genetics is population structure. Salmon stocks home with remarkable precision to their "home" stream to spawn. Behavioral barriers to gene flow result in a significant degree of genetic diversity among salmon stocks. The amount of diversity is dependent on a number of factors, such as time since stocks separated and amount of gene flow between stocks. The amount of gene flow may be related to distance between stocks, or other impediments to migration.

Fitness can be defined as the probability that an individual will survive from conception to reproduction. However, we are primarily interested in the average fitness of the population or stock. It is very difficult to measure the total fitness of an individual because of the complexity of the trait. Anything that can increase or decrease the chance of an individual's survival to maturity affects the fitness of that individual and, therefore, the average fitness of the population to which it belongs. Any loss of genetic variation results in a loss of fitness, but any gain in genetic variation may or may not improve fitness.

What We Think We Know

It follows from what we know about population genetics theory that wild stocks must be approximately in genetic equilibrium. Being in genetic equilibrium means that though the population is constantly subject to natural selection tending to increase fitness, the gene frequencies remain relatively stable and fitness does not improve. The reason this is the case is that additive genetic variance (that portion of genetic variance that will respond to selection) will, over time, have been removed from the population by natural selection. (This has been called the "Red Queen" hypothesis after the character in Alice In Wonderland who said it was necessary to run as fast as they could to stay where they were.) Therefore, a wild stock at any particular location is assumed to be close to maximum fitness and, therefore, the stock best adapted for that location.

We assume also that transplanted salmon will not home as accurately to the new location, at least initially, as native salmon. Homing of some transplanted salmon has improved rapidly over the first few generations at a new location. This lends support to our assumption.

Finally, genetic distance and geographic distance are assumed to be correlated. Although salmon home with a remarkable degree of accuracy, there is some straying. Chances are that they stray into nearby streams with greater regularity than into more distant streams. It is not unreasonable, therefore, to assume that gene flow between neighboring stocks would result in genetic similarity. Having made that assumption, we have to recognize that there will be exceptions to this general rule. Life history characteristics, environmental features, and geological formations can effectively block gene flow between stocks that are geographically close.

Given these assumptions, we might also consider factors that would enter into an objective consideration of any proposed enhancement project. What is the environment to which salmon adapt? We should recognize that the environment of a salmon population is extremely complex. First, their environment encompasses both freshwater and marine habitats. <u>Both environments vary spatially as well as temporally</u>. In addition, it seems clear that salmon populations are characterized by a great deal of plasticity. Most salmon stocks are able to physiologically adapt to a wide variety of environmental conditions. Further, much mortality in salmon populations is due to pure chance or phenotypic difference rather than genetic selection. "Much differential survival and fertility is purely accidental - an animal may survive because it happens to be in the right place at the right time. This is especially true of organisms that produce a great excess of progeny of which only a few survive to maturity" (Crow and Kimura, <u>An Introduction to Population Genetic Theory</u>, 1970. Harper and Row, New York). Many of the assumptions on which we base our policy decisions are tied to the notion that the genetic composition of indigenous wild salmon determined primarily by selection. The value of these assumptions is not necessarily negated by the understanding that many differences between stocks have arisen by chance, and environment can perpetuate phenotypic differences without the populations undergoing genetic change. Our basic assumptions represent the most conservative approach to policy; however, we must recognize that these unknowns exist.

SOLUTION

The genetic policy is the solution to the problem of development of a salmon enhancement program while protecting wild salmon populations. As stated earlier, the genetic policy was developed in 1975 to protect wild stocks from possible detrimental effects of artificial propagation and management practices. However, since public and private nonprofit hatcheries have come on-line and proven successful, additional guidelines have been added to protect hatchery and enhanced stocks. The policy was reviewed and revised in 1978, and again in 1985. The purpose of the genetic policy is still to protect wild stocks. The following describes pertinent genetic considerations and how these have influenced the development of the genetic policy.

From the beginning of enhancement efforts, there has been a recognized need for controls on the movement of salmon stocks. The Fish Transport Permit (FTP) was developed to provide control of fish transport. In order for anyone to transport, possess, export from the state, or release fish into the waters of the state, they must hold an FTP issued by the Commissioner of the Department of Fish and Game. Each FTP is reviewed and commented on by selected staff of the department.

Control of fish transport is the only method available for limiting gene flow into fish stocks that need to be protected. Indiscriminate movement of stocks can result in decreased genetic diversity among stocks. Development of criteria for the genetic review of FTP applications has been a problem since the permit was established. Specific knowledge of salmon population genetics and the genetic impacts of salmon enhancement on wild stocks is limited. Consequently, the genetic policy is based more on information from agricultural genetics and population genetics of other species then on knowledge of our own salmon resources. The result is a policy containing guidelines that are rather flexible. We have tried to develop nonambiguous criteria for judging fish transport permits. The policy suggests that because our knowledge is limited, we should apply the policy and presumably evaluate the FTPs conservatively. An attempt to act conservatively gives the appearance of being arbitrary and begs the comment that the policy is too ambiguous. Unfortunately, the present level of our knowledge forces us to be somewhat ambiguous in our guidelines. Conservative application of the genetic policy can occur only if we set somewhat arbitrary limits based on what we know about the genetics of populations.

APPLYING GENETIC POLICY

When stocks are moved, wild salmon are subjected to increased danger of genetic impact. Direct genetic impact requires first that gene flow occur from the transplanted stock to the indigenous wild stock and, second, requires that the fitness of the wild stock be reduced. Simple, starch gel electrophoresis of tissue proteins can often detect whether or not gene flow has occurred between two salmon stocks. But to prove genetic impact conclusively, it is necessary to demonstrate that the fitness of the indigenous wild stock has been reduced. Fitness is measured in terms of production of biomass by the stock, and any change in fitness must be a measure of that change in production ascribable only to gene substitution. Numerous environmental variables, both biotic and abiotic, also influence production by the stock, and so it borders on the impossible to measure any change in fitness (production) due to gene flow. Year-to-year variation in production due to this set of other variables masks any reduction in fitness that could be expected over a period of time. Hence, changes in fitness of salmon stocks due to interbreeding have never been measured. So it follows that direct genetic impact due to interbreeding has never been demonstrated in salmon.

The genetic policy has been developed to provide guidelines that will allow development of a hatchery/enhancement program while minimizing the potential for genetic impacts on wild stocks to an acceptable level. Stock interaction must allow for the long-term retention of natural communities under conditions that provide the potential for continuing evolution.

Significant Stocks

Salmon populations vary in size from intermittent runs, which may be maintained by straying, to runs of hundreds of thousands of fish. It seems reasonable that all salmon population are not of equal importance. The effect of a salmon enhancement project depends to some degree on the relative value of the stock that might be impacted. The concept of significant stocks arose out of such considerations. Early versions of the policy (1975 and 1978) distinguished between introductions into systems with large indigenous stocks and into systems with few or no indigenous fish. The earlier policies made no attempt to set limits on population size but clearly had introduced the concept of significant stocks.

The 1985 review and revision of the genetic policy was initiated because of a need to remove ambiguity and increase consistency in application of the policy. Members of the review committee were unable to define the term, "significant stock," but did develop an approach to the problem. The committee felt that, while the size of the population is important, "significance" must be defined not only by the magnitude of the run, but also in the context of local importance and utilization. The committee suggested as well that "Because local utilization is an important concern, a regional planning group such as the Salmon Enhancement Regional Planning Teams should consider what criteria will be used to determine significant stocks within a region and recommend such stock designations." At this time, these suggestions have not been implemented.

Genetic and Geographic Distance

The idea that genetic distance and geographic distance are correlated has also been used in developing and applying the genetic policy. We are led to this idea by two facts of salmon biology. Salmon stocks home to their own spawning grounds with some accuracy and adapt to that particular environment. This tends to cause some degree of genetic separation between stocks. However, there must be background levels of straying occurring between local salmon stocks. The fact that salmon species will repopulate barren streams is evidence that salmon stray; however, straying may also lead to reduced fitness of a recipient stock. Background levels of straying occurs between neighboring, thus genetically similar, stocks. We become concerned when stocks that have been transported from distant locales stray because they are not genetically similar to local stocks. The chance that strays from one stock will interbreed with another is dependent on the distance between the two stocks. It would seem to follow that, other things being equal, two stocks that are separated by a short distance will be more alike genetically than two stocks that are separated by a greater distance. Every stock will have its own sphere of influence, circumscribed by the straying of its members. The influence of each stock will decrease with distance from its home stream.

Changes of location on the globe result in changes in the environment. That is, in general, environment also changes as a function of distance. This, coupled with the fact that natural selection works to adapt a stock to its environment, lends support to the assumption that genetic differences between stocks separated by a great distance are larger than genetic differences between neighboring stocks.

This relationship between genetic similarity and distance leads to two conclusions: First, local stocks transplanted to a site will have less genetic impact on indigenous populations because of their genetic similarity than stocks transplanted from a greater distance; and, second, stocks local to an area are best suited for transplant within the area or for development of a broodstock at a site within the area.

Salmon stocks have a genetic sphere of influence because of their life history characteristics. All stocks interact genetically with those around them. This concept has governed the way the genetic policy has been applied. It seems obvious as well that each hatchery or enhanced population will also have a genetic sphere of influence. The larger the production of the wild stock, hatchery stock, or enhanced stock, the greater its influence will be on surrounding stocks.

The effect of these genetic spheres of influence is that decisions made in the past seem bound to limit options for future projects. Consider what it means when all stocks influence and, in turn, are influenced by those around them. Transplanted stocks will impact the genetic composition of stocks adjacent to the release site. Because we assume that wild stocks are in approximate equilibrium, we must assume also that any genetic impact caused by a stock adapted to a different environment (a transplanted stock) will result in some loss of fitness to the indigenous wild stock. The reduction may not be critical; it is impossible to know. It is conceivable that the indigenous wild stock will derive some benefit from the introduction of genetic variation. The result would probably depend on the amount of gene flow that occurs. The amount of gene flow would depend, in turn, on ability to manage the enhanced stock so that straying of returns would be minimized. It would also depend on the degree of genetic difference between stocks and the reproductive success of the straying fish. This aspect of salmon population genetics is not understood. This problem reemphasizes the need to apply the genetic policy conservatively.

Transplants will modify to some degree the genetic composition of local stocks. When remote stocks are transplanted to areas with significant wild stocks, the wild stocks in this locale are changed to some degree genetically, and their status must be reconsidered. Future options may have been limited.

Multiple Use of Stocks

It is important to build stock diversity into the hatchery system. Salmon stocks differ in levels of disease resistance, temperature tolerance, acid tolerance, and in response to artificial selection. Stock diversity will tend to buffer the hatchery system against both natural and man-made disasters. Further, the ability to genetically improve hatchery broodstock performance in the future depends on the availability of genetic variability. Such variability would be present in a hatchery system with a variety of diverse broodstocks.

There is an apparent conflict between the need for stock diversity in the hatchery system and the need to start up individual hatcheries as economically as possible. It is more economical in the short run to develop a hatchery broodstock from excess eggs of an existing broodstock than from a wild source. And, it is difficult to place a monetary value on the long-term value of stock diversity. The genetic policy limits to three the number of hatchery broodstocks that can be established from a single donor. It does not limit the number of release sites for terminal harvest. This limit on multiple use of stocks balances the need for short-term economy and the need to establish and maintain genetic diversity. It will limit the spread of a single stock.

CONCLUSION

Can the genetic policy in its present form be applied in a way that will achieve the objectives for which it was developed? The answer is yes. Although there is an inherent risk to wild stocks from the development and operation of a hatchery/enhancement program, this risk can be managed by reducing the genetic impact on wild stocks to an acceptable level. The need is not to avoid all genetic change, but to allow for the long-term retention of natural communities under conditions that would provide for continuing evolution. To achieve this goal, we have to apply the genetic policy conservatively. This means that if we know, for example, that genetic similarity decreases with distance and our decisions are not to be ambiguous, we must set arbitrary limits on distance a stock can be transported. An effective genetic policy must allow for implementing successful enhancement activities while protecting and maintaining healthy wild stocks.

There are only two primary genetic concerns in protecting wild stocks and implementing a successful enhancement program. The first concern is possible genetic impacts due to gene flow into wild or enhanced stocks. The second concern is the loss of genetic variation within or among stocks. We are obviously concerned with both wild and enhanced stocks. However, Alaska's valuable salmon industry is founded on production from wild stocks, and wild stocks are the source of genetic variation for development of enhanced stocks; therefore, our primary concern is wild stocks. Both gene flow and loss of genetic variation can potentially cause the reduction of total fitness in wild stocks and hatchery broodstocks. The genetic policy addresses these problems in its three main topic areas. The topics addressed are Stock Transport, Protection of Wild Stocks, and the Maintenance of Genetic Variance. The genetic policy addresses the genetic concerns adequately. The policy describes the genetic concerns and presents guidelines that protect wild stocks from impacts of enhancement activities, as well as protecting hatchery broodstocks and enhanced stocks from the problems associated with loss of genetic variation.

The only problems with the policy are those of perception. It is our hope that this paper will serve to promote a better understanding of the policy. One important task remains to be accomplished: The Genetic Policy Review Committee (1985) outlined an approach to the problem of defining significant and unique wild stocks. Any designation of stocks as significant or nonsignificant will be arbitrary. However, some means of defining these terms is critical to the successful application of the genetic policy and must be found.

SECTION C

Regulation Changes, Policies and Guidelines for Alaska Fish and Shellfish Health and Disease Control

Regulation Changes, Policies and Guidelines for Alaska Fish and Shellfish Health and Disease Control

by

State Pathology Review Committee

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1985 - 1987

October 1988

MISSION STATEMENT

The following document includes proposed changes in state regulations, new policies, and recommendations to be used by recognized authorities and user groups for maintaining adequate finfish and shellfish health within the State of Alaska. These criteria include regulating and permitting protocols, diagnostic procedures, prophylactic measures, and treatments of infectious diseases of salmonid fishes and oyster species. The criteria are established for the purpose of regulating interstate and intrastate movements of the above live animals or their gametes for planting in natural waters, research and education purposes, and/or other interests not defined herein. The long-range goal of this document is to prevent dissemination of infectious finfish and shellfish diseases within or outside the borders of Alaska without introducing impractical constraints for aquaculture and necessary stock-renewal programs. In so doing, other established state criteria regarding genetic and aquaculture policies will be maintained.

CHANGES IN EXISTING REGULATIONS

The recommendations of this committee include suggested changes in existing regulations found within the Alaska Statutes and Regulations for Private Nonprofit Salmon Hatcheries (ASRPNSH).

<u>Pursuant to Article 3, 5 AAC 41.070(b)(2)</u>

There are several parasitisms in oysters, and other shellfish species, which may or may not be indigenous to Alaska, that do not affect their health or marketability. These are considered insignificant diseases that should not restrict oyster importation into Alaska. Article 3, 5 AAC 41.070(b)(2) should read[1]:

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[1] Proposed additions to regulations will be underlined, and proposed deletions will be bracketed in capital letters.

(2) the disease history or an inspection indicates no incidence of disease that is not indigenous to Alaska <u>or is considered significant (by the Fish Pathology Section) to oyster health or marketability</u>.

<u>Pursuant to Article 3, 5 AAC 41.080(b)</u>

Egg disinfection should be practiced on <u>all</u> eggs coming into a hatchery, regardless of their origin. Returning stocks originating at a hatchery can and do have disease prevalences which wax and wane from year to year which could be reduced by thorough external egg disinfection. Article 3, 5 AAC 41.080(b) should read:

(b) Within 24 hours of <u>taking and fertilizing live fish eggs or</u> transporting live fish eggs between watersheds, all eggs must be treated, for at least 10 minutes, with iodine solution of at least 100 parts per million of active iodine ingredient, with pH at least 6.0 or greater, or in a manner approved by the Fish Pathology Section of the Department. This requirement does not apply to shellfish eggs <u>and may, at the discretion of the Commissioner or his authorized designee, also exclude eggs taken at certain large scale pink salmon facilities where the operational history shows that disease has not been a problem in returning stocks of fish.</u>

<u>Pursuant to Article 3, 5 AAC 41.080(c)</u>

It is recommended that not all hatcheries need inspection <u>every</u> year. Some facilities have had no disease problems; consequently, if management and hatchery design remain the same, such facilities may only require inspection once every other year. Also, poor spring weather makes it extremely difficult to fly to and inspect hatcheries prior to release of fish. Also, prerelease inspections of fish are generally not necessary and should be eliminated unless warranted in certain instances by the fish pathology section. Article 3, 5 AAC 41.080(c) should be amended to read:

(c) Each fish hatchery or fish rearing facility must be inspected by the Department's Fish Pathology Section at least once [EACH] <u>every other</u> year [AT LEAST TWO WEEKS PRIOR TO THE TRANSPORT OR RELEASE OF FISH]. The Commissioner or his designee may require and conduct additional inspections if the disease history of the stock or facility is incomplete, or if the disease history or current condition of the stock evidences incidence of disease.

<u>Pursuant to Article 3, 5 AAC 41.080(d)</u>

All disease categories have been completely changed to reflect current understandings of disease problems and concerns. Article 3, 5 AAC 41.080(d) has been entirely replaced with this amended version:

(d) The occurrence of any of the following pathogens or diseases of fish must immediately be reported to the Department's Fish Pathology Section:

1. Finfish Disease Categories

a. Class I. <u>Diseases of Critical Concern</u>

1) VHS - Viral hemorrhagic septicemia
2) IPN - Infectious pancreatic necrosis
3) OMV - <u>Oncorhynchus</u> <u>masou</u> virus
4) <u>Herpesvirus</u> <u>salmonis</u>
5) Whirling disease (<u>Myxobolus</u> <u>cerebralis</u>)

b. Class II. <u>Endemic Diseases of Concern</u>

1) IHN - Infectious hematopoietic necrosis
2) BKD - Bacterial kidney disease (<u>Renibacterium salmoninarum</u>)
3) Furunculosis (<u>Aeromonas</u> <u>salmonicida</u>)
4) ERM - Enteric redmouth (<u>Yersinia</u> <u>ruckeri</u>)
5) ICH - Ichthyophthiriasis (<u>Ichtyophthirius multifiliis</u>)

c. Class III. Nuisance Diseases

1) Vibriosis (saltwater *Vibrio anguillarum*, *V. ordalii*, *V. alginolyticus*)
2) Cold water disease (*Cytophaga psycrophila*)
3) Columnaris (*Flexibacter columnaris*)
4) Trichodiniasis (*Trichodina*, etc.)
5) Ichthyobodiasis (*Ichthyobodo* = *Costia*)
6) Hexamitiasis (*Hexamita*)
7) Lymphocystis Virus
8) Helminth diseases
9) Fungal diseases (*Saprolegnia* sp.; *Phoma herbarum*)
10) Motile bacterial septicemias (*Aeromonas hydrophila*, *Pseudomonas*)

d. Class IV. Uncategorized Diseases

1) VEN - Viral erythrocytic necrosis
2) PKD - Proliferative kidney disease
3) Vibriosis (freshwater)
4) *Loma* (Microsporidan)
5) Reovirus
6) Ceratomyxiasis (*Ceratomyxa shasta*)
7) Finfish pathogens not defined in Category I, II, and III including non-salmonid agents.

2. Shellfish disease categories

a. Class I. Diseases of Critical Concern

1) European Iridoviruses
2) Oyster Herpesvirus
3) *Ostracoblabe implexa* (Foot disease fungus)
4) *Perkinsus marinus* and other like protozoa
5) *Haplosporidium* sp. (*nelsoni*; *costalis*)

6) *Marteilia* sp. (*refringens*; *sydnei* aber disease; QX)
7) *Bonamia ostreare* (protozoan microcell)
8) Velar disease (Iridovirus)
9) *Mytilicola* sp. (*intestinalis*; *orientalis*) Copepod
10) Malpeque Bay disease
11) Denman Island disease

b. Class II - Nuisance Diseases

1) Focal necrosis (Gram + bacteria, *Nocardia*-like)
2) Prokaryote inclusions (chlamydia; mycoplasma; rickettsia)
3) Bacillary necrosis (*Vibrio*; *Pseudomonas*; *Aeromonas*; others)
4) *Sirolpidium zoophthorum* (fungus)
5) Mycelial disease (Actinomycete-like)
6) *Hexamita* sp. (protozoan)
7) Ciliates (*Sphenophrya*; trichodinids; *Ancistrocoma*)
8) *Nematopsis* sp. (sporozoan)
9) Microsporidea (HEP and others)
10) Helminth parasites
11) Neoplastic disease
12) Ovacystis virus (papovavirus)
13) Symbionts
    a) *Polydora* (mudworm)
    b) *Diplothyra* (boring clam)
    c) *Cliona* (boring sponge)
    d) Bryozoa
14) Predators
    a) *Stylochus* (polyclad)
    b) drills
       Urosalpinx cinerea
       Ocenebra japonica
       Rapana sp.

Finfish diseases have been divided into four categories that may be handled differently when diagnosed. Only salmonid diseases have been specified. As addressed in Category IV, diseases of other fish will be examined on a case-by-case basis as the need arises.

Shellfish diseases have been divided into only two categories; only diseases of oysters have been considered. Other shellfish diseases will be considered on a case-by-case basis as the need arises.

<u>Pursuant to Article 3, 5 AAC 41.080(e)</u>

Although all fish and shellfish diseases should be reported, not all are important enough to merit cause for the Commissioner to prohibit stocking in new areas and to quarantine the permittee's facility until disinfected. Recommend omission of last sentence in (e), beginning with "Presence". Exotics are addressed in (f). Article 3, 5 AAC 41.080(e) should read:

> Diseases reported under (d) of this section, if found by inspection under (c) of this section, must be treated by taking steps acknowledged by the Fish Pathology Section to be effective in eliminating the disease. Containers or facilities must be disinfected by the permittee in a manner directed or approved by the Commissioner or his authorized designee. [PRESENCE OF ANY OF THESE DISEASES OR ANY OTHER DISEASE NOT PREVIOUSLY OBSERVED IN ALASKA MAY BE CAUSE FOR THE COMMISSIONER OR HIS AUTHORIZED DESIGNEE TO PROHIBIT STOCKING OF THE FISH IN NEW AREAS AND TO QUARANTINE THE PERMITTEE'S FACILITY UNTIL DISINFECTED.]

<u>Pursuant to Article 3, 5 AAC 41.080(f)</u>

The finfish diseases of critical concern listed in Class I are extremely serious, such that if detected more specific and drastic measures regarding containment and eradication need to be addressed. Much of (f) has been reworded. This category includes five infectious agents that have not been detected in Alaska, two of which (OMV, VHS) are exotic to the North American Continent. Three of these agents (VHS, IPN, and _M. cerebralis_) can be extremely virulent and capable of killing whole populations of fish. The remaining two can also cause severe problems, making infected stocks unsuitable for any purpose. There is no known treatment for any of these agents, except prevention.

The shellfish diseases of critical concern listed in Class I include 11 infectious agents that are exotic to Alaska; two of these (1, 6) are exotic to North America. Any oysters for importation into Alaska having detectable Class I agents will be refused for entry. Any oysters within the state infected with agents exotic to North America should be considered for destruction or immediate marketing to protect the environment or other oyster stocks.

Because no baseline survey work has been done, there is no class including endemic diseases of concern for bivalve mollusks in the state of Alaska. Consequently, some of the diseases listed in Class I may actually be endemic and will have to be considered on a case-by-case basis when detected in cultured stocks within the state. Until that time, the state of Alaska will take the conservative approach with seed imports of _Crassostrea gigas_ and consider all Class I diseases as exotic. Article 3, 5 AAC 41.080(f) should read:

> As determined by the Commissioner or his authorized designee, detection of any Class I disease in finfish stocks or Class I disease exotic to North America in shellfish stocks within a hatchery or rearing facility will require immediate action, including quarantine, stoppage of water flows to eliminate effluent release, complete destruction and proper disposal (caustic lime burial or incineration) of affected stocks within the facility, and a thorough disinfection of holding

areas and equipment. A facility so affected may be required to remain dry or out of production for one year and be certified free of the disease before continued production of fish or shellfish.

[STOCKS OF FISH IN HATCHERIES OR REARING FACILITIES IN WHICH A] If Class I diseases [HAS BEEN DETECTED MUST BE IMMEDIATELY DESTROYED] exotic to Alaska but not to North America are detected in Alaskan oysters, they may require destruction by the permittee if the Commissioner or his authorized designee determine that the disease. . . poses a threat to the health and perpetuation of native, wild, or hatchery stocks of shellfish in the [HATCHERY EFFLUENT WATERSHED] immediate area or the intended release location. In limited circumstances, the Commissioner or his authorized designee may allow retention or transportation of these diseased fish or shellfish under controlled conditions that pose no threat to native, wild, or hatchery stocks of fish and shellfish (e.g. movement to a disease laboratory having effluent depuration).

Pursuant to Article 3, 5 AAC 41.080(g)

The Finfish diseases of endemic concern listed under Class II include five obligate pathogens causing most of the serious finfish disease problems in Alaska. These are of concern because they currently affect fish transport within and outside the state and define sampling sizes, frequencies, and methodologies. All but two (IHN, BKD) are treatable to some degree, and depending upon the agent and the circumstances involved, fish in the diseased state may or may not require destruction and proper disposal followed by complete disinfection of the hatchery facility. (*See* Policy Section III A-D for treatment of different diseases under various circumstances.) Article 3, 5 AAC 41.080(g) should read:

Stocks of finfish in hatcheries or rearing facilities in which a Class II disease has been detected [MUST BE

IMMEDIATELY DESTROYED] may require destruction and complete disinfection of the facility by the permittee, [IF] depending upon the agent involved as determined by the Commissioner or his authorized designee [DETERMINES THAT] and if the disease poses a threat to the health and perpetuation of native, wild or hatchery stocks of finfish in the hatchery effluent watershed of the intended release location.

Article 3, 5 AAC 41.080(e) includes adequate action for finfish Class III and Class IV diseases and requires no additional amendment. Class III diseases include several agents that often are secondary to poor environmental conditions and/or finfish husbandry techniques. Some of these require movement restrictions based on prevalence of the disease and resultant fish mortality. In general, these do not constitute a major concern for finfish health in Alaska.

Class IV diseases include those entities as yet undiscovered, six other agents that remain obscure regarding their importance to finfish health in Alaska, and all other nonsalmonid diseases that could become concerns in the future. As the need arises, each entity will be evaluated on a case-by-case basis. Four of the agents (excluding Loma and C. shasta) are as yet exotic to salmonids in Alaska and may necessitate destruction of infected stocks if detected. C. shasta is a serious pathogen of salmonids in the Pacific Northwest, and has been reported in salmonids from tributaries of the Yukon River. This agent as yet has not been detected in the usual Alaska State finfish transport proceedings and will not be routinely searched for. If this agent or any other entity in this category become a serious problem in Alaska, they will be treated as Category II diseases and sampled for accordingly.

The symbionts and predators listed in Shellfish Class II Nuisance Diseases are not adequately treated in Article 3, 5 AAC 41.080(e). Some of these nontarget species are unwanted exotics and if

Class II shellfish diseases in general, the state reserves the right to refuse certification or restrict movement of oysters if there is oyster mortality or significant disease associated with the prevalence of any agent(s).

Consequently, the following new section is recommended: Article 3, 5 AAC 41.080(h) should read:

(h) The presence of predators recognized in Class II shellfish diseases which may be exotic to Alaska will result in refusal of shellfish import certification by the Commissioner or his authorized designee until resubmitted representative samples of the shipment are free of nontarget invertebrate species. The Commissioner or his authorized designee also will refuse certification or restrict movement of oysters if there is oyster mortality or significant disease associated with the prevalence of any infectious agent(s).

Pursuant to Article 3, 5 AAC 41.100

The definition "fish pathology section" needs to be expanded to include the new Juneau fish pathology laboratory. Definition (3) under Article 3, 5 AAC 41.100, should read:

(3) "Fish pathology section" means the Alaska Department of Fish and Game, Fisheries Rehabilitation, Enhancement and Development Division, Fish Pathology Section located at: 333 Raspberry Road, Anchorage, Alaska 99502, telephone (907) 344-0541; and 3333 Old Glacier Highway, Juneau, Alaska 99802, telephone (907) 465-3577.

Fish transport permits for in-state movement, possession, etc., are required for shellfish as well as finfish since fish are defined in AS 16.05.940(6) to include all invertebrates and amphibians. However, this is not made clear in the ASRPNSH and should be explained by defining "fish" in this definitions section as it is within the Alaska Statutes except when designated otherwise. Article 3, 5 AAC 41.100 should include an additional definition with the following changes:

(14) "Fish" means any species of aquatic fish, invertebrates and amphibians in any stage of their life cycle found in or introduced into the state except where specifically designated "finfish" or "shellfish."

APPLICATIONS

The State of Alaska has, within its boundaries, large areas of separated watersheds supporting wild fish stocks which have never been examined for diseases. Consequently, there is a risk of unknowingly transporting presently undiscovered finfish diseases (in Alaska) from one major geographic area to another which may not be detected at the 5% level in 60 adult fish examined prior to transport. To minimize this risk the Department of Fish and Game will not advocate the transplant of wild finfish stocks between the major geographic zones designated as Southeast, Kodiak Island, Prince William Sound, Cook Inlet, Bristol Bay, AYK, and interior. To maintain consistency with the Alaska Department of Fish and Game Genetic Policy, and because wild fish stocks are in several hatchery water supplies, this disease policy will include hatchery stocks of fish as well, with exceptions considered only on a case-by-case basis. Proposals to do so must be for gametes only and accompanied by adequate justification for using a non-local stock and a FRED pathology disease history based on cultured fish having no detectable diseases in at least the last two consecutive years of screening a minimum of 150 adult fish and no diseases during rearing of their progeny.

A. WILD FISH TRANSPLANTS	DISEASE CONSIDERATIONS

1. BETWEEN WATERSHEDS WITHIN A DESIGNATED GEOGRAPHIC AREA

a) Transplant of adult fish to a watershed barren of salmonids

(1) Prior year sampling recommended to define year to year variability in disease prevalence.

(2) Sampling required in same year but prior to transplant of adult fish of stock.

(3) Class II disease criteria:[a]

Bacterial Kidney Disease (BKD) - Cannot exceed levels in Schedule I (See Section IV, Appendix E).

Furunculosis - Carrier state cannot exceed levels in Schedule I

Infectious Hematopoietic Necrosis (IHN) - No samples required unless proposed transplants are IHNV susceptible salmonids from a sockeye or kokanee watershed since IHN disease has not been prevalent in salmonid species other than sockeye - All sockeye and kokanee are presumed carriers. Detection of IHNV in any salmonid other than sockeye/kokanee precludes use for transplant.

Ichthyophthirius (ICH) - Not applicable unless present as a clinical disease, in which case consideration would be on a case-by-case basis.

Enteric Redmouth (ERM) - A rare disease in Alaska because of which fish are not routinely screened for *Yersinia ruckeri*. Consequently, its dissemination is a significant concern when detected. If diagnosed, transplant of those fish would be decided on a case-by-case basis.

[a] Classes I, III, and IV finfish diseases are addressed sufficiently in the regulation section.

1. BETWEEN WATERSHEDS (continued)

b. Transplant of juvenile fish to a watershed barren of salmonids.

Class II disease criteria:

BKD - No significant (defined on page 55 __ 0.5%/day) mortality and immediate disease history of hatchery performance cannot exceed levels in Schedule I.

Furunculosis - As indicated by fluorescent antibody technique with confirmation by isolation. If the disease state exists, treat and release when mortality becomes insignificant and prevalence does not exceed Schedule I. If prevalence of infection exceeds Schedule I, fish cannot be released.

IHN (sockeye, kokanee) - Release if no disease. Clinical signs of IHN and isolation of virus will require destruction of affected lots. Lots which are virus negative may be released as soon as posible.

IHN (chum, chinook, steelhead, rainbow, cutthroat) - Detection of IHNV necessitates destruction. Operator of a facility that has IHNV detected must demonstrate that remaining stocks have been sufficiently isolated to prevent cross contamination; that is, the facility must have been qualified for acceptance at least as a PQU.

ERM - Same as for adult fish except if diagnosed in the diseased state with significant mortality, destruction of the lot may be required.

Ich - Saltwater release allowed. Freshwater release: treat and release as soon as practical to minimize exposure of other hatchery stocks.

1. BETWEEN WATERSHEDS (continued)

c. Transplant of adults, juveniles or eggs, to a watershed containing other "significant" stocks of salmonids.

(1) Stocks to be transplanted:

Juveniles and eggs
- If no disease history then prior year samples from spawning or post-spawned adult fish recommended.

Adults
- If no disease history then samples of adult fish (preferably post-spawned) stock to be transplanted required prior to transplant in year of transport.

(2) Stocks in receiving watershed:

If stocks to be transplanted are negative for finfish pathogens then there is no need to sample stock for disease in the recipient watershed. If pathogens are detected in donor fish or the intent is to establish a broodstock source then the following applies. Prior year sampling of resident fish is strongly recommended. Sampling should include all stocks determined to be significant by area biologists. In order to develop a disease history, stocks in receiving watershed should have 60 samples collected from adult fish (preferably post-spawned) for examination. If, for the purpose of transplanting fish stocks having a known carrier state of a fish pathogen, 60 resident fish are not available for examination, then the latter stocks are presumed negative for all pathogens. In any case Class II criteria below apply.

(3) Class II disease criteria:

BKD and Furunculosis - If stocks in receiving watershed have zero prevalence, then stock proposed for transplant must also have zero prevalence (min. sample size = 60). Responsibility for obtaining a 60 adult fish sample rests with the applicant. If adequate transplant sample numbers are unavailable, the transplant cannot be made.

1. BETWEEN WATERSHEDS (continued)

If any stock in the receiving watershed is positive for BKD or furunculosis, then the stock proposed for transplant must not exceed levels in Schedule I. (A. salmonicida in the receiving and donor watersheds must be confirmed by culture. This is due to non-specific fluorescence encountered in FAT.)

IHN - No samples required for sockeye or kokanee except for establishment of a disease history: all stocks are presumed carriers.

Transplant of sockeye or kokanee into non-sockeye systems having IHNV susceptible species is not advocated and will be evaluated on a case-by-case basis regarding: average titer and prevalence of virus in the stock to be transplanted and the resource value of the susceptible species at risk in the recipient or nearby watersheds.

Transplant of IHNV-susceptible species to a watershed containing sockeye or kokanee would also be evaluated on a case-by- case basis and may not necessarily be rejected solely on the basis of fish health concerns. Applicant and resource managers must be willing to accept the possible loss of transplanted fish or condemnation of the stock due to IHNV. Transplant of chinook, chum, rainbow, steelhead, or cutthroat into a non-sockeye system from a system with sockeye will require virus sampling. Any virus positive stock would be disqualified. However, if virus negative, these species would be presumed IHNV carriers, and decision criteria for sockeye and kokanee transplants would apply.

Ich - If there is a disease history of Ich then no transplant is permitted unless receiving waters also have a history of Ich.

ERM - Same as for BKD and furunculosis except if diagnosed in the diseased state with significant mortality, destruction of the lot may be required.

A. WILD FISH TRANSPLANTS	DISEASE CONSIDERATIONS
2. TO A HATCHERY	
a. Quarantine Unit (QU) (see Section IV, Appendix A)	(1) Class II disease criteria. No constraints for pathogens in carrier state since they will be in isolation.
b. Other than a QU	(1) Class II disease criteria. If no other stocks are present at hatchery, criteria in Section A.1.a.(3) apply. If other stocks are present in the hatchery and their disease histories are negative for pathogens, then the transplanted stock history must be negative. If other stocks are present in the hatchery and they have a history of BKD, furunculosis or ERM, then the transplanted stock must meet the criteria for Schedule I. If a pathology-approved Partial Quarantine Unit (PQU-Section IV, Appendix A) is to be used, then other stocks at the hatchery are not a concern. In either case (except effluent depuration (page 38) in a PQU), if there are wild salmonids present in the hatchery watershed criteria in A.1.c apply.

B. BROODSTOCK SCREENING FOR EGG-TAKES i/ — DISEASE CONSIDERATIONS

1. EGG-TAKE AT HATCHERY (indigenous stock)

a. For release of progeny at hatchery.

As long as an acceptable disease history (Schedule I) within the broodstock has been established and fry performance has indicated no disease concerns, no disease screening required, but recommended every other year. Disease outbreaks in juveniles and/or significantly high levels of a Class II pathogen in broodstock may require corrective action and more sampling.

b. For release of progeny at another site.

Samples can be taken in year prior to initial eggtake.

Class II disease criteria:

BKD - Prevalence in brood source cannot exceed levels in Schedule I. Depending upon the circumstances, Family Tracking ii/ may be an acceptable alternative.

Furunculosis and ERM - Not considered (B.2.a) unless (1) there has been recent problems within the disease histories or (2) it is a new stock without prior disease history, in which case screening should be done for a disease history.

IHN (Sockeye, Kokanee) - Sample size = 60 adult (postspawned) fish in prior year for establishing population prevalence - ripe fish can be used thereafter at the eggtake. For small-scale eggtake Family Tracking Method preferred, with elimination of eggs from high titer ($\geq 10^4$) females or fertilized by high titer males. In rare instances, when numbers permit, eggs from any mating of virus positive parents should be destroyed.

IHN (chum, chinook, steelhead, rainbow, cutthroat) - Screening for IHNV would not be routine in indigenous non-sockeye hatchery stocks unless IHN disease or other virus exposure is suspected. For large scale eggtakes, sampling in year prior is recommended. Any detection of IHNV would disqualify the broodstock.

i/ Note: The following "Disease Considerations" regarding BKD are in lieu of the preferred use of fish stocks having no history of the agent causing this disease. Toleration of the Schedule I minimal levels of this disease agent in stocks used at any facility is condoned only if: an alternative stock(s) is unavailable; other circumstances specific to on-going programs leaves no practical alternative; other corrective procedures such as Family Tracking are practiced to mitigate disease concerns. (see Section IV, Appendix E, Schedule I Rationale)

ii/ For small populations of less than 1,000 where a sample of 60 adult fish in one year would constitute a significant loss, alterative arrangements can be made with Pathology. The recommended procedure is to sample fish over a period of years prior to the proposed egg-take. Under well justified circumstances another method might be approved. This is called Family Tracking and requires sampling at the time of eggtake. Family tracking involves keeping egg lots separate during water hardening, disinfection, and incubation in Heath Trays until testing of individual parents is completed. Egg lots from disease-positive parents are discarded.

2. EGG-TAKE AT A SITE REMOTE FROM HATCHERY

a. For stocking of progeny back to system of origin

Class II disease criteria.
- approved QU - no constraints.

- Non-QU (sampling required but recommended in year prior to egg take).

BKD - Prevalence in brood source cannot exceed levels in Schedule I. For hatcheries requiring reuse or recirculation of water, the consequences of bringing BKD in from outside could not be tolerated. If feasible, Family Tracking would be used or a known BKD-negative stock would be required.

Furunculosis and ERM - No specific limitation. Pathology does not recommend that high-risk stocks be used if there are alternatives. Egg disinfection is required; Pathology may monitor/assist at eggtake, and may require fry samples prior to release depending upon fry performance. At present, there is no evidence to indicate that vertical transmission of either *A. salmonicida* or the ERM agent occurs WITHIN the eggs of salmonids. Consequently, eggs from a low number of carrier brood should pose no additional risk if rigorous external disinfection is practiced. However, the risk of inadequate egg disinfection would increase with increasing numbers of carrier broodfish.

IHN (sockeye, kokanee) - Sample size = 60 post-spawning adult fish in year prior, required for disease history information; specific precautions to be recommended by Pathology will relate to facility type, location, and fish handling capabilities. All sockeye are presumed carriers. Once a disease history is established for a particular stock, subsequent sampling may only include 60 of those fish actually used in the eggtake in order to monitor the virus prevalence actually brought into the hatchery.

B. BROODSTOCK SCREENING FOR EGG-TAKES	DISEASE CONSIDERATIONS
2. EGG-TAKE AT A SITE REMOTE FROM HATCHERY (continued)	IHN (chum, steelhead, rainbow, chinook, cutthroat) - In a system with sockeye - 60 samples from the desired susceptible species (post-spawners) are required in year prior. Any incidence of IHNV in sample precludes using that stock for eggs. Ich - Not applicable.
b. For release at the hatchery or c. For release at a remote site	Same criteria as B.1.b. Also, IHNV susceptible species other than sockeye from sockeye systems are not advocated for use and will be considered on a case-by-case basis.
d. Stock originating from hatchery fish at remote site for release into barren system.	Same criteria as A.1.b and C.3.b.
e. Stock originating from hatchery fish at remote site for release to a system with salmonids.	Same criteria as A.1.c. and C.4.

C. DISEASE HISTORY OF JUVENILE FISH PRIOR TO RELEASE	DISEASE CONSIDERATIONS
1. AT THE HATCHERY SITE	Pre-release examination of juvenile fish will not be performed as a general rule unless: mortality or another clinical disease sign or otherwise poor performance anytime prior to release warrants concern by the Fish Pathology Section; the broodstock disease history at eggtake was positive for BKD at levels greater than Schedule I and Family Tracking was not practiced. Class II disease criteria: BKD - If no significant mortality, no restriction; A total cumulative mortality equal to or greater than 5% in 90 days prior to release attributable to BKD will preclude release. It is the long-range goal that all

C. DISEASE HISTORY OF JUVENILE FISH PRIOR TO RELEASE	DISEASE CONSIDERATIONS
1. AT THE HATCHERY SITE (continued)	facilities surpass or meet the minimal subclinical detection criteria in Schedule I. Facilities that do not meet Schedule I limits but have total cumulative mortalities of less than 5% in the 90 days immediately prior to release can release provided they develop a plan that will alter the physical plant and/or operation to assure meeting the limits of Schedule I within 6 years from date of adoption of these policies. Furunculosis - Must be treated until mortality reaches background level (.03%/day/lot of fish), then release will be allowed. IHN - (sockeye, kokanee) Infected lots, as determined by clinical signs and/or detection of IHNV must be immediately destroyed. Lots which are negative for virus may be released as soon as possible. Any further outbreaks will require destruction of additional affected lots. IHN (chum, chinook, steelhead, rainbow, cutthroat) - Same as sockeye except finding of IHNV in fry is sufficient cause for destruction of the inventory of that stock unless demonstrated that lots within that stock have been sufficiently isolated and unexposed to the virus. Also, operator of a facility that has a positive diagnosis of IHNV must demonstrate that sufficient isolation has been maintained to assure that other susceptible stocks have not been contaminated. Otherwise, the disposition of the exposed stock(s) may also be in jeopardy. ERM - If diagnosed in disease state with significant mortality, elimination of a stock may be required, depending upon circumstances. Ich - Treat prior to release.

C. DISEASE HISTORY OF JUVENILE FISH PRIOR TO RELEASE	DISEASE CONSIDERATIONS

2. RETURN TO SYSTEM OF ORIGIN

Class II disease criteria:

BKD -If broodstock was negative, juveniles are assumed negative unless examination prompted by mortality or other poor hatchery performance reveals otherwise. In this case, release will not be recommended unless the broodstock and not the hatchery water supply (such as in a QU or PQU) is determined to actually have been positive in which case release will be considered on a case-by-case basis. If the broodstock were screened and had positive samples exceeding Schedule I and resultant egg lots were not culled by Family Tracking then a 60 fish prerelease sample of juveniles will be required and cannot exceed Schedule I for release authorization.

Furunculosis - If the disease state is present, treat and release when mortality returns to background level and prevalence does not exceed Schedule I. However, if brood source had no confirmed history of *A. salmonicida*, release (to the system of origin) of positive juveniles in the carrier state will not be authorized.

IHN (sockeye, kokanee) - Infected lots with clinical signs of disease or detectable virus must be destroyed. Virus negative lots may be released as soon as possible. Further diagnosis of IHNV or increases in mortality in additional lots will necessitate their destruction.

IHN (chum, chinook, steelhead, rainbow, cutthroat) - Same as sockeye except finding of IHNV in fry is sufficient cause for destruction of the inventory of that stock unless demonstrated that lots within that stock have been sufficiently isolated and unexposed to the virus. Also, operator of a facility that has a positive diagnosis of IHNV must demonstrate that sufficient isolation has been maintained to assure that

C. DISEASE HISTORY OF JUVENILE FISH PRIOR TO RELEASE	DISEASE CONSIDERATIONS
2. RETURN TO SYSTEM OF ORIGIN (continued)	other susceptible stocks have not been contaminated. Otherwise, the disposition of the exposed stock(s) may also be in jeopardy. ERM - If diagnosed in the disease state with significant mortality, elimination of a stock may be required depending upon circumstances. If detected in the carrier state and the brood source had no confirmed history of the ERM agent, release of juveniles back into the system of origin will not be authorized. Ich - Saltwater release allowed. Freshwater release may be allowed on a case-by-case basis as quickly as practical after treatment to minimize exposure of other hatchery stocks.
3. TO BARREN SYSTEMS (no salmonids)	
a. Closed system (landlocked lake)	(1) A closed or landlocked lake has no surface drainage or connection to an anadromous stream. (2) Class II disease criteria: ERM - If detected in a carrier state, transplant would be decided on a case-by-case basis. If diagnosed in a disease state with significant mortality, destruction of the lot(s) may be required. All other Class II diseases - no restriction for pathogen in carrier state. Release of fish in the diseased state (excluding ERM) would be considered for research purposes only.
b. Open system	Class II disease criteria: BKD - No significant mortality and immediate disease history of hatchery performance cannot exceed levels in Schedule I.

3. TO BARREN SYSTEMS (no salmonids) (continued)

Furunculosis - As indicated by fluorescent antibody technique with confirmation by isolation. If the disease state exists, treat and release when mortality becomes insignificant and prevalence does not exceed Schedule I. If prevalence of infection exceeds Schedule I, fish cannot be released.

IHN (sockeye, kokanee) - Release if no disease. Clinical signs of IHN and isolation of virus will require destruction of affected lots. Release virus negative lots as soon as possible. Subsequent to release, destroy any additional lots that show high mortality and clinical signs of IHN or yield virus on isolation.

IHN (chum, chinook, steelhead, rainbow, cutthroat) - Detection of IHNV necessitates destruction. Operator of a facility that has IHNV detected must demonstrate that remaining stocks have been sufficiently isolated to prevent cross contamination; that is, the facility must have been qualified for acceptance at least as a PQU.

ERM - Same as for C.3.a.

Ich - Saltwater release allowed. Freshwater release: treat and release as soon as practical to minimize exposure of other hatchery stocks.

4. TO SYSTEMS WITH OTHER "SIGNIFICANT" STOCKS OF SALMONIDS

a. Closed system (landlocked lake)

b. Open System

Class II disease criteria:

BKD - If detected within the prior 2 years of stock disease history or within the present inventory of juveniles prior to release then those juveniles cannot be released unless other species or stocks at release site or upstream in the tributary of release also have a history of BKD, in which case the carrier state in released juveniles cannot exceed levels in Schedule I. Release is not allowed if the disease state exists as indicated by significant BKD related mortality occurring within 90 days prior to release date.

C. DISEASE HISTORY OF JUVENILE FISH PRIOR TO RELEASE	DISEASE CONSIDERATIONS
4. TO SYSTEMS WITH OTHER SALMONIDS (continued)	Furunculosis - If detected in the present inventory of juveniles prior to release then those juveniles cannot be released unless other species or stocks at release site or upstream in the tributary of release also have a history of the causative agent, in which case released juveniles cannot exceed levels in Schedule I. If disease state exists fish must be treated until mortality is insignificant and carrier state does not exceed Schedule I. IHN (sockeye, kokanee) - Release allowed as long as no clinical signs of disease are present or virus can be isolated. Release into non-sockeye systems having IHNV susceptible species is not advocated and will be evaluated on a case-by-case basis. IHN (chum, chinook, steelhead, rainbow, cutthroat) - Detection of IHNV will require destruction of lot and possible entire inventory of that stock and others unless operator can demonstrate sufficient isolation from infected lots to prevent cross contamination. Transplant of chinook, chum, rainbow or steelhead into a non-sockeye system from a hatchery on a sockeye system will be evaluated according to sockeye transplant criteria <u>if</u> such a stock has not been adequately isolated and/or has been exposed to a water supply containing rearing or spawning sockeye during any period of its life cycle. ERM - Same as for furunculosis except if diagnosed in a disease state with significant mortality then destruction of the lot may be required depending upon circumstances. Ich - Saltwater release allowed. - Freshwater release may be allowed on a case-by-case basis as quickly as practical after treatment to minimize exposure of other hatchery stocks.

C.	DISEASE HISTORY OF JUVENILE FISH PRIOR TO RELEASE	DISEASE CONSIDERATIONS
5.	REMOTE SALTWATER RELEASE FOR TERMINAL FISHERIES	Class II disease criteria: BKD and Furunculosis - An exception to the Schedule I carrier rate criteria may be made on a case-by-case basis when involving large inventories of presmolts destined for release into a "mop up" terminal harvest fishery. Depending upon the fishery, there may be little disease risk to natural stocks since the surviving adult returns are almost completely harvested by the commercial fleet before entering freshwater. Release of smolts would not be allowed if clinical disease exists as indicated by a $\geq 5\%$ cumulative mortality occurring within 90 days prior to saltwater rearing.

D.	TRANSFERS BETWEEN HATCHERIES	DISEASE CONSIDERATIONS
1.	EGGS	Class II disease criteria: BKD - Not allowed unless the receiving hatchery has a history of BKD and the donor broodstock disease history must meet Schedule I. An exception would be the use of a BKD positive broodstock from one facility as a source of eggs for several other facilities in which case the Family Tracking method would be used. Eggs from BKD positive parents would be destroyed before transport or while in isolation at the receiving facility. This methodology should also reduce the carrier rate to acceptable limits within broodstock returning to the parent facility within 2 to 3 years. Furunculosis - Eggs from high risk stocks not recommended if alternative sources exist. However, no restrictions for reasons previously stated (B.2.a).

D. TRANSFERS BETWEEN HATCHERIES	DISEASE CONSIDERATIONS
1. EGGS (continued)	IHN (sockeye, kokanee) - If receiving facility would qualify to take eggs directly from broodstock, then it would qualify to receive eggs from another facility. IHN (chum, chinook, steelhead, rainbow, cutthroat) - Eggs from IHNV susceptable species from a sockeye facility are not recommended for transfer to a non-sockeye facility unless the receiving facility is a QU or the stock has been adequately isolated and not exposed to a water supply containing rearing or spawning sockeye during any period of its life cycle. ERM - Same as for furunculosis. Ich - Not applicable.
2. FISH (from hatchery to hatchery, excluding a QU).	Class II disease criteria: BKD - Not allowed if fish to be transferred have had BKD or if the agent of BKD has been detected within the previous two years of stock disease history unless receiving facility has a history of BKD, in which case the detection level in the juveniles to be transferred cannot exceed Schedule I and no significant BKD related mortality can have occurred. Furunculosis - Not allowed if fish to be transferred have had furunculosis unless receiving facility has a history of furunculosis, in which case the detection level in the juveniles to be transferred cannot exceed Schedule I and no significant related mortality can have occurred. IHN (sockeye, kokanee) - Can be transferred to another sockeye facility unless there are clinical signs of IHN confirmed by virus isolation. - Not permitted to a non-QU which contains susceptible species (chum, chinook, steelhead, rainbow, or cutthroat).

2. FISH (from hatchery to hatchery, excluding a QU). (continued)

IHN (chum, chinook, steelhead, rainbow, cutthroat) - Can be transferred from a non-sockeye facility to a sockeye facility if a QU where they can be reared in an IHN-virus-free water supply and are not intended for return to the same site as the sockeye returns. Screening for IHNV in susceptible species other than sockeye is presently not necessary from non-sockeye water supplies unless clinical disease suggestive of IHN is present. Clinical disease with isolation of IHNV will result in the destruction of any fish stocks. - IHNV susceptible stocks cannot be transferred from a non-QU sockeye facility to a non-sockeye facility having other susceptible species or stocks unless this facility is also a QU.

ERM - Same as furunculosis except diseased fish sustaining significant mortality may have to be destroyed depending upon circumstances.

Ich - Not allowed if the fish to be transferred have had an outbreak of Ich unless the receiving facility also has a history of Ich in its water supply. In the latter case, the fish for transfer must not be sustaining significant mortalities, otherwise treatment and holding of fish will be necessary at the donor facility until mortalities fall within background levels.

Sockeye Salmon Culture

Issue:

Artificial propagation of sockeye salmon is seriously limited by infectious hematopoietic necrosis (IHN). This disease has caused catastrophic mortalities of sockeye salmon in the State. IHN is caused by a rhabdovirus which can adapt to and infect other salmonid species besides sockeye salmon. Consequently, the virus has been isolated from Alaskan chinook and chum salmon and has caused mass mortalities of chinook salmon and rainbow and steelhead trout in other states as well as rainbow trout and chum salmon in Japan. Careful monitoring is needed in Alaska due to the potential for the virus to adapt and infect other IHNV susceptible fish species as well as sockeye salmon.

Policy:

Following the 1980 IHN epizootics, the most logical disease control concepts and techniques applicable to sockeye salmon culture were assembled into a departmental Sockeye Salmon Culture Policy Statement[a]. This policy has undergone some revision since then but in many instances remains unchanged.

Understanding the following policy statements will minimize future mortalities due to IHN and enhance the success of sockeye salmon hatcheries. Much of the policy is based on the following knowledge gained through IHN virus (IHNV) disease-control research, and will be periodically revised as data and technology suggest.

1. Water-borne transmission occurs. Fish shed IHNV from the anal vent and in reproductive products during spawning.

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[a] These guidelines were developed by a team of FRED staff including R. Burkett (Chairman), R. Saft, J. Burke, J. Sullivan and B. Kepshire.

Water-borne virus can enter previously uninfected salmon via infection of the gills or skin. Crowding sockeye facilitates this horizontal infection between fish, which increases IHNV prevalence.

2. The quantity of IHNV in gonadal fluids can range from no detectable virus to $\geq 10^8$ infectious viral units per ml. The current assumption is that the more virus present, the greater the disease risk. Eggs from a single female containing large amounts of virus may transmit the virus, upon hatching, throughout a common incubator. Compartmentalization and good environmental sanitation can limit the magnitude of mortality when IHN occurs.

3. Sockeye stocks are carriers of IHNV which can be vertically transmitted. Iodophor disinfection of eggs does not kill all virus associated with eggs or ovarian fluids that contain higher quantities of virus. Hatcheries with sockeye stocks will normally have some covert virus within the facility. Excessive stress may precipitate a change from the carrier state to the disease state. This change usually results in mass mortality among the fish involved. Actions or events causing stress include poor incubator performance, marginal water quality or supplies, and excessive handling, grading, and marking.

Hatchery Water Supply:

Virus-free water is required and may be achieved by use of well water, hanging lakes having no resident salmonids or depuration of a suspect water supply.

Species Mix Within a Hatchery:

In Alaska, the disease state (IHN) is becoming more frequent in salmonid species other than sockeye. Combinations of chinook and chum salmon, and steelhead or rainbow trout are allowed within a facility. However, when sockeye are present, none of these other known susceptible species will be allowed in the same facility unless the Department determines that the design and operation of the facility precludes interspecies transmission of the virus. This is to prevent virus infection and possible adaption with resultant mortality of species other than sockeye, both in the hatchery and in local feral populations.

Equipment, Supplies, and Personnel Movement:

1. Equipment between hatcheries: Hatcheries containing sockeye salmon will have little exchange of equipment to or from other hatcheries. Only items that can be adequately disinfected and <u>must</u> be moved from a sockeye hatchery will be moved. These items must be cleaned and disinfected, using at least 200 ppm chlorine or iodophor solutions for 10 minutes or live stream, at the shipping hatchery and similarly disinfected at the receiving hatchery.

   Equipment that cannot be effectively disinfected will not be moved from a hatchery culturing sockeye salmon.

2. Equipment within hatcheries: No movement of equipment within a hatchery between established compartments, where one compartment or several compartments contain different sockeye stocks, will be allowed without adequate disinfection (as above). A stock is defined for the purpose of this document as a distinct spawning population having the same water supply.

   Equipment that cannot be effectively disinfected, such as that containing wood will not be moved between stock compartments.

3. Supplies: Most supplies and materials are not readily disinfected and will not be moved from facilities culturing sockeye salmon.

4. Personnel: Personnel entering or leaving a hatchery that cultures sockeye salmon will go through a disinfection foot bath (same strength as above). Protective clothing, such as rain gear and spawning gloves will be kept separate from other clothing used in the field, etc., and will be left in the work place before leaving through the footbath. This procedure will be used by all visitors and hatchery personnel.

Egg-take Procedures:

The following procedures will be incorporated into any sockeye salmon egg-take:

1. Eggs and sperm of individual fish will be collected in separate disinfected containers or disposable bags or combined immediately in the same container in the desired fertilization ratio. If numbers of males permit, a 1:1 fertilization ratio is recommended.

2. Eggs will be fertilized, water hardened, and rinsed (if necessary) in virus-free water such as well water, depurated (UV or ozone) water, or surface water not exposed to sockeye salmon at any time during the year. This will require either separate collection and transportation of gametes from remote egg-take sites to a suitable processing site (a hatchery) or the use of known virus-free water transported to or available at the site.

3. Eggs will be disinfected during water hardening in a 100 ppm iodophor solution for 1 hour.

4. Adult sockeye salmon will not be severely crowded in any holding structure. Crowding causes stress and facilitates the spread of IHNV to all of the contained fish. Adult exposure to IHNV at remote areas will be minimized by removing dead and moribund sockeye from areas of broodstock holding with disposal of carcasses at a remote distance

downstream from the egg take. The ventral surface of all fish will be disinfected prior to egg or sperm stripping with a solution of iodophor (100 ppm). This may be applied with a sponge or paper towel. Disinfectant must be wiped from these surfaces immediately prior to spawning with a clean paper towel.

5. Egg takes may be restricted to the early and middle portions of the run because in some stocks, the later spawning fish tend to have higher prevalences as well as titers of IHNV. Depending upon genetic and virus prevalence concerns, egg-takes from each sockeye stock can be evaluated on a case-by-case basis.

6. Any eggs or seminal fluids that are of questionable appearance will be discarded.

7. Utensils, spawning gloves, knives, and other items coming in contact with fish will be disinfected (200 ppm chlorine or 100 ppm iodophor) between uses for each fish. Each utensil should then be rinsed in water after disinfection and before its next use.

8. Eggs, when seeded for hatching, should be distributed with substrate (saddles recommended) at densities well below the known optimal number for sockeye in whatever incubator type used. These low densities will optimize survival and minimize the number of eggs in each incubator (i.e., eggs from a given stock should be spread as equally as possible throughout all incubators available to that stock, and not crowded into several incubators while leaving others unused). Production goals will be adjusted accordingly.

Isolation of Stocks, Incubation and Rearing:

1. Physical separation or compartmentalization of sockeye stocks will be provided to the maximal extent practical

during all stages of incubation and rearing. The emphasis of sockeye culture will be on the quality of fish produced, not production numbers alone.

2. Each incubator unit or stack and rearing container will be serviced by a separate incurrent and efferent water flow.

3. If fish are reared, a designated group of incubators (or incubator) will be assigned to a single distinct rearing container that will serve that incubator grouping alone.

4. Direct release or minimal rearing will be practiced when possible.

5. Heating of water for egg incubation or fry rearing is potentially stressful and is not recommended, unless inadequate temperature units make this necessary.

6. Disinfection of utensils, gloves, dip nets, etc., will occur between contacts with different incubation, holding, or rearing containers.

7. A flush treatment of iodophor (100 ppm) is recommended after eggs are picked to reduce numbers of potential residual IHN virus particles released from infected dead eggs. Periodic formalin drips as recommended for fungus control would also be an effective alternative treatment.

8. Periodic floor cleaning with steam or disinfectant (200 ppm chlorine or 100 ppm iodophor) will be done as needed to maintain high levels of environmental sanitation. Do not use a combination of steam and disinfectant as this will present a major health hazard to hatchery personnel. Periodic disinfection will eliminate organic debris that may retain virus.

9. Containers, pumps, hoses, and other devices coming in contact with or containing salmon will be disinfected after use.

10. The hatchery will be disinfected after an IHNV-induced mortality (see IV C. Disinfection for Hatcheries). Portions of a facility that are physically and operationally separate, including the water supply, may be considered a different hatchery.

Transplanting of sockeye salmon.

1. Sockeye salmon will not be transplanted to any watershed upstream of a hatchery water intake or allowed to enter there naturally if sockeye or other susceptible salmonids are cultured in the hatchery. Exception would be allowed if the water is depurated with ultraviolet radiation or ozone prior to exposure to hatchery fish, or if an alternate virus-free water source exists.

2. Any stock of sockeye salmon experiencing clinical signs and mortality related to IHNV or from which virus can be isolated will be destroyed immediately to facilitate containment of the disease and prevent contamination of other stocks or lots of fish.

Shellfish Culture

Oysters:

1. Importation of oysters from outside Alaska.

   a. Only oyster stocks from those vendors having a hatchery broodstock will be evaluated for certification of imported oyster spat. A continual change in brood source or use of multiple sources practiced by some vendors would require a complete certification of all stocks or complete certification every year rather than a certification renewal. This would be a needless cost of time and expense to the Fish Pathology Section and an unnecessary additional risk that pathogens would be missed when other single developed stocks with an established disease history are available.

b. Certification sample sizes for adults and juveniles will follow the American Fisheries Society procedures manual (Amos 1985). These will require a random sample of 200 spat (and approximately 1000 larvae if available) and 60 adult brood stock (numbers sufficient to determine carrier prevalence of approximately 2-5% at a 5% error) prior to shipment.

c. Certification renewal will be on a yearly basis and will require examination of 60 spat and/or larvae from the year class to be imported and an updated disease history and hatchery performance review of the hatchery stocks from the vendor for the previous growing season. A certification will become invalid if a disease outbreak occurs within stocks at the facility or if an uncertified stock is brought into the rearing facility or grow-out areas.

d. Any disease agent listed in Class I or known to be causing mortality or significant disease will disqualify the lot and prevent issuance of a Fish Transport Permit (FTP).

e. All lots must be free of predators.

f. Each stock should have a disease history (preferably testing from previous transports outside Alaska).

g. Live oysters from Korea, the Gulf of Mexico, and the Atlantic Coast of North America may not be imported into Alaska for cultural purposes pursuant to Article 3, 5 AAC 41.070(b).

2. Movement of oysters or indigenous shellfish stocks within the state for cultural purposes.

a. 30 live animals will be examined before movement is authorized.

b. Such would also include subsequent movement of animals imported into Alaska; i.e., stock would be sampled prior to import, and then re-sampled if they were to be moved again at a later date. If a setting station or hatchery is established for wide distribution of spat or juvenile shellfish then the seawater influent should be depurated to reduce risk of disseminating indigenous shellfish diseases.

c. The definition of what constitutes "movement" (how far) relative to the need for primary or additional testing is defined by the discreteness of stocks or populations with regard to dispersal by ocean currents, etc. If this cannot be determined, any movement regardless of distance will require pathology evaluation. Any movement will require an FTP.

d. Additional criteria for approval following disease outbreaks, etc., are the same as described under disease control for shellfish in II-F.

3. Oyster Facility Inspections

a. Annual sampling of 30 animals/lot/year class will not be required but is recommended for establishment of endemic disease histories.

b. Additional sampling will be required if mortalities exceed usual background levels or if abnormal animals are observed.

c. In either case, if a disease agent exotic to North America is present, the stock would be considered for destruction and if any other Class I diseases are detected, the disposition of those infected stocks will be decided on a case-by-case basis.

4. PMFC Agreement (copy attached)

Alaska is a signatory to this agreement. Final decisions must be consistent with this agreement.

5. Shellfish other than oysters

Importation of any shellfish species other than oysters into Alaska is prohibited.

APPENDIX

Quarantine Unit Fish Hatcheries

Introduction:

Hatcheries are often used to support projects that require transport of fish or gametes from remote sites to the hatchery. Any movement of fish between areas raises concern that pathogens may be spread. Consequently, such risk dictates that measures be taken to minimize the inadvertent dissemination of diseases.

Disease screening and disinfection play major roles in reducing the risk of spreading pathogens. However, testing is usually limited to a few diseases of highest concern and testing can be ineffective in the detection of carrier-state levels of disease. To provide additional protection for other hatchery stocks, the hatchery should be able to isolate the remote stock from others in the facility through incubation and rearing. Varying levels of isolation can be achieved through use of physical barriers and other safeguards in the hatchery's design. Isolation capability falls into three categories ranging from almost none to quarantine levels. It should be stressed, however, that no design is fail-safe; its efficacy is determined by the operating procedures and the commitment of the hatchery personnel to carrying out these procedures.

Definitions:

Three levels of isolation are described based on the efficacy of the hatchery design in providing barriers to the transfer of pathogens within the hatchery and outside to local wild stocks. The most effective design is the Quarantine Unit (QU) which provides strict isolation. The second design has significant safeguards and is called a Partial Quarantine Unit (PQU). Those hatcheries that cannot meet the criteria of the two isolation units fall into the third category: conventional hatchery. If disease appears in any stock within a conventional hatchery, all stocks are at a higher risk of being exposed than if they were in a quarantine unit.

	Quarantine Unit	Partial Quarantine Unit
Water Source	well, spring, or depurated having no Class I or II pathogens.	no Class I or II pathogens detected in water source, not accessible to anadromous fish; i.e., barriered lakes or streams.
Isolation Measures	-stocks separated by physical barrier during incubation.	-no physical separation of stocks by a barrier during incubation.
	-no water transfer between stocks during incubation or rearing.	-no water transfer between stocks during incubation or rearing.
	-rearing units will be in separate rooms for each stock.	-physical separation between rearing units.
	-thorough disinfection of unit and its equipment prior to introduction of new stock.	-thorough disinfection of unit and its equipment prior to introduction of new stock.
	-Separate footwear and outerwear to be left in each isolation unit/rearing room. Footbaths used when necessary.	-disinfection of footwear using footbaths upon entering and exiting isolation unit.
Effluent	-depuration	-depuration may or may not be required.
Equipment	-separate for each incubation and rearing unit	-separate for each incubation and rearing unit

Pathology guidelines clearly encourage development of quarantine units in hatcheries supporting remote projects. If disease occurs in a facility without quarantine capability, releases may not be authorized. At the very least, extensive testing and waiting periods may be involved before fish can be certified for release. Development of quarantine facilities is an important investment in controlling pathogen spread, particularly in Alaska, where wild stocks are so valuable.

Classification:

Hatcheries involved in offsite projects will be classified according to their ability to meet the quarantine criteria. A FRED pathologist will determine the facility's classification after making an on-site visit. The Pathology Laboratory recommends either ultraviolet or chlorination-dechlorination depuration systems. Ultraviolet units should have a minimum rating of 30,000 microwatt seconds/cm^2 after 7,500 hours of lamp operation. Any chlorination system should deliver at least a 2 ppm residual level of chlorine with a 1 minute contact time before dechlorination with sodium thiosulfate or sulfur dioxide gas. The hatchery operator will be responsible for ensuring that operational procedures necessary for quarantine culture are followed. Failure to do so will trigger the potential for reclassification.

Drugs and Other Chemicals Used in Aquaculture

Drugs and other chemicals are used in aquaculture for a number of purposes. Many uses include treatment of the water to improve water quality, remove or control aquatic algae or vegetation, eradicate nuisance fish species or aquatic invertebrates, or immobilize fish (anesthetics). However, this discussion will address only those chemicals recommended by the FRED Pathology Section for use in the State of Alaska to control salmonid fish pathogens and to improve fish health. These chemicals fall into the general categories of drugs and disinfectants. Disinfectants include chemicals that destroy the pathogen on contact whether the pathogen is on the fish or an inanimate object. Drugs are normally fed to fish to treat systemic infections but some are also used to treat external infections.

The use of drugs is generally regulated by the Food and Drug Administration (FDA) while other chemicals are controlled by the Environmental Protection Agency (EPA). Generally, any use that has a medical claim or could affect the safety of the food consumed is regulated by the FDA. Uses that affect animal safety or environment are regulated by the EPA. Because there is some overlap of these uses in the aquatic environment, there is some confusion as to which agency approves a drug or other chemical use. In either case, the compounds must be shown to be effective and safe. Safety applies to the welfare of the fish being treated, non-target fish, and other aquatic plants and animals. The FDA also requires that treated fish are safe for human consumption.

There are a few chemicals that do not require registration by either agency; such chemicals are "approved" because they have been in use for a number of years and are considered "generally regarded as safe" (GRAS).

The following is a description of the drugs and other chemical compounds advocated for fisheries use in Alaska. The suppliers, when provided, are those approved to distribute specific compounds for fisheries use and are the legal sources. Some of the compounds listed below (Quaternary Ammonias and Iodophors) are not yet federally approved or prohibited for general or specific uses in aquaculture and do not have satisfactory substitutes. Consequently, the state will continue their use.

Antibiotics:

The only FDA approved antibiotic for foodfish use is oxytetracycline (Terramycin, Pfizer, Inc., New York, NY). Terramycin is approved only for treatment of *Aeromonas*, *Pseudomonas*, and *Hemophilus* infections at 2.5-3.75 g/45 kg of fish per day for 10 days in the feed. It is approved only for salmonids and catfish and there is a 21-day withdrawal period before the fish can be slaughtered or released for stocking or potential immediate human consumption. Terramycin has also been used widely for treatment of *Vibrio*, sp., and systemic myxobacterial infection, but these are not federally approved uses of the drug.

Sulfonamides:

Two sulfonamides are FDA approved for foodfish use, sulfamerazine (American Cyananimid Co., Princeton, New Jersey) and a potentiated sulfonamide which is a combination of sulfadimethoxine and ormetoprim (Romet-30, Hoffman-LaRoche, Inc., Nutley, New Jersey).

Sulfamerazine. Sulfamerazine is approved for the treatment of furunculosis in salmon at 10g/45 kg of fish per day for 14 days in the diet. It is approved only for salmonids and there is a 21-day withdrawal period before the fish can be released or slaughtered. Although the FDA approval is limited, the drug has been used widely in fisheries for both foodfish and non-foodfish. Furthermore, generic sources of sulfamerazine are widely available, which has resulted in substitution of other sulfonamides. Consequently, the demand and cost recovery for the approved product have dropped, forcing the manufacturer above to discontinue producing the drug for fisheries use.

Romet-30. Romet-30 was registered in October 1984 for treatment of furunculosis in salmonids at 50mg/kg of fish per day for 5 days, and there is a 6-week withdrawal period. Romet-30 has broader activity than sulfamerazine and experimentally shows activity for other bacterial infections in a variety of fish and is effective against most strains of *Aeromonas salmonicida* resistant to oxytetracycline and sulfamerazine.

Disinfectants:

Three chemicals have FDA approved theraputic claims and three have EPA disinfection approval. Acetic acid and salt (sodium chloride) are FDA approved as GRAS for all foodfish. Acetic acid is approved as a parasiticide at 1000-2000ppm for 1-10 minutes, and salt is approved as an osmoregulatory enhancer at 0.5-1% indefinitely or 3% for 10-30 minutes. Uniodized salt and seawater have also been used to treat fungus infestations on incubating fish eggs (see procedures in FRED Fish Culture Manual).

Formalin. Formalin (Formalin-F, Natchez Animal Supply Co., Natchez, Mississippi) is approved for salmonids, catfish, largemouth bass, and bluegill as a parasiticide at 25ppm in ponds or up to 250ppm for 1 hour (not on consecutive days) in tanks or raceways, or at 1000-2000ppm for 15 minutes to treat fungus on eggs. No withdrawal time is needed for formalin, although a 4-7 day withdrawal prior to smolting may be necessary to assure adequate saltwater adaption in presmolts. Use of formalin for fungus control on eggs has been an adequate substitute for malachite green in Alaska State hatcheries. Consequently, because of its teratogenic potential and subsequent refusal for federal approval, malachite green is not acceptable for use by state facilities and is not recommended for use by private hatcheries.

Didecyl-dimethyl ammonium chloride. Didecyl-dimethyl ammonium chloride(Net-Dip, Aquasciences Research Group, Inc., North Kansas City, Missouri) and calcium hypochlorite (Olin HTH chlorinator granules, Olin Corporation, Stamford, Connecticut) are both EPA approved as general disinfectants and sanitizers and are not to be used directly on fish. Net Dip is for fish holding equipment at 3.5 fluid oz. in 4 gallons of water for 10 minutes, and HTH is to be used at 200ppm available chlorine for 1 hour to disinfect and sanitize fish tanks, raceways, and utensils. HTH can also be used to disinfect water to be used for fish at 5-10ppm chlorine for 12-24 hours.

Calcium oxide. Calcium oxide (Quick lime) and calcium hydroxide (slaked lime) are approved by FDA as GRAS and EPA has limited their approval as pond sterilants at 1,338 lbs and 1,784 lbs per acre, respectively.

Iodophors:

Iodophors are also used widely in fisheries as general disinfectants for utensils and as egg disinfectants. Products such as Wescodyne, Betadine, and Argentyne have been used. Iodophors are very effective and are generally used at 25-50ppm for general disinfection and at 100ppm for 10 minutes as external egg disinfectants or for 1 hour for internal disinfection during water hardening of eggs. Iodophors can be toxic to eggs unless buffered to about pH 7.0 and this is easily done with sodium bicarbonate (Argentyne is prebuffered).

Quaternary ammonium compounds. Quaternary ammonium compounds (quats) such as Hyamine 1622, Roccal, or Purina 4 Power are used at 2-4ppm for 1 hour to treat bacterial gill diseases and can be used as a general disinfectant following the manufacturer's recommendations, usually at 600ppm.

Diquat. Diquat (1, 1'-ethylene-2, 2'-dipyridylium dibromide) (Lubar Company, Kansas City, Missouri), also known as Bipyridilium and Reglone is used to treat bacterial gill diseases at 2ppm final active concentration for 1 hour. Diquat is federally approved to be used as an herbicide with foodfish at 0.25 to 2.5ppm having a withdrawal period of 14 days before treated water can be used for other purposes.

For detailed reference and recommended procedures in chemical treatment of fish diseases, refer to the FRED Fish Culture Manual (1983), Wood (1979) and Schnick, Meyer and Gray (1986).

Disinfection Procedures for Hatcheries

Although the compounds discussed below are commonly used as disinfectants in hatchery practices, they are also toxic to human health if misused. Precautions should be taken in their handling as directed by OSHA guidelines, and the FRED Safer Chemical Use in Alaska Aquaculture Manual (1988).

Egg Disinfection:

Introduction. To control the spread of pathogens carried on the surface of eggs, disinfection is necessary. This is done immediately after fertilization and during or after water hardening upon arrival and prior to exposure to running water at the receiving station. If preparations have not been made, under no circumstances should eggs be placed in water at the receiving station unless the water can be held and sanitized before release. If preparations cannot be made, eggs should be returned to the point of origin or destroyed. This can be done by burial in dry ground or in wet ground with quicklime. Disinfection should also occur when eggs are taken at the site where incubation will occur (Wood 1979).

Products. (The Alaska Department of Fish and Game does not endorse any particular supplier or brand except in those instances where they are the only distributor or product approved for fisheries use.)

Betadine - (VF Grace, Anchorage). Non-detergent, with 10% povidone iodine, aqueous polyvinyl pyrrolidone-iodine (1%). Not buffered. (Amend 1974; Vestal Laboratories, 1974)

Wescodyne - (West Chemical Co.). Detergent, with 1.6% active iodine in ethanol-iodine complexes. Not buffered. (Amend 1974; Vestal Laboratories, 1974)

Argentyne - (Argent Chemicals). Non-detergent polyvinyl pyrrolidone iodophor similar to Betadine, but buffered.

Methods. (Wood 1979, FRED Staff, 1983).

Betadine or Argentyne: 1:100 dilution of jug strength for 10 minutes (100ppm iodine).

Wescodyne: 1:150 dilution of jug strength for 10 minutes (100ppm iodine).

Disinfect before exposing to running water at the receiving station, even when the egg take occurs at the receiving station.

Comments. To avoid the toxic acidifying effect from soft water, buffer Betadine and Wescodyne with 0.05% sodium bicarbonate.

Change iodophor solution between lots of fish or when it begins to lighten in color. A lot is defined as a group of fish of the same species and age that originated from the same discrete spawning population and that always have shared a common water supply within the hatchery.

Equipment Sanitization:

Introduction. The prevention of contamination or recontamination of a hatchery on disease-free status is of the utmost importance. Infectious fish diseases do not occur at a fish cultural station unless pathogens have been introduced or occur naturally among resident fish in the water supply. The increase of inter-hatchery activities in Alaska raises concern about the importance of maintaining adequate disinfection and control of endemic diseases at those facilities.

Methods. (Hnath 1983)

Equipment: All equipment used in one hatchery should not be allowed to enter any other hatchery until that equipment has been sanitized. Ideally, sanitation should occur before equipment leaves its resident station and again on its arrival at a second station. Equipment includes nets, fish pumps, utensils, raingear, waders, boots, egg sorters, fish transport vehicles or anything that may have contact with fish, eggs, or cultural waters. If fish transport motor vehicles are exchanged between facilities, they should be disinfected according to fish transport vehicle disinfection instructions. Disinfection must always be done thoroughly and properly to be effective.

Fish tanks. 200 ppm active chlorine in the form of liquid bleach (sodium hypochlorite, 5.25% active ingredient) or calcium hypochlorite (HTH, registered, 65% active ingredient chlorine) for 10 minutes minimum. After disinfection, the solution should be dumped at a safe site where it will not directly drain into natural waters. Neutralization of chlorine is recommended, and can be done by using 2.2 lb sodium thiosulfate/lb HTH or 1.5gm sodium thiosulfate/liter of 200ppm chlorine. Chlorine can be corrosive to metal and should be thoroughly rinsed following use with clean, uncontaminated water. Raingear should be worn to prevent/reduce chlorine contact with clothing. Because organic substances will readily inactivate chlorine and limit its effectiveness, dirty equipment should be cleaned before it is disinfected with chlorine.

Fish transport vehicle exterior. The exterior of motor vehicles including chassis and undercarriage is decontaminated with high temperature (115-130°C) steam or with 20ppm chlorine. Chlorine should be thoroughly rinsed with clean, uncontaminated water to minimize corrosion. It is not necessary to disinfect the exterior of aircraft or boats used for transporting fish or eggs.

Fish transport vehicle interior. Interior surfaces of motor vehicles, aircraft, or boats that have been contaminated during transport by contact with fish, eggs, or cultural waters should be scrubbed with noncorrosive 600ppm quaternary ammonia compounds, i.e., Hyamine or Roccal using 1.5 ml of 50% stock solution/ liter water; Roccal at 800-1000ppm for 30 minutes is the disinfectant of choice for transport tank interiors rather than chlorine solutions which adversely affect pumps and aerators.

Other equipment. Utensils, fish pumps, nets, egg sorters, waders, boots, raingear, etc., can be disinfected with 200ppm chlorine for 10 minutes; or in 600ppm quaternary ammonium compound for 30 minutes; or 100ppm iodophor solution for 10 minutes. If necessary, the disinfectant should be scrubbed onto the surface. Disinfected equipment should be thoroughly rinsed with clean, uncontaminated water and dried before use.

Personnel. All individuals involved in transport operations should wear outer protective garments (rain gear, boots, waders, etc.) when handling fish, eggs, or cultural water. Hands should always be disinfected before handling cultural water at another station. When work is completed at the station, hands and protective garments should be properly disinfected. Natural cotton and wool fabrics that contact cultural water at a station can be disinfected by soaking them for 30 minutes in 600ppm quaternary ammonia compound and rinsed thoroughly before being worn.

Disinfectants are not only toxic to fish, but also to human beings. Care and good sense should be applied in their use to avoid upper respiratory irritations and/or contact dermatitis from continued overexposure. All containers of disinfectant should be capped or with lids on when not in use. The recommended levels for disinfection should not be exceeded. On a routine basis, disinfectants should be applied with brushes rather than aerosolized in a closed area. Aerosolization of disinfectants in a closed area may be necessary on occasion (i.e., to sanitize a facility after a disease outbreak) and is acceptible if personnel wear adequate protective respirators equipped with the appropriate filters, goggles and other outerware. If possible, a better alternative would be to fog closed areas with disinfectant (not formalin) using an automated device. Live steam from a portable steam generator should be used for disinfection whenever possible to reduce chemical use.

Complete Hatchery Sanitization:

Introduction. Plans for sanitizing a hatchery should be incorporated into the design of the facility such that, when and if necessary, disinfection can be accomplished easily and effectively.

Planning. Personnel designated to conduct the sanitization should formulate a detailed plan prior to the operation. This should incorporate inspection of the facility, discussions with the manager, methods, materials, safety, training, and adequate follow-up. Methods should include drying, elimination of water leaks or potential sources of contamination, volumetric measurements of the buildings, purchase of chemicals, initial cleaning, ventilation, and preventive maintenance.

Methods.

Cleaning: Most pathogens are removed from environmental surfaces by cleaning. For disinfectants to be effective, surfaces must be cleaned of dirt and organics beforehand.

Drying: Since most fish pathogens (except IPNV) are destroyed by drying, anything that is clean and dry is generally free of viable agents. Some things may be dry on the surface but not within. For example, wood is often surface dry, but wet internally. Concrete raceways can have cracks where water remains.

Design: A hatchery should be designed to allow maximal cleaning and drying of surfaces. The use of wood should be avoided when possible. Concrete floors should be sloped so that adequate drainage and drying occurs. Gravel floors cannot be adequately sanitized. Walls sealed with waterproof paint would also make later sanitation easier. Separate water manifolds supplying egg and rearing containers and different stocks of fish also help prevent pathogen spread via water.

Wood: Equipment and containers made of wood or other porous material used in the hatchery cannot be adequately disinfected and should be burned rather than attempting to reuse after sanitizing. Wooden incubators or rearing containers coated with fiberglass resin, although better than uncoated wood, should also be eliminated since their disinfection is still unreliable because of often unnoticed delamination or cracking of the fiberglass.

Concrete raceways: Raceway sanitation is best accomplished by soaking in chlorine. First, assess the raceway for cracks and leakage into and from other raceways and repair accordingly. Any significant amount of curing compounds, sealer or new concrete applied to a raceway surface for repair may require an undefined amount of time to leach out toxic compounds in running water before fish can safely inhabit the raceway. When in doubt, test a small number of fish in the raceway for at lease 48 hours.

Aluminum raceways: Outside spraying with chlorine (and use of a proper respirator) rather than soaking should suffice since aluminum is non-porous. However, soaking is preferred. Gasoline or electrically powered high pressure sprayers have been very effective at some facilities for cleaning raceways (and other equipment) prior to disinfection.

Fiberglass containers: These may have some cracks and therefore may be at least semi-porous. Spraying disinfectant on them may not be sufficient. Soaking is preferred.

Artificial substrate: Saddles or bio-rings should be precleaned of organic debris and disinfected in chlorine for at least 30 minutes, rinsed in clean water and thoroughly dried before reuse the following season. After prolonged use, sub- strate will develop a surface scum which can be removed prior to disinfection by either of two methods: (1) agitation with sand in a cement mixer or; (2) pressure spraying with water using commercially made equipment for this purpose.

Chlorine (adequate respirator use recommended): 200ppm chlorine should be used as a soak or for spray disinfecting. Active available chlorine from HTH is about 65% (check label). Hnath (1983) recommends filling a raceway halfway and then adding half the HTH while stirring. The raceway is then filled to within 5 cm of the top and the final half of the HTH is stirred in. Fill all raceways in the same manner and include chlorination of all pipelines, especially drains. If possible, the entire raceway system should be disinfected at the same time. If the hatchery is too large to allow simultaneous disinfection it can be done in sections, being careful not to permit contaminated water to backflow into areas or pipelines already disinfected. The goal is to retain a level of 200ppm chlorine in the raceways and lines for 1 hour and at least 100ppm for several hours. Letting the raceways soak overnight is the safe way to do this. Sodium thiosulfate (0.7g/l) provides the necessary quantity of sodium ions needed to neutralize the chlorine ions at 200ppm strength after disinfection. Sufficient sodium thiosulfate should be on hand <u>before</u> chlorination begins so that an accident can be neutralized before an environmental disaster occurs. Allowing the chlorine solution to sit longer will permit enough chlorine molecules to escape into the atmosphere so that mixing or solubility variables will be more than compensated for. A level of 1.5g of thiosulfate/liter has been recommended in the past as an overkill concentration but the cost of the thiosulfate can be prohibitive. Measuring the residual chlorine (orthotolidine reagent or iodometric titration) after neutralization is recommended so that toxic levels are not released into the environment. Drinking water often contains 0.1ppm and this level will still kill fish. Chlorine should not be detectable in effluent water.

Formalin fogging: Formalin fogging or fumigation is not recommended for human health reasons. Formalin fogging will produce a precipitate on every surface that dries, leaving a paraformaldehyde film. Paraformaldehyde sublimates slowly into the atmosphere as formaldehyde gas, leaving hazardous fumes in the hatchery for unpredictably long periods of time. Formalin fumigation using potassium permanganate can potentially produce a violent explosion and resultant formaldehyde gas is extremely dangerous in closed areas.

Iodophor: Disinfection with iodophor solutions containing 100ppm available iodophor will suffice for walls, floors, and other non-porous surfaces.

Quaternary Ammonium Compounds (Roccal, Hyamine, etc.): Follow manufacturer's recommendations for use, but remember that these compounds can be very toxic to fish and must be thoroughly rinsed from equipment before use.

Respirators/Protective Clothes: Should be worn whenever formalin, iodophor, chlorine, or other toxic chemicals are used, particularly in any manner that might cause vaporization or splash. Respirators may be in order when formalin treatments for fungus control on eggs are performed. Knowledge of proper use or respirators, in addition to the assurance that the respirators are functioning properly, must be established before requiring an individual to perform tasks that require respirators. The correct respirator cartridges must be selected with regard to the toxic substances used.

Environment: Prior to sanitizing a raceway or anything else that will require large quantities of toxic chemicals, devise a failsafe plan that prevents environmental contamination. Have another person independently assess it and repeat the mathematical calculations.

Inspection and Diagnostic Procedures:

Finfish Diagnostics. Diagnostic procedures used for detection of fish disease agents will be according to the American Fisheries Society Fish Health Bluebook (Amos 1985). Additional specific procedures may be found in the FRED Report #29 (Fried 1984) and the unpublished Fish Pathology Section procedures manual.

The major purpose of this section is to clarify the proper fish sampling procedures to be carried out at the facilities by hatchery personnel when disease problems arise. This is an absolute necessity in order that samples received by the pathology lab are adequate to allow a definitive disease diagnosis. The following discussion is a modification of the Fish Health section from the FRED Fish Culture Manual.

Disease Recognition and Action: Whenever abnormal behavior patterns of fish, external abnormalities, or high mortalities occur at a hatchery, an immediate response from the hatchery manager is imperative. Assistance should be requested from the regional project manager and the Fish Pathology Section (FPS) of FRED whenever mortalities appear excessive. An epizootic is occurring when mortalities reach 1.5% per day. This requires immediate attention. A total commitment of the facility staff and appropriate personnel is needed to save the remaining fish.

Mortalities less than 1.5% down to 0.5% indicate that a fish health problem is present. Notify the regional project manager and FPS.

Mortalities of less than 0.5% per day but greater than .03% should be investigated. Hatchery personnel should attempt to remedy the situation by modifications of environment or feeding. Inform the regional project manager and the FPS.

The percentages given above are for total mortalities. It is no less a matter of concern, however, if one lot of fish is dying at 1.5% per day while the others remain healthy. Contact your supervisor immediately and isolate the sick fish as much as possible to prevent transmission of the disease to other lots.

In order to reduce the spread of fish disease, make sure that dead fish are incinerated or soaked in a solution of 200ppm of chlorine or iodine (active ingredient) for 12 hours before disposal.

Sample Collection and Shipment: Prior to collecting any samples, contact the Fish Pathology Section to discuss the appropriate type of sample and numbers of fish needed. The following instructions are general guidelines but some samples need special treatment and the pathology personnel will be able to provide details. Samples that are not in an adequate condition upon arrival will not be processed. All proposals for sampling (Southeast Region, Southcentral Region and AYK-Westward Regions) should be cleared through pathology by contacting the appropriate lab personnel assigned to a particular facility.

Preparing Samples: Different procedures are followed in sampling for bacteriological, virological, parasitological, and histological analyses. Further details regarding the procedures below will be provided to hatchery personnel upon initial contact with the FPS.

In clinical cases of disease (≥0.5% mortality/day) 10 moribund fish are generally a sufficient sample size to make a diagnosis. In situations where no excessive mortality or clinical disease is apparent, a larger sample size of 60 fish may be necessary. However, depending upon individual circumstances, sample sizes may vary between 10 and 60. Samples should be examined from each affected lot, incubator, or rearing container. Consult with the FPS for specific sampling requirements in each situation.

Bacteriology. Small fish must be received either alive or freshly dead (within 1-2 hours) on ice in a cooler. Fish should not be frozen.

Live fish are preferred for diagnostic samples. Place at least 10 moribund fish in one or more large leak-proof plastic bags containing hatchery water. Seal the bags so space for air remains and leakage will not occur. Label bags with fish status (moribund or healthy), incubator or raceway number, stock and species. If oxygen is available, add to bags before sealing. Addition of an oxygen tablet to each bag is recommended particularly for samples that must be shipped. Make a similar bag containing 10 healthy fish. Again, if the fish are large fingerlings or smolts, the amount of fish per bag should be adjusted accordingly.

In addition, enclose 10 moribund fish in a smaller dry plastic bag. Do not add water. If the live fish do not survive transport, then the dry fish, which will have undergone less deterioration and contamination from the water and its bacterial flora, will be processed instead. In a disease outbreak, 30 fish per lot of affected fish will be required for shipment (10 moribund, 10 healthy and 10 moribund, but dry).

Virology. Clinical Disease: In clinical disease outbreaks of suspected IHNV in sockeye salmon, 10 moribund or freshly dead fish are sufficient to isolate the virus for a confirmed diagnosis. In other salmonid species, 60 moribund fish may be required to establish an etiology. For alevins, fry and fingerlings, whole fish should be sent.

For suspected viral outbreaks in juvenile fish primarily in sockeye and chum salmon: 1) follow instructions given above, and 2) enclose additional moribund fry, 5 per bag, (10 fish/lot), but do not add water.

Broodstock and Disease History Examination: For establishing a disease history in adult fish or in broodstock screening, 60 samples from adult fish will be required. Samples of choice are from postspawning female fish consisting of ovarian fluids collected from each fish and shipped in separate sterile containers with lids (factory sterilized disposable centrifuge tubes). When required, samples from post-spawning males should consist of livers and spleens from each fish, asceptically removed and pooled in individual sealed plastic bags. Tissues from more than one fish should not be combined in one bag. All tissues and fluids for virus assays should be shipped to the FPS on ice (4°C) but never frozen. Freezing and subsequent thawing inactivates IHNV producing lower titers, which in some samples may be too low to detect routinely. Virus samples on ice should be sent to the FPS lab as soon as possible within 72 hours of collection.

These sampling procedures are applicable to assays for other finfish viruses should the need arise.

Ovarian fluids for virology testing: Obtain instructions from the lab regarding whether you should take ovarian fluids from ripe fish used in the egg take or from postspawning fish. Disinfect the external ventral surface and either rinse with clean, pathogen-free water or wipe dry with paper towels.

For postspawners, partially strip a single fish's ovarian fluids into a paper cup (recommend 4 oz pleated portion cups but paper drink cups can be used), avoiding the extrusion of blood and fecal material. For ripe fish, you may either extrude a small amount of fluid prior to taking eggs or remove eggs and pour fluid off the eggs. Two ml of fluid is adequate for ripe fish, but 3-5 ml should be obtained if sampling post-spawners since these fish may take on some water diluting the ovarian fluids.

Crimp edges of cup to form a spout and pour fluid into a 15 ml centrifuge tube with cap, "straining out" any eggs. Avoid contaminating the rim with your hands. Discard cup after each fish.

Cap tubes <u>tightly</u> making sure that the cap is not cross-threaded. Place tubes in a rack and label with stock of fish, sampling location and date. Place upright in cooler with cold packs or ice. <u>Do not freeze</u>.

Tissue samples from males for virology testing: Disinfect the external ventral surface and either rinse with clean, pathogen-free water or wipe dry with paper towels.

Carefully cut open fish, taking care not to cut the gastro-intestinal tract which would contaminate tissues with bacterial flora.

Aseptically remove the spleen and a portion of the liver about the size of the spleen and place into a single plastic bag using a spoon, knife or forceps.

Seal each bag and keep cool (4°C).

Between the sampling of each fish, clean dissecting utensils with ethanol or iodine and dry with a clean paper towel. Organic matter will affect the working ability of disinfectants so any tissue should be wiped off utensils with a separate paper towel prior to disinfecting. Disinfect hands between the sampling of each fish.

When done sampling place all sealed sample bags in a large plastic bag. Label the bag with number of samples, stock of fish, sample location, sample type and date. Place in cooler on cold pack.

Fluorescent antibody testing (FAT). BKD, ERM, and *Aeromonas salmonicida*. In disease outbreaks involving small fish, 10 moribund or freshly dead fish per affected lot(s) shipped in plastic bags on ice (not frozen) are sufficient for a disease diagnosis. Frozen samples are not desired because a presumptive diagnosis of *A. salmonicida* cannot be confirmed by bacteriologic culture of such material. Sampling would be according to A.(1) and (2) described above. An additional sample of 60 randomly selected apparently normal fish from the same lot(s) may be required at a later date to determine the prevalence of subclinical disease within a given group of fish before release is approved.

In situations where a disease history and/or broodstock screening is desired, a minimal sample size of 60 fish will be required. Family tracking will require screening of all parent fish involved in the egg take. Whole fish should be sent when sampling alevins, fry and fingerlings. In situations where large fish are to be examined, only kidney tissues are required. Sampling procedures are similar to those described in 4(a) to (f) except kidney would be taken instead of liver and spleen. Also, the kidney sample from large fish should be larger, about 6-8 cm in length.

Although fresh-on-ice samples are necessary for successful isolation of certain disease agents, freezing would become necessary if there will be excessive delay in getting the samples to the FPS.

In situations where it is more practical for field personnel to prepare the slides for FAT rather than mail tissues, the appropriate materials will be provided by the FPS. Briefly, after collection of kidney tissues the procedure requires:

1) Homogenization of the kidney sample from each fish by kneading within the plastic sample bag.

2) A sterile wooden applicator stick is touched to an individual homogenized kidney sample and then mixed with a drop of phosphate buffered saline (PBS) deposited in a single numbered well on a multiple well slide.

3) The samples are allowed to air dry at room temperature and the slides may be mailed to the FPS in slide boxes.

Each kidney sample requires a separate applicator stick and well. Slides are prepared in duplicate for parallel testing if fish are to be screened for both BKD and *A. salmonicida*. Homogenization of the kidney is important to break open BKD pustules and distribute the organism for easier detection. It is also important to *not* make kidney smears too thick within the depressions which makes interpretation difficult. Also, such smears may wash off the slide during processing.

Parasitology and General Necropsy. The same sampling procedures as in Bacteriology [A.(1)(2)] apply here. Live fish are preferred to frozen or preserved fish. This is especially true for detection of external protozoan parasites and general gross tissue lesions, which are usually lost during freezing. Fish may be fixed in 10% buffered formalin if live fish are not available. Fish longer than 6 cm should be opened along the belly to ensure adequate formalin fixation of all tissues.

The FPS discourages routine submission of large numbers of fish (≥20) for purposes of establishing parasite (helminth) prevalences since the effort does not justify the value of the resulting information.

Histology. Histological samples should be fixed in Bouin's solution. Fix live fish. Use 10 moribund fish and 10 that are apparently normal from the same lot. Dead fish are not suitable for histology. The volume of fixative should be 10 times the volume of the tissue. For fish longer than 6 cm, slit the belly, detach the intestine at the anus, and pull the internal organs out slightly. For large fish, send only specified organs in fixative. Call the FPS for specific instructions prior to fixing.

Sample Shipment Instructions (for all samples)

1) Pack samples in a small ice chest made of plastic or sturdy styrofoam which will not be damaged in transit. Ice chests (other than styrofoam) will be returned to the hatchery.

2) Add ice in sealed, leak-proof plastic bags or use pre-packaged ice substitutes. To prevent freezing, separate the samples from the ice with newspaper or other insulative material.

3) Place completed Case Data Report(s) (forms available from FPS) for each stock sampled within a waterproof plastic bag and enclose in ice chest.

4) Close, seal, and label the ice chest with "refrigerate but do not freeze" (unless samples are frozen F.A.T. specimens) and "perishable". Label with mailing address and the name of the person contacted in the lab. The mailing addresses for the pathology labs are:

Fish Pathology Lab
ADF&G, FRED Division
333 Raspberry Road
Anchorage, AK 99518-1599

Juneau Fish Pathology Lab
ADF&G, FRED Division
3333 Old Glacier Highway
Juneau, AK 99801

5) Ship via express air or air freight (if you know it will not get bumped off the flight) as soon as possible. Instruct airline to refrigerate sample upon its arrival in Anchorage. If sent early in the week, fewer air freight and delivery problems are encountered. Avoid shipping on Fridays.

6) Contact the courier services currently used by the FPS in Anchorage or Juneau to have the sample(s) delivered.

7) Phone the Fish Pathology Lab to notify that the sample is enroute. Please provide the flight number, airbill number and expected time of arrival. Subsequently check to see if it has arrived. It is the responsibility of the sender to ensure that the sample arrives in the laboratory and in satisfactory condition.

Shellfish Diagnostics:

Rationale. Invertebrate pathology is still in its infancy, with diagnostic technology far behind that used for finfish. Consequently, the diagnostician is limited to the rudimentary detection of shellfish diseases through the use of histology because almost none of the recognized pathogens have been cultured on artificial media. The exceptions are the *Perkinsus* species of protozoa which can be cultivated in thioglycollate broth. Based on the above information, shellfish certification procedures in Alaska will consist of a 2-way approach; histological examination for shellfish pathogens, and thioglycollate screening for *Perkinsus* organisms.

Out-of-State vendors of oyster spat who desire to market their products in Alaska must contact the FPS and arrange shipment of shellfish samples for disease certification as designated below. Those oyster growers in Alaska desiring to purchase out-of-state oyster spat must do so only from ADF&G certified stocks and are required to submit an application for a Fish Transport Permit for prior approval of oyster importation.

Sample Collection. Randomly select animals through entire lot. Need nonbiased samples from each lot being shipped.

Sample Type and Numbers.

1) Motile larvae - 200-1000
2) Spat - 200
3) Adult - 60+

Sample shipment should be as described in the finfish section. All oyster samples shipped to the FPS should be dry and on ice except that larvae will have to be in a sealed container of seawater.

Hatchery Inspections:

Annual or biannual hatchery inspections made by a fish pathologist are for the purpose of observing facility design and practices as they relate to the control of fish and shellfish diseases. The function of the pathologist is to offer advice to correct perceived fish health problems. A hatchery inspection includes an on-site visit and a written report submitted to the hatchery manager addressing the criteria listed below.

Fish stocks at facility (eggs or rearing fish). 1) number, 2) brood year, 3) source, 4) release date, and 5) release location.

Incubator types. (fish species, loading densities and % survival to eyed stage)

Rearing containers. (fish species, size, and loading densities)

Water flow. 1) volume, 2) single pass, 3) re-use - details (treatment, # passes, etc.), 4) recirculation - details (treatment, # passes, etc.), 5) water source, 6) resident fish, 7) depuration (in or out and method), 8) water temperature (at time of inspection), 9) source for water hardening of eggs, and 10) total dissolved gas.

Methods of fish movement from incubators to rearing to release.

Disinfection procedures. (methods and dose) 1) eggs (before entering hatchery), 2) substrate (after each season), 3) utensils (between stocks), 4) equipment and incubators (between stocks or after each season), 5) footbaths - in and out of facility, and 6) mortality disposal.

Current type of feed. 1) brand, 2) method of storage, and 3) turn over time (expiration dates, lot #s).

Health problems observed in eggs and/or fish at facility. 1) stock-lot, 2) age, and 3) signs.

Previous problems. 1) water quality (pH, temperature, sediment, DO, TDG, hardness, etc.), 2) percent egg or fish mortality/stock or lot/day, 3) previous treatments: a) fungus control (chemical, dose, schedule), and b) other prophylactic or therapeutic treatments (reason, when, lot or stock, drug or chemical, method of application, dose, and results), and 4) feed: a) feed type, b) problem (odor, texture, palatability to fish, etc.), c) date, and d) lot #.

Schedule I - Rationale

Detection of disease-causing agents becomes more difficult when they covertly exist within fish populations in a carrier state. This condition produces no obvious outward signs of disease. Thus, destructive sampling is required of larger numbers of fish to provide prevalence data such that the risk of not detecting a disease organism is at an acceptable statistical level. The effort and expense involved in processing such samples is considerable, and proportional to the number of samples. Consequently, it is imperative that sample numbers be as small as possible, but still provide statistically reliable prevalence data. The model that best fits most situations encountered in sampling fish for disease detection is the hypergeometric distribution (Ossiander and Wedemeyer 1973). This model was used to compute Schedule I from a program written in Turbo Pascal for the IBM/PC microcomputer. The hypergeometric distribution was used for all finite sample sizes. Populations greater than 25,000 fish may be assumed to be infinite. The binomial approximation to the hypergeometric distribution was used for the infinite population case.

The Schedule I used in this document for BKD, _A. salmonicida_ and ERM screening consists of the bottom sub-table where population size is infinite. Note that there is little change in the schedule as population sizes increase from 1000 to infinity. Sixty fish is the sample size which still provides 95% confidence that at least a single diseased fish will be detected in the sample if disease is present within 5% of the population. Currently, BKD and ERM agents and _A. salmonicida_ are detected in fish using fluorescent antibody testing (FAT) in which results are recorded on a scale of 1+ to 4+ according to the intensity of fluorescence. This intensity is based upon relative numbers of organisms within a given number of microscope fields. The most conservative approach would be to reject a fish population if one fish tests positive in a sample of 60. However, a more practical compromise is necessary between the ideal situation of no disease and a more realistic one where some disease in the carrier state is frequently present and must be tolerated to some degree. That degree of tolerance (acceptable percent of positive FAT categories within the population) is arbitrarily determined in Schedule I whereby at a 5% risk of no detection in a 60-fish sample the population is rejected (i.e., limitations may be placed upon the disposition of those fish as determined on a case-by-case basis) if: 7 or more fish are 1+ in FAT (Population prevalence of 20%); 2 or more fish are 2+ (population prevalence of 10%); 1 or more fish are 3+ (population prevalence 5%), i.e., no 3+ or 4+ fish are allowed because of the large numbers of disease organisms carried and potentially shed into the environment.

SCHEDULE I. Rejection numbers for different population and sample sizes when the risk is 5% (0.05).

Population Size = 1000

FAT	% Disease Prevalence	Sample Size 30	60	100	120	200	300	500
1+	20	3	7	14	17	32	51	90
2+	10	1	3	6	7	14	23	42
3+	05		1	2	3	6	10	19
4+	01						1	2

Population Size = 2000

FAT	% Disease Prevalence	Sample Size 30	60	100	120	200	300	500
1+	20	3	7	14	17	31	50	87
2+	10	1	2	5	7	14	22	41
3+	05		1	2	2	5	9	18
4+	01						1	2

Population Size = 5000

FAT	% Disease Prevalence	Sample Size 30	60	100	120	200	300	500
1+	20	3	7	14	17	31	49	86
2+	10	1	2	5	7	13	22	40
3+	05		1	2	2	5	9	18
4+	01						1	2

Population Size = 10000

FAT	% Disease Prevalence	Sample Size 30	60	100	120	200	300	500
1+	20	3	7	14	17	31	49	86
2+	10	1	2	5	7	13	22	39
3+	05		1	2	2	5	9	17
4+	01						1	2

Population Size = 25000

FAT	% Disease Prevalence	Sample Size 30	60	100	120	200	300	500
1+	20	3	7	14	17	31	49	86
2+	10	1	2	5	7	13	22	39
3+	05		1	2	2	5	9	17
4+	01						1	2

Population Size = infinite

FAT	% Disease Prevalence	Sample Size 30	60	100	120	200	300	500
1+	20	3	7	14	17	31	49	85
2+	10	1	2	5	7	13	22	39
3+	05		1	2	2	5	9	17
4+	01						1	2

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SECTION D

Salmon Escapement Goal Policy

SALMON ESCAPEMENT GOAL POLICY

Alaska Department of Fish and Game

Introduction:

The Alaska Constitution mandates the Department of Fish and Game to manage fishery resources on a sustained yield basis. For salmon fisheries with stable fishing effort, sustained yield can be achieved by conservative management practices such as limited catch quotas and limited scheduled fishing periods. However, for fisheries with expanding levels of fishing effort or excessive fishing power, sustained yield management requires that the department assess the number of salmon that spawn on an annual basis. The department has the authority to establish the annual level of salmon spawning stock required to maintain a sustainable harvest and also to manage commercial, sport, personal use, and subsistence fisheries to ensure that annual spawning escapement requirements are met.

The mission of the department needs to be clearly defined with respect to the mandated sustained yield principle. A wide range of sustainable yields are possible for salmon fisheries. The department has improved the methods and procedures for enumerating salmon spawning stock levels. The department has also developed methods for estimating the salmon carrying capacity of freshwater rearing environment for selected stocks. This information has enabled the department to obtain a better scientific understanding of the relationship between salmon spawning stock level and resulting level of return. Consequently, scientifically based spawning stock levels that produce the maximum number of harvestable fish can be estimated for many salmon fisheries.

There are many fisheries where the department lacks the necessary management program and scientific information to manage for maximum sustained yield. For these situations where fishing effort is expanding or fishing power is excessive, the department must necessarily implement more conservative fisheries management measures to assure sustainable yield. For fisheries that are supported by numerous, small, and unsurveyed streams, management will remain more a matter of scientific judgement. In all cases, conservative fishery management practices will result in yields that are lower than the stock's potential.

Unless otherwise directed by regulation, the department will manage Alaska's salmon fisheries, to the extent possible, for maximum sustained yield. To this end, the department will aggressively pursue the further development of escapement enumeration programs, in-season fishery management programs, and scientific methods to determine escapement levels which produce maximum sustained yield.

Purpose of the Escapement Goal Policy:

This policy applies to wild anadromous Pacific salmon. The purposes for this policy are to:

1. Establish definitions and concepts relating to escapement goals.

2. Specify criteria and procedures for establishing and modifying escapement goals.

3. Set up a process that facilitates public review of allocative issues associated with establishing and modifying escapement goals.

<u>Definitions</u>:

Salmon: is any of the five wild anadromous Pacific salmon species native to Alaska: chinook, coho, sockeye, chum and pink salmon.

Stock: is a locally interbreeding group of salmon that is distinguished by a distinct combination of genetic, phenotype, life history, and habitat characteristics. Recognizing that most fisheries harvest mixed stocks and when this constrains management, stocks may be aggregated into larger groups for purposes of this policy. This definition is consistent with "stock" as defined in statute (AS 16.05.940(15)).

Escapement: is the annual estimated size of the spawning stock. Quality as characterized by sex and age composition may be considered in estimating escapement.

Yield: is the number of fish harvested in a particular year or season from a stock.

Sustainable Yield: is the average annual yield that results from a level of escapement that can be maintained on a continuing basis. A wide range of average annual yield levels are sustainable.

Maximum Sustainable Yield (MSY): is the greatest average annual yield from a stock. In practice, MSY is approached when a constant level of escapement is maintained on an annual basis regardless of run strength. The achievement of MSY requires a high degree of management precision and scientific information regarding the relationship between escapement and subsequent return.

Biological Escapement Goal (BEG): is the estimated escapement that produces the greatest yield, is the specific management objective for the escapement, is developed from the best available biological information, and is scientifically defensible on the basis of available biological information. The BEG is determined by the Department of Fish and Game.

Optimal Escapement Goal (OEG): is a specific management objective for the escapement that considers biological and allocative factors. The optimal escapement goal is determined by the Alaska Board of Fisheries. The optimal escapement goal may or may not be equal to the BEG but is always sustainable.

Action Point: is a threshold value for some quantitative indicator of stock run strength at which some explicit management action will be taken to reach the optimal escapement goal. An action point may be derived from criteria about locations or dates and may include a statistical projection of abundance, escapement, or harvest.

In-River Run Goal: is defined by the Board of Fisheries for stocks that are subject to in-river harvest above the point where escapement can be estimated. The in-river run goal is comprised of the optimal escapement goal plus specific allocations to in-river fisheries and may include allocations to provide higher catch per unit effort for in-river sport fisheries.

Procedures for Documenting, Establishing and Modifying, and Reviewing Escapement Goals:

Documentation of Existing Escapement Goals:

The department will document existing escapement goals for Alaska salmon fisheries in a single report. The development of the report will be coordinated by the Chief Fisheries Scientist, Division of Commercial Fisheries. Escapement goals will be summarized by fishery, species and stock for the following commercial finfish regulatory areas or groups of areas: 1) Southeast Alaska and Yakutat areas, 2) Prince William Sound area, 3) Cook Inlet area, 4) Kodiak area, 5) Chignik area, 6) Alaska Peninsula and Aleutian Islands areas, 7) Bristol Bay area, and 8) Kuskokwim, Yukon, Norton Sound-Port Clarence, and Kotzebue-Northern areas.

The report will encompass all stocks which are currently managed for an escapement goal or other repeatable, quantitative estimate of spawner abundance. The department will classify each goal so that it is consistent with this policy, provide a brief explanation of the genesis of the current goal, identify the method for estimating or indexing escapement, and identify the fishery division having primary management responsibility. It is the department's intent to revise the report as escapement goals are established or modified.

Establishing and Modifying Escapement Goals:

The department will follow these guidelines for establishing and modifying escapement goals:

1. Biological escapement goals should be established for stocks for which the department can estimate or index salmon escapement levels. Biological escapement goals will be changed whenever new information suggests that future sustained harvest levels can be increased by that change.

2. Biological escapement goals may be a single escapement level or a range of escapement levels. Whenever the biological escapement goal is specified as a range; the lower and upper limits of escapement will be consistent with MSY and based on the inherent variability in production of the stock.

3. Whenever the department wishes to establish a new biological escapement goal or modify an existing biological escapement goal, a scientific analysis with supporting data must be prepared.

4. The department will determine whether there is substantive allocation impacts arising from management actions needed to achieve any proposed biological escapement goal. When such a determination is made, it will be presented to the Board of Fisheries.

Review Process for Escapement Goals:

An analysis supporting the proposed biological escapement goal or biological escapement goal change will be developed by the region of the division with primary management responsibility for the affected stock. The region developing the proposal will provide opportunities for appropriate personnel from other divisions to participate in developing the analysis of the proposed BEG.

Following development of the analysis supporting the proposed BEG, an inter-divisional review team will be appointed by the appropriate regional supervisors of the Divisions of Commercial Fisheries and Sport Fish. The regional supervisors will request technical assistance from their respective division's headquarters, FRED Division, and also non-departmental experts as appropriate. The review team will assess the scientific merits of the BEG by reviewing available scientific information and by analyzing the impact of the proposed BEG on the existing management program for affected stocks. In addition, the review team will make a determination of whether there is substantive allocative impacts arising from management actions needed to achieve the proposed biological escapement goal.

If the team, by consensus, determines there is no substantive allocative impact arising from management actions to achieve the BEG, the proposed BEG will be submitted to the director of the division of primary management responsibility with a recommendation for its approval.

If the team cannot achieve a consensus, either with respect to the level of the BEG or the determination of allocative impact, the proposed BEG will be submitted to the division directors (and to the Commissioner, if necessary) for resolution.

If a determination of substantive allocative impact is made by the review team or a division director, the division directors will develop a joint proposal for the Commissioner to present to the Board of Fisheries to establish an optimal escapement goal and associated management plan to achieve the goal.

Cycle for Review of Existing Escapement Goals and Establishing New Escapement goals:

At a minimum, the department will review existing BEGs or propose new BEGs on a schedule that conforms to the Board of Fisheries triennial cycle of consideration of area regulatory proposals. Specific proposals for establishing and modifying BEGs will be developed, as appropriate within limits of available personnel, based on the availability of new scientific information and new techniques or programs for escapement enumeration.

<u>Public Review and Implementation of Biological Escapement Goals</u>:

Escapement Goals with Little or No Allocative Impact:

An effort to inform the public of any change in a biological escapement goal will be made. This process may include review of the change with Advisory Committees in the affected area and with user groups that depend on the affected stock.

Escapement Goals with Potentially Substantive Allocative Impact:

Whenever substantive allocation issues arise from proposed management actions needed to achieve a biological escapement goal, the department will request regulatory action from the Alaska Board of Fisheries to adopt a management plan for the fisheries involved. The management plan may identify an optimal escapement goal that differs from the proposed biological escapement goal to achieve the specific allocation objectives of the Board of Fisheries. The management plan will be drafted with departmental assistance and submitted to the Board of Fisheries for consideration.

The department will determine the biological escapement goals for the affected stocks, together with analyses of allocation impacts of alternative optimal escapement goals that the Board may consider.

In development of draft management plans for stocks with significant in-river fisheries, specific allocations to in-river fisheries will be added to the optimal escapement goal to set an in-river run goal. The fisheries outside the river will be managed to achieve the in-river run goal. The draft management plan will define specific action points and associated management actions for the department to follow in managing fisheries to meet the optimal escapement goal and/or the in-river run goal.

APPROVED:

R C Clasby — 10/16/92
Robert C. Clasby — Date
Acting Director, Division of Commercial Fisheries

10/16/92
Norval Netsch — Date
Director, Sport Fish Division

10/16/92
Jeff Koenings — Date
Director, FRED Division

C. Meacham — 10-16-92
Charles P. Meacham — Date
Deputy ~~Commissioner, Alaska~~ Department of Fish and Game

Carl L. Rosier — 10/21/92
Carl L. Rosier — Date
Commissioner, Alaska Department of Fish and Game

SECTION E

Policy and Requirements for Fish Resource Permits

ALASKA DEPARTMENT OF FISH AND GAME

POLICY AND REQUIREMENTS FOR FISH RESOURCE PERMITS

GENERAL

The Alaska Department of Fish and Game (ADF&G) is the custodian of the fish resources of the state. Permits are required for all collections of fish, shellfish, and aquatic plants not covered by existing regulations. This requirement includes methods and means (gear), numbers, locations, seasons, or the possession and/or transportation of live fish in any life-stage outside of existing sport, personal use, aquatic farm, and commercial regulations. Fish resource permits are a privilege and will be issued only to those organizations and individuals who meet the departmental requirements specified in this policy, and who are engaged in scientific, educational, propagative, or exhibition activities.

The provisions of this policy govern the permits required for collecting, holding, and propagating fish, shellfish, or aquatic plants. They do not apply to the cultivation of ornamental fish.

Possession of a permit issued under this policy does not relieve the permittee of the responsibility for securing any other local, state, or federal permits required for the project.

Permits issued under this policy are nontransferable. Falsification of any information on an application, affidavit, permit, or report required by the permit or by this policy will be grounds for permit revocation or denial of future permit applications.

PERMIT REQUIRED

No organization or individual may collect or hold alive any live fish, shellfish, or aquatic plants, or their gametes for purposes of science, education, propagation, or exhibition unless that organization or individual holds a fish resource permit issued by the commissioner. Unless otherwise specified or revoked, a permit shall expire no later than December 31 of the year in which it was issued.

A fish resource permit authorizes only the activities specified in the permit. Any change in the permit or terms of the permit requires an amendment to the permit.

UNIFORM APPLICATION PROCEDURES

Each applicant for a fish resource permit shall submit the following information to the department on a form approved by the commissioner:

(1) The name of the applicant and the name of the primary employer, or instructor, sponsor or contractor of the study.

(2) A written operational plan that identifies the purpose and the need for the desired collection, research objectives, procedures, and an explanation of benefits that may accrue from the requested activities.

(3) Dates and specific locations where collections are to be made.

(4) Specific numbers of specimens, by species and life stage, required to meet the objectives of the project, including both common and scientific names.

(5) Plans for final disposition, manner of disposition, and anticipated date when disposition of specimens will occur.

(6) Specific methods and/or gear to be used in the collection of specimens.

(7) The names of all persons, in addition to the applicant or chief investigator, who will be participating in field activities; or the number of people expected to participate with an agreement to furnish the names when they are identified.

(8) Applicant's signature and date.

A completed application must be submitted to the department headquarters office at P.O. Box 25526, Juneau, AK 99802 as follows:

(1) applications for capture, collection, and holding of fish and aquatic plants for non-propagative purposes from freshwater are to be sent to the attention of the Division of Sport Fish;

(2) applications for capture, collection, and holding of fish and aquatic plants for non-propagative purposes from saltwater are to be sent to the attention of the Commercial Fisheries Management and Development Division;

(3) applications for finfish propagation are to be sent to the attention of the Commercial Fisheries Management and Development Division;

(4) applications for activities related to shellfish and aquatic plant propagation, and shellfish and aquatic plant farm and hatchery operations are to be sent to the attention of the Mariculture Coordinator, Commercial Fisheries Management and Development Division.

If the commissioner determines that an application is incomplete and that further information is necessary, the department will return the application to the applicant with a description of the deficient information.

PERMIT CLASSIFICATIONS

The commissioner may issue a fish resource permit for the following activities:

I. Collection: Applicants must be involved in legitimate research or educational activities. Permit applications are reviewed and processed by the Commercial Fisheries Management and Development Division (salt water) and the Sport Fish Division (fresh water) to collect specimens of fish, shellfish and aquatic plants from salt and freshwater. The specimens will be killed at the collection site, or caught and released unharmed at the collection site.

   The reasons for capturing and/or collecting fish are diverse; however, most requests for scientific collections stem from a need to: (1) properly conduct impact analysis from proposed activities; (2) manipulate aquatic habitat features for improving fish productivity; and/or (3) obtain fish resource data that will support legitimate academic inquires (research). Moreover, the capture, collection, and disposition of fish, if done in the proper manner, can have considerable educational value. Examples of educational uses include the preparation of voucher specimens of fish from a specific location, fish dissection, field ecology investigations, and aquatic education programs.

II. Holding: Applicants must be involved in legitimate research or educational activities. Permit applications are reviewed and processed by Commercial Fisheries Management and Development Division (salt water) and Division of Sport Fish (fresh water) to allow individuals or organizations to exhibit live saltwater or fresh water specimens, to export live specimens from the state, or for non-propagative research that requires maintaining live specimens for some amount of time after capture. Exportation of live specimens from Alaska requires an importation permit issued by the appropriate resource agency of the importing state or country.

   A permit in this category will allow the transport and live holding of specimens to be contained in aquaria. Specimens are not to be released. The permit number must be displayed on the aquaria. This permit will fulfill the requirements of 5 AAC 41, for transportation and possession of live fish. Carcasses must be disposed in a manner approved by the department. All aquarium systems (open and closed) may be inspected and will require approval by an ADF&G Fish Health Services Pathologist.

III. <u>Propagation</u>: Permit applications are reviewed and processed by the Commercial Fisheries Management and Development Division (all species) for educational, vocational, research, or site suitability purposes. Applications will also be reviewed by the Sport Fish Division. Applicants must be involved in legitimate activities for a scientific, educational, or aquaculture organization. If the applicant is an Alaska public school, the school will be considered the primary employer, not the school district, and the classroom instructor who has daily supervision will be considered the applicant.

A. Mariculture site suitability. Approval by an ADF&G Fish Health Services Pathologist is required. The permit will fulfill fish transport permit (FTP) requirements as specified under 5 AAC 41.

1. Limited to one year, no renewal;
2. Limited to 10,000 organisms with no release;
3. No commercial use;
4. Does not establish any proprietary interest in the site.

B. Scientific/Educational. This permit will serve to transport and hold alive species and will fulfill FTP requirements as specified under 5 AAC 41. Approval by an ADF&G Fish Health Services Pathologist may be required. Only wild coho, pink, and chum salmon or any species obtained from a hatchery in the state (other than sockeye salmon) will be allowed for classroom projects. In this category, the following conditions apply:

1. No releases (of fish or effluent into waters of the state).

(a) Less than or equal to 500 eggs or one spawning pair;
(b) Wild stock or hatchery eggs;
(c) Shellfish and aquatic plant projects related to aquatic farming.

2. Small number releases

(a) Progeny from less than or equal to 500 eggs or one spawning pair;
(b) Fish release only at place of origin or in a departmentally approved landlocked lake; effluent release either disinfected or discharged into a sewage treatment facility;
(c) Cumulative impacts from multiple projects in an area or drainage will be carefully assessed;
(d) The project must be for educational purposes only and any adult returns from the project may not be claimed as exclusive property of the project. The returns are considered common property and no special harvest rights may be claimed for cost recovery or any other reason;

(e) Release must be timed as nearly as possible to the natural timing of the donor stock, the plankton bloom, or at a time appropriate to maximize the survival.

3. If an event occurs that results in substantial egg mortalities, a report is required to explain the nature of the incident, the cause of the incident, the date of the incident, and any corrective action taken. This report must be received in the headquarters office before any further live fish or egg transport is made. The classroom may be allowed one additional transport of less than or equal to 500 eggs or one spawning pair from the original source.

C. Vocational. Up to 50,000 eggs or equivalent in spawning pairs (sockeye salmon should not be used).

1. Inspection by an ADF&G Fish Health Services Pathologist and genetic sampling may be required, and additional restrictions may be required for fisheries management and conservation needs;

2. Regional planning team (RPT) review at a regularly scheduled meeting is required. Based on the recommendation of the RPT, additional restrictions may be required for fisheries management and conservation needs, and cumulative impacts from multiple projects in an area or drainage may be carefully assessed;

3. If an RPT does not exist for the area, the department's two fisheries divisions will formally review the application. As part of the review, public comment will be solicited through a newspaper advertisement paid for by applicant. The public will be invited to submit written comment for a 30-day period to the Commercial Fisheries Management and Development Division Juneau headquarters office;

4. An FTP for brood stock selection is required.

5. The project must be for educational purposes only and any adult returns from this project may not be claimed as exclusive property of the project. The returns are considered common property and no special harvest rights may be claimed for cost recovery or any other reason.

D. Propagative. Eggs in the amounts intended to result in less than or equal to 5,000 returning adults. No more than 500,000 eggs of non-smolt species (e.g. pink or chum salmon) or 100,000 eggs of smolt species (e.g. coho, sockeye, or chinook) or the equivalent in spawning pairs may be used.

1. Research and Bioenhancement. Accredited institutions of higher learning and cooperative governmental projects.

(2) the permittee fails to comply with terms and conditions of the permit, or the provisions of this policy.

An application for a fish resource permit that has been denied or a permit that has been revoked by the commissioner will, in the commissioner's discretion, be reconsidered if the applicant provides new or additional written information that may have altered the original decision.

AMENDMENTS TO THE PERMIT

A permittee may request an amendment to a fish resource permit by writing to the department's headquarters office. The permittee must submit an amended plan, and a written explanation of why the amendment is being requested. The commissioner may approve or deny an amendment to the permit. The commissioner may alter, amend, or revoke a permit if additional information or changed circumstances affect the adequacy of its terms and conditions.

Amendments become effective on approval by the commissioner, receipt of the amendment by the permittee, or at a later date specified in the amendment. Unless otherwise specified, amendments remain valid for the duration of the permit and must be attached to the original permit.

PERMIT CONDITIONS

The commissioner may prescribe conditions in a permit to control or prevent the occurrence of disease, genetic change, or other disturbances of a biological nature that may affect native, wild, or propagated fish, shellfish or aquatic plants. The commissioner may prescribe conditions in a permit to minimize disturbances or alterations to traditional fisheries or other uses of fish and wildlife resources. These conditions may include limitations on the number of a stock or a species to be taken, release locations, methods of transport or release, quarantine, effluent control, disease inspection, or other measures, such as the requirement for an FTP, as specified under 5 AAC 41, that are necessary to achieve the purposes of this policy.

The commissioner may prescribe special permit requirements, depending upon the complexity of the overall project for which the specific application is being made. Each project component will be evaluated independently and modified as appropriate.

RETENTION OF PERMIT FOR INSPECTION

A copy of the permit, including any amendments, must be retained by the permittee and made available for inspection upon request by a representative of the department or a law enforcement officer. The permit or a copy of the permit must be available at all field collection sites and at the project site.

Each permittee must give authorized representatives of the department and law enforcement officers free and unobstructed access at all times to permit sites. Each permittee must give such assistance and furnish information that the representative or law enforcement officer may reasonably require for monitoring and inspection purposes.

REPORTING

A collection report is required and must be submitted to the divisional headquarters office that issued the permit within 30 days after the expiration date of the permit, unless an earlier date is specified. The report shall include: numbers of each species collected, date and place taken, disposition of the specimens, and, if applicable, sex, life stage, age, lengths and weights of fish, or any other information required in the permit.

A completion report detailing the results and findings of any data analysis for the project, if not submitted with the collection report described above, must be submitted to the department within six months of the expiration of the permit. Data from such reports are considered public information.

The commissioner will not re-issue a permit to the permittee or agency until the above reporting requirements are met.

DELEGATION OF AUTHORITY

No authorities or activities granted under terms of a fish resource permit may be delegated by the permittee to another person. Permits to agencies will be made to the highest practical level or individual in each agency. Additional personnel may engage in approved collection activities only after written notification by the permittee and approval by the department. If the applicant is an Alaskan public school, the school will be considered the primary employer, not the school district, and the classroom instructor who has daily supervision will be considered the applicant.

RESTRICTIONS

(a) Collected fish, shellfish, or aquatic plant specimens may not be sold, bartered, or used as food, and may be used only for the purposes specified in the permit.

(b) If species to be taken or possessed are those under primary jurisdiction of the federal government, the applicant must first obtain a federal permit and submit a copy of it along with the application when applying for the state permit. The state permit may be more restrictive, but not more liberal than the federal permit.

(c) The permittee is responsible for securing any other required state or local permits. The fish resource permit will not be valid without all other permits required by local, state, and federal agencies.

(d) Permits will indicate the number of specimens that may be taken, by species and life stage. Sampling or collecting activities must stop when the maximum allowable number of specimens is obtained. All live fish, shellfish, and aquatic plants collected in excess of the number specified on the permit must be released immediately and unharmed at the capture location, unless otherwise specified in the permit.

(e) All fish traps, nets or similar capture devices must be labeled with the collector's name and permit number. A valid sport fishing license must be in the possession of each person collecting fish with a hook and line or clams with a shovel.

(f) Use of explosives or chemicals, especially poisons other than chemical baits or lures for collecting purposes is prohibited. Any chemical anesthetics used must be approved for human consumption by the Food and Drug Administration if fish treated with such chemicals are susceptible to human consumption within 14 days after exposure.

(g) Department staff identified in the permit must be notified before collections or sampling.

(h) Marking or tagging of fish is closely regulated by the state and must not conflict with other programs. Specific approval is required for any marking or tagging project. The number of each species to be marked and the location and type of mark or tag to be used must be specified.

(i) A Title 16 permit may be required from the department's Habitat Division if a weir is to be used to collect fish, or if the proposed activities include stream alteration, water diversion, or other activities that may put fish resources at risk in waters that contain anadromous fishes.

(j) Use of electroshocking devices will be closely regulated because such devices can cause substantial injury to fish. In general, electroshocking will not be allowed if large rainbow trout or any species of fish in spawning condition are present.

(k) The applicant should recognize that an application for an educational project is for educational purposes only. Any adult returns from the project may not be claimed as exclusive property of the project. Returning fish are considered common property and no special harvest rights may be claimed for cost recovery or any other reason.

DEFINITIONS

Unless the context indicates otherwise, in this policy

(1) "aquatic plants" means a plant indigenous to state water or that is authorized to be imported into the state under a permit issued by the commissioner;

(2) "barter" means the exchange or trade of fish or game, or their parts, taken for subsistence uses;

(3) "commissioner" means the commissioner of the Department of Fish and Game or his or her delegated representative;

(4) "complete application" means a final application containing required information which has been accepted by the commissioner and which contains a study plan.

(5) "department" means the Alaska Department of Fish and Game.

(6) "fish" means any species of aquatic finfish, invertebrate, or amphibian, in any stage of its life cycle, found in or introduced into the state, and includes any part of such aquatic finfish, invertebrate, or amphibian as defined in AS 16.05.940;

(7) "fish transport permit (FTP)" means a permit issued under the authority of 5 AAC 41.001-41.100 which has not expired, been suspended, or terminated;

(8) "law enforcement officer" means a person defined in AS 16.05.150.

(9) "legitimate research" means conforming to recognized scientific principles or recognized rules and standards which will benefit the state or the department;

(10) "management plan" means a written document which explains the harvest and escapement strategy the department will implement to regulate commercial, sport, and/or subsistence fisheries. The plan may be either a formally adopted Board of Fisheries regulation, an annually revised plan written by ADF&G describing how a specific area's fisheries will be managed, or the regional comprehensive salmon plan for the area.

(11) "mark" or "marking and tagging" means all forms of skin alterations, fin clipping or other mutilation, or the insertion of foreign materials in live fish or other procedures that permit later identification;

(12) "ornamental fish" means a fish commonly known as a "tropical fish," "aquarium fish," or "goldfish", which was imported, cultured, or sold in the state, customarily for viewing in aquaria or for raising in closed artificial systems, and not used for sport fishing or human consumption purposes;

(13) "permittee" means the applicant and holder of the permit who is responsible for the project and activities;

(14) "propagation" means the breeding and reproduction of fish, shellfish, or aquatic plants for the purpose of achieving scientific, educational, or vocational objectives;

(15) "shellfish" means any species of crustacean or mollusk, in any stage of its' life cycle that is indigenous to state water or that is authorized to be imported into the state under a permit issued by the commissioner;

(16) "transport" means to ship, carry, import, export, receive, or deliver for shipment, transportation, carriage, or export.

(17) "vocational" is relating to or being in training in a skill or trade to be pursued as a career related to biology or culturing of fish.

APPROVED:

Jeffery P. Koenings, Director — Date: 12/5/94
Commercial Fisheries Management and Development Division

John Burke

John A. Burke, Acting Director — Date: December 1, 1994
Sport Fish Division

Carl L. Rosier

Carl L. Rosier, Commissioner — Date: 12/15/94
Alaska Department of Fish and Game

SECTION F

Transportation, Possession, and Release of Live Fish

CHAPTER 41. TRANSPORT, POSSESSION AND RELEASE OF LIVE FISH; AQUATIC FARMING

Article

Article 1. Scope of Regulations

Section

5 AAC 41.001. APPLICATION OF THIS CHAPTER. The provisions of this chapter govern the transportation, possession, or release of live fish transplanted for or cultivated for human consumption or sport fishing purposes, or as part of an aquaculture program for scientific, educational, or propagative purposes, and the transportation and possession of shellfish or aquatic plants for commercial purposes in conjunction with an aquatic farming operation. Unless specifically provided, the provisions of this chapter do not apply to the cultivation of ornamental fish. Additionally, the provision of this chapter do not apply to the transportation, possession, or release of fish taken for commercial fishing, sport, or subsistence purposes. (In effect before 1988; am 4/10/88, Register 106; am 8/12/89, Register 111)

Authority: AS 16.05.050 AS 16.40.100
AS 16.05.251 AS 16.40.160

Article 2. Permit System Established

Section

5 AAC 41.005. PERMIT REQUIRED. (a) No person may transport, possess, export from the state, or release into the water of the state, any live fish unless the person holds a fish transport permit issued by the commissioner or his authorized designee, and the person is in compliance with all conditions of the permit and the provisions of this chapter. A fish transport permit will be issued for a fixed term subject to the provisions of (c) of this section.

(b) A fish transport permit authorizes only that operation specified in the permit. Any change of species, brood stock, or location requires a new permit. Any other change requires an amendment to the permit.

(c) The commissioner shall suspend the permit, or particular provisions of the permit including amendments, if he finds

(1) on the basis of new information or changed circumstances, that the permitted activity will adversely affect the continued health and perpetuation of native, wild, or hatchery stocks of fish; or

(2) the permittee has failed to comply with permit terms or the provisions of this chapter.

(d) Notwithstanding the expiration, termination or suspension of a fish transport permit, each permittee is responsible for the obligations arising under the terms and conditions of the permit, and under the provisions of this chapter. (In effect before 1988)

Authority: AS 16.05.251(a)

5 AAC 41.010. UNIFORM APPLICATION PROCEDURES. (a) Each applicant for a fish transport permit shall submit the following information to the department:

(1) identification of each species and location of the stock to be transported, possessed or released;

(2) the destination of the transported fish and the release site;

(3) the number of fish and their life history stage or age;

(4) a descriptive history of previous transport, if any;

(5) a statement on the health or condition of the fish, including a disease history of the stock, a disease history of the hatchery or rearing facilities through which they may have passed, and any previous disease treatment or vaccinations, or, if the disease history is incomplete or unavailable a brood stock inspection and certification pursuant to 5 AAC 41.020;

(6) isolation measures planned to control disease during transport, including a description of containers, water source, depuration measures, and plans for disinfection;

(7) a description of proposed egg-take methods:

(8) the source of water for rearing and proposed effluent discharge location;

(9) identification and status of native stocks in the area of taking, retention and release site, including a statement of expected interactions with other stocks in these areas;

(10) the method of transport or release and the expected date of transport or release;

(11) the purpose and expected benefits of the transport or release; and

(12) evaluation plans.

(b) A completed application must be submitted to the department regional office in the region in which the proposed transport or release will occur.

(c) If the commissioner or his authorized designee determines that an application is incomplete and that further information is necessary, the department will return the application to the applicant with a description of the deficient information.

(d) The commissioner or his authorized representative will approve, condition, or deny a permit within 45 days after a completed application containing all of the applicable information listed in (a) of this section has been received in the appropriate regional office. (In effect before 1982; am 7/25/82, Register 83)

Authority: AS 16.05.251(a)

5 AAC 41.020. INSPECTION FOR DISEASE OF BROOD STOCK. If the disease history of the brood stock is unavailable or incomplete as required by 5 AAC 41.010(a)(5), an inspection of the brood stock to detect fish disease must be scheduled by the applicant and conducted by the fish pathology section of the department, or by a person designated by the fish pathology section. The applicant must submit samples of the brood stock as directed by the fish pathology section for the purpose of inspection. The applicant will receive a certification form the fish pathology section upon successful completion of the inspection. (In effect before 1988)

Authority; AS 16.05.251(a)
AS 16.05.868

5 AAC 41.030. PERMIT ISSUANCE OR DENIAL. (a) The commissioner or his authorized designee will issue a fish transport permit if it is the department's determination that the proposed transport, possession or release of fish will not adversely affect the continued health and perpetuation of native, wild, or hatchery stocks of fish; or

(b) The commissioner or his authorized designee will issue a fish transport permit with terms and conditions attached if it is the department's determination that the terms and conditions are necessary to protect the continued health and perpetuation of native, wild, or hatchery stocks of fish.

(c) The commissioner of his authorized designee will deny an application for a permit, or a request for amendment of a permit, if the applicant's proposed plans, methods, or specifications are not adequate, on the basis of fish disease, genetics, competition, predation, or other biological considerations, to assure the continued health and perpetuation of native, wild, or hatchery stocks of fish. Written notice of denial shall be given to the applicant, including the reasons for denial. (In effect before 1988)

Authority: AS 16.05.251(a)

5 AAC 41.040. AMENDMENTS TO THE PERMIT. (a) A permittee may request amendment of a fish transport permit by submitting, in writing to the department regional office where the permit was issued, an amended plan and a statement explaining why the amendment is necessary.

(b) The commissioner or his authorized designee will issue an amendment to the permit upon a determination made pursuant to 5 AAC 41.030(a) or (b). The commissioner or his authorized designee will approve, condition or deny a request for amendment within 30 days after receipt of the request in the appropriate regional office.

(c) The commissioner or his authorized designee may alter or amend permit conditions if additional information or unforeseen changes allow relaxation, or changed circumstances affect the adequacy of permit terms and conditions

(d) Amendments approved by the commissioner or his authorized designee become effective when received by the permittee, or at a later date specified in the amendment. Unless otherwise specified, amendments remain valid for the duration of the permit. (In effect before 1988)

Authority: AS 16.05.251(a)

5 AAC 41.050. PERMIT CONDITIONS. The commissioner or his authorized designee may prescribe conditions on a permit to control the occurrence of fish disease, genetic change, or control other disturbances of biological origin affecting native, wild, or hatchery stocks of fish.

These conditions may include designation of brood stock and release locations, methods of transport or release, quarantine and depuration requirements and procedures, disease inspections, disposal of wastes and effluent, timing of transportation and release, reporting requirements, and other measures necessary to achieve the purposes of 5 AAC 41. (In effect before 1988)

Authority: AS 16.05.251(a)

5 AAC 41.060. RETENTION OF PERMIT FOR INSPECTION. (a) After issuance a copy of the permit including any amendments must be retained by the permittee, and be made available upon request for inspection by a representative of the department, or a law enforcement officer of the Department of Public Safety.

(b) For the purposes of inspecting and monitoring compliance with the terms of the permit or the requirements of this chapter for the continued health and perpetuation of native, wild, or hatchery stocks of fish, each permittee shall give authorized representatives of the department, and law enforcement officers of the Department of Public Safety, free and unobstructed access at all times to permit sites. Each permittee shall give such assistance and furnish information the representative or law enforcement office may reasonably require for monitoring and inspection. (In effect before 1988)

Authority: AS 16.05.251(a)

Article 3. General Provisions

5 AAC 41.070. PROHIBITIONS ON IMPORTATION AND RELEASE OF LIVE FISH. (a) Except as provided in (b), (c), and (d) of this section, no person may import any live fish into the state for purposes of stocking or rearing in the waters of the state.

(b) Live oysters native to and originating from the Pacific Coast of North America may be imported for aquaculture purposes, under a permit required by this chapter, and may be released into the waters of the state only if

(1) the brood stock is derived from oysters commercially cultured on the Pacific Coast of North America through three or more generations; and

(2) the disease history or an inspection indicates no incidence of disease that is not indigenous to Alaska.

(c) Ornamental fish not raised for human consumption or sport fishing purposes may be imported into the state, but may not be reared in or released into the waters of the state. Fish wastes and waste water from ornamental fish may not be released directly into the waters of the state.

(d) Weathervane scallops originating from wild stocks or cultured stocks in the Southeastern Alaska and Yakutat Areas may be imported for aquaculture purposes and may be released only into the waters of the Southeastern Alaska and Yakutat Areas under a permit required by this chapter only if

(1) the brood stock was taken under the provisions of a permit issued by the department;

(2) the brood stock was certified by the department's fish pathology section before transport out of the state;

(3) the brood stock was held continuously in a department-approved isolation facility;

(4) the weathervane scallops proposed for import have been held continuously in a department-approved isolation facility before import into the state;

(5) the disease history, or an inspection, of the weathervane scallops proposed for import indicates no incidence of a disease of transport significance. (In effect before 1988; am 9/19/90, Register 115; am 4/30/91, Register 118)

Authority: AS 16.05.251(a)

5 AAC 41.080. REPORTING AND CONTROL OF FISH DISEASES AT EGG-TAKE SITES, HATCHERIES, AND REARING FACILITIES. (a) The requirements of this section apply to all public and private egg-take programs, fish hatcheries, and fish rearing facilities in the state.

(b) Within 24 hours of transporting live fish eggs between water sheds, all eggs must be treated, for at least 10 minutes, with an iodine solution of at least 100 parts per million of active iodine ingredient, with pH at least 6.0 or greater, or in a manner approved by the fish pathology section of the department. This requirement does not apply to shellfish eggs.

(c) Each fish hatchery or fish rearing facility must be inspected by the department's fish pathology section at least once each year at least two weeks prior to the transport or release of fish. The commissioner or his authorized designee may require and conduct additional inspections if the disease history of the stock or facility is incomplete, or if the disease history of current condition of the stock evidences incidence of disease.

(d) The occurrence of any of the following pathogens or disease of fish must immediately be reported to the department's fish pathology section:

(1) Class I — Diseases of Critical Concern.

Infectious Pancreatic Necrosis Virus (IPNV) — trout pancreatic virus;
Viral Hemorrhagic Septicemia Virus (VHSV) — Egtved virus;
Pike Fry Rhabdovirus;
Spring Viremia of Carp (SVC) — a carp virus of potential danger to native cyprinids;
Ceratomyxa shasta — myxosporidian disease of salmonids;
Myxosoma cerebralis — whirling disease; and
Mytilicola intestinalis — an endoparasitic copepod of shellfish.

(2) Class II — High-risk Diseases.

Infectious Hematopoietic Necrosis Virus (IHNV) — sockeye or chinook salmon kidney virus;
Herpesvirus salmonis — low-temperature virus;
Viral Erythrocytic Necrosis (VEN) — intranuclear virus of marine fish;
Vibrio parahemolyticus — vibriosis in fish and shellfish;
Aeromonas salmonicidia — furunculosis;
Yersinia ruckeri — enteric redmouth disease;
Renibacterium salmoninarum — bacterial kidney disease (BKD);
Flexibacter columnaris — columnaris disease;

Henneguya — ssp. — myxosporidian disease of fish and shellfish;
Labyrinthomyxa marina — fungal or haplosporidian disease of shellfish;
Minchinia nelsoni — a haplosporidian disease of shellfish; and
Ocenebra japonica — an oyster drill;

(3) Class III — Diseases of Concern.
Vibrio alginolyticus — vibriosis in fish and shellfish;
Vibrio anguillarum — vibriosis in fish and shellfish;
Aeromonas hydrophila — aeromonad septicemia;
Ichthyobodo — spp. — costiasis in fish and shellfish;
Hexamita — protozoan disease of salmonids and shellfish;
Trichodina — spp. — external fish parasite;
Diplostomum — spp. — eye fluke disease of fishes; and
Mytilicola orientalis — an endoparasitic copepod of shellfish.

(e) Diseases reported under (d) of this section, or found by inspection under (c) of this section, must be treated by taking steps acknowledged by the fish pathology section to be effective in eliminating the disease. Containers or facilities must be disinfected by the permittee in a manner directed or approved by the commissioner or his authorized designee. Presence of any of these diseases, or any other disease not previously observed in Alaska, may be cause for the commissioner or his authorized designee to prohibit stocking of the fish in new areas, and to quarantine the permittee's facility until disinfected.

(f) Stocks of fish in hatcheries or rearing facilities in which a Class I disease has been detected must be immediately destroyed by the permittee if the commissioner or his authorized designee determines that the disease is new to the area, the disease is different strain of a disease than occurs locally, or if the disease poses a threat to the health and perpetuation of native, wild, or hatchery stocks of fish in the hatchery effluent watershed or the intended release location. In limited circumstances, the commissioner or his authorized designee may allow retention or transportation of these diseased fish under controlled conditions that pose no threat to native, wild, or hatchery stocks of fish (e.g. movement to a disease laboratory).

(g) Stocks of fish in hatcheries or rearing facilities in which a Class II disease has been detected must be immediately destroyed by the permittee if the commissioner or his authorized designee determines that the disease poses a threat to the health and perpetuation of native, wild, or hatchery stocks of fish in the hatchery effluent watershed or the intended release location. (In effect before 1988)

Authority: AS 16.05.251(a)

5 AAC 41.090. DELEGATION OF AUTHORITY. For the purposes of administering this chapter, the commissioner may delegate his authority to designated employees of the department. (In effect before 1988)

Authority: AS 16.05.020
AS 16.05.270

5 AAC 41.100. DEFINITIONS. In addition to the definitions set out in AS 01.10.060 and AS 16.05.940, in 5 AAC 41.001 — 5 AAC 41.100

(1) "completed application: means a form, series of forms, letters, or other documents

that provide all of the information necessary for the commissioner or the commissioner's designee to issue, condition, or deny a permit:

(2) "department regional office" means the Alaska Department of Fish and Game, fisheries rehabilitation, enhancement and development division offices located as follows:

Region I — Southeastern Region
230 South Franklin Street
Juneau, Alaska 99801

Region II — Central, Westward and
Arctic-Yukon-Kuskokwim Region
333 Raspberry Road
Anchorage, Alaska 99502

(3) "fish pathology section" means the Alaska Department of Fish and Game, fisheries rehabilitation, enhancement and development division, fish pathology section, located at 333 Raspberry Road, Anchorage, Alaska 99502, telephone (907) 344-0541;

(4) "ornamental fish" means a fish commonly known as "tropical fish," "aquarium fish," or "goldfish," which are imported, cultured, or sold in the state customarily for viewing in aquaria or for raising in artificial systems, and not customarily used for sport fishing or human consumption purposes;

(5) "permit" means a fish transport permit, including any amendment or condition issued or approved by the commissioner or the commissioner's designee, which has not been suspended, terminated, or expired;

(6) "permittee" means the holder of a permit and includes anyone employed, contracted, or assigned by the person to whom the permit was issued. (In effect before 1988)

Authority: AS 16.05.251(a)

SECTION G

Policy for the Management of Mixed Stock Salmon Fisheries

POLICY FOR THE MANAGEMENT OF MIXED STOCK SALMON FISHERIES

5 AAC 39.220:

(a) In applying this statewide mixed stock salmon policy for all users, conservation of wild salmon stocks consistent with sustained yield shall be accorded the highest priority. Allocation of salmon resources under this policy will be consistent with the subsistence preference in AS 16.05.258, and the allocation criteria set out in 5 AAC 39.205, 5 AAC 75.017, and 5 AAC 77.007.

(b) In the absence of a regulatory management plan that otherwise allocates or restricts harvest, and when it is necessary to restrict fisheries on stocks where there are known conservation problems, the burden of conservation shall be shared among all fisheries in close proportion to their respective harvest on the stock of concern. The board recognized that precise sharing of conservation among fisheries is dependent on the amount of stock-specific information available.

(c) The board's preference in assigning conservation burdens in mixed stock fisheries is through the application of specific fishery management plans set out in the regulations. A management plan incorporates conservation burden and allocation of harvest opportunity.

(d) Most wild Alaska salmon stocks are fully allocated to fisheries capable of harvesting available surpluses. Consequently, the board will restrict new or expanding mixed stock fisheries unless otherwise provided for by management plans or by application of the board's allocation criteria. Natural fluctuations in the abundance of stocks harvested in a fishery will not be the single factor that identifies a fishery as expanding or new.

(e) This policy will be implemented only by the board through regulations adopted (1) during its regular meeting cycle, or (2) through procedures established in the Joint Board's Petition Policy (5 AAC 96.625), Subsistence Petition Policy (5 AAC 96.625(f)), Policy for Changing Board Agenda (5 AAC 39.999), or Subsistence Proposal Policy (5 AAC 96.615).